

Contents

Preface iv

PART ONE

Developing Systems 3

1 THE VALUE OF SYSTEMS ANALYSIS AND DESIGN 5

Introduction 6 A Framework for Systems Analysis and Design 6 The Players—System Stakeholders 7

> Systems Owners 7 Systems Users 7 Systems Designers 10 Systems Builders 10 Systems Analysts 11 External Service Providers 16 The Project Manager 16

Business Drivers for Today's Information Systems 16

Globalization of the Economy 17
Electronic Commerce and Business 18
Security and Privacy 19
Collaboration and Partnership 20
Knowledge Asset Management 21
Continuous Improvement and Total Quality
Management 21
Business Process Redesign 22

Technology Drivers for Today's Information Systems 22

Networks and the Internet 22
Mobile and Wireless Technologies 24
Object Technologies 25
Collaborative Technologies 25
Enterprise Applications 26

A Simple System Development Process 30

System Initiation 32
System Analysis 32
System Design 33
System Implementation 33
System Support and Continuous
Improvement 33

THE COMPONENTS OF INFORMATION SYSTEMS 43

Introduction 44
The Product—Information Systems 44
A Framework for Information Systems
Architecture 46

KNOWLEDGE Building Blocks 47
PROCESS Building Blocks 51
COMMUNICATIONS Building Blocks 55

Network Technologies and the IS Building Blocks 58

3 DEVELOPING INFORMATION SYSTEMS 67

Introduction 68
The Process of Systems Development 68

The Capability Maturity Model 69
Life Cycle versus Methodology 70
Underlying Principles for Systems
Development 72

A Systems Development Process 76

Where Do Systems Development Projects Come From? 77 The FAST Project Phases 77 Cross Life-Cycle Activities 88 Sequential versus Iterative Development 89

Alternative Routes and Strategies 92

The Model-Driven Development
Strategy 94
The Rapid Application Development
Strategy 98
The Commercial Application Package
Implementation Strategy 100
Hybrid Strategies 104
System Maintenance 104

Automated Tools and Technology 107

Computer-Assisted Systems Engineering 108 Application Development Environments 109 Process and Project Managers 111

4 PROJECT MANAGEMENT 119

Introduction 120 What Is Project Management? 120

> The Causes of Failed Projects 121 The Project Management Body of Knowledge 123

The Project Management Life Cycle 127

Activity 1—Negotiate Scope 130
Activity 2—Identify Tasks 130
Activity 3—Estimate Task Durations 132
Activity 4—Specify Intertask
Dependencies 134
Activity 5—Assign Resources 136
Activity 6—Direct the Team Effort 139
Activity 7—Monitor and Control
Progress 140
Activity 8—Assess Project Results and
Experiences 149

PART TWO

Systems Analysis Methods 157

5 SYSTEMS ANALYSIS 159

Introduction 160 What Is Systems Analysis? 160 Systems Analysis Approaches 161

Model-Driven Analysis Approaches 161
Accelerated Systems Analysis Approaches 163
Requirements Discovery Methods 165
Business Process Redesign Methods 166
FAST Systems Analysis Strategies 166

The Scope Definition Phase 167

Task 1.1—Identify Baseline Problems and Opportunities 169
Task 1.2→Negotiate Baseline Scope 172
Task 1.3—Assess Baseline Project
Worthiness 173
Task 1.4—Develop Baseline Schedule and Budget 173
Task 1.5—Communicate the Project Plan 173

The Problem Analysis Phase 174

Task 2.1—Understand the Problem
Domain 175
Task 2.2—Analyze Problems and
Opportunities 180
Task 2.3—Analyze Business Processes 180
Task 2.4—Establish System Improvement
Objectives 182

Task 2.5—Update or Refine the Project Plan 183 Task 2.6—Communicate Findings and Recommendations 183

The Requirements Analysis Phase 185

Task 3.1—Identify and Express System
Requirements 185
Task 3.2—Prioritize System
Requirements 188
Task 3.3—Update or Refine the Project
Plan 188
Task 3.4—Communicate the Requirements
Statement 189
Ongoing Requirements Management 189

The Logical Design Phase 189

Task 4.1a—Structure Functional
Requirements 191
Task 4.1b—Prototype Functional Requirements
(alternative) 192
Task 4.2—Validate Functional
Requirements 192
Task 4.3—Define Acceptance Test Cases 192

The Decision Analysis Phase 192

Task 5.1—Identify Candidate Solutions 194
Task 5.2—Analyze Candidate Solutions 195
Task 5.3—Compare Candidate Solutions 197
Task 5.4—Update the Project Plan 197
Task 5.5—Recommend a System
Solution 197

6 REQUIREMENTS GATHERING 207

Introduction 208
An Introduction to Requirements Discovery 208
The Process of Requirements Discovery 210

Problem Discovery and Analysis 210
Requirements Discovery 212
Documenting and Analyzing
Requirements 212
Requirements Management 214

Fact-Finding Techniques 215

Sampling of Existing Documentation, Forms, and Files 215
Research and Site Visits 217
Observation of the Work Environment 218
Questionnaires 220
Interviews 222
How to Conduct an Interview 224
Discovery Prototyping 228
Joint Requirements Planning 229

A Fact-Finding Strategy 234

7 USE CASES 243

Introduction 244
An Introduction to Use-Case Modeling 244
System Concepts for Use-Case Modeling 246

Use Cases 246 Actors 247 Relationships 248

The Process of Requirements Use-Case Modeling 251

Step 1: Identify Business Actors 251
Step 2: Identify Business Requirements Use
Cases 252
Step 3: Construct Use-Case Model
Diagram 254
Step 4: Document Business Requirements
Use-Case Narratives 256

Use Cases and Project Management 260

Ranking and Evaluating Use Cases 260 Identifying Use-Case Dependencies 261

8 DATA MODELING AND ANALYSIS 269

Introduction 270 What Is Data Modeling? 270 System Concepts for Data Modeling 271

Entities 271 Attributes 272 Relationships 274

The Process of Logical Data Modeling 283

Strategic Data Modeling 283
Data Modeling during Systems
Analysis 285
Looking Abead to Systems Design 286
Automated Tools for Data Modeling 286

How to Construct Data Models 288

Entity Discovery 289
The Context Data Model 290
The Key-Based Data Model 292
Generalized Hierarchies 295
The Fully Attributed Data Model 295

Analyzing the Data Model 298

What Is a Good Data Model? 298 Data Analysis 299 Normalization Example 299

Mapping Data Requirements to Locations 306

9 PROCESS MODELING 315

Introduction 316
An Introduction to Process Modeling 316
System Concepts for Process Modeling 319

External Agents 319
Data Stores 320
Process Concepts 321
Data Flows 325

The Process of Logical Process Modeling 334

Strategic Systems Planning 334
Process Modeling for Business Process
Redesign 334
Process Modeling during Systems
Analysis 335
Looking Ahead to Systems Design 337
Fact-Finding and Information Gathering for
Process Modeling 337
Computer-Aided Systems Engineering (CASE) for
Process Modeling 337

How to Construct Process Models 338

The Context Data Flow Diagram 338
The Functional Decomposition
Diagram 339
The Event-Response or Use-Case List 341
Event Decomposition Diagrams 342
Event Diagrams 345
The System Diagram(s) 347
Primitive Diagrams 349
Completing the Specification 349

Synchronizing of System Models 359

Data and Process Model
Synchronization 359
Process Distribution 360

10 OBJECT-ORIENTED ANALYSIS AND MODELING USING THE UML 369

An Introduction to Object-Oriented
Modeling 370
History of Object Modeling 370
System Concepts for Object Modeling 371

Objects, Attributes, Methods, and Encapsulation 371 Classes, Generalization, and Specialization 373 Object Class Relationships 376 Messages and Message Sending 378 Polymorphism 380 The UML Diagrams 381
The Process of Object Modeling 383

Modeling the Functional Description of the
System 383

Constructing the Analysis Use-Case
Model 383

Modeling the Use-Case Activities 390

Guidelines for Constructing Activity
Diagrams 394

Drawing System Sequence
Diagrams 394

Guidelines for Constructing System Sequence
Diagrams 395

Finding and Identifying the Business
Objects 396

Organizing the Objects and Identifying Their

11 FEASIBILITY ANALYSIS AND THE SYSTEM PROPOSAL 413

Introduction 414
Feasibility Analysis and the System
Proposal 414

Relationships 400

Feasibility Analysis—A Creeping Commitment
Approach 414
Systems Analysis—Scope Definition
Checkpoint 416
Systems Analysis—Problem Analysis
Checkpoint 416
Systems Design—Decision Analysis
Checkpoint 416

Six Tests for Feasibility 417

Operational Feasibility 417
Cultural (or Political) Feasibility 417
Technical Feasibility 418
Schedule Feasibility 418
Economic Feasibility 419
Legal Feasibility 419
The Bottom Line 419

Cost-Benefit Analysis Techniques 419

How Much Will the System Cost? 419 What Benefits Will the System Provide? 420 Is the Proposed System Cost-Effective? 422

Feasibility Analysis of Candidate Systems 426

Candidate Systems Matrix 426 Feasibility Analysis Matrix 429

The System Proposal 431

Written Report 431
Formal Presentation 433

PART THREE

Systems Design Methods 443

12 SYSTEMS DESIGN 445

Introduction 446 What Is Systems Design? 446 Systems Design Approaches 446

> Model-Driven Approaches 447 Rapid Application Development 451 FAST Systems Design Strategies 453

Systems Design for In-House Development—The "Build" Solution 453

Task 5.1—Design the Application
Architecture 453
Task 5.2—Design the System Database(s) 457
Task 5.3—Design the System Interface 457
Task 5.4—Package Design
Specifications 459
Task 5.5—Update the Project Plan 460

Systems Design for Integrating Commercial Software—The "Buy" Solution 460

Task 4.1—Research Technical Criteria and Options 462
Task 4.2—Solicit Proposals or Quotes from Vendors 463
Task 5A.1—Validate Vendor Claims and Performances 465
Task 5A.2—Evaluate and Rank Vendor Proposals 465

Task 5A.3—Award (or Let) Contract and Debrief Vendors 466 Impact of Buy Decision on Remaining

13 APPLICATION ARCHITECTURE AND MODELING 475

Introduction 476
Application Architecture 476
Physical Data Flow Diagrams 477

Life-Cycle Phases 466

Physical Processes 477 Physical Data Flows 481 Physical External Agents 481 Physical Data Stores 481

Information Technology Architecture 483

Distributed Systems 484
Data Architectures—Distributed Relational
Databases 494

Interface Architectures—Inputs, Outputs, and Middleware 495 Process Architectures—The Software Development Environment 500

Application Architecture Strategies for Systems
Design 502

The Enterprise Application Architecture Strategy 502 The Tactical Application Architecture Strategy 503

Modeling the Application Architecture of an Information System 503

Drawing Physical Data Flow Diagrams 504
Prerequisites 504
The Network Architecture 505
Data Distribution and Technology
Assignments 506
Process Distribution and Technology
Assignments 510
The Person/Machine Boundaries 510

14 DATABASE DESIGN 517

Introduction 518
Conventional Files versus the Database 518

The Pros and Cons of Conventional Files 518 The Pros and Cons of Databases 520

Database Concepts for the Systems Analyst 520

Fields 521 Records 521 Files and Tables 522 Databases 523

Prerequisite for Database Design— Normalization 528 Conventional File Design 529 Modern Database Design 529

Goals and Prerequisites to Database Design 530
The Database Schema 530
Data and Referential Integrity 535
Roles 538
Database Distribution and Replication 538
Database Prototypes 539
Database Capacity Planning 539
Database Structure Generation 539

15 OUTPUT DESIGN AND PROTOTYPING 549

Introduction 550
Output Design Concepts and Guidelines 550

Distribution and Audience of Outputs 550 Implementation Methods for Outputs 553 How to Design and Prototype Outputs 558

Automated Tools for Output Design and Prototyping 558 Output Design Guidelines 559 The Output Design Process 562 Web-Based Outputs and E-Business 570

16 INPUT DESIGN AND PROTOTYPING 581

Introduction 582 Input Design Concepts and Guidelines 582

Data Capture, Data Entry, and Data
Processing 582
Input Methods and Implementation 585
System User Issues for Input Design 587
Internal Controls—Data Editing for
Inputs 589

GUI Controls for Input Design 590

Common GUI Controls for Inputs 592 Advanced Input Controls 596

How to Design and Prototype Inputs 598

Automated Tools for Input Design and Prototyping 598 The Input Design Process 599 Web-Based Inputs and E-Business 605

17 USER INTERFACE DESIGN 613

Introduction 614
User Interface Design Concepts and
Guidelines 614

Types of Computer Users 614 Human Factors 615 Human Engineering Guidelines 616 Dialogue Tone and Terminology 617

User Interface Technology 618

Operating Systems and Web Browsers 618 Display Monitor 618 Keyboards and Pointers 619

Graphical User Interface Styles and Considerations 619

> Windows and Frames 620 Menu-Driven Interfaces 620 Instruction-Driven Interfaces 627 Question-Answer Dialogues 628 Special Considerations for User Interface Design 629

How to Design and Prototype a User Interface 633

Automated Tools for User Interface Design and
Prototyping 634
The User Interface Design Process 635

18 OBJECT-ORIENTED DESIGN AND MODELING USING THE UML 647

Introduction 648
The Design of an Object-Oriented System 648

Entity Classes 648
Interface Classes 648
Control Classes 649
Persistence Classes 649
System Classes 649
Design Relationships 650
Attribute and Method Visibility 650
Object Responsibilities 651

The Process of Object-Oriented Design 651

Refining the Use-Case Model 651
Modeling Class Interactions, Behaviors,
and States That Support the Use-Case
Scenario 656
Updating the Object Model to Reflect the
Implementation Environment 665

Object Reusability and Design Patterns 666

Design Patterns 668

The Strategy Pattern 669
The Adapter Pattern 670
Object Frameworks and Components 671

Additional UML Design and Implementation Diagrams 671

PART FOUR

Beyond Systems Analysis and Design 681

19 SYSTEMS CONSTRUCTION AND IMPLEMENTATION 683

Introduction 684
What Is Systems Construction and Implementation? 684

The Construction Phase 684

Task 6.1—Build and Test Networks
(if Necessary) 684
Task 6.2—Build and Test Databases 687
Task 6.3—Install and Test New Software
Packages (if Necessary) 687
Task 6.4—Write and Test New Programs 688

The Implementation Phase 689

Task 7.1—Conduct System Test 689
Task 7.2—Prepare Conversion Plan 689
Task 7.3—Install Databases 692
Task 7.4—Train Users 693
Task 7.5—Convert to New System 694

20 SYSTEMS OPERATIONS AND SUPPORT 701

Introduction 702
The Context of Systems Operation and Support 702
System Maintenance 706

Task 8.1.1—Validate the Problem 706
Task 8.1.2—Benchmark Program 706
Task 8.1.3—Study and Debug the Program 708
Task 8.1.4—Test the Program 709

System Recovery 709
Technical Support 710
System Enhancement 710

Task 8.4.1—Analyze Enhancement Request 712 Task 8.4.2—Make the Quick Fix 712 Task 8.4.3—Recover Existing Physical System 713

System Obsolescence 714

Photo Credits 720 Glossary/Index 721