Contents

Publisher's Message		xi
Fo	Foreword by Shizuo Senju Preface	
Pı		
1	Overview of Early Equipment Management	1
	New Issues for Today's Companies	1
	Technical Issues	2
	Early Equipment Management in TPM	3
	Outlook for TPM	3
	Linking Product Development and	
	Design with Production	6
	Early Equipment Management: Issues and	
	Basic Approaches	6
	Five Conditions for Early Equipment Management	7
	Overview of Early Equipment Management	11
	Early Equipment Management Issues	15
	Carrying Out Early Equipment Management	25

	The Engineer's Two Pitfalls: Equipment	
	Ergonomics and Cost Efficiency	28
2	Implementing Early Equipment Management	39
	From Equipment to Product Development and Design	39
	Factory-friendly Products	40
	Five Measures for Factory-friendly Products	41
	Two Examples of Factory-friendly Product Design	41
	From Equipment Development and Design to Product	
	Development and Design	47
	Designing New Products Based on	
	Current Conditions	53
	Product Design Modification Request	
	(at Prototype/Trial Evaluation Stage)	55
	Establishing an Equipment Design Mission	57
	Approach to Establishing an Equipment	
	Design Mission	58
	Preliminary Evaluation (Design Review)	63
	Two Steps in the Preliminary Evaluation	63
	Step-by-Step Management	65
	Application of Step-by-Step Preliminary	
	Evaluation Chart	67
	Collecting and Using Maintenance	
	Prevention (MP) Data	72
	MP Activities Help Prevent Problems during	
	Commissioning Control	73
	Roles of Equipment Design (and Fabrication)	
	Engineers and Maintenance Engineers	89
	MP Data Collection System	90
	Problems Related to MP Data	90
	Maintenance Data Feedback	93

Contents	vii

	Standardization and Use of MP Data	95
	Establishing Commissioning Control	102
	Production Setup Procedure and Daily Management	106
3	Quality Assurance (QA) Design	121
	Equipment Reliability and Human-Machine Systems	122
	Equipment Free of Early Defects (Intrinsic Reliability)	124
	How Does Intrinsic Reliability Decline?	124
	Five Ways to Boost Intrinsic Reliability	125
	QA-Friendly (Reliable-Operation) Equipment	127
	Why Does Operational Reliability Decline?	128
	Five Conditions for QA-Friendly Equipment	129
	Case Study 3-1: QA-Friendly Equipment	
	(Toyota Auto Body)	134
	QA Design for Intrinsic Reliability and	
	Operational Reliability	137
	Accurate and Sustainable Operations and	
	QA Design	137
	Case Study 3-2: QA Design for Intrinsic	
	Reliability and Operational Reliability	145
	Maintenance Quality (MQ) Management and	
	QA Design	153
4	LCC Design	159
	Basic Approach to LCC Design	161
	General Procedure for LCC Design	164
	Minimum IC Design	165
	Functional Cost Needs Analysis	166
	Case Study 4-1: FCNA Design Procedure	
	at Toyota Auto Body	168

	Minimum RC Design	177
	Early Breakdown Characteristics and MP Design	178
	Routine Production Breakdown Characteristics and	
	MP Design Countermeasures	186
	Case Study 4-2: MP Design Countermeasures	
	for Routine Production Breakdowns	189
	Minimum IC/RC Design (ICR-RCR Design)	195
	Approach and General Procedure for	
	ICR-RCR Design	195
	Case Study 4-3: ICR-RCR Design	197
	Case Study 4-4: ICR-RCR Design for Painting Unit	
	At Toyota Auto Body	205
	LCC Design under Uncertain Conditions	
	(Design Using Sensitivity Analysis)	217
	Approach and Procedure for Design Using SA	221
	Case Study 4-5: QA/SA Design for a New Spot	
	Welding Process at Toyota Auto Body	228
	Some Final Tips About Using LCC Design	235
	Databases	235
	Focus on Easy, Low-cost Maintenance	
	and Operation	235
	LCC Design Priorities	242
	Economic Analysis	242
	Review of Design Standards	243
5	Design for Flexibility	245
	Designing Flexibility for Variable Yield	245
	Losses Incurred as a Result of Variable Yield	246
	Design Approach for Variable Yield	248
	Case Study 5-1: Design for Variable Yield	251

Contents ix

Designing Flexibility for Diverse Models	256
Example of Loss Related to Mixed Production	258
Basic Approach to Mixed Production	262
Case Study 5-2: Mixed Production	266
Case Study 5-3: Adding a New Product to	
an Existing FMS Line	285
Designing Flexibility for Successive Models	293
Basic Design Approach for Successive Models	300
Case Study 5-4: Flexible Design for	
Successive Models	304
About the Author	
Index	

NOTE: Due to the format requirements of the illustrations, many of which are two-page spreads, you will occasionally find a blank page. Please note that these are intentional, and that there is no material missing from the book.