APPLYING S88

BATCH CONTROL FROM A USER'S PERSPECTIVE

JIM PARSHALL
AND LARRY LAMB



TABLE OF CONTENTS

FOREWORD XI

ACKNOWLEDGMENTS XIII

INTRODUCTION XV

CHAPTER 1 BASIC CONCEPTS 1

Batch Manufacturing 1

What Really Is S88? 2

E-R Diagrams 6

Sequential Function Charts 8

A Typical Mix-Making System 14

CHAPTER 2 ARE YOU READY TO GO YET? 19

Gathering Requirements 19

Selling the Concept (Getting Funding) 22

CHAPTER 3 STARTING (WHAT YOU HOPE WILL BE) A SUCCESSFUL PROJECT 25

Step One of a Successful Project 25

Moving Forward with a Successful Project 27

CHAPTER 4 THE PHYSICAL MODEL 31

Enterprise and Site Levels 31

Area Level 33

Unit Level 34

Process Cell Level 36

Control Module Level 38

Equipment Module Level 41

Designing the Physical Model 42

CHAPTER 5 RECIPES, PART 1: PROCEDURES 45

Information in a Recipe 45

Types of Recipes 46

General and Site Recipe Procedures 50

Master and Control Recipe Procedures 52

Recipe Collapsibility 58

Converting Site Recipes into Master Recipes 58

Linking the Physical, Procedural Control, and Process Models 59

viii Process Control

CHAPTER 6 RECIPES, PART 2: ALL THE OTHER STUFF 61

Information in a Recipe 61

CHAPTER 7 LINKING RECIPES TO EQUIPMENT 67

Types of Control 67 Linking Recipes and Equipment Control 70

CHAPTER 8 OTHER IMPORTANT BATCH CONTROL ITEMS 77

Modes of Operation 77

States and Commands Associated with Batch Control 79

Exception Handling 83

Allocating and Arbitrating Equipment Use 85

CHAPTER 9 BATCH ACTIVITIES AND INFORMATION MANAGEMENT (THE CACTUS MODEL) 89

The Control Activity Model 89

Presenting Information to the User 102

CHAPTER 10 SYSTEM SPECIFICATION AND DESIGN (SOME OF IT, ANYWAY ...) 105

Creating a Control System Functional Specification 106

Documenting Equipment Control 109

A Sensitive Subject: Working with Your IS/IT Department 109

One Final Note 110

CHAPTER 11 SPECIFYING AND DESIGNING EQUIPMENT PHASES 111

A Phase Review 111

Modes and States 117

Allocation and Arbitration 123

Unit-to-Unit Synchronization 123

Exception Handling 125

Data Collection 126

Important Design Notes 126

CHAPTER 12 WRITING PHASE LOGIC 127

Using Distributed Control Systems 128

Writing PLC Phase Logic 130

Writing Control Modules (Device Drivers) 137

A Design/Code Process 138

Tips 139

The PLI 140

Table of Contents ix

CHAPTER 13 STARTING YOUR SYSTEM RIGHT ... THE FIRST TIME 141

Validation 141 Start-up Tips 143

CHAPTER 14 FINIS 145

What We Learned—The Big Picture 145 A Challenge to Think Beyond Manufacturing 147 For More Information 147 One Last Thing 149

INDEX 151

ABOUT THE AUTHORS 157