SECTION 1 Total System and Implementation Steps

Chapter 1 Total Framework of the Toyota Production System ...... 3

§ 1 Primary Purpose ......................................................... 3
  Profit through Cost Reduction ....................................... 3
  Elimination of Overproduction ...................................... 4
  Quantity Control, Quality Assurance, Respect for Humanity ............................................................................. 6
  Just-in-Time and Autonomation ...................................... 6
  Flexible Workforce and Originality and Ingenuity ............. 8
  JIT Production ................................................................. 8

§ 2 Kanban System .............................................................. 9
  Maintaining JIT by the Kanban System ................................ 9
  Information via Kanban .............................................. 10
  Adapting to Changing Production Quantities ...................... 10

§ 3 Production Smoothing .................................................. 11
  Production in Accordance with Market Demand .................. 11
  Determining the Daily Production Sequence .................... 12
  Adapting to Product Variety by General-Purpose Machines ............................................................................. 13

§ 4 Shortening Setup Time .................................................. 13
§ 5 Process Layout for Shortened Lead Times and One-Piece Production ........................................... 14
§ 6 Standardization of Operations ......................................... 15
§ 7 Autonomation ................................................................. 16
  Autonomous Defects Control System ................................. 16
  Visible Control System ..................................................... 17
§ 8 Improvement Activities ................................................... 17
§ 9 The Goal of TPS ............................................................... 18
  The Ultimate Goal of TPS .................................................... 18
  To Improve Margin Ratio, Costs Must Be Reduced, since Profit = Revenue - Costs ........................................ 18
  To Improve Turnover Ratio, Lead Time Must Be Reduced ...................................................... 19
Another Measure of the Integrated Goal:
  "JIT Cash-Flows" ................................................................ 20
Motivational Effects of the JIT Cash Flow Measure ............... 21
  Control Measure at the Top Management Level of the Whole Supply-Chain ........................................... 21
  Control Measure at the Level of Plant Managers and Supervisors .................................................. 22
  Control Measures at the Level of Shop Floor Operators ....................................................................... 23
§ 10 Summary ........................................................................ 23

Chapter 2 Implementation Steps for the Toyota Production System ........................................................................ 25
§ 1 Introductory Steps to the Toyota Production System ........ 25
  Step 1: Upper Management Plays a Key Role ..................... 25
  Step 2: Establish a Project Team ........................................... 26
  Step 3: Prepare an Implementation Schedule and Set Goals to Be Achieved within the Schedule ............ 26
  Step 4: Introduce a Pilot Project ........................................... 26
  Step 5: Move from a Downstream Process to an Upstream Process ..................................................... 26
  Application Order of JIT Techniques .................................. 27
§ 2 Introduction of JIT at Toyo Aluminum—A Case Study ......................................................................... 29
SECTION 2 Subsystems

Chapter 3 Adaptable Kanban System Maintains Just-In-Time Production

§ 1 Pull System for JIT Production

§ 2 What Is a Kanban?
   How to Use Various Kanban
   Two Methods of Utilizing Production-Ordering Kanban

§ 3 Kanban Rules
   Rule 1—The Subsequent Process Should Withdraw the Necessary Products from the Preceding Process in the Necessary Quantities at the Necessary Point in Time
   Whirligig
   Constant-Cycle and Round-Tour Mixed-Loading System

Rule 2—The Preceding Process Should Produce Its Products in the Quantities Withdrawn by the Subsequent Process

Rule 3—Defective Products Should Never Be Conveyed to the Subsequent Process

Rule 4—The Number of Kanban Should Be Minimized

Rule 5—Kanban Should Be Used to Adapt to Small Fluctuations in Demand (Fine-Tuning of Production by Kanban)

§ 4 Other Types of Kanban
   Express Kanban
   Emergency Kanban
   Job-Order Kanban
   Through Kanban
   Common Kanban
   Cart or Truck as a Kanban
   Label
   Full-Work System
## Chapter 4

Supplier Kanban and the Sequence Schedule Used by Suppliers

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>§ 1</td>
<td>Monthly Information and Daily Information</td>
<td>60</td>
</tr>
<tr>
<td>§ 2</td>
<td>Later Replenishment System by Kanban</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>How the Supplier Kanban Should Be Applied to the Supplier</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>How the In-Process Kanban Will Circulate in the Supplier’s Plant</td>
<td>63</td>
</tr>
<tr>
<td>§ 3</td>
<td>Sequenced Withdrawal System by the Sequence Schedule</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>Store Space and a Variety of Products</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>How the Sequence Schedule Is Used in the Assembly Lines of a Supplier</td>
<td>68</td>
</tr>
<tr>
<td>§ 4</td>
<td>Problems and Countermeasures in Applying the Kanban System to Subcontractors</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>Criticism by the Communist Party against the Toyota Production System</td>
<td>70</td>
</tr>
<tr>
<td>§ 5</td>
<td>Guidance by the Fair Trade Commission Based on the Subcontractors Law and the Anti-monopoly Law</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>How Toyota Is Coping with Criticism</td>
<td>74</td>
</tr>
<tr>
<td>§ 6</td>
<td>Supplier Kanban Circulation in the Paternal Manufacturer</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>Inventory Quantity of Purchased Parts</td>
<td>82</td>
</tr>
<tr>
<td>§ 7</td>
<td>Practical Examples of Delivery System and Delivery Cycle</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>Number of Supply Runs and Delivery Schedule of Each Plant</td>
<td>83</td>
</tr>
<tr>
<td></td>
<td>Kanban System and Adaptation to Emergency</td>
<td>86</td>
</tr>
</tbody>
</table>

## Chapter 5

Smoothed Production Helps Toyota Adapt to Demand Changes and Reduce Inventory

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>§ 1</td>
<td>Smoothing of the Total Production Quantity</td>
<td>89</td>
</tr>
<tr>
<td></td>
<td>Demand Fluctuation and Production Capacity Plan</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td>Adapting to Increased Demand</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td>Adapting to Decreased Demand</td>
<td>93</td>
</tr>
<tr>
<td>§ 2</td>
<td>Smoothing Each Model’s Production Quantity</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>Sequence Schedule for Introducing Models</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>Sequence Schedule Sheet Sample</td>
<td>97</td>
</tr>
</tbody>
</table>
## Contents

- Sequenced Withdrawal of Engines .................................. 97
- Two Phases of Production Smoothing ............................... 99
- Flexible Machinery Supporting Smoothed Production .......... 99
- § 3 Comparison of the Kanban System with MRP .............. 101
- § 4 Summary of the Concept of Production Smoothing ........... 102

### Chapter 6
The Information System for Supply Chain Management between Toyota, Its Dealers, and Parts Manufacturers ........................................... 105

- § 1 The Order Entry Information System .......................... 105
  - Monthly Production System ...................................... 105
    - Master Production Schedule and Parts Requirement Forecast ........................................ 105
    - Daily Production System ....................................... 106
  - The Product Delivery Schedule and Sequence Schedule ........................................... 106
  - The Sequenced Production Schedule ............................ 109
  - Online System at the Distribution Stage ...................... 109
- § 2 The Information System between Toyota and Parts Manufacturers ........................................... 110
  - Parts Requirement Forecast Table ............................... 110
  - Network System within Toyota Group Using VAN .......... 112
  - The Parts Distribution System .................................. 113
- § 3 New Toyota Network System (TNS) ............................ 114
  - Establishment of Type II Carrier by Toyota .................. 114
  - Toyota’s New TNS (Toyota Network System) .................. 116
  - Parts Procurement Networks: JNX and WARP ................ 117
- § 4 Production Planning System at Nissan ....................... 118
  - Nissan’s Ordering Systems from Parts Suppliers ............ 121
    - Daily Order ....................................................... 121
    - 10-Day Order .................................................... 121
    - Synchronized Order ............................................. 122
    - Special Order ................................................... 122

### Chapter 7
How Toyota Shortened Production Lead Time ..................... 123

- § 1 Four Advantages of Shortening Lead Time .................... 123
- § 2 Components of Production Lead Time in a Narrow Sense .............................................................................. 124
§ 3 Shortening Processing Time through Single-Unit Production and Conveyance
Functional Division of Labor Using Specialized Workers with “Lot” Production and Conveyance
Product-Flow Layout with Multi-Skilled Workers for One-Piece Production
Comparison between Functional Division of Processes and Multi-Process Handling: A Summary
Outline of Toyota’s Plants
Shortening Processing Time through Small-Sized Lot Production
Advantages of Small Lots in the Production of Different Products
Control Chart of Lot Size Reduction
§ 4 Shortening Waiting Time and Conveyance Time
How to Balance Each Process
Shortening Waiting Time Caused by Pre-Process Lot Size
Two Steps for Conveyance Improvement
§ 5 A Broad Approach to Reducing Production Lead Time
Five Principles for the Ideal Factory Automation

Chapter 8  Machine Layout, Multi-Functional Workers, and Job Rotation Help Realize Flexible Workshops
§ 1 Shojinka: Meeting Demand through Flexibility
§ 2 Layout Design: The U-Turn Layout
Improper Layouts
Bird Cage Layouts
Isolated Island Layouts
Linear Layouts
Combining U-Form Lines
Cellular Manufacturing
§ 3 Attaining Shojinka through Multi-Functional Workers
Cultivating Multi-Functional Workers through Job Rotation
Step 1: Rotation of Supervisors
Step 2: Rotation of Workers within Each Shop........... 154
Step 3: Job Rotation Several Times per Day ............. 156
Additional Advantages of Job Rotation ..................... 158
Importance of the Line Chief: Giving Rest Time
and Job Rotation to Workers .................................. 159

Chapter 9 One-Piece Production in Practice .............. 161
§ 1 Requirements for One-Piece Production ............... 161
§ 2 Resistance to Working Standing Up .................... 162
§ 3 Resistance to Multi-Skilling ............................ 164
§ 4 Barriers to Autonomation .............................. 164
  How to Achieve Autonomation (in the Sense
  of Decoupling Operators from Their Machines) ......... 165
§ 5 Attaching Castors ....................................... 167
§ 6 Smoothed Production .................................... 168
§ 7 An Example of Improvement for One-Piece
  Flow: A Factory Producing Cabinets
  for Use as Flat-Screen Television Stands ................. 169

Chapter 10 Standard Operations Can Attain Balanced
Production with Minimum Labor ............................. 171
§ 1 Goals and Elements of Standard Operations .......... 171
§ 2 Determining the Components of Standard
  Operations .................................................. 172
  Determining the Cycle Time ............................. 173
  Determining the Completion Time per Unit .......... 173
  Determining the Standard Operations Routine .......... 175
  Yo-i-don System ......................................... 178
  One-Shot Setup .......................................... 182
  Determining the Standard Quantity
  of Work-in-Process ....................................... 183
  Preparing the Standard Operations Sheet .............. 184
§ 3 Proper Training and Follow-Up: The Key
  to Implementing a Successful System .................... 185

Chapter 11 Reduction of Setup Time—Concepts and Techniques .... 187
§ 1 Effects of Shortening the Setup Time ................. 187
§ 2 Setup Concepts ......................................................... 188
  Concept 1: Separate the Internal Setup from the External Setup .......... 188
  Concept 2: Convert as Much as Possible of the Internal Setup to the External Setup .......... 188
  Concept 3: Eliminate the Adjustment Process .......... 189
  Concept 4: Abolish the Setup Step Itself .......... 191
§ 3 Concept Application ................................................ 192
  Technique 1: Standardize the External Setup Actions ..192
  Technique 2: Standardize Only the Necessary Portions of the Machine .......... 192
  Technique 3: Use a Quick Fastener .......... 192
  Technique 4: Use a Supplementary Tool .......... 194
  Technique 5: Use Parallel Operations .......... 195
  Technique 6: Use a Mechanical Setup System .......... 196

Chapter 12 5S—Foundation for Improvements ..................................... 197
  § 1 5S Is to Remove Organizational Slack ...................................... 197
  § 2 Visual Control ................................................................. 200
    Visual Seiri ................................................................. 201
    Indicator Plate for Visual Seiton ........................................ 203
      Step 1—Decide Item Placement ........................................ 204
      Step 2—Prepare the Container ........................................ 204
      Step 3—Indicate the Position for Each Item .................... 204
      Step 4—Indicate the Item Code and Its Quantity ................ 204
      Step 5—Make Seiton a Habit ........................................ 205
  § 3 Practical Rules for Seiton ............................................... 207
    Seiton of WIP ................................................................. 207
      Rule 1: First-In, First-Out ........................................ 207
      Rule 2: Setup for Easy Handling .................................... 207
      Rule 3: Regard Stock Space as Part of Manufacturing Line .......... 208
    Seiton of Jigs and Tools ................................................. 210
    Seiton of the Cutting Instruments, Measures, and Oil ................ 211
    Visual Controls for Limit Standards .................................... 213
  § 4 Seiso, Seiketsu, Shitsuke .............................................. 214
  § 5 Promotion of 5S System ................................................ 216
    Point Photography ........................................................... 217
Chapter 13  Autonomous Defect Control Ensures Product Quality...

§ 1 Development of Quality Management Activities ...............................................219
§ 2 Statistical Quality Control .............................................................................221
§ 3 Autonomation .................................................................................................223
§ 4 Autonomation and the Toyota Production System ........................................225
  Methods for Stopping the Line ...........................................................................225
  Mechanical Checks in Aid of Human Judgment .................................................227
  Mistake-Proofing Systems for Stopping the Line ..............................................228
    Contact Method ..................................................................................................229
    Altogether Method .............................................................................................229
    Action Step Method ...........................................................................................229
  Visual Controls ....................................................................................................231
    Andon and Call Lights .....................................................................................231
    Standard Operations Sheets and Kanban Tickets ..............................................232
    Digital Display Panels .....................................................................................234
    Store and Stock Indicator Plates .......................................................................234
§ 5 Robotics ............................................................................................................235
  Robots and the Toyota Production System ..........................................................236
§ 6 Company-Wide Quality Control ......................................................................236
  All Departments Participate in QC .....................................................................237
  All Employees Participate in QC .........................................................................238
  QC Is Fully Integrated with Other Related Company Functions .......................238

Chapter 14  Cross-Functional Management to Promote Company-Wide Quality Assurance and Cost Management .................................................................239

§ 1 Introduction .......................................................................................................239
§ 2 Quality Assurance ...........................................................................................240
§ 3 Cost Management .............................................................................................241
  Relations among Departments, Steps in Business Activities, and Functions ..........244
§ 4 Organization of the Cross-Functional Management System .........................245
  Business Policy and Functional Management ....................................................250
  Business Policy Development ..............................................................................252
  Critical Considerations for Functional Management .........................................253
  Advantages of Functional Management .............................................................254
Chapter 15 Kaizen Costing

§ 1 Concept of Kaizen Costing
§ 2 Two Types of Kaizen Costing
§ 3 Preparing the Budget
§ 4 Determination of the Target Amount of Cost Reduction
§ 5 Kaizen Costing through "Management by Objectives"
§ 6 Measurement and Analysis of Kaizen Costing Variances

Chapter 16 Material Handling in an Assembly Plant

§ 1 The Parts Supply System in an Assembly Plant
§ 2 A System for Supplying Parts in Sets (the SPS, or Set Parts System)
   The SPS System
   The Rationale for SPS, and Its Benefits
§ 3 "Empty-Handed" Transportation
   Rationalizing the Reception of Outsourced Parts and the Removal of Empty Boxes
   Movement of the Site Materials Handler
   Area for Storing Each Parts Manufacturer's Empty Pallets, and Trolleys with Tractor
   Movement of the Parts Manufacturers' Drivers: Coupling Station for the Trolleys Used to Bring the Parts in to Each of the Assembly Lines

Chapter 17 Further Practical Study of the Kanban System

§ 1 Maximum Number of Production Kanban to be Stored
§ 2 Triangular Kanban and Material Requisition Kanban on a Press Line
   The Roulette System
§ 3 Control of Tools and Jigs through the Kanban System
§ 4 JIT Delivery System Can Ease Traffic Congestion and the Labor Shortage
JIT Will Contribute to Rationalization of Physical Distribution .......................................................... 286
Genuine JIT System Has Prerequisite Conditions .......................................................... 287
External Environment for Physical Distribution Should Be Rationalized .................................................. 288

Chapter 18 Smoothing Kanban Collection .......................................................... 291
§ 1 Obstacles to Collecting Smoothed Numbers of Kanban .......................................................... 291
§ 2 Relationship between Smoothed Collection of Kanban and Parts Delivery .................................................. 292
§ 3 Smoothing Schedule for the Timing of Kanban Collection .......................................................... 293
§ 4 Inventions of Kanban Posts at the Production Site, Parts Storage Site in the Assembling Factory .......................................................... 295
§ 5 Post-Office Mechanism for Outgoing Supplier Kanban .......................................................... 296

Chapter 19 Applying the Toyota Production System Overseas .......................................................... 299
§ 1 Conditions for Internationalizing the Japanese Production System .................................................. 300
§ 2 Advantages of the Japanese Maker-Supplier Relationship .......................................................... 301
§ 3 Reorganization of External Parts Makers in the United States .......................................................... 302
§ 4 Solution for Geographical Problems Involving External Transactions .................................................. 305
§ 5 External Transactions of NUMMI .......................................................... 306
§ 6 Industrial Relations Innovations .......................................................... 308
  Prerequisites of Flexible Labor Systems .......................................................... 308
  Prerequisites of Workplace Improvements .......................................................... 310
  Features of New Labor Contracts .......................................................... 310
    Point 1 .......................................................... 310
    Point 2 .......................................................... 312
    Point 3 .......................................................... 312
§ 7 Conclusion .......................................................... 314
SECTION 3 Quantitative Techniques

Chapter 20 Sequencing Method for the Mixed-Model Assembly Line to Realize Smoothed Production 317

§ 1 Goals of Controlling the Assembly Line 317
Goal One: Work Load Streamlining 318
Goal Two and the Sequencing Model for Parts Usage Streamlining 318

§ 2 Goal-Chasing Method: A Numerical Example 320
Evaluation of the Goal-Chasing Method 324

§ 3 The Toyota Approach: A Simplified Algorithm 326
Sequence Scheduling in the Practice: An Example 328

§ 4 Simultaneous Achievement of Two Simplifying Goals 329

Chapter 21 New Sequence Scheduling Method for Smoothing 331

§ 1 Basic Logic of Sequence Scheduling 331
Assisting Rules 333

§ 2 Sequence Scheduling Using Artificial Intelligence 337
Five Patterns for Deciding the Sequence Schedule 340

§ 3 Diminishing Differences between Product Lead Times 342

Chapter 22 Computation of the Number of Kanban 347

§ 1 Computation of the Number of Kanban 347
§ 2 The Constant-Cycle Withdrawal System for Computing the Number of Inter-Process Withdrawal Kanban 348
Numerical Example: Number of Inter-Process Withdrawal Kanban in the Constant-Cycle System 349

§ 3 Computation of the Number of Supplier Kanban 354
Supplier Kanban Using the “Constant-Cycle Withdrawal System” 354
Computation of Supplier Kanban 354
Numerical Example for Computing the Number of Supplier Kanban 357
§ 4 Constant-Quantity Withdrawal System for Computing the Number of Inter-Process Withdrawal Kanban

General Formula for the "Constant-Quantity Withdrawal System" 358
Numerical Example for Computing the Number of "Inter-Process Withdrawal Kanban" Based on the Constant-Quantity Withdrawal System 359
Effect of Lead Time Reduction through Kaizen Activities on the Number of Kanban 360
Effect of Increasing the Capacity of Parts Boxes Because of Smaller Parts Size 360

§ 5 Computation of the Number of Production-Ordering Kanban 361
Computation of the Number of Production Kanban Under the "Constant-Cycle Withdrawal System" 361
Computation of the Number of Production Kanban under the Constant-Quantity Withdrawal System 362
Ping-Pong Ball as a Production Kanban 362
Use of Production Kanban as a Two-Bin System 363
Triangular Kanban of the Stamping Process 365

§ 6 Computation of the Re-order Point 365

§ 7 Determination of Lot-Size 365

§ 8 Changes in the Number of Kanban 366
Changes in the Number of Supplier Kanban 367

§ 9 Maintaining the Necessary Number of Kanban 368
Maximum and Minimum Numbers of the Parts Boxes on the Indicator Plate at the Parts Shelf 368
Automatic System for Pushing Aside Excess Kanban 369
Discovery of Lost Kanban 370

Chapter 23 New Developments in e-Kanban 371

§ 1 The Two Types of e-Kanban 371
§ 2 Sequenced Withdrawal Method e-Kanban: Sequenced Withdrawal of Parts Matched to the Vehicle Loading Sequence Schedule 371
The Evolution of the Kanban 371
e-Kanban 372
Chapter 24 Kanban Supporting Information Systems

§ 1 Toyota Production System Is Supported by Many Information Systems

§ 2 Material Requirement Planning Subsystem

§ 3 Kanban Master Planning Subsystem

   Internally Produced Parts

   Externally Produced Parts

   Material Usage

§ 4 Process-Load Planning Subsystem

§ 5 Accounts Payable and Accounts Receivable Subsystem via Electronic Kanban

§ 6 Actual Performance Measurement Subsystem

SECTION 4 Humanized Production Systems

Chapter 25 Cultivating the Spontaneous Kaizen Mind

§ 1 Developing the Spontaneous Kaizen Mindset: Toward Embedding TPS

§ 2 How Taiichi Ohno Came to Be Daihatsu’s Consultant

§ 3 Create a Difficult Situation and Give People a Problem to Solve

   Case 1: Mixed Assembly of the Starlet (the Successor to the Publica) and Daihatsu’s Own Popular Car

   Case 2: Development of the Ready, Set, Go! System in the Body Welding Process

   Case 3: “You Mustn’t Think, ‘What Am I Going to Teach Them?’”
§ 4 Conclusions

1. Get People to Exercise Their Ingenuity by Creating a Difficult Situation and Giving Them a Problem to Solve

2. Never Lead People by Their Noses to the Solution of the Problem but Always Make Them Come Up with Their Own Improvement Strategies, and Encourage Them to Develop Their Own Problem-Solving Abilities

3. Even If Your Subordinates Fail, Do Not Communicate a Feeling of Frustration to Them; Lend Them a Helping Hand—Leaders Should Become Charismatic People on Whom Others Can Rely

Chapter 26 Improvement Activities Help Reduce the Workforce and Increase Worker Morale

§ 1 Resolving the Conflict between Productivity and Human Factors

§ 2 Improvements in Manual Operations

§ 3 Reduction of the Workforce

§ 4 Improvements in Machinery

Policies in Promoting Jidoka

§ 5 Job Improvements and Respect for Humanity

Give Workers Valuable Jobs

Keep the Lines of Communication within the Organization Open

§ 6 The Suggestion System

§ 7 Kanban and Improvement Activities

§ 8 QC Circles

Structure of the QC Circle

QC Topics and Achievements

Commendation Systems

Education Systems for QC Circles

§ 9 New Technical Personnel System

Labor-Management System for Toyota Shop-Floor Technicians from 1990s Onward

Introduction of Technical Specialists
Chapter 27 Respect-for-Humanity Subsystem in the JIT Production System ........................................... 433
§ 1 Toward Respect for Humanity Based on Ergonomics ... 433
§ 2 Conventional JIT Systems for Respect-for-Humanity Realization ............................................. 433
§ 3 Process Improvements............................................................... 435
   Facility Investments Incorporating Automation ........ 435
   Facility Investments Incorporating Respect for Humanity ......................................................... 436
      Worker-Compatible Machines ........................................ 436
      Improving Working Conditions ................................. 437
      Work Strain Avoidance ............................................. 437
§ 4 Need for Objective Evaluation of Workload .......... 442
§ 5 Conclusion ................................................................. 443
§ 6 Appendix: TVAL Model for Measuring Workload .... 444
   The Model ...................................................................... 444
   Applying the TVAL Model to Assembly Operations .. 446
   Author’s Comment on the Model .............................. 447
Acknowledgments .............................................................. 447

Chapter 28 Motivational and Productivity Effects of Autonomous Split-Lines in the Assembly Plant........ 449
§ 1 Why Can Split-Lines Enhance Morale and Productivity? ..................................................... 449
§ 2 Problem with the Conventional Assembly Line .... 450
§ 3 Structure of the Functionally Diversified Autonomous Line ............................................. 452
   Physical Structure of Split-Lines ............................... 452
   Personnel Structure of Split-Lines ........................... 454
   Training of Line Workers and the Role of the Foreman .................................................. 454
Training Corner and the Assembly Skill

Master Program ................................................................. 455

§ 4 The Merits of Autonomous Split-Lines ......................... 456
Worker Motivation ............................................................... 456
Productivity and Autonomy Based on Risk Spreading ........ 458
Size of Buffer Stocks ......................................................... 462
Line Stop Causes ................................................................. 462
Unnecessary Inventory Eliminated as Waste .................... 463

Chapter 29 Mini Profit Centers and the JIT System ............. 465

§ 1 Why Do MPC and JIT Systems Fit Each Other Well? .... 465
§ 2 Comparison and Mutual Extension of Merits between JIT and MPC Systems ........................................ 466
Motivating People in an MPC through the Single Goal of Profit ................................................................. 467
Delegation of Larger and Wider Authority ....................... 468
Authority for Flexible Exchange of Workers among Various MPCs ......................................................... 468
Decentralized Authorities of Each MPD ............................. 468
Deployment of Target Profit .................................................. 472
§ 3 Computation Formula for MPC Profit ............................. 473
§ 4 Another Type of Mini Profit Center ............................... 475
NEC's Line-Company ......................................................... 475
§ 5 Local Optimization and Global Optimization ............... 476
§ 6 JIT Production System as a Prerequisite for MPC Accounting ................................................................. 478
MPC Accounting Is “Cash-Basis” Accounting .................. 478
§ 7 MPC Accounting Will Provide Motivation to Reduce Excess Inventory ................................................... 479
§ 8 Conclusion ................................................................. 480

Appendix: Reinforcing the JIT System after the Disasters of 3/11/2011, Japan ........................................ 481

Bibliography and References ............................................. 487
English Language Literature .............................................. 487
Japanese Literature ............................................................ 492

Index ............................................................................. 501