Index

A
active adaptation 49
active implementation 49
active service 49
adaptive control 215, 225, 231, 232
adaptive resonance theory (ART) ANN model 115, 117, 176, 204, 205, 208, 213, 307
Advice Taker program 14
agents, autonomous 48, 52, 53, 71
agents, interface 50
agents, personal 50
agents, software 50
agents, task 50
agents, user 50
agent technology 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 75, 76, 77, 78, 81, 82, 83
age of craftsmanship 1
age of information and flexible automation 1, 2
age of knowledge and intelligent automation 1, 2
age of machines and hard automation 1, 2
AI, ANN based 304
AI, behavior-based 304, 325
AI, case-based 304, 311
AI, knowledge-based 304, 305, 311
AI, machine learning based 304, 306, 324, 325, 326
air traffic control 161
AI, rules-based 304, 324
AI technology 48, 56
artificial intelligence (AI) 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 13, 16, 17, 19, 21, 31, 32, 37, 38, 44, 45, 46, 48, 62, 70, 84, 85, 102, 110, 214, 215, 217, 235, 242, 245, 251, 256, 257, 260, 270, 304, 324, 327, 329, 330, 331, 332, 354, 355, 357, 358, 377, 378, 379
artificial-intelligent technology 301
artificial neural networks (ANN) 14, 113, 114, 115, 130, 131, 132, 133, 163, 273, 281, 282, 283, 284, 285, 302, 310, 330
assumption-based truth maintenance system (ATMS) 252, 264
automatically manufacturing research laboratory (AMRL) 164
automatic design 2
automatic manufacturing 160
automation, flexible 1, 2
automation, hard 1, 2
automation, intelligent 1, 2
automatism 248
AUTOPROS CAPP system 275

B
Bayesian formula 164
Bayesian networks 164
biological evolvement 277
biological nervous systems 112, 114
biological neurons 113
Boltzmann ANN model 115, 116, 117, 119
BPM/ISM methodologies 138, 139, 140, 156
business engineering 138
business intelligence (BI) 329
business process design 137, 138
business processes 137, 138, 139, 142, 143, 144, 145, 147, 148, 149, 150, 156, 157, 158
business process modeling techniques 138
business process reengineering (BPR) 138, 143
business systems 330
business systems options (BSO) 141

C
calculation intelligence 111
calculation theory 111, 112
Carnegie Mellon University (USA) 251
case-based reasoning (CBR) 3
CASE tools 139
cellular manufacturing system (CMS) 198
CIM applications 142
cluster analysis 199
cluster analysis tools 3
cognitive architecture 51
cognitive subsystem 51
collaborative design 249, 260
command control communication intelligence (C3I) system 161
complex systems 301, 303, 306, 308
computational intelligence (CI) 3, 4, 8, 111, 112, 130, 134, 136
computational intelligence technology 112, 130
computed numerical control (CNC) 2, 6, 11
computer aided engineering (CAE) 2
computer aided manufacturing (CAM) 2, 8, 190, 191, 209
computer aided manufacturing-international (CAM-I) system 275
computer aided production planning (CAPP) 2, 8, 190, 210, 213
computer integrated manufacturing (CIM) 192
computer integrated manufacturing system (CIMS) 190, 213
computer management systems 330
computing intelligence 160, 214, 357, 377, 380
concurrent design 249, 252, 261
configuration management 2
customer analysis 90
customer consumption levels 90
customer database based marketing 89
customer groups, composition of 90
customer loyalty analysis 90
customer relationship management (CRM) 89, 90, 91
customers, geographical distribution of 90
customer share 90
customer spending habits 90
cybernetics 302

D
data analysis 85, 89, 91, 95, 106
data analysis, database-oriented 89
data analysis, data warehouse-oriented 89
data analysis, machine learning 89
data analysis, neural network 89
data analysis, pattern recognition 89
data analysis, statistical 89
data archaeology 85
database management systems (DBMS) 86
databases 16, 17, 24, 25, 26, 27, 35, 38, 40, 41, 42, 43, 84, 85, 90, 98
database technology 84, 86, 87
data flow diagram (DFD) 141, 147, 148, 149
data fusion technology 160, 186
data mining and knowledge discovery (DMKD) 84, 85, 86, 96, 97, 103, 109, 160, 214
<table>
<thead>
<tr>
<th><strong>Index</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>data mining (DM)</td>
</tr>
<tr>
<td>data warehouses</td>
</tr>
<tr>
<td>decision support systems (DSS)</td>
</tr>
<tr>
<td>DENDRAL (dendritic algorithm) project</td>
</tr>
<tr>
<td>design for disassembly (DFD)</td>
</tr>
<tr>
<td>design for environment (DFE)</td>
</tr>
<tr>
<td>digitalization</td>
</tr>
<tr>
<td>digital manufacturing</td>
</tr>
<tr>
<td>distributed monitoring and diagnosis systems (DMDS)</td>
</tr>
<tr>
<td>distributed parallel information processing</td>
</tr>
<tr>
<td>driver mining system, confirmed</td>
</tr>
<tr>
<td>driver mining system, discovery</td>
</tr>
<tr>
<td>dynamic workshop environments</td>
</tr>
</tbody>
</table>

| **E** |
| economic growth | 1 |
| enterprise material | 274 |
| environmental information | 162 |
| environmental problems | 359 |
| error back propagation (BP) ANN model | 115, 124, 125, 131, 134 |
| evolotional computing | 111 |
| evolutionary computation (EC) | 111 |
| executive information systems (EIS) | 329, 333 |
| expert CAPP system | 275, 276 |
| expert system control | 215 |
| expert systems, design-typed | 247, 256, 258 |
| expert systems (ES) | 3, 4, 8, 13, 14, 37, 38, 45 |
| explanation facilities | 16 |
| extract-transform-load (ETL) task | 333, 334, 335 |

| **F** |
| factory flow analysis | 198 |
| factory ID | 279, 280 |
| FART algorithm | 209 |
| FART category proliferation problem | 209 |
| FART (fuzzy ART) network | 208, 209, 213 |
| FART neural networks | 209 |
| fault diagnosis theory | 302 |
| fault information discipline | 302 |
| feed forward neural networks | 114 |
| feed forward neural networks, interconnected | 114 |
| feed forward neural networks, multi-layer | 114 |
| feed forward neural networks, single-layer | 114 |
| feed forward neural network with feedback | 114 |
| Feigenbaum, Edward | 14, 16, 17, 19, 20, 24, 44, 45 |
| flexible manufacturing systems | 189, 190 |
| fractal theory | 3, 11 |
| fuzzy computing | 111 |
| fuzzy control | 112, 121, 123, 215, 221, 222, 231, 232, 233, 242 |
| fuzzy logic | 14, 215, 217, 221, 222, 225, 229, 231, 232, 233, 236, 242, 304, 312 |
| fuzzy neural networks | 112, 123, 124, 125, 134 |
| fuzzy systems (FS) | 111, 112, 121, 122, 123 |

| **G** |
| Gaussian distribution | 161, 163 |
| General Problem Solver (GPS) project | 14, 45 |
| genetic algorithms, calculation theory of | 112 |
| genetic algorithms (GA) | 3, 6, 8, 9, 111, 112, 126, 128, 129, 130, 131, 132, 133, 134, 273, 277, 278, 279, 280, 281, 300 |
| genetic algorithms, real-time | 112 |
| geographic information systems (GIS) | 333, 337 |
| geometric information | 273, 290, 292 |
| globalization | 137, 245, 246, 247 |
| global manufacturing | 1 |
global positioning systems (GPS) 161
gross domestic products (GDP) 357
group analysis 198
group technology (GT) 189, 190, 191, 192, 193, 198, 203, 209, 210, 211, 213, 214

H
hierarchical techniques 197
hierarchical techniques, agglomerative 197
hierarchical techniques, divisive 197
Hopfield ANN model 115, 116, 134
human beings 47, 48, 49, 52, 53, 55
human experts 13, 14, 17, 27, 32, 44
human expert thinking 13
human intelligence 214, 217, 222, 225
human neural network model 112
hybrid architectures 51
hybrid control systems 216, 220, 221, 243
hybrid genetic algorithms (HGA) 112
hybrid system control 215

I
I3CAD system 251, 252, 257
IDEF (integration definition) language 142, 143
industrial control 161, 214, 215, 216, 219, 225, 242
industrial revolution 2
inertial navigation system (INS) 161
inference engine 16, 20, 21, 23, 24, 26, 27, 37, 38
information discovery 85
information flow design 249
information harvesting 85
information services 330
information systems 137, 138, 139, 140, 142, 150, 153, 156, 157
information technology 137, 138, 273, 274, 329
information theory 302
integrated computer-aided manufacturing (ICAM) initiative 142
integrated data description language (IDDL) 252
integrated intelligence systems 330
integrated intelligent CAD (I2CAD) 248, 249, 250, 270
integrated management functions 330, 331
integrated systems 160
integration 1, 10
intelligence 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
intelligence-oriented design 249
intelligent agents 47, 48, 49, 68, 73, 81, 82, 83
intelligent analysis 248
intelligent CAD (ICAD) 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 256, 257, 259, 260, 262, 263, 264, 270, 271
intelligent controllers 214, 215, 216, 231, 242
intelligent control technology 214
intelligent control theory 214, 242
intelligent creativity 248
intelligent decision making (IDM) 329
intelligent decision support 2
intelligent decision support systems (IDSS) 329, 331, 332, 333, 337, 338, 339, 354
intelligent design 2, 248
intelligent devices 48
intelligent diagnosis 301, 302, 303, 304, 307, 308, 309, 324, 325, 326
intelligent diagnostic systems 302
intelligent digital controlling 357, 377
intelligent digital designing 357, 377
intelligent digital diagnosis and maintenance 357
intelligent digital machining 357, 377
intelligent digital process planning 357, 377
intelligent digital scheduling 357, 377
intelligent management information system (IMIS) 329, 330, 331, 354
intelligent management systems 330, 356
intelligent manufacturing (IM) 1, 3, 5, 6, 8, 10, 11, 13, 34, 36, 47, 70, 73, 74, 160, 167, 186, 189
intelligent manufacturing system 359, 378, 380, 381
intelligent multimedia technology 249
intelligent optimized design 249
intelligent software 48
intelligent technologies 301, 325
intelligent theory, artificial 48
intelligent theory, natural 47
interconnected joint neural networks 115
InteRRap hybrid architecture 51
irreversibility 111

J
JLBM-1 system 194, 195, 196
just-in-time manufacturing 246

K
KBS, design 16
KBS, diagnosis 15
KBS, explanation 14
KBS, forecasting 15
KBS, monitoring 15
KBS, planning 15
KBS, structure of 16, 17
KK-1 system 194
KK-3 system 194, 195
KK system 194
knowledge acquisition 13, 14, 16, 18, 28, 29,
30, 31, 35, 44
knowledge acquisition mechanism 16
knowledge applications 16
knowledge base 14, 16, 18, 19, 20, 21, 23, 24,
25, 26, 28, 29, 30, 31, 32, 34, 35, 36, 37,
38, 40, 42, 43
knowledge-based control 215
knowledge-based DSS (KB-DSS) 332
knowledge-based economies 359, 360
knowledge-based expert systems 14
knowledge-based systems (KBS) 3, 13, 14, 15,
16, 17, 19, 21, 24, 27, 28, 29, 31, 32, 34,
35, 36, 44, 45, 46, 47, 84, 160, 214, 229,
230
knowledge, deep 305, 306, 324
knowledge discovery in databases (KDD) 84,
85, 86, 87, 109, 110
knowledge discovery (KD) 18, 84, 85, 86, 87,
88, 89, 93, 102, 109, 110
knowledge engineering 16, 17, 18, 29, 30, 36,
44, 139, 159, 330, 331
knowledge extraction 18, 85
knowledge operations 17
knowledge processing 16, 18
knowledge representation 13, 14, 16, 17, 18,
19, 20, 21, 23, 28, 32, 33, 44
knowledge, shallow 305, 306, 323, 324
Kross, Robert 246

L
layered architecture 51
layered manufacturing (LM) 252, 253
learning control 215, 218, 219, 221, 225, 226,
242
line analysis 198
Lisp computer language 215
local area networks (LAN) 250
logical data model (LDM) 141
logical data structures (LDS) 141
logical sensor networks 163
logical sensors 163
Lu, Rujin 18

M
machine learning 85, 87, 89, 95, 99, 102, 215,
217
management information systems (MIS) 330
management multi-sensor fusion research 161
man-machine harmony 330
manual organizational processes 138
manufacturing 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11,
12
manufacturing activities 358
manufacturing adaptability 2, 3
manufacturing, continuous development of
273, 274
manufacturing development 1, 4
manufacturing environment 1, 5
manufacturing flexibility 2
manufacturing, four revolutions of 1
manufacturing industrial development, four
stages of 1
manufacturing information 358, 378
manufacturing intelligence (MI) 1, 3, 4, 11, 84,
160, 214, 357, 367, 368, 371, 372, 373,
374, 375, 377, 383
manufacturing intelligence technology 357,
377, 378
manufacturing process 273
manufacturing systems, next generation 13
manufacturing technologies 358
manufacturing technology 1, 5, 6
marine surveillance 161
market share 90
mass customization 245, 246
mass production 2, 189
metadata 333, 334, 335
Minsky, Marvin 48, 83
mobile robot navigation 162
modern diagnostic systems 303
monitoring and diagnosis system (MDS) 304
monocodes 193
multi-agent (MA) technology 47, 48, 58, 59,
61, 63, 65, 66, 82, 83
multi-agent systems (MAS) 47, 48, 52, 53, 54,
55, 57, 58, 59, 60, 62, 64, 65, 67, 68, 69,
70, 78, 81, 84, 160, 214, 273, 290, 295
multi-sensor integration 160, 161, 162, 163,
164, 165, 166, 186
multi-sensor integration system 160
multi-sensors outputs 160
multi-sensor technology 160, 161, 163, 164,
168, 173, 174, 180, 186, 187, 188
mutual validation 160
MYCIN expert system 14, 30, 34, 46

natural intelligence 48
network-centric environments 329
network status monitoring and diagnosis 302
network technology 48, 53
neural computing 111
neural network control 215, 221, 230, 232,
233, 242
neural network control technology 112
neural network methodologies 215
neural network models 112, 115, 134
neural networks (NN) 3, 6, 89, 102, 111, 112,
113, 119, 121, 122, 123, 124, 134, 136,
163, 164, 167, 174, 176, 177, 186, 331
neural networks, smart 111
neuron model 113
neurons 113, 114, 115, 116, 117, 118, 119, 134

non-deterministic polynomial Completeness
(NPC) 112
nonlinearity 111
numerical control (NC) 2, 11

O
object-oriented design 249
office automation systems (OAS) 330
office transaction processing 330
offshoring 246
online analytical processing (OLAP) 329, 333,
335, 336
operation ID 279
operations research 214, 216
optimization methods 3, 6, 7
optimization technology 112
OPTIZ system 193, 194, 195
organizational process modeling 139
Organization for Economic Cooperation and
Development (OECD) 359, 360
outsourcing 246

P
part families 191, 196, 197, 198, 202, 203,
205, 208, 211
pattern recognition 330, 331
pattern recognition technology 87
physical symbol system 51
planning subsystem 2
polycodes 193
population 359
process and system modeling 214
process-based thinking 138
process cards 275, 295
processes 138, 139, 140, 141, 143, 144, 145,
146, 147, 148, 153, 158
process modeling software 139
process planning 273, 274, 275, 276, 277, 281,
282, 283, 285, 287, 300
process sorting 278
product design 2, 7
production control 2, 3, 4, 5, 6, 7, 8, 9, 10
production flow analysis 198
production planning 2, 5, 8, 10
Prolog computer language 215
### Index

#### R
- reactive architecture 51
- reactive subsystem 51
- reliability theory 302
- remote diagnosis systems 301, 314
- resource problems 359
- retail marketing 90
- rich pictures technique 140
- robot applications 162, 166
- robotics 2, 161
- robots 48, 49, 58, 69
- robots, physical 49
- robots, software 49
- rules-based systems 164

#### S
- Schreiber, Guus 17
- semantic networks 215
- sensor integration 160, 214
- Shi, Zhongzhi 17
- simulated annealing (SA) algorithm 112
- single sensor technology 160
- society behavior concept 48
- society concept 48
- soft systems methodology (SSM) 139, 140
- software engineering 139, 149
- solid modeling 246
- statistical techniques 84
- statistical theory 87, 89
- STRIPS cognitive architecture 51, 82
- structured analysis and design technique (SADT) 142
- structured query languages (SQL) 86, 94
- structured systems analysis and design method (SSADM) 140, 141, 147
- symbolic reasoning mechanism 51
- symbol reasoning (SR) 3, 4
- system automaticity 160
- system intelligence 160

- systems design problems 138
- systems development, waterfall model of 140
- systems engineering 329, 355, 356
- systems thinking 139
- system theory 302

#### T
- tabu search (TS) 112
- technical engineer experience 301
- telecommunications marketing 90
- theory of intelligence 47
- three-dimensional (3D) modeling 246, 330, 331
- time quality cost service environment (TQCES) 360
- tool access direction (TAD) 279
- tooling analysis 198
- Touring Machine hybrid architecture 51
- Turing, Alan 14, 46
- Turing Test 14

#### U
- uncertainty 111
- user interface 16, 30, 32, 33

#### V
- virtual corporations 304
- virtual design 249
- virtual enterprises 304
- virtual reality (VR) technology 249
- visualization 84, 87, 88, 94, 96, 105, 109
- visualization technology 84, 87, 88, 94, 96, 105, 249
- visualization theory 87

#### W
- workflow management systems (WMS) 139
- work practice model 141

#### Z
- Zadeh, Lotfi 14, 46