

Contents

PART A: The System Concept

- A1 Everyday Use and Meaning3**
 - A1.1 A Brief History [1]3
 - A1.2 Current Use and Meaning4
 - A1.3 “Systematic” and Ordering.....6
 - A1.4 Previous Definitions in the Context of Engineering.....7
 - References 10
- A2 The Philosophical Context11**
 - A2.1 The Philosophical Framework [1] 11
 - A2.1.1 The Characteristics of Philosophy11
 - A2.1.2 The Subject Matter of Philosophy12
 - A2.1.3 The Structure of Philosophy12
 - A2.2 Sentence Structure, Reference, and Meaning [2] 13
 - A2.3 The Philosophy of Mind [4]15
 - A2.4 Abstract Entities and Linguistic Frameworks [7].....17
 - References 19
- A3 The System Concept within the Philosophical Framework.....21**
 - A3.1 Categorisation of the System Concept21
 - A3.2 A Simple Model of How the Brain Handles Complexity [3]24
 - A3.3 A Linguistic Framework for the System Concept in Engineering25
 - A3.4 Implications for the Use of the System Concept28
 - References29
- A4 Some Features of the System Concept31**
 - A4.1 Emergence.....31
 - A4.2 Size and Composition33
 - A4.3 Structure34
 - A4.4 Systems and Thermodynamics37
 - A4.5 Coherence.....38
 - A4.6 Stability46
 - References51
- A5 Applying the System Concept53**
 - A5.1 Systems Thinking and the Systems Approach53
 - A5.2 Representation of an Object54

A5.3	Abstraction and the Top-Down Process	56
A5.4	Projects and Products	58
A5.5	Application to the Product.....	61
A5.6	Application to Projects.....	63
	References.....	66

PART B: Engineering

B1	A Short History	69
B1.1	Introduction	69
B1.2	The Beginning	69
B1.3	The Renaissance	71
B1.4	The Industrial Revolution.....	74
B1.5	The Last Century.....	76
	References.....	78
B2	Characteristics of Engineering.....	79
B2.1	Role in Society	79
B2.2	Code of Ethics	83
B2.3	The Process of Engineering.....	85
B2.4	First Step towards an Engineering Ontology.....	91
B2.5	Two Additional Characteristics of Engineering	102
	References.....	105
B3	Usefulness – The Purpose of Engineering	107
B3.1	Definition and Measure	107
B3.2	Commercial Framework.....	109
B3.3	The Contractual Framework.....	111
B3.4	Engineering as a Commodity	114
B3.5	The Value of Systems Engineering	115
	References.....	117
B4	Design and Creativeness	119
B4.1	Overview	119
B4.2	A Taxonomy of Engineering Activities.....	124
B4.3	The Functional Domain.....	129
B4.4	Creativeness and Design in the Functional Domain.....	131
	References.....	133
B5	Requirements Definition [1].....	135
B5.1	Introduction	135
B5.2	The Basics	137
B5.3	Using Natural Language.....	138
	References.....	143

B6	Standardisation and the Bottom-Up Design Process	145
B6.1	The Engineering Body of Knowledge	145
B6.2	The Bottom-Up Design Process	147
B6.3	Standardisation	150
	References	151
B7	Managing the Process of Engineering	153
B7.1	Management Is an Inherent Component of Engineering	153
B7.2	The Industrial Environment	154
B7.3	The Special Features of Engineering Management	156
	Reference	159
 PART C: Applying the System Concept to Engineering		
C1	Complexity in the Context of Engineering.....	163
C1.1	Overview	163
C1.2	The Nature of Complexity	164
C1.3	Two Sources of Complexity as Drivers of Systems Engineering	165
C1.4	A Taxonomy of Complexity in Engineering Projects	166
C1.5	Complexity in the External Project Locations	168
	C1.5.1 The Service Requirements	168
	C1.5.2 The Project Environment	170
	C1.5.3 The Resource Base	171
	C1.5.4 The Knowledge Base	171
	C1.5.5 Quantifying the External Complexity	172
C1.6	Complexity within the Project	173
	References	174
C2	The Systems Engineering Approach to Handling Complex Engineering Projects.....	177
C2.1	Overview	177
C2.2	Plant and Work—Two Complex Entities	179
C2.3	Work Breakdown Structure and Contracting Strategy	181
C2.4	Developing the Plant Breakdown Structure	184
C2.5	The Project Database	185
C2.6	Standards and Current Practice	186
	C2.6.1 A Note on The Influence of Software [5]	186
	C2.6.2 Standards	189
	C2.6.3 Current Practice	190
	Notes and References	190
C3	Architecting and Functional Analysis	193
C3.1	Introduction	193
C3.2	Functional Elements	194
C3.3	The Top-Down Approach to Functional Analysis	196
C3.4	Optimisation and the Concept of Value	198

C3.5	Architecture Descriptions.....	200
C3.6	Addition to the Engineering Ontology	201
	References.....	203
C4	The Functional Domain.....	205
C4.1	Foundations	205
C4.2	Some Properties of Complete Functional Elements	209
C4.3	Types of Functional Elements	211
C4.4	Primary Functional Elements and Linguistics	214
C4.5	The Irreducible Element.....	217
C4.6	Structure of the Functional Domain	218
C4.7	Structure of Real Functional Elements.....	221
C4.8	The Functional Parameter Space	222
	References.....	223
C5	Systems in the Functional Domain	225
C5.1	Interactions between Functional Elements	225
C5.2	Element States and System States	227
C5.3	Primary Element Behaviour	229
C5.4	Systems of Primary Elements.....	230
C5.5	The Secondary Elements	231
	References.....	231
C6	Value and Optimisation.....	233
C6.1	Overview.....	233
C6.2	The Top-Down Design Process.....	234
C6.3	The Revenue Element	235
C6.3.1	The Value Function	235
C6.3.2	Fluctuations, Averages, and Non-linearity	236
C6.3.3	A Simple Value Model.....	239
C6.3.4	Evaluation Methods.....	242
C6.3.5	Two Illustrative Examples	243
C6.3.6	A Related Model [3].....	247
C6.3.7	Discussion.....	253
C6.4	The Cost Element.....	254
C6.4.1	The Nature of Cost and Cost Elements.....	254
C6.4.2	The Cost Element	255
C6.4.3	Cost Estimating and the Cost Database	256
C6.5	The Irreducible Element.....	257
	References.....	259
	Index	261