Index

Symbols	accumulating grain fact tables, 12
3NF (third normal form) models, 7	accumulating snapshots, 44, 118–119,
ERDs (entity-relationship diagrams), 8	194–196
normalized 3NF structures, 8	claims (insurance case study), 393 complex workflows, 393–394
4-step dimensional design process, 38, 70–72	timespan accumulating snapshot,
	394–395
A	ETL systems, 475
abnormal scenario indicators, 255–256	fact tables, 121, 326-329
abstract generic dimensions, 66	complementary fact tables, 122
geographic location dimension, 310	milestones, 121
accessibility goals, 3	OLAP cubes, 121–122
accidents (insurance case study), factless fact	updates, 121–122
tables, 396	healthcare case study, 343
accounting case study, 202	policy (insurance case study), 384–385
budgeting, 210–213	type 2 dimensions and, 196
fact tables, consolidated, 224–225	activity-based costing measures, 184
G/L (general ledger), 203	additive facts, 11, 42
chart of accounts, 203-204	add mini dimension and type 1 outrigger
currencies, 206	(SCD type 5), 55 add mini-dimension (SCD type 4), 55
financial statements, 209–210	multiple, 156–159
fiscal calendar, multiple, 208	add new attribute (SCD type 3), 55, 154–155
hierarchies, 209	multiple, 156
journal entries, 206–207	add new row (SCD type 2), 54, 150–152
period close, 204–206	effective date, 152–153
periodic snapshot, 203	expiration date, 152–153
year-to-date facts, 206 hierarchies	type 1 in same dimension, 153
fixed depth, 214	addresses
modifying, ragged, 221	ASCII, 236
ragged, alternative modeling approaches,	CRM and, customer dimension, 233-238
221–223	Unicode, 236–238
ragged, bridge table approach, 223	add type 1 attributes to type 2 dimension
ragged, modifying, 220–221	(SCD type 6), 56
ragged, shared ownership, 219	admissions events (education case study),
ragged, time varying, 220	330
ragged, variable depth, 215–217	aggregate builder, ETL system, 481
variable depth, 214–215	aggregated facts
OLAP and, 226	as attributes, 64
•	CRM and, customer dimension, 239–240

aggregate fact tables, 45	ASCII (American Standard Code for
clickstream data, 366-367	Information Interchange), 236
aggregate OLAP cubes, 8, 45	atomic grain data, 17, 74
aggregate tables, ETL system development,	attributes
519	aggregated facts as, 64
agile development, 34-35	bridge tables, CRM and, 247
conformed dimensions and, 137–138	changes, 514
airline case study, 311	detailed dimension model, 437
bus matrix, 311–315	expiration, 266
calendars as outriggers, 321–323	flags, 48
class of service flown dimension, 319–320	indicators, 48
destination airport dimension, 320–321	null, 48, 92
fact tables, granularity, 312–316	numeric values as, 59
origin dimension, 320–321	pathstring, ragged/variable depth
passenger dimension, 314	hierarchies, 57
sales channel dimension, 315	product dimensions, 132
segments, linking to trips, 315–316	SCD type 3 (add new attribute), 154–155
time zones, multiple, 323	multiple, 156
aliasing, 171	audit columns, CDC (change data capture)
allocated facts, 60	452
allocating, 184–186	audit dimensions, 66, 192-193, 284, 495
allocations, profit and loss fact tables, 60	assembler, 460
ALTER TABLE command, 17	insurance case study, 383
analytics	key assignment, 511–512
big data management, 531	automation, ETL system development
GA (Google Analytics), 367	errors, 520
in-database, big data and, 537	exceptions, 520
analytic solutions, packaged, 270–271	job scheduling, 520
AND queries, skill keywords bridge, 275	<i>y</i>
architecture	D
big data best practices	В
backflow, 535–536	backflow, big data and, 535-536
boundary crashes, 536	backups, 495
compute resources, 537	backup system, ETL systems, 485
data highway planning, 533–534	archiving, 485–486
data quality planning, 535	compliance manager, 493–495
data value, 535	dependency, 490-491
ecosystems, 534	high performance, 485
fact extractor, 534	lights-out operations, 485
in-database analytics, 537	lineage, 490–491
performance improvements, 537	metadata repository, 495
prototypes, 536	parallelizing/pipelining system, 492
streaming data, 536	problem escalation system, 491–492
DW/BI alternatives, 26–29	recovery and restart system, 486–488
enterprise data warehouse bus architecture,	retrieval, 485–486
22, 123–125	security system, 492–493
hub-and-spoke CIF architecture, 28–29	simple administration, 485
hybrid hub-and-spoke Kimball architecture,	sorting system, 490
29	version control system, 488
independent data mart architecture, 26–27	version migration system, 488
MapReduce/Hadoop, 530	workflow monitor, 489-490
RDBMS, extension, 529–530	banking case study, 282
real-time processing, 522–524	
	bus matrix, 282–296
archiving, 447–448, 485–486 artificial keys, 98	

mini-dimensions, 289–291	customer contacts, CRM and, 248
multivalued, weighting, 287–289	mini-dimensions, 290–291
too few, 283–286	multivalued
facts, value banding, 291–292	CRM and, 245–246
heterogeneous products, 293–295	time varying, 63
hot swappable dimensions, 296	multivalued dimensions, 63, 477–478
user perspective, 293	ragged hierarchies and, 223
behavior	ragged/variable depth hierarchies, 57
customers, CRM and, 249–251	sparse attributes, CRM and, 247
sequential, step dimension and, 251-252	bubble chart, dimension modeling and,
study groups, 64, 249	435–436
behavior tags	budget fact table, 210
facts, 241	budgeting process, 210–213
time series, 63, 240–242	bus architecture, 124–125
BI application design/development (Lifecycle), 408, 423 –424	enterprise data warehouse bus architecture 52
BI applications, 22	business analyst, 408
BI (business intelligence) delivery interfaces,	Business Dimensional Lifecycle, 404
448	business-driven governance, 136–137
big data	business driver, 408
architecture best practices	business initiatives, 70
backflow, 535–536	business lead, 408
boundary crashes, 536	business motivation, Lifecycle planning, 407
compute resources, 537	business processes
data highway planning, 533–534	characteristics, 70–71
data quality planning, 535	dimensional modeling, 39, 300
data value, 535	retail sales case study, 74
ecosystems, 534	value chain, 111–112
fact extractor, 534	business representatives, dimensional
in-database analytics, 537	modeling, 431–432
performance improvements, 537	business requirements
prototypes, 536	dimensional modeling, 432
streaming data, 536	Lifecycle, 405, 410
data governance best practices, 541	documentation, 414
dimensionalizing and, 541	forum selection, 410–411
privacy, 541–542	interviews, 412–414
data modeling best practices	launch, 412
data structure declaration, 540	prioritization, 414–415
data virtualization, 540	
dimension anchoring, 539	representatives, 411–412 team, 411
integrating sources and confined	business rule screens, 458
dimensions, 538	_
	business sponsor, 408
name-value pairs, 540	Lifecycle planning, 406
SCDs (slowly changing dimensions), 539	business users, 408
structured/unstructured data integration,	perspectives, 293
539	bus matrix
thinking dimensionally, 538	accounting, 202
management best practices	airline, 311
analytics and, 531	banking, 282
legacy environments and, 532	detailed implementation bus matrix, 53
sandbox results and, 532–533	dimensional modeling and, 439
sunsetting and, 533	enterprise data warehouse bus matrix, 52
overview, 527–529	healthcare case study, 339–340
blobs, 530	HR (human resources), 268–269
boundary crashes, big data and, 536	insurance, 378–389
bridge tables	detailed implementation 300

Index

inventory, 113–119	change tracking, 330
opportunity/stakeholder matrix, 127	course registrations, 330–333
order management, 168	facility use, 334
procurement, 142–147	instructors, multiple, 333
telecommunications, 297–299	metrics, artificial count, 331–332
university, 325–326	research grant proposal, 329
web retailers, clickstream integration,	student dimensions, 330
368–370	term dimensions, 330
300 310	electronic commerce
C	clickstream data, 353–370
C	profitability, sales transactions and,
calculation lag, 196–197	370–372
calendar date dimensions, 48	financial services, 282, 287–295
calendars, country-specific as outriggers,	dimensions, household, 286–287
321–323	
cannibalization, 90	dimensions, too few, 283–286 healthcare, 339–340
cargo shipper schema, 317	
case studies	billing, 342–344
accounting, 202	claims, 342–344
budgeting, 210–213	date dimension, 345
consolidated fact tables, 224–225	diagnosis dimension, 345–347
G/L (general ledger), 203–210	EMRs (electronic medical records),
hierarchies, 214–223	341–348
OLAP and, 226	HCPCS (Healthcare Common Procedure
airline, 311	Coding System), 342
calendars as outriggers, 321–323	HIPAA (Health Insurance Portability and
class of service flown dimension, 319–320	Accountability Act), 341
destination airport dimension, 320–321	ICD (International Classification of
fact table granularity, 312–316	Diseases), 342
_ 0	images, 350
origin dimension, 320–321	inventory, 351
passenger dimension, 314	measure type dimension, 349-350
sales channel dimension, 315	payments, 342–344
time zones, multiple, 323	retroactive changes, 351-352
CRM (customer relationship management)	subtypes, 347–348
analytic, 231–233	supertypes, 347–348
bridge tables, 245–248	text comments, 350
complex customer behavior, 249–251	HR (Human Resources Management)
customer data integration, 256–260	bus matrix, 268
customer dimension and, 233-245	employee hierarchies, 271-272
fact tables, abnormal scenario indicators,	employee profiles, 263–267
255–256	hierarchies, 273–274
fact tables, satisfaction indicators,	managers key, 272–273
254–255	packaged data models, 270–271
fact tables, timespan, 252–254	periodic snapshots, 267–268
low latency data, 260–261	skill keywords, 274–277
operational, 231–233	survey questionnaire, 277–278
step dimension, sequential behavior,	insurance, 375–377
251–252	accident events factless fact table, 396
education, 325–326	accumulating snapshot, 384–385
accumulating snapshot fact table,	bus matrix, 378, 389–390
326–329	claim transactions, 390–396
additional uses, 336	conformed dimensions, 386
admissions events, 330	conformed dimensions, 386
applicant pipeline, 326–329	
attendance, 335	degenerate dimension, 383
*	dimensions, 380

dimensions, audit, 383 grain declaration, 74–75 POS schema, 94 dimensions, low cardinality, 383 dimensions, multivalued, 388 retail schema extensibility, 95-97 junk dimensions, 392 telecommunications, 297-299 mini-dimensions, 381-382 causal dimension, 89–90, 284 multivalued dimensions, 382 CDC (change data capture) NAICS (North American Industry ETL system, 451 Classification System), 382 audit columns, 452 numeric attributes, 382 diff compare, 452 pay-in-advance facts, 386-387 log scraping, 453 periodic snapshot, 385 message queue monitoring, 453 policy transaction fact table, 383 timed extracts, 452 centipede fact tables, 58, 108-109 policy transactions, 379–380 premiums, periodic snapshot, 386-388 change reasons, 266-267 SCDs (slowly changing dimensions), change tracking, 147–148 380 - 381education case study, 330 SIC (Standard Industry Classification), HR (human resources) case study, embedded managers key, 272-273 supertype/subtype products, 384, 387 SCDs. 148 timespan accumulating snapshot, 394 chart of accounts (G/L), 203-204 value chain, 377-378 uniform chart of accounts, 204 checkpoints, data quality, 516 inventory accumulating snapshot, 118–119 CIF (Corporate Information Factory), 28–29 fact tables, 115-116 CIO (chief information officer), 377 periodic snapshot, 112-114 claim transactions (insurance case study). semi-additive facts, 114-115 transactions, 116-118 claim accumulating snapshot, 393-394 order management, 167 junk dimensions and, 392 accumulating snapshots, 194–196 periodic snapshot, 395–396 timespan accumulating snapshot, 394–395 audit dimension, 192-193 customer dimension, 174-175 class of service flown dimension (airline case deal dimension, 177-179 study), 319-320 header/line pattern, 186 cleaning and conforming, ETL systems, 450 header/line patterns, 181-182 audit dimension assembler, 460 invoice transactions, 187 conforming system, 461–463 junk dimensions, 179–180 data cleansing system, 456 lag calculations, 196 quality event responses, 458 multiple currencies, 182–184 quality screens, 457–458 product dimension, 172–173 data quality improvement, 455-456 profit and loss facts, 189-191 deduplication system, 460-461 transaction granularity, 184–186 error event schema, 458–460 transactions, 168–171 clickstream data, 353–354 units of measure, multiple, 197-198 dimensional models, 357-358 procurement, 141-142 aggregate fact tables, 366–367 bus matrix, 142–143 customer, 361-362 complementary procurement snapshot date, 361-362 fact table, 147 event dimension, 359 transactions, 142-145 GA (Google Analytics), 367 retail sales, 72-73 page dimension, 358–359 business process selection, 74 page event fact table, 363-366 dimensions, selecting, 76 referral dimension, 360 facts, 76-77 session dimension, 359–360 facts, derived, 77–78 session fact table, 361-363 facts, non-additive, 78 step dimension, 366 fact tables, 79 time, 361-362 frequent shopper program, 96 session IDs, 355-356

visitor identification, 356-357	dates, 238
visitor origins, 354–355	facts, aggregated, 239–240
web retailer bus matrix integration,	hierarchies, 244–245
368–370	names, 233–236
collaborative design workshops, 38	names, international, 236–238
column screens, 457	outriggers, low cardinality attribute set
comments, survey questionnaire (HR), 278	and, 243–244
common dimensions, 130	scores, 240–243
compliance, ETL system, 445	segmentation, 240–243
compliance manager, ETL system, 493–495	facts
composite keys, 12	abnormal scenario indicators, 255–256
computer resources, big data and, 537	satisfaction indicators, 254–255
conformed dimensions, 51, 130, 304	timespan, 252–254
agile movement and, 137–138	low latency data, 260–261
drill across, 130–131	operational, 231–233
grain, 132	overview, 230–231
identical, 131–132	social media and, 230
insurance case study, 386	step dimension, sequential behavior,
limited conformity, 135	251–252
shrunken on bus matrix, 134	currency, multiple
shrunken rollup dimensions, 132	fact tables, 60
shrunken with row subset, 132–134	G/L (general ledger), 206
conformed facts, 42, 139	order transactions, 182–184
insurance case study, 386	current date attributes, dimension tables,
inventory case study, 138–139	82–83
conforming system, ETL system, 461–463	customer contacts, bridge tables, 248
consistency	customer dimension, 158, 174–175
adaptability, 4	clickstream data, 361–362
goals, 3	CRM and, 233
consolidated fact tables, 45	addresses, 233–236
accounting case study, 224–225	addresses, international, 236–238
contacts, bridge tables, 248	counts with Type 2, 243
contribution amount (P&L statement), 191	dates, 238
correctly weighted reports, 288	facts, aggregated, 239–240
cost, activity-based costing measures, 184	hierarchies, 244–245
COUNT DISTINCT, 243	names, 233–236
country-specific calendars as outriggers,	names, international, 236–238
321–323	outriggers, low cardinality attribute set
course registrations (education case study),	and, 243–244
330	scores, 240–243
CRM (customer relationship management),	segmentation, 240–243
229	factless fact tables, 176
analytic, 231–233	hierarchies, 174–175
bridge tables	multiple, partial conformity, 258–259
customer contacts, 248	single, 256–258
multivalued, 245–246	single versus multiple dimension tables,
sparse attributes, 247	175–176
complex customer behavior, 249–251	customer matching, 257
customer data integration, 256	customer relationship management. case
multiple customer dimension conformity,	study. See CRM, 230
258–259	study. See Cidvi, 250
single customer dimension, 256–258	D
customer dimension and, 233	D
addresses, 233–236	data architect/modeler, 409
addresses, international, 236–238	data bags, 530
counts with Type 2, 243	database administrator, 409
· · · · / F · · / - / -	

data cleansing system, ETL system, 456	calendar date, 48
quality event responses, 458	clickstream data, 361–362
quality screens, 457–458	current date attributes, 82-83
data compression, ETL system, 454	fixed time series buckets and, 302-303
data governance, 135–136	healthcare case study, 345
big data best practices, 541	populating, 508
dimensionalizing, 541	relative date attributes, 82–83
privacy, 541–542	role playing, 171
business-driven governance, 136–137	smart keys, 101–102
objectives, 137	textual attributes, 82
data handlers, late arriving, 478–479	
data highway planning, 533–534	time-of-day, 83
data integration	dates
conformed dimensions, 130–138	CRM and, customer dimension, 238
CRM and, 256	dimension tables, 89
,	timespan fact tables, 252–254
multiple customer dimension conformity,	transaction fact table, 170–171
258–259	foreign key, 170
single customer dimension, 256–258	role playing, 171
ETL system, 444–446	date/time
MDM (master data management), 256	GMT (Greenwich Mean Time), 323
structure/unstructured data, 539	time zones, multiple, 323
value chain integration, 111–112	UTC (Coordinated Universal Time, 323
data latency, ETL system, 447	date/time dimensions, 470
data mart, independent data mart	date/time stamp dimensions, 284
architecture, 26–27	deal dimensions, 177–178
data mining	decision-making goals, 4
DW/BI system and, 242–243	decodes, dimensions, 303–304
null tracking, 92	decoding production codes, 504
data modeling, big data best practices	deduplication system, 460–461
data structure declaration, 540	degenerate dimension, 47, 284, 303
data virtualization, 540	insurance case study, 383
dimension anchoring, 539	order number, 178–179
integrating sources and conformed	retail sales case study, 93–94
dimensions, 538	surrogate keys, 101
name-value pairs, 540	telecommunications case study, 303
SCDs (slowly changing dimensions), 539	transaction numbers, 93–94
structured/unstructured data integration,	demand planning, 142
539	demographics dimension, 291
thinking dimensionally, 538	size, 159
data models, packaged, 270–271	denormalized flattened dimensions, 47
data profiling	
ETL system, 450–451	dependency analysis, 495
tools, 433	dependency, ETL, 490–491
data propagation, ETL system, 482	deployment
data quality	Lifecycle, 424
checkpoints, 516	OLAP, 9
ETL system, 445	derived facts, 77–78
improvement, 455–456	descriptions, dimensions, 303–304
planning, big data and, 535	descriptive context, dimensions for, 40
data steward, 408	destination airport dimension (airline case
data structure, analysis time, 540	study), 320–321
data value, big data and, 535	detailed implementation bus matrix, 53, 390
data virtualization, big data and, 540	detailed table design documentation,
data warehousing versus operational	437–439
processing, 2	diagnosis dimension (healthcare case study),
date dimension, 79–81, 284, 302	345–347

1:00 CD C (1 1 1)	. 420 121
diff compare, CDC (change data capture),	overview, 429–131
452	participant identification, 431–432
dimensional modeling, 7	reports, 17
3NF (third normal form) models, 7–8	simplicity in, 16
4-step design process	sources, 300
business process, 70–71	star schemas, 8
dimensions, 72	terminology, 15
facts, 72	tools, 432
grain, 71	dimensional thinking, big data and, 538
atomic grain data, 17	dimension manager system, 479–480
benefits of thinking dimensionally, 32–33	dimensions
business processes, 300	anchoring, big data and, 539
business representatives, 431–432	attributes, 514
calendar coordination, 433–434	aggregated facts as, 64
clickstream data, 357–367	bridge tables, CRM and, 247
data profiling tools, 433	changes, 514
design	detailed dimension model, 437
bubble chart, 435–436	
detailed model development, 436–439	expiration, 266
documentation finalization, 441	flags, 48
· · · · · · · · · · · · · · · · · · ·	indicators, 48
validation, 440–441	null, 48, 92
dimension tables, 13	numeric values as, 59
attributes, 13–14	pathstring, ragged/variable depth
hierarchical relationships, 15	hierarchies, 57
snowtlaking, 15	product dimensions, 132
extensibility, 16	SCD type 3 (add new attribute), 154–156
facts	See also attributes, 48
additive facts, 11	audit dimension, 66, 192-193, 284
composite keys, 12	assembler, 460
FK (foreign keys), 12	insurance case study, 383
grains, 10	average number in model, 284
numeric facts, 11	calendar date, 48
textual facts, 12	causal, 89–90, 284
fact tables, 10–12	change reasons, 266–267
grain categories, 12	class of service flown (airline case study),
fundamentals	319–320
business processes, 39	
business requirement gathering, 37–38	conformed, 51, 130, 304
collaborative workshops, 38	agile movement and, 137–138
data realities gathering, 37–38	drill across, 130–131
descriptive context, 40	grain, 132
facts, 40	identical, 131–132
four-step dimensional design process, 38	insurance case study, 386
grain, 39	limited conformity, 135
model extensions, 41	shrunken, bus matrix and, 134
star schemas, 40	shrunken rollup dimensions, 132
Lifecycle data track, 420	shrunken with row subset, 132–134
mistakes to avoid, 397–401	customer dimension, 158, 174–175
	conformity, 258–259
myths, 30	CRM and, 233–245
departmental versus enterprise, 31	factless fact tables, 176
integration, 32	hierarchies, 174–175
predictable use, 31–32	single, 256–258
scalability, 31	single versus multiple dimension tables,
summary data, 30	175–176
naming conventions, 433	data governance, big data and, 541
OLAP (online analytical processing) cube, 8	date dimension, 48, 284, 302
deployment considerations, 9	aace difficusion, 10, 201, 302

fixed time series buckets and, 302-303	outrigger, 50
healthcare case study, 345	page dimension, clickstream data, 358-359
populating, 508	passenger (airline case study), 314
role playing, 171	product dimension
date/time stamp, 284	characteristics, 172–173
deal dimension, 177–178	operational product master, 173
decodes, 303–304	order transactions, 172–173
	rapidly changing monster dimension, 55
degenerate, 47, 284, 303	. ,
order number, 178–179	referral dimension, clickstream data, 360
demographic, 291	retail sales case study, 76
size, 159	role-playing, 284
denormalized flattened, 47	sales channel, airline case study, 315
descriptions, 303–304	service level performance, 188–189
destination airport (airline case study),	session dimension, clickstream data,
320–321	359–360
detailed dimension model, 437	shrunken, 51
diagnosis (healthcare case study), 345–347	shrunken rollup, 132
dimensional design models, 72	special dimensions manager, ETL systems,
drilling across, 51	470
event dimension, clickstream data, 359	date/time dimensions, 470
generic, abstract, 66	junk dimensions, 470
	mini-dimensions, 471
geographic location, 310	shrunken subset, 472
granularity, hierarchies and, 301–302	static, 472
hierarchies	user-maintained, 472–473
fixed depth position hierarchies, 56	
ragged/variable depth with hierarchy	static dimension, population, 508
bridge tables, 57	status, 284
ragged/variable depth with pathstring	step dimension, 65
attributes, 57	clickstream data, 366
slightly ragged/variable depth, 57	sequential behavior, 251–252
hot swappable, 66, 296	student (education case study), 330
household, 286–287	term (education case study), 330
insurance case study, 380	text comments, 65
degenerate dimension, 383	too few, 283–286
mini-dimensions, 381-382	transaction profile dimension, 49, 179
multivalued dimensions, 382	transformations
numeric attributes, 382	combine from separate sources, 504
SCDs (slowly changing dimensions),	decode production codes, 504
380–381	relationship validation, 504–505
junk dimensions, 49, 179-180, 284	simple data, 504
keys, natural, 162	surrogate key assignment, 506
late arriving, 67	value chain, 52
low cardinality, insurance case study, 383	dimension surrogate keys, 46
measure type, 65	dimension tables, 13
healthcare case study, 349–350	attributes, 13–14
mini-dimensions, 289–290	calendar date dimensions, 48
bridge tables, 290–291	changed rows, 513–514
insurance case study, 381–382	date dimension, 79–81
type 5 SCD and, 160	current date attributes, 82-83
	smart keys, 101–102
multivalued	textual attributes, 82
bridge table builder, 477–478	time-of-day, 83
bridge tables and, 63	dates, 89
insurance case study, 382–388	degenerate dimensions, 47
weighting, 287–289	surrogate keys, 101
origin (airline case study), 320–321	transaction numbers, 93–94
	,

denormalized flattened dimensions, 47	dual type 1 and type 2 dimensions
drilling down, 47	(SCD type 7), 56
durable keys, 46	duplication, deduplication system, 460–461
extracts, 513	durable keys, 46
fact tables, centipede, 108–109	supernatural keys, 101
flags, 48, 82	DW/BI, 1
hierarchical relationships, 15	alternative architecture, 26–29
hierarchies, multiple, 48, 88–89	data mining and, 242–243
historic data population, 503–506	goals, 3
holiday indicator, 82	international goals, 237–238
indicators, 48, 82	Kimball architecture, 18
junk dimensions, 49	BI applications, 22
loading, 506–507	ETL (extract, transformation, and load)
loading history, 507–508	system, 19–21
	hybrid hub-and-spoke Kimball, 29
natural keys, 46, 98–101	operational source systems, 18
new rows, 513–514	presentation area, 21–22
null attributes, 48	restaurant metaphor, 23–26
outrigger dimensions, 50	*
outriggers, 106–107	publishing metaphor for DW/BI managers, 5–7
product dimension, 83–84	system users, 2
attributes with embedded meaning, 85	· ·
drilling down, 86–87	dynamic value bands, 64, 291
many-to-one hierarchies, 84–85	E
numeric values, 85–86	E
promotion dimension, 89–91	ecosystems, big data and, 534
null items, 92	case study, 325–326
role-playing, 49	education
snowflaking, 15, 50, 104–106	accumulating snapshot fact table, 326-329
store dimension, 87–89	additional uses, 336
structure, 46	admissions events, 330
supernatural keys, 46, 101	applicant pipeline, 326-329
surrogate keys, 46, 98–100	attendance, 335
transaction profile dimensions, 49	bus matrix, 325-326
weekday indicator, 82	change tracking, 330
dimension terminology, 15	course registrations, 330–333
dimension-to-dimension table joins, 62	facility use, 334
documentation	instructors, multiple, 333
detailed table design, 437–439	metrics, artificial count, 331–332
dimensional modeling, 441	research grant proposal, 329
ETL development, 502-503	student dimension, 330–332
sandbox source system, 503	term dimension, 330
Lifecycle architecture requirements, 417	effective date, SCD type 2, 152–153
Lifecycle business requirements, 414	EHR (electronic health record), 341
draft design	electronic commerce case study, 353-372
exercise discussion, 306-308	embedded managers key (HR), 272–273
remodeling existing structures, 309	embedding attribute meaning, 85
drill across, 51, 130–131	employee hierarchies, recursive, 271–272
drill down, 47, 86–87	employee profiles, 263–265
ETL development, 500	dimension change reasons, 266–267
hierarchies, 501	effective time, 265–266
table schematics, 501	expiration, 265–266
G/L (general ledger) hierarchy, 209	fact events, 267
management hierarchies, 273–274	type 2 attributes, 267
dual date/time stamps, 254	EMRs (electronic medical records),
1 ,	healthcare case study, 341, 348

enterprise data warehouse bus architecture, 22, 52, 123–125	drill down, 500–501 high-level plan, 498
enterprise data warehouse bus matrix, 52, 125–126	incremental processing, 512–519 OLAP loads, 519
columns, 126	one-time historic load data, 503–512
hierarchy levels, 129	specification document, 502–503
common mistakes, 128–129	system operation and automation, 520
opportunity/stakeholder matrix, 127	tools, 499
procurement, 142–143	ETL architect/designer, 409
retrofitting existing models, 129–130	extracting, 450
rows	CDC (change data capture), 451–453
narrowly defined, 128	data profiling, 450–451
overly encompassing, 128	extract system, 453–455
overly generalized, 129	legacy licenses, 449
shrunken conformed dimensions, 134	lineage, 447–448
uses, 126–127	managing, 450, 483
ERDs (entity-relationship diagrams), 8	backup system, 485–495
error event schema, ETL system, 458–460	job scheduler, 483–484
error event schemas, 68	OLAP cube builder, 481–482
ETL (extract, transformation, and load)	process overview, 497
system, 19-21, 443	security, 446
archiving, 447–448	skills, 448
BI, delivery, 448	subsystems, 449
business needs, 444	event dimension, clickstream data, 359
cleaning and conforming, 450	expiration date, type 2 SCD, 152–153
audit dimension assembler, 460	extended allowance amount (P&L
conforming system, 461–463	statement), 190
data cleansing system, 456-458	extended discount amount (P&L statement),
data quality, improvement, 455–456	190
deduplication system, 460–461	extended distribution cost (P&L statement),
error event schema, 458–460	191
compliance, 445	extended fixed manufacturing cost (P&L
data integration, 446	statement), 190
data latency, 447 data propagation manager, 482	extended gross amount (P&L statement), 189
data quality, 445	extended net amount (P&L statement), 190
delivering, 450, 463	extended net amount (1&L statement), 190
aggregate builder, 481	extended variable manufacturing cost (P&L
dimension manager system, 479–480	statement), 190
fact provider system, 480–481	extensibility in dimensional modeling, 16
fact table builders, 473–475	extracting, ETL systems, 450
hierarchy manager, 470	CDC (change data capture), 451
late arriving data handler, 478–479	audit columns, 452
multivalued dimension bridge table	diff compare, 452
builder, 477–478	log scraping, 453
SCD manager, 464–468	message queue monitoring, 453
special dimensions manager, 470–473	timed extracts, 452
surrogate key generator, 469-470	data profiling, 450–451
surrogate key pipeline, 475-477	extract system, 453–455
design, 443	extraction, 19
Lifecycle data track, 422	extract system, ETL system, 453-455
developer, 409	
development, 498	F
activities, 500	fact extractors, 530
aggregate tables, 519	big data and, 534
default strategies, 500	0

factless fact tables, 44, 97–98, 176	pay-in-advance, insurance case study,
accidents (insurance case study), 396	386–387
admissions (education case study), 330	periodic snapshots, 43, 120–122
attendance (education case study), 335	policy transactions (insurance case study),
course registration (education case study),	383
330–333	profitability, 370–372
facility use (education case study), 334	profit and loss, 189–192
order management case study, 176	profit and loss, allocations and, 60
fact provider system	real-time, 68
ETL system, 480–481	referential integrity, 12
facts, 10, 12, 72, 79	reports, 17
abnormal scenario indicators, 255–256	retail sales case study, identifying, 76–79
accumulating snapshots, 44, 121–122,	satisfaction indicators, 254–255
326–329	semi-additive, 42, 114–115
additive facts, 11, 42	service level performance, 188–189
aggregate, 45	session, clickstream data, 361–363
as attributes, 64	set difference, 97
clickstream data, 366–367	shrunken rollup dimensions, 132
CRM and customer dimension, 239–240	single granularity and, 301
allocated facts, 60	snapshot, complementary procurement,
allocating, 184–186	147
behavior tags, 241	structure, 41–42 subtype, 67, 293–295
budget, 210	7 1
builders, ETL systems, 473–475	supertype, 67, 293–295
centipede, 58, 108–109	surrogate keys, 58, 102–103 textual facts, 12
compliance-enabled, 494	_
composite keys, 12	terminology, 15 time-of-day, 83
conformed, 42, 138–139	,
consolidated, 45	timespan, 252–254 timespan tracking, 62
currency, multiple, 60	transactions, 43, 120
derived, 77–78	dates, 170–171
detailed dimension model, 437	single versus multiple, 143–145
dimensional modeling process and, 40	transformations, 509–512
drill across, 130–131	value banding, 291–292
employee profiles, 267	year-to-date, 206
enhanced, 115–116	YTD (year-to-date), 61
FK (foreign keys), 12	fact-to-fact joins, avoiding with multipass
grains, 10, 12	SQL, 61
granularity, airline bus matrix, 312–315	feasibility in Lifecycle planning, 407
header/line fact tables, 59	financial services case study, 281
historic, 508	bus matrix, 282
incremental processing, 515, 519	dimensions
invoice, 187–188	hot-swappable, 296
joins, avoiding, 259–260	household, 286–287
lag/duration facts, 59	mini-dimensions, 289–291
late arriving, 62	multivalued, weighting, 287–289
loading, 512	too few, 283–286
mini-dimension demographics key, 158	facts, value banding, 291–292
multiple units of measure, 61	heterogeneous products, 293–295
non-additive, 42, 78	OLAP, 226
normalization, order transactions, 169-170	user perspective, 293
null, 42, 92	financial statements (G/L), 209–210
numeric facts, 11	fiscal calendar, G/L (general ledger), 208
numeric values, 59, 85–86	fixed depth position hierarchies, 56, 214
page event, clickstream data, 363-366	fixed time series buckets, date dimensions
partitioning, smart keys, 102	and, 302–303

FK (foreign keys). <i>See</i> foreign keys (FK), 12 flags as textual attributes, 48 dimension tables, 82 junk dimensions and, 179–180 flattened dimensions, denormalized, 47 flexible access to information, 407 foreign keys (FK) demographics dimensions, 291 fact tables, 12	periodic snapshots, 43 single, facts and, 301 transaction fact tables, 43 granularity, 300 GROUP BY clause, 18 growth Lifecycle, 425–426 market growth, 90
managers employee key as, 271–272 mini-dimension keys, 158 null, 92 order transactions, 170 referential integrity, 12 forum, Lifecycle business requirements, 410–411 frequent shopper program, retail sales schema, 96 FROM clause, 18	H Hadoop, MapReduce/Hadoop, 530 HCPCS (Healthcare Common Procedure Coding System), 342 HDFS (Hadoop distributed file system), 530 headcount periodic snapshot, 267–268 header/line patterns, 181–182, 186 healthcare case study, 339–340 billing, 342, 344
1 KONI Clause, 10	billing, 342–344 claims, 342–344
G	date dimension, 345
GA (Google Analytics), 367	diagnosis dimension, 345–347 EMRs (electronic medical records), 341,
general ledger. See G/L (general ledger), 203	348
generic dimensions, abstract, 66	HCPCS (Healthcare Common Procedure
geographic location dimension, 310	Coding System), 342
G/L (general ledger), 203	HIPAA (Health Insurance Portability and
chart of accounts, 203-204	Accountability Act), 341
currencies, multiple, 206	ICD (International Classification of
financial statements, 209–210	Diseases), 342
fiscal calendar, multiple, 208	images, 350
hierarchies, drill down, 209	inventory, 351
journal entries, 206–207	measure type dimension, 349–350
period close, 204–206	payments, 342–344
periodic snapshot, 203	retroactive changes, 351–352
year-to-date facts, 206	subtypes, 347–348
GMT (Greenwich Mean Time), 323 goals of DW/BI, 3–4	supertypes, 347–348 text comments, 350
Google Analytics (GA), 367	heterogeneous products, 293–295
governance	hierarchies
business-driven, 136–137	accounting case study, 214–223
objectives, 137	customer dimension, 174–175, 244–245
grain, 39	dimension granularity, 301-302
accumulating snapshots, 44	dimension tables, multiple, 88-89
atomic grain data, 74	drill down, ETL development, 501
budget fact table, 210	employees, 271–272
conformed dimensions, 132	ETL systems, 470
declaration, 71	fixed-depth positional hierarchies, 56
retail sales case study, 74–75	G/L (general ledger), drill down, 209
dimensions, hierarchies and, 301–302	management, drilling up/down, 273–274
fact tables, 10	many-to-one, 84–85
accumulating snapshot, 12 periodic snapshot, 12	matrix columns, 129 multiple, 48
transaction, 12	nodes, 215
transaction, 12	110403, 213

ragged/variable depth, 57	I
slightly ragged/variable depth, 57	ICD (International Classification of
trees, 215–216	Diseases), 342
high performance backup, 485	identical conformed dimensions, 131–132
HIPAA (Health Insurance Portability and	images, healthcare case study, 350
Accountability Act), 341	impact reports, 288
historic fact tables	incremental processing, ETL system
extracts, 508	development, 512
statistics audit, 508	changed dimension rows, 513-514
historic load data, ETL development, 503–512	dimension attribute changes, 514
dimension table population, 503–506	dimension table extracts, 513
holiday indicator, 82	fact tables, 515–519
hot response cache, 238	new dimension rows, 513–514
hot swappable dimensions, 66, 296	in-database analytics, big data and, 537
household dimension, 286–287	independent data mart architecture, 26–27
HR (human resources) case study, 263	indicators
bus matrix, 268–269	abnormal, fact tables, 255–256
employee profiles, 263–265	as textual attributes, 48
dimension change reasons, 266-267	dimension tables, 82
effective time, 265–266	junk dimensions and, 179–180 satisfaction, fact tables, 254–255
expiration, 265–266	Inmon, Bill, 28–29
fact events, 267	insurance case study, 375–377
type 2 attributes, 267	accidents, factless fact tables, 396
hierarchies	accumulating snapshot, complementary
management, 273–274 recursive, 271–272	policy, 384–385
managers key	bus matrix, 378–389
as foreign key, 271–272	detailed implementation, 390
embedded, 272–273	claim transactions, 390
packaged analytic solutions, 270–271	claim accumulating snapshot, 393–394
packaged data models, 270–271	junk dimensions and, 392
periodic snapshots, headcount, 267–268	periodic snapshot, 395–396
skill keywords, 274	timespan accumulating snapshot, 394–395
bridge, 275	conformed dimensions, 386
text string, 276–277	conformed facts, 386
survey questionnaire, 277	dimensions, 380
text comments, 278	audit, 383
HTTP (Hyper Text Transfer Protocol),	degenerate, 383
355–356 hub-and-spoke CIF architecture, 28–29	low cardinality, 383
hub-and-spoke Kimball hybrid architecture,	mini-dimensions, 381-382
29	multivalued, 382, 388
human resources management case study.	SCDs (slowly changing dimensions),
See HR (human resources), 263	380–381
hybrid hub-and-spoke Kimball architecture,	NAICS (North American Industry
29	Classification System), 382
hybrid techniques, SCDs, 159, 164	numeric attributes, 382
SCD type 5 (add mini-dimension and type	pay-in-advance facts, 386–387 periodic snapshot, 385
1 outrigger), 55, 160	policy transactions, 379–380, 383
SCD type 6 (add type 1 attributes to type 2	premiums, periodic snapshot, 386–388
dimension), 56, 160–162	SIC (Standard Industry Classification), 382
SCD type 7 (dual type 1 and type 2	supertype/subtype products, 384, 387
dimension), 56, 162–163	value chain, 377–378
hyperstructured data, 530	integer keys, 98
	sequential surrogate keys, 101

integration conformed dimensions, 130–138 customer data, 256 customer dimension conformity, 258–259 single customer dimension, 256, 257, 258 dimensional modeling myths, 32 value chain, 122–123 international names/addresses, customer dimension, 236–238 interviews, Lifecycle business requirements, 412–413 data-centric, 413–414 inventory case study, 112–114 accumulating snapshot, 118–119 fact tables, enhanced, 115–116 periodic snapshot, 112–114	ETL system, 475–477 fact tables, 102–103 generator, 469–470 lookup pipelining, 510–511 keywords, skill keywords, 274 bridge, 275 text string, 276–277 Kimball Dimensional Modeling Techniques. See dimensional modeling Kimball DW/BI architecture, 18 BI applications, 22 ETL (extract, transformation, and load) system, 19–21 hub-and-spoke hybrid, 29 presentation area, 21–22 restaurant metaphor, 23–26
semi-additive facts, 114–115 transactions, 116–118 inventory, healthcare case study, 351 invoice transaction fact table, 187–188	source systems, operational source systems, 18 Kimball Lifecycle, 404 DW/BI initiative and, 404
ī	KPIs (key performance indicators), 139
job scheduler, ETL systems, 483–484 job scheduling, ETL operation and automation, 520 joins dimension-to-dimension table joins, 62 fact tables, avoiding, 259–260 many-to-one-to-many, 259–260 multipass SQL to avoid fact-to-fact joins, 61 journal entries (G/L), 206–207 junk dimensions, 49, 179–180, 284 airline case study, 320 ETL systems, 470 insurance case study, 392 order management case study, 179–180 justification for program/project planning, 407	L lag calculations, 196–197 lag/duration facts, 59 late arriving data handler, ETL system, 478–479 late arriving dimensions, 67 late arriving facts, 62 launch, Lifecycle business requirements, 412 Law of Too, 407 legacy environments, big data management, 532 legacy licenses, ETL system, 449 Lifecycle BI applications, 406 development, 423–424 specification, 423
keys dimension surrogate keys, 46 durable, 46 foreign, 92, 291 managers key (HR), 272–273 natural keys, 46, 98–101, 162 supernatural keys, 101 smart keys, 101–102 subtype tables, 294–295 supernatural, 46 supertype tables, 294–295 surrogate, 58, 98–100, 303 assigning, 506 degenerate dimensions, 101	business requirements, 405, 410 documentation, 414 forum selection, 410–411 interviews, 412–413 interviews, data-centric, 413–414 launch, 412 prioritization, 414–415 representatives, 411–412 team, 411 data, 405 dimensional modeling, 420 ETL design/development, 422 physical design, 420–422 deployment, 424 growth, 425–426 maintenance, 425–426 pitfalls, 426

products	master dimensions, 130
evaluation matrix, 419	MDM (master data management), 137, 256,
market research, 419	446
protoypes, 419	meaningless keys, 98
program/project planning, 405–406	measurement, multiple, 61
business motivation, 407	measure type dimension, 65
business sponsor, 406	healthcare case study, 349–350
development, 409–410	message queue monitoring, CDC (change
feasibility, 407	data capture), 453
justification, 407	metadata coordinator, 409
planning, 409–410	metadata repository, ETL system, 495
readiness assessment, 406–407	migration, version migration system, ETL,
scoping, 407	488
staffing, 408–409	milestones, accumulating snapshots, 121
technical architecture, 405, 416–417	mini-dimension and type 1 outrigger (SCD
implementation phases, 418	type 5), 160
model creation, 417	mini-dimensions, 289–290
plan creation, 418	bridge tables, 290–291
requirements, 417	ETL systems, 471
requirements collection, 417	insurance case study, 381-382
subsystems, 418	type 4 SCD, 156–159
task force, 417	modeling
lift, promotion, 89	benefits of thinking dimensionally, 32–33
lights-out operations, backup, 485	dimensional, 7–12
limited conformed dimensions, 135	atomic grain data, 17
lineage analysis, 495	dimension tables, 13–15
lineage, ETL system, 447–448, 490–491	extensibility, 16
loading fact tables, incremental, 517	myths, 30–32
localization, 237, 324	reports, 17
location, geographic location dimension, 310	simplicity in, 16
log scraping, CDC (change data capture),	terminology, 15
453	multipass SQL, avoiding fact-to-fact table
low cardinality dimensions, insurance case	joins, 61
study, 383	multiple customer dimension, partial
low latency data, CRM and, 260–261	conformity, 258–259 multiple units of measure, 61, 197–198
14	multivalued bridge tables
M	CRM and, 245–246
maintenance, Lifecycle, 425-426	time varying, 63
management	multivalued dimensions
ETL systems, 450, 483	bridge table builder, 477–478
backup system, 485-495	bridge tables and, 63
job scheduler, 483–484	CRM and, 245–247
management best practices, big data	education case study, 325–333
analytics, 531	financial services case study, 287–289
legacy environments, 532	healthcare case study, 345–348
sandbox results, 532–533	HR (human resources) case study, 274–275
sunsetting and, 533	insurance case study, 382–388
management hierarchies, drilling up/down,	weighting factors, 287–289
273–274 managara publishing matanbar 5 7	myths about dimensional modeling, 30
managers, publishing metaphor, 5–7	departmental versus enterprise, 31
many-to-one hierarchies, 84–85 many-to-one relationships, 175–176	integration, 32
many-to-one-to-many joins, 259–260	predictable use, 31–32
MapReduce/Hadoop, 530	scalability, 31
market growth, 90	summary data, 30
ilminet growth, 70	

N	accumulating snapshot, 194–196
names	type 2 dimensions and, 196
ASCII, 236	allocating, 184–186
CRM and, customer dimension, 233-238	audit dimension, 192–193 bus matrix, 168
Unicode, 236–238	currency, multiple, 182–184
name-value pairs, 540	customer dimension, 174–175
naming conventions, 433	factless fact tables, 176
natural keys, 46, 98–101, 162	single versus multiple dimension tables,
supernatural keys, 101	175–176
NCOA (national change of address), 257	date, 170–171
nodes (hierarchies), 215	foreign keys, 170
non-additive facts, 42, 78	role playing, 171
non-natural keys, 98	deal dimension, 177–178
normalization, 28, 301	degenerate dimension, order number and,
facts	178–179
centipede, 108–109	fact normalization, 169–170
order transactions, 169–170	header/line patterns, 181–186
outriggers, 106–107	junk dimensions, 179–180
snowflaking, 104–106	product dimension, 172–173
normalized 3NF structures, 8	order number, degenerate dimensions,
null attributes, 48	178–179
null fact values, 509	order management case study, role playing,
null values	171
fact tables, 42	origin dimension (airline case study),
foreign keys, 92	320–321
number attributes, insurance case study, 382 numeric facts, 11	OR, skill keywords bridge, 275
numeric values	outrigger dimensions, 50, 89, 106-107
as attributes, 59, 85–86	calendars as, 321–323
as facts, 59, 85–86	low cardinality attribute set and, 243–244
as facts, 55, 65–66	type 5 and type 1 SCD, 160
0	overwrite (type 1 SCD), 54, 149–150
	add to type 2 attribute, 160–162
off-invoice allowance (P&L) statement, 190	type 2 in same dimension, 153
OLAP (online analytical processing) cube,	
8, 40	P
accounting case study, 226	packaged analytic solutions, 270-271
accumulating snapshots, 121–122	packaged data models, 270–271
aggregate, 45	page dimension, clickstream data, 358–359
cube builder, ETL system, 481–482	page event fact table, clickstream data,
deployment considerations, 9	363–366
employee data queries, 273	parallelizing/pipelining system, 492
financial schemas, 226	parallel processing, fact tables, 518
Lifecycle data physical design, 421 loads, ETL system, 519	parallel structures, fact tables, 519
what didn't happen, 335	parent/child schemas, 59
one-to-one relationships, 175–176	parent/child tree structure hierarchy, 216
operational processing versus data	partitioning
warehousing, 2	fact tables, smart keys, 102
operational product master, product	real-time processing, 524–525
dimensions, 173	passenger dimension, airline case study, 314
operational source systems, 18	pathstring, ragged/variable depth hierarchies,
operational system users, 2	57
opportunity/stakeholder matrix, 53, 127	pay-in-advance facts, insurance case study,
order management case study, 167–168	386–387
<i>5</i>	payment method, retail sales, 93

performance measurement, fact tables, 10, 12 additive facts, 11	many-to-one hierarchies, 84–85 numeric values, 85–86
grains, 10–12	operational product master, 173
numeric facts, 11	order transactions, 172–173
textual facts, 12	operational product master, 173
period close (G/L), 204–206	production codes, decoding, 504
periodic snapshots, 43, 112–114	products
education case study, 329, 333	heterogeneous, 293–295
ETL systems, 474	Lifecycle
fact tables, 120–121	evaluation matrix, 419
complementary fact tables, 122	market research, 419
G/L (general ledger), 203	prototypes, 419
grain fact tables, 12	profit and loss facts, 189–191, 370–372
headcount, 267–268	allocations and, 60
healthcare case study, 342	granularity, 191–192
insurance case study, 385	program/project planning (Lifecycle),
claims, 395–396	405–406
premiums, 386–387	business motivation, 407
inventory case study, 112–114	business sponsor, 406
procurement case study, 147	development, 409–410
perspectives of business users, 293	feasibility, 407
physical design, Lifecycle data track, 420	justification, 407
aggregations, 421	planning, 409–410
database model, 421	readiness assessment, 406–407
database standards, 420	scoping, 407
index plan, 421	staffing, 408–409
naming standards, 420–421	task list, 409
OLAP database, 421	project manager, 409
storage, 422	promotion dimension, 89-91
pipelining system, 492	null values, 92
planning, demand planning, 142	promotion lift, 89
P&L (profit and loss) statement	prototypes
contribution, 189–191	big data and, 536
granularity, 191–192	Lifecycle, 419
policy transactions (insurance case study), 379–380	publishing metaphor for DW/BI managers, 5–7
fact table, 383	
PO (purchase orders), 142	Q
POS (point-of-sale) system, 73	quality events responses 458
POS schema, retail sales case study, 94	quality events, responses, 458 quality screens, ETL systems, 457–458
transaction numbers, 93–94	questionnaire, HR (human resources), 277
presentation area, 21–22	text comments, 278
prioritization, Lifecycle business	text comments, 270
requirements, 414–415	D
privacy, data governance and, 541–542	R
problem escalation system, 491–492	ragged hierarchies
procurement case study, 141–142	alternative modeling approaches, 221-223
bus matrix, 142–143	bridge table approach, 223
snapshot fact table, 147	modifying, 220–221
transactions, 142–145	pathstring attributes, 57
product dimension, 83–84	shared ownership, 219
attributes with embedded meaning, 85	time varying, 220
characteristics, 172–173	variable depth, 215–217
drilling down, 86–87	rapidly changing monster dimension, 55

RDBMS (relational database management system), 40	RFP (request for proposal), 419 role playing, dimensions, 49, 89, 171, 284
architecture extension, 529–530	airline case study, 313
blobs, 530	bus matrix and, 171
fact extractor, 530	healthcare case study, 345
hyperstructured data, 530	insurance case study, 380
real-time fact tables, 68	order management case study, 170
real-time processing, 520–522	,,,, ,
architecture, 522–524	S
partitions, 524–525	3
rearview mirror metrics, 198	sales channel dimension, airline case study,
recovery and restart system, ETL system,	315
486–488	sales reps, factless fact tables, 176
recursive hierarchies, employees, 271–272	sales transactions, web profitability and,
reference dimensions, 130	370–372
referential integrity, 12	sandbox results, big data management,
referral dimension, clickstream data, 360	532–533
	sandbox source system, ETL development,
relationships	503
dimension tables, 15	satisfaction indicators in fact tables, 254-255
many-to-one, 175–176	scalability, dimensional modeling myths, 31
many-to-one-to-many joins, 259–260	SCDs (slowly changing dimensions), 53, 148,
one-to-one, 175–176	464–465
validation, 504–505	big data and, 539
relative date attributes, 82–83	detailed dimension model, 437
remodeling existing data structures, 309	hybrid techniques, 159–164
reports	insurance case study, 380–381
correctly weighted, 288	type 0 (retain original), 54, 148–149
dimensional models, 17	type 1 (overwrite), 54, 149–150
dynamic value banding, 64	ETL systems, 465
fact tables, 17	type 2 in same dimension, 153
impact, 288	type 2 (add new row), 54, 150–152
value band reporting, 291–292	accumulating snapshots, 196
requirements for dimensional modeling, 432	customer counts, 243
restaurant metaphor for Kimball architecture,	effective date, 152–153
23–26	ETL systems, 465–466
retail sales case study, 72–73, 92	expiration date, 152–153
business process selection, 74	type 1 in same dimension, 153
dimensions, selecting, 76	type 3 (add new attribute), 55, 154–155
facts, 76–77	ETL systems, 467
derived, 77–78	multiple, 156
non-additive, 78	type 4 (add mini-dimension), 55, 156–159
fact tables, 79	ETL systems, 467
frequent shopper program, 96	type 5 (add mini-dimension and type 1
grain declaration, 74–75	outrigger), 55, 160
payment method, 93	ETL systems, 468
POS (point-of-sale) system, 73	
POS schema, 94	type 6 (add type 1 attributes to type 2 dimension), 56, 160–162
retail schema extensibility, 95–97	
SKUs, 73	ETL systems, 468
retain original (SCD type 0), 54, 148–149	type 7 (dual type 1 and type 2 dimension), 56, 162–164
retrieval, 485–486	
retroactive changes, healthcare case study,	ETL systems, 468
351–352	scheduling jobs, ETL operation and
reviewing dimensional model, 440, 441	automation, 520
RFI measures 240	scoping for program/project planning, 407

scoring, CRM and customer dimension,	education case study, 326
240–243	ETL systems, 475
screening	fact tables, 121–122, 326–329
ETL systems	fact tables, complementary, 122
business rule screens, 458	healthcare case study, 343
column screens, 457	inventory case study, 118–119
structure screens, 457	order management case study, 194–196
quality screens, 457–458	procurement case study, 147
security, 495	type 2 dimensions and, 196
ETL system, 446, 492–493	incremental processing, 517
goals, 4	periodic, 43
segmentation, CRM and customer dimension,	education case study, 329
240–243	ETL systems, 474
segments, airline bus matrix granularity, 313	fact tables, 120–121
linking to trips, 315–316	fact tables, complementary, 122
SELECT statement, 18	G/L (general ledger), 203
semi-additive facts, 42, 114-115	headcounts, 267-268
sequential behavior, step dimension, 65,	insurance case study, 385, 395-396
251–252	inventory case study, 112-114
sequential integers, surrogate keys, 101	premiums (insurance case study),
service level performance, 188–189	386–388
session dimension, clickstream data, 359-360	snowflaking, 15, 50, 104-106, 470
session fact table, clickstream data, 361-363	outriggers, 106–107
session IDs, clickstream data, 355-356	social media, CRM (customer relationship
set difference, 97	management) and, 230
shared dimensions, 130	sorting
shipment invoice fact table, 188	ETL, 490
shrunken dimensions, 51	international information, 237
conformed	source systems, operational, 18
attribute subset, 132	special dimensions manager, ETL systems,
on bus matrix, 134	470
row subsets and, 132-134	date/time dimensions, 470
rollup, 132	junk dimensions, 470
subsets, ETL systems, 472	mini-dimensions, 471
simple administration backup, 485	shrunken subset, 472
simple data transformation, dimensions, 504	static, 472
single customer dimension, data integration	user-maintained, 472–473
and, 256–258	specification document, ETL development
single granularity, facts and, 301	502–503
single version of the truth, 407	sandbox source system, 503
skill keywords, 274	SQL multipass to avoid fact-to-fact table
bridge, 275	joins, 61
AND queries, 275	staffing for program/project planning,
OR queries, 275	408–409
text string, 276–277	star joins, 16
skills, ETL system, 448	star schemas, 8, 40
SKUs (stock keeping units), 73	static dimensions
slightly ragged/variable depth hierarchies, 57	ETL systems, 472
slowly changing dimensions. See SCDs, 148	population, 508
smart keys	statistics, historic fact table audit, 508
date dimensions, 101–102	status dimensions, 284
fact tables, partitioning, 102	step dimension, 65
snapshots	clickstream data, 366
accumulating, 44, 118–119, 194–196	sequential behavior, 251–252
claims (insurance case study) 393–395	stewardship 135–136

storage Lifernale data 422	collection 417
storage, Lifecycle data, 422	collection, 417
store dimension, 87–89	documentation, 417
strategic business initiatives, 70	requirements collection, 417
streaming data, big data and, 536	subsystems, 418
strings, skill keywords, 276–277	task force, 417
structure screens, 457	telecommunications case study, 297–299
student dimension (education case study),	term dimension (education case study), 330
330	text comments
study groups, behavior, 64	dimensions, 65
subsets, shrunken subset dimensions, 472	healthcare case study, 350
subtypes, 293–294	text strings, skill keywords, 276–277
fact tables	text, survey questionnaire (HR) comments, 278
keys, 294–295	textual attributes, dimension tables, 82
supertype common facts, 295	textual facts, 12
healthcare case study, 347–348	The Data Warehouse Toolkit (Kimball), 2, 80
insurance case study, 384, 387	third normal form (3NF) models, 7
schemas, 67	entity-relationship diagrams (ERDs), 8
summary data, dimensional modeling and, 30	normalized 3NF structures, 8
sunsetting, big data management, 533	time
supernatural keys, 46, 101	GMT (Greenwich Mean Time), 323
supertypes	UTC (Coordinated Universal Time), 323
fact tables, 293–294	timed extracts, CDC (change data capture),
keys, 294–295	452
subtype common facts, 295	time dimension, 80
healthcare case study, 347–348	clickstream data, 361–362
insurance case study, 384–387	timeliness goals, 4
schemas, 67	time-of-day
surrogate keys, 58, 98–100, 303	dimension, 83
assignment, 506	fact, 83
degenerate dimensions, 101	time series
dimension tables, 98–100	behavior tags, 63, 240-242
ETL system, 475–477	fixed time series buckets, date dimensions
generator, 469–470	and, 302–303
fact tables, 102–103	time shifting, 90
fact table transformations, 516	timespan fact tables, 252–254
late arriving facts, 517	dual date/time stamps, 254
lookup pipelining, 510–511	timespan tracking in fact tables, 62
survey questionnaire (HR), 277	time varying multivalued bridge tables, 63
text comments, 278	time zones
synthetic keys, 98	airline case study, 323
T	GMT (Greenwich Mean Time), 323
T	multiple, 65
tags, behavior, in time series, 63	number of, 323
team building, Lifecycle business	UTC (Coordinated Universal Time), 323
requirements, 411	tools
representatives, 411–412	dimensional modeling, 432
technical application design/development	data profiling tools, 433
(Lifecycle), 406	ETL development, 499 transactions, 43, 120, 179
technical architect, 409	claim transactions (insurance case study),
technical architecture (Lifecycle), 405,	390
416–417	claim accumulating snapshot, 393–394
architecture implementation phases, 418	junk dimensions and, 392
model creation, 417	periodic snapshot, 395–396
plan creation, 418	timespan accumulating snapshot,
requirements	394–395
	4

fact tables, 12, 143–145 healthcare case study, 342	type 5 (add mini-dimension and type outrigger) SCD, 160
inventory transactions, 116–118	ETL system, 468
invoice transactions, 187–188 journal entries (G/L), 206–207	type 6 (add type 1 attributes to type 2 dimension) SCD, 56, 160–162
numbers, degenerate dimensions, 93–94	ETL system, 468
order management case study	type 7 (dual type 1 and type 2 dimension)
allocating, 184–186	SCD, 56, 162–163
date, 170–171	as of reporting, 164
deal dimension, 177-178	ETL system, 468
degenerate dimension, 178-179	,
header/line patterns, 181-182, 186	U
junk dimensions, 179–180	
product dimension, 172–173	Unicode, 236–238
order transactions, 168	uniform chart of accounts, 204
audit dimension, 192-193	units of measure, multiple, 197–198
customer dimension, 174-176	updates, accumulating snapshots, 121–122
fact normalization, 169-170	user-maintained dimensions, ETL systems,
multiple currency, 182-184	472–473
policies (insurance case study), 379–380	UTC (Coordinated Universal Time), 323
procurement, 142–143	••
transaction profile dimension, 49, 179	V
transportation, 311	validating dimension model, 440–441
airline case study, 311–323	validation, relationships, 504–505
cargo shipper schema, 317	value band reporting, 291–292
localization and, 324	value chain, 52
travel services flight schema, 317	insurance case study, 377–378
travel services flight schema, 317	integration, 122–123
trees (hierarchies), 215	inventory case study, 111–112
parent/child structure, 216	variable depth hierarchies
type 0 (retain original) SCD, 54	pathstring attributes, 57
retain original, 148–149	ragged, 215–217
type 1 (overwrite) SCD, 54	slightly ragged, 214–215
add to type 2 dimension, 160–162	variable depth/ragged hierarchies with
ETL system, 465	bridge tables, 57
overwrite, 149–150	variable depth/slightly ragged hierarchies
type 2 in same dimension, 153	57
type 2 (add new row) SCD, 54, 150–152	version control, 495
accumulating snapshots, 196	ETL system, 488
customer counts, 243	version migration system, ETL system, 488
effective date, 152–153	visitor identification, web sites, 356–357
employee profile changes, 267	
ETL system, 465–466	\mathbf{W}
expiration date, 152–153	weekday indicator, 82
type 1 in same dimension, 153	WHERE clause, 18
type 3 (add new attribute) SCD, 55, 154–155	workflow monitor, ETL system, 489–490
ETL system, 467	workshops, dimensional modeling, 38
multiple, 156 type 4 (add mini-dimension) SCD, 55,	po, amienosoma medernig, 50
156–159	X-Y-Z
ETL system, 467	
type 5 (add mini-dimension and type 1	YTD (year-to-date) facts, 61
outrigger) SCD. 55	G/L (general ledger), 206