

CONTENTS

LIST OF FIGURES	xxvii
INTRODUCTION	3
PART ONE	7
CHAPTER 1 DATABASE INTRODUCTION	9
1.1 DATABASE COMES OF AGE	10
1.1.1 Three Schemas	10
1.1.2 Keys, Pointers, and Record Identification	15
1.1.3 Hierarchical and Network Representations	15
1.1.4 Relational Representations	17
1.2 DATABASE DESIGN TECHNIQUES	19
1.2.1 Design for a Specific Technology	19
1.2.2 Logical, then Physical, Design Approach	20
1.2.3 Design for a Single Purpose	20
1.2.4 Designing a Shared Resource	21
1.3 TRADITIONAL SYSTEM DESIGN	22
1.3.1 Function-Centered Design	22
1.3.2 Data as Unplanned Byproduct	22
1.3.3 Database Management Systems as Storage Mechanisms	23
1.4 DATA-CENTERED DESIGN	23
1.5 NEED FOR MANAGEMENT INFORMATION	24
1.5.1 Consolidating Information	24
1.5.2 Integrating in the Back End	25
1.5.3 Guiding the Front End	26
1.6 SUMMARY	26
1.7 REVIEW EXERCISES	27
1.8 REFERENCES	27

CHAPTER 2	CONTEXT FOR INFORMATION MODELING	29
2.1	INFORMATION MANAGEMENT ENVIRONMENT	29
2.1.1	Information	30
2.1.2	Information Management	32
2.1.3	Information Systems Architecture	37
2.1.4	Methods, Tools, and Templates	41
2.2	ADDING VALUE TO THE BUSINESS	42
2.2.1	Where Information Modeling Helps	43
2.2.2	Making Right Choices	46
2.3	REVIEW EXERCISES	47
2.4	REFERENCES	48
CHAPTER 3	INFORMATION MODELING BASICS	49
3.1	INFORMATION MODELS	49
3.1.1	Information Model Components	50
3.1.2	Types of Information Models	53
3.1.3	Relationship to Function Models	54
3.1.4	Information Modeling Benefits	54
3.2	IDEF1X INFORMATION MODELS	56
3.2.1	Area Information Models	59
3.2.2	Project Information Models	60
3.2.3	Database Management System Model for Relational Systems	63
3.3	INFORMATION MODELING APPROACHES	64
3.3.1	Top-down, Bottom-up, and Middle-out Approaches	64
3.3.2	When to Begin	65
3.4	INFORMATION MODELING LANGUAGES	66
3.5	REVIEW EXERCISES	68
3.6	REFERENCES	68
PART TWO		71
CHAPTER 4	IDEF1X OVERVIEW	73
4.1	JOURNEY THROUGH A SAMPLE MODEL	73
4.2	BASIC DIAGRAM COMPONENTS	77
4.2.1	Entities and Attributes	77
4.2.2	Diagram Syntax for Entities and Attributes	79
4.2.3	Keys	79
4.2.4	Candidate and Primary Key Attributes	80
4.2.5	Rules for Choosing Primary Keys	83
4.2.6	Alternate Keys and Inversion Entries	84
4.2.7	Generalization Hierarchies	86
4.2.8	Category Discriminators	86

4.3	RELATIONSHIPS AND FOREIGN KEY ATTRIBUTES	87
4.3.1	Relationships	88
4.3.2	Diagram Syntax for Relationships	88
4.3.3	Notion of Many	89
4.3.4	Reading a Model	90
4.3.5	Key Migration and Relationship Types	93
4.3.6	Identifying Relationships	93
4.3.7	Nonidentifying Relationships	96
4.3.8	Independent and Dependent Entities	98
4.4	ROLE NAMES	99
4.5	REVIEW EXERCISES	103
4.6	REFERENCES	105
CHAPTER 5 NAMES AND DEFINITIONS		106
5.1	CHOOSING A NAME	106
5.1.1	Singular Names	107
5.1.2	Clear Names	107
5.1.3	Naming Associative Entities	108
5.2	DEFINING ENTITIES	109
5.2.1	Entity Definition Structure	109
5.2.2	Defining Associative Entities	111
5.3	DEFINING ATTRIBUTES	111
5.4	DOMAINS	112
5.4.1	Domain Specifications	113
5.4.2	Domain Declarations and Explicit Entities	114
5.4.3	Logical and Physical Domain Distinction	115
5.5	DATA TYPES AND ROLE NAMES	116
5.6	DEFINING GROUP ATTRIBUTES	118
5.6.1	Group Attribute Descriptions	119
5.6.2	Composite Domains	120
5.6.3	Domains and Business Rules	120
5.7	DEFINITION REFERENCES	121
5.7.1	Circularity	122
5.8	SYNONYMS, HOMONYMS, AND ALIASES	122
5.9	DEFINITION EXAMPLES	123
5.9.1	Attribute Definition Examples	124
5.10	REVIEW EXERCISES	128
CHAPTER 6 ENTITIES, ATTRIBUTES, AND RELATIONSHIPS		130
6.1	ENTITIES	130
6.2	ATTRIBUTES	133
6.2.1	Derived Attributes	134
6.2.2	Group Attributes	135

6.3	RELATIONSHIPS AND CARDINALITY	139
6.3.1	Cardinality	139
6.3.2	One-to-Many Relationships	141
6.3.3	Recursive Relationships	143
6.3.4	Nonspecific Relationships	146
6.3.5	Resolving Nonspecific Relationships	147
6.3.6	Reading Many-to-Many Relationships	149
6.3.7	Associative Entities and N-ary Relationships	151
6.4	REVIEW EXERCISES	153
 CHAPTER 7 GENERALIZATION		 155
7.1	FORMING A GENERALIZATION HIERARCHY	155
7.1.1	Collecting Common Attributes	157
7.1.2	Using Ands and Ors	163
7.1.3	Specifying Complete and Incomplete Category Structures	165
7.1.4	Collecting Common Relationships	169
7.1.5	Deciding When to Form a Generalization Hierarchy	170
7.1.6	Collapsing Relationships Among Categories	170
7.2	OVERCOMING GENERALIZATION HIERARCHY PROBLEMS	173
7.2.1	Boolean Constraints	173
7.2.2	Key Substitution	176
7.3	RIGHT AMOUNT OF GENERALIZATION	179
7.4	REVIEW EXERCISES	181
 CHAPTER 8 EDGE OF THE LANGUAGE		 184
8.1	CONSTRAINTS	184
8.1.1	Insert, Replace, and Delete Rules	185
8.1.2	Referential Integrity Constraints and Structured Query Language	188
8.1.3	Domain and Boolean Constraints	190
8.1.4	Unification	191
8.2	SURROGATE KEYS	197
8.3	HISTORY, TIMESTAMPS, AND EVENTS	198
8.3.1	Timestamps	200
8.3.2	Events	201
8.4	PRESENTING A MODEL	202
8.4.1	Views	203
8.4.2	View Descriptions	203
8.5	SUMMARY	204
8.6	REVIEW EXERCISES	204
8.7	REFERENCES	206

CHAPTER 9	NORMALIZATION AND BUSINESS RULES	207
9.1	COMMON DESIGN PROBLEMS	208
9.1.1	Repeating Attributes	208
9.1.2	Multiple Use of the Same Attribute	210
9.1.3	Multiple Occurrences of the Same Fact	213
9.1.4	Conflicting Facts	214
9.1.5	Missing Information	217
9.1.6	Incorrect Business Rules	220
9.2	HIDDEN ERRORS	228
9.2.1	Unwanted Unification	228
9.2.2	Errors Introduced by Surrogate Keys	232
9.2.3	Overuse of Groups	233
9.3	A CAUTION	235
9.4	REVIEW EXERCISES	236
9.5	REFERENCES	240
CHAPTER 10	REVERSE ENGINEERING	241
10.1	REVERSE-ENGINEERED MODELS	242
10.1.1	Definitions	242
10.1.2	Usage	243
10.1.3	Levels of Reverse-Engineered Models	244
10.1.4	Expected Results	246
10.2	REVERSE-ENGINEERING EXAMPLE	246
10.2.1	Level-1 Model Inferences	247
10.2.2	Level-2 Model Inferences	254
10.2.3	Level-3 Model	256
10.3	SWEET DREAMS	256
10.4	REVIEW EXERCISES	258
CHAPTER 11	FUTURE DIRECTIONS	259
11.1	BUSINESS ENVIRONMENT	259
11.1.1	Changing Focus	259
11.1.2	Information Delivery	260
11.1.3	Harder Problems	261
11.1.4	Short Time Frames	261
11.1.5	Decentralization	262
11.1.6	Niche Solutions	262
11.2	FUTURE OPPORTUNITIES	263
11.2.1	Information Management Opportunities	263
11.2.2	New Information Product Opportunities	263
11.2.3	Information Research Opportunities	264
11.2.4	Integration and Bridging Opportunities	264

11.3	TOOLS	265
11.3.1	CASE Tools	265
11.3.2	Repositories	266
11.3.3	Intelligent Front Ends	270
11.3.4	Automation of the Transform	271
11.3.5	Support for Multiple Viewpoints	271
11.4	SPECIFICATION LANGUAGES	272
11.4.1	Precision	272
11.4.2	Graphic Interfaces and Interactive Assistance	273
11.4.3	Functional Language Integration	274
11.5	REFERENCES	275
 CHAPTER 12 OBJECTS AND DMT/2		276
12.1	OBJECTS, LOGIC, AND THE EXTENDED CONCEPTUAL SCHEMA	276
12.2	DMT/2 MOTIVATION	278
12.3	OBJECT-ORIENTED MODELING	279
12.3.1	Object Subsumes Entity	280
12.3.2	Examples from the Video Store	280
12.3.3	Property Definition	283
12.3.4	Message Patterns	284
12.3.5	Specification Language	286
12.4	RULE-BASED MODELING	289
12.4.1	Rules	289
12.4.2	Control	290
12.5	TYPES OF MODELS	291
12.6	REFERENCES	292
 PART THREE		293
 CHAPTER 13 MARKET BUSINESS MODEL		295
13.1	FUNCTION MODEL	296
13.2	ACQUIRING THE ENTITY RELATIONSHIP DIAGRAM	299
13.3	ERD DEFINITIONS	315
13.4	REFERENCES	317
 CHAPTER 14 MARKET KEY BASED MODEL		318
14.1	ACQUIRING THE KEY BASED MODEL	318
14.1.1	Choosing and Sequencing the Sessions	319
14.1.2	Acquiring the Views	319

14.1.3	Integrating and Validating the Views	324
14.1.4	Views and View Descriptions	326
14.2	PROTOTYPING	334
CHAPTER 15 MARKET DATABASE		346
15.1	FULLY ATTRIBUTED MODEL	346
15.1.1	Extending the Key Based Model	346
15.1.2	Logical Transactions	353
15.2	TRANSFORMATION	359
15.2.1	Physical System Names	360
15.2.2	Transformation Model	362
15.3	DATABASE GENERATION	368
15.4	REFERENCES	372
APPENDICES		373
APPENDIX A ZACHMAN'S FRAMEWORK		375
A.1	ZACHMAN'S FRAMEWORK	375
A.1.1	Labels for the Rows and Columns	375
A.1.2	Framework Extensions	378
A.1.3	Notion of Completeness	379
A.1.4	Rules for Extensions	380
A.1.5	Framework Revisions for Objects	385
A.2	REFERENCES	385
APPENDIX B DATA ADMINISTRATION		387
B.1	NEEDS OF A BUSINESS	387
B.1.1	Business Client Needs	387
B.1.2	Application Development Needs	388
B.1.3	Database Administration Needs	388
B.1.4	Systems Programming Needs	388
B.1.5	Telecommunications Needs	388
B.1.6	Data Processing Operations Needs	389
B.1.7	Audit Needs	389
B.2	DATA ADMINISTRATION PRODUCTS (FUNCTIONS)	389
B.2.1	Education	389
B.2.2	Business Planning Support	390
B.2.3	Business Requirements Analysis and Database Requirements Definition	391
B.2.4	Requirements Documentation	391

B.2.5	Logical and Physical Design	391
B.2.6	Database and Copy-Code Generation	392
B.2.7	Data Object Standardization	392
B.2.8	Existing System and Package Analysis	392
B.2.9	Systems Documentation and Inventory / Change Management	393
B.2.10	Standards / Policy Enforcement	393
B.2.11	Speed	393
B.2.12	Summary	394
APPENDIX C INFORMATION MODELING SESSIONS		396
C.1	SESSION PLANNING	397
C.2	SESSION ROLES	397
C.3	SESSION RULES	398
C.4	SESSION STEPS	400
	C.4.1 Session Steps Summary	403
C.5	FORMING A MODEL FROM THE VIEWS	404
C.6	VALIDATION AND STRESS TESTS	404
C.7	REFERENCES	405
APPENDIX D IRD RULE SUMMARY		406
D.1	IRD RULE SUMMARY—IDENTIFYING RELATIONSHIPS	407
D.2	IRD RULE SUMMARY—NONIDENTIFYING RELATIONSHIPS	409
D.3	IRD RULE SUMMARY—COMPLETE CATEGORY RELATIONSHIPS	415
D.4	IRD RULE SUMMARY—INCOMPLETE CATEGORY RELATIONSHIPS	416
D.5	CONSTRAINTS	417
	D.5.1 Primary Key	418
	D.5.2 Alternate Key	418
	D.5.3 Foreign Key	419
	D.5.4 Category	419
D.6	REFERENCES	422
APPENDIX E COMMERCIAL PRODUCT SUPPORT FOR IDEF1X		423
E.1	LEVERAGE	423
	E.1.1 Product Functions	423
	E.1.2 Normalization Support	429
E.2	ERWIN	430
	E.2.1 Product Functions	430
	E.2.2 First Normal Form Support	432
	E.2.3 Second and Third Normal Form Support	432
E.3	REFERENCES	433

APPENDIX F CASE STUDY SUPPLEMENTARY MATERIAL	434
F.1 KEY BASED MODEL ENTITY DEFINITIONS	435
F.2 KEY BASED MODEL ATTRIBUTE DEFINITIONS	443
F.3 LEVERAGE STRUCTURED MODELING LANGUAGE FOR THE KEY BASED MODEL	471
APPENDIX G IBM'S REPOSITORY MODELING LANGUAGE	479
G.1 IBM ENTITY TYPES	479
G.2 IBM ATTRIBUTES	482
G.3 IBM ENTITY KEYS	482
G.4 IBM RELATIONSHIP TYPES	483
G.5 IBM RELATIONSHIP PROPERTIES	484
G.5.1 Instance Control Property	485
G.5.2 Mandatory Property	486
G.5.3 Controlling Property	487
G.5.4 Ordered Set Property	489
G.6 IBM TO IDEF1X MODEL TRANSLATIONS—INDEPENDENT ENTITIES	489
G.7 IBM TO IDEF1X MODEL TRANSLATIONS—DEPENDENT ENTITIES	492
G.8 GENERALIZATION HIERARCHIES	494
G.9 ALTERNATE KEYS AND INVERSION ENTRIES	494
G.10 CONSTRAINTS, POLICIES, AND NOTES	495
G.11 AGGREGATION TYPES	496
G.12 STRENGTHS AND WEAKNESSES	496
G.12.1 Strengths of the IBM Language	497
G.12.2 Weaknesses of the IBM Language	497
G.13 ANALYSIS	498
G.14 REFERENCES	499
APPENDIX H ANSWERS TO SELECTED REVIEW EXERCISES	500
H.1 CHAPTER 1	500
H.2 CHAPTER 2	501
H.3 CHAPTER 3	504
H.4 CHAPTER 4	506
H.5 CHAPTER 5	511
H.6 CHAPTER 6	515
H.7 CHAPTER 7	517
H.8 CHAPTER 8	519
H.9 CHAPTER 9	520
H.10 CHAPTER 10	524
GLOSSARY	527
INDEX	539