

Endorsements

“Finally, the long expected book about sustainable supply chains! Its topic is of great importance. This opus conveys powerful insights for managers and professionals concerned with value chains and networks.”

- **Markus Schwaninger**, Professor, Institute of Management, University of St. Gallen, Switzerland.

“This book provides unique perspectives and modeling-based solutions for sustainable supply chains. No matter at what stage of sustainability is your organization, this book is an essential read for you to achieve next level of sustainability.”

- **BaekSeo Seong**, Professor, Operations & Management, Konkuk Business School, Konkuk University, Seoul, South Korea.

“This book offers a unique and an effective combination of experts’ perspectives and state-of-art technologies to design innovative solutions for supply chain problems. The book includes a number of case studies that provides useful insights for decision makers to enhance and maintain the performance of supply chain processes.”

- **Dr. Arif Mehmood**, Department of Transport, Abu Dhabi, United Arab Emirates.

Index

A

Accumulated capacity average (ACA), 215
Active Pharmaceutical Ingredient (API), 227
Agent-based modeling, 3, 4, 11, 12, 338, 341
Agent-based simulation, 331
Agriculture, 290, 292, 293, 296
Airport technology initiative, 21
Analytics techniques, 185
Anticipatory model, 119, 122, 127–130
Anticipatory strategy model, 117–119
Asynchronous policy
 ANEEL, 202
 growth rate, 202
 performance measure and security, 203
 structure, 203
 sustainability, 204
 transmission infrastructure
 and renewables, 201
 transmission network investment, 202
 upstream and downstream, 203
Autonomous-guided vehicles (AGVs), 22

B

“Beacon effect”, 281
Bioenergy, 317
Biofuel, 331
Biomass, 317
Boeing 777, 112
Business analytics, 184

C

Capabilities trap, 192, 193
Catalytic innovation, 268

Causal diagrams, 180, 190, 191
Causal modeling, 224, 259
Center of excellence (CoE), 189
Centralized procurement model, 188
Certifiable environmental
 standards, 71, 73
Circular economy, 111, 112, 120, 123, 126
Climate change, 289, 290
Complexity, 320
Construction industry, 21
Contract management, 184

D

Data envelopment analysis
 (DEA), 64
Demand management, 265
Department for Environment, Food and Rural
 Affairs of the United Kingdom
 (DEFRA), 303
Design modularity, 7, 336
Dimensional consistency, 147
Disruptive innovation, 268
Dynamic agent, 323, 324
Dynamic hypothesis
 balancing loop, 206, 207
 causal loop diagram, 206
 energy policies, 206
 feedback loop, 207
 PROINFA, 205
 supply chain performance, 206
 transmission lines
 and towers, 205
 wind-power supply chain, 206
Dynamic variables, 137, 142, 147

E

- Early manufacturing involvement (EMI), 29
- Early supplier involvement (ESI), 29
- E-commerce industry, 21
- Electricity transmission, 200, 207
- Emerging markets, 272
- Enabling technology, ITF R&D
 - airport technology initiative, 21
 - construction industry, 21
 - E-commerce industry, 21
 - in environment and industries, 22, 23
 - LBS, 22
 - logistic and transport, 21
 - R&D technology, 21
 - robotics application, 22
 - smart community service, 22
- Environmental criteria
 - approaches, 65
 - in automotive industry, 70
 - in collected papers, 62
 - DEA and TOPSIS, 65
 - labor practices and decent work, 63
 - labor-intensive industries, 69
 - and papers considering certifiable EMS, 71
 - qualitative and quantitative criteria, 75
 - qualitative criteria, 62
- Environmental management system (EMS), 84, 336
- Environmental performance, 82, 88–90, 98, 101
- “Essential consumer goods”, 223
- Essential consumer goods industry supply chain, 10
- Ethical sourcing, 83
- European Association of Euro-Pharmaceutical Companies (EAEPC), 226
- European Association of Hospital Pharmacists (EAHP), 224
- External management practices, 82, 89, 94, 96

F

- Farmers, 305
- Feedstock supply risk, 338
- First-In-First-Out (FIFO) policy, 236
- Flow diagram, 141, 152
- Food and Agriculture Organization (FAO), 290, 292, 293, 306, 307
- Food crisis, 289, 291
 - See also* Global food crisis
- Food Security Information Network Secretariat (FSIN), 289
- Food supply chain
 - DEFRA, 303
 - global issues, 291
 - integrated framework

- benefits, 309
- Coles Supermarkets, 309, 310
- FAO, 306, 307
 - guiding principle, 307, 309
 - PDCA cycle, 308
 - reinforcing and institutionalizing change, 309
 - value chain, 309
- reconnecting people with food, 305
- restoring ecosystems, 305
- rethinking value creation, 305
- SSCM, 300–302, 304
 - supply chain management, 299, 300
 - sustainable development, 291, 293
- Forest Management Plans (FMPs), 321
- Forest Management Units (FMUs), 321, 322
- Forest resource inventory (FRI), 321
- Forest sector, 321

G

- Geographic information system (GIS), 328
- GIRP
 - European Healthcare Distribution Association, 227
- Global food crisis
 - causes
 - armed conflicts, 297
 - demand and supply, 295
 - exchange rate, US Dollar, 296
 - fuel and energy prices, 296
 - poverty and unequal access, 297
 - productivity decline and falling supply, 296
 - trade shocks, 297
 - definition, 293
 - environmental impact, 299
 - evidence, 294
 - FAO, 293
 - financial impact, 298
 - food insecurity, 294
 - IHRR, 293
 - social impact, 298
 - Somalia, 295
 - UNICEF, 294
- Global food supply chain, 11
- Globalization, 111, 285
- Good Manufacturing Practice (GMP), 227
- Green design innovation, 89
- Green innovation
 - business environment, 95
 - description, 86, 87
 - drivers
 - external factors, 91
 - internal, 92

- market demand, 91
- stakeholder pressure, 91
- supplier selection, 91
- environmental requirements, 91
- green practices, 93–94
- green stewardship, 95
- international focus, 99, 102, 104
- macro- and microlevel factors, 90
- outcomes, 92
- proactive, 87
- reactive, 87
- TBL, 95
- types
 - green design innovation, 89
 - green management innovation, 87, 88
 - green process innovation, 88
 - green product innovation, 88
 - green technological innovation, 89
- Green management innovation, 87, 88
- Green practices, 7, 93–94
- Green process innovation, 88
- Green product innovation, 88
- Green stewardship, 95
- Green supply chain management (GSCM)
 - carbon footprint, 83
 - characteristics, 85
 - Chinese manufacturing firms, 82
 - conventional, 83
 - CSR, 85
 - direct and indirect actors, 86
 - ecological and economic factors, 85
 - EMS, 84
 - environmental sustainability, 85
 - ethical and social responsible measure, 84
 - ethical sourcing, 83
 - external, 82
 - green innovation, 82 (*see also* Green innovation)
 - internal, 82
 - intra- and interorganizational practices, 82, 86
 - JIT, 85
 - Paris Climate Conference, 83
 - reducing overall waste, 86
- Green supply chains, 7, 336
- Green technological innovation, 89

H

- Hard skills trainings, 140, 141, 143, 146, 153
- Hospital pharmacy echelon
 - medicine sourcing
 - delivery delay, 241
 - expected treatment rate, 241
 - HP Inventory, 239

- primary supplier stock on order, 240
- second supplier stock on order, 241
- structure, 239
 - patient treatment, 242, 243
- Hunger, 292, 298
- Hydroelectricity, 199, 200

I

- IBM's System/360, 112
- IFAD's National Agribusiness Development Programme, 292
- Incentive Programme for Alternative Sources (PROINFA), 200
- Industry-specific supply chains
 - essential consumer goods industry supply chain, in Europe, 10
 - global food supply chain, 11
 - timber supply chain, in Southern Ontario, 11–12
 - tourism supply chain, 10–11
 - wind-power industry's supply chain, in Brazil, 9, 10
- Information technology, 266, 284, 285
- Innovation and Technology Bureau (ITB), 20
- Innovation and technology fund (ITF)
 - R&D technology commercialization (*see* ITF R&D technology commercialization)
- Innovation process, R&D
 - communication and information sharing, 24
 - key processes, 24
 - linear model, new product development, 23
 - nonlinear model, 23, 24
 - prototypicalization, 24
- Innovation strategy, 26
- Institute of Hazard, Risk and Resilience (IHRR), 293
- Integrated framework
 - benefits, 309
 - Coles Supermarkets, 309, 310
 - FAO, 306, 307
 - guiding principle, 307, 309
 - PDCA cycle, 308
 - reinforcing and institutionalizing change, 309
 - value chain, 309
- Intellectual property (IP), 31, 32, 35, 36, 45
- Intergenerational and intragenerational equity, 292
- Interim Management Plan, 321
- Internal management practices, 82, 88, 92, 96
- International Fund for Agricultural Development (IFAD), 292
- Inventory, 234

- Inventory management, 266
- ITF R&D ecosystem, 25
- ITF R&D technology commercialization challenge
- in Hong Kong, 19
 - in logistics and supply chain industry, 19, 20
- data collection and analysis
- monitoring mechanism, 34
 - qualitative analysis, 35, 36
 - quantitative analysis (*see* Quantitative assessment, ITF R&D project)
 - survey questionnaire, 34
- ecosystem, 25
- enabling technology, 21–23
- innovation strategy, 26
- MSTAM model, 26, 27
- projects development proposition (*see* Project management, R&D)
- R&D process, in innovation, 23, 24
- research model development, 26
- research questions (RQ), 18
- SME, 18
- stage-gate system, 26, 27
- STAM model, 26, 27
- J**
- Just-in-time (JIT), 85
- K**
- Key performance indicators (KPIs)
- cost of production per unit, 258, 259
 - fraction of patients receiving first choice treatment, 256
 - graph, 256
 - total cost per patient per week, 256, 257
- L**
- Labor-intensive industries, 69
- Literature review, 55–57
- Location-based service (LBS), 22
- Logistics, 335, 339
- Loop gain, 182
- Loop polarity, 182
- M**
- Market-science-technology-application-market (MSTAM), 6
- Material management system, 233–235
- Medicines shortages
- API, 227
 - business reasons, 226
 - categories, 226
 - causes, 226, 227
 - definitions, 225
 - EAEPC, 226
 - economic reasons, 226
 - GIRP, 227
 - GMP, 227
 - primary causes, 231
 - reliability, 227
 - secondary causes, 232, 233
 - semi-structured interviews, 226
 - tertiary causes, 232
- Meta-analysis, sustainable supplier selection
- combined methods, use of, 66
 - economic dimension
 - hybrid approaches, 64, 65
 - single approaches, 64
 - environmental dimension
 - hybrid approaches, 65
 - single approaches, 65
 - hybrid approaches, 67–69
 - MP techniques, 66, 67
 - single approaches, 67
 - “sustainable” approaches, 66
- Meta-analysis-based perspective, 6
- Methodology, 4–5
- Microfinance enterprises, 269
- Model-based approaches, 335
- Model validation
- behavior reproduction test, 151
 - boundary adequacy test, 150–151
 - description, 147
 - dimensional consistency, 147
 - extreme condition verification, 149, 150
 - parameter verification, 149
 - structure verification, 148
 - tests, 140
- Modular product designs, 112
- Modularity, 112
- See also* Product modularity
- MSTAM (market, science, technology, application, and market) model, 26, 27
- Multi-criteria decision-making (MCDM), 55, 185
- N**
- Negative feedback loop, 137
- New product development (NPD), 25, 30, 32
- News vendor models, 117
- NGOs, 283, 287

O

- Oncological medications
 - cancer medicines, 224
 - EAHP, 224
 - quantitative data, 224
- Oncological Medicine Supply Chain Model (OncoMedSCM)
 - feedback loops, 232
 - hospital pharmacy echelon
 - medicine sourcing, 239, 241
 - patient treatment, 242, 243
 - manufacturing echelons
 - material management, 233–235
 - order processing, 235, 237
 - plant management, 237–239
 - production and distribution, 232
 - medicines shortages, 231, 233
 - model boundary
 - API and FP, 230
 - input values, 228
 - organization-centric focus, 228
 - parallel trade, 228
 - three echelons, 228, 229
 - naming convention, 232
 - order amplification, 230
 - pharmaceutical suppliers, changes, 230
 - plant management, 231
 - product perishability, 230
 - production capacity change, 231
 - simulation
 - balanced equilibrium, 251
 - disturbances, 252
 - equilibrated model, 252
 - ingredient availability disturbances, 254
 - inventory coverage, 252, 253
 - KPIs, 255, 256, 258, 259
 - medicines shortages, 250
 - output, 251
 - reference mode, 251
 - run specifications, 251
 - testing
 - model information, 244
 - potential omissions, 246
 - SDM-doc tool, 244, 245
 - warnings, 244, 246
 - validation
 - behavior reproduction tests, 247
 - categories, 247
 - data, 247
 - extreme condition tests, 247–250
 - tests, 247, 248
- Oncology medicine
 - EAHP, 227
 - shortages (*see* Medicines shortages)

Ontario

- disturbance, 325, 327
- forest agent, 324
- forest sector, 321
- resilient, 327
- robust, 327
- sawmill agent, 323, 324
- sawmills, 326–328
- simulation, 321, 322
- stationary and dynamic agent, 323, 324
- truck agent, 325
- Ontario Ministry of Natural Resources and Forestry (OMNRF), 321, 322
- Operational risks, 318
- Operations research, 59, 72
- Order processing
 - backlog structure, 235, 236
 - co-flow, 236
 - FIFO, 237
 - stocks and feedback loops, 235
 - structure, 235, 236
- Organization manager (OM), 44
- “Our Common Future” report, 291

P

- Paradigm, 137
- Parallel trade, 228
- Paris Climate Agreement of 2016, 81
- Partnerships
 - educational institutions, 283
 - governments/international aid organizations, 284
 - hotels, spa and tour operators, 283
 - local NGOs, 283
 - social enterprise, 283
- Peculiar Encounters* case study
 - economic impact, 275
 - experiences, 277
 - globalization, 278
 - India, 275
 - Indonesia, 275
 - issues, 279
 - Laos, 275
 - local communities, 278–279
 - NGO, 274
 - origins, 273, 274
 - Phnom Penh, 275, 276
 - tourism supply chain, 279
 - fixed costs, 280
 - globalization, 284, 285
 - partnerships, 283
 - product development, 281, 282
 - pull system, 280

- Peculiar Encounters* case study (*cont.*)
 push system, 279
 social enterprise, 281
 trainer, 281
 Vietnam, 275
- Plant management, 237–239
- Policy design
 cultural and behavioral issue,
 organization, 146
 decision streams, 146, 147
 low-rate trainers, engaging, 146
- Procurement
 analytics techniques, 185
 business analytics, 184
 capabilities trap, 192, 193
 causal diagrams, 190, 191
 contract management, 184
 demand management, 187
 fact-based decision-making, 185
 growth variables, 186
 incremental savings, 182
 internal credibility, 186
 leverage, 186
 loop gain, 182
 loop polarity, 182
 productivity and growth, 188–190
 reinforcing and balancing loops, 181
 spend under management, 180
 spend under management and savings, 189
 supplier negotiations, 180
 supply chain, 183
 supply chain analytics, 185
 time horizon, 189
 total spend funneled, 187
 value, 181
 value creation, 186, 187
- Procurement operations, 5, 9
- Product design modularity, 7
- Product development, 266
- Product modularity
 anticipatory strategy model, 117–119
 numerical analysis
 consumers' return behavior and
 attitude, 120, 122, 123
 return period, effects of changes, 124–126
 supply chain strategies, 123
 optimization problems, 115
 product design decision problem, 115
 on production, 113, 114
 production costs, 116
 production/remanufacturing, 115
 reactive strategy model, 119, 120
 remanufactured products, 116
 reverse logistics, 115
- Project coordinator (PC), 37, 42, 45
- Project management (PM), 24, 30, 34, 42
- Project management, R&D
 development process, 28
 industry requirement, collection, 29
 industry user involvement, 29, 30
 IP assessment system, 31
 pre-IP registration, 32
 product specification, 29, 30
 project risk, 30
 research framework, 28
 specification-based prototyping, 31
 technical support and product
 specification, 33
 trial implementation, in industry
 premises, 32, 33
 virtual and augmented reality approach, 32
- Project manager (PM), 45
- Q**
- Quantitative assessment, ITF R&D project
 control factors, 37
 determinant factor,
 commercialization, 38–39
 motivating factors, 37
 quality factors, 37
 time factors, 37
- R**
- R&D technologist survey questionnaire, 43–50
- R&D technology commercialization, *see* ITF
 R&D technology commercialization
- Reactive model, 115, 119, 122, 123, 130
- Reindustrialization, 20
- Relationship management, 266
- Requirements traceability (RT), 28
- Research and development (R&D)
 perspective, 6
- Research categories, 5
- Reverse logistics, 112, 114, 115, 117, 120
- Robotics, 22
- Robustness, 319
- S**
- Simulation
 asynchronous energy policies, 213
 coordinating investment policy, 215
 delivery time, 215, 216
 electricity market, 209
 maintenance time, 216, 217
- OncoMedSCM
 balanced equilibrium, 251
 disturbances, 252

- equilibrated model, 252
- ingredient availability disturbances, 254
- inventory coverage, 252, 253
- KPIs, 255, 256, 258, 259
- medicines shortages, 250
- output, 251
- reference mode, 251
- run specifications, 251
- stock and flow diagram, 208
- synchronous energy policies, 214
- transmission capacity, 209, 210
- Skills training, 8
- Small- and medium-sized enterprises (SMEs), 18, 26
- Smart community service, 22
- Social criteria
 - GRI guidelines, 61
 - “real sustainable” approaches, 63
 - for supplier selection, 58–59
 - in textile/apparel industry, 71
- Social enterprise, 269, 283
- Social sustainability, 223
- Soft skills trainings, 140–143, 146, 147, 153
- Southeast Asia
 - Cambodia, 272
 - China, 271
 - economic and social indicators, 270
 - India, 271
 - Laos, 272
 - Nepal, 271
 - Singapore, 272
 - Vietnam, 272
- Specification-based prototyping, 31
- Stage-gate system, 26, 27
- Stakeholders, 335, 336, 339, 340
- STAM (science, technology, application, and market) model, 26, 27
- Standards, supplier selection, 71, 72
- Stationary agent, 323
- Strategic sourcing, 183, 185, 186, 193, 194
- Supplier selection
 - categorization, 59–61
 - content analysis, 56
 - category selection, 57
 - descriptive analysis, 57
 - material collection, 57
 - material evaluation, 57
 - steps, 56
- definition, 55
- descriptive analysis, 58, 59
- hybrid approaches, 73
- to industries, 69–71
- material collection, 57
- material evaluation
 - criteria applied, 61–63
 - meta-analysis (*see* Meta-analysis, sustainable supplier selection)
 - operationalization, 72
 - qualitative criteria, 73
 - social issues, 72
 - standards, 71, 72
 - TBL approach, 55, 56
- Supplier selections, 5, 6
- Supply chain coordination, 266
- Supply chain disturbance, 319, 325
- Supply chain management (SCM)
 - categories, 300
 - definition, 299
 - risk assessment, 225
 - systemic approach, 300
 - triple-bottom line, 223
- Supply chain performance score, 146, 154, 156
- Supply chain resilience (SCRES), 320
- Supply chain visibility, 319
- Supply chain vulnerability, 319
- Supply management, 266
- Supply shortage, 223, 224, 227, 230, 237, 243, 252, 253
- Sustainability
 - supplier selection (*see* Supplier selection)
- Sustainable supply chains
 - green perspective, 7
 - meta-analysis-based perspective, 6
 - perspectives and modeling approaches, 3, 4
 - product design modularity perspective, 7
 - R&D perspective, 6
 - system dynamics perspective, 9
 - training perspective, 8
- Sustainable development, 291, 293
- Sustainable development goals (SDGs), 290, 291, 311
- Sustainable supply chain management (SSCM)
 - AMUL, 303, 304
 - definition, 301
 - economic, environmental, and social, 302
 - emissions assessment, 302
 - greening supply chains, 302
 - reverse logistics, 301, 302
 - triple bottom line, 300–301
- Sustainable supply chains
 - continuum, 338
 - roadmap
 - design modularity, 336
 - essential consumer goods supply dynamics, 337
 - feedstock supply risk, 338
 - finale of finale, 338
 - green supply chains, 336
 - management, 338

- Sustainable supply chains (*cont.*)
 - model-based training, 336
 - R&D, in supply chains, 335
 - supplier selection, 335
 - sustainable procurement
 - operation, 337
 - tourism industry, 337
 - wind power industry supply
 - dynamics, 337
- Sustainable tourism
 - disruption, 268
 - economic dimension, 267
 - local communities, 263
 - social enterprise, 267, 269
 - UNWTO, 267
- System dynamics
 - causal diagrams, 180
 - definition, 135
 - feedback loops, 179
 - model structure and behavior
 - employee recruitment process, 138
 - feedback structure, 141–143
 - hard skills training loop, 143
 - process improvement and productivity
 - loop, 144
 - reinforcing loops, 142
 - soft skills training loop, 142
 - training process, 140–141
 - training types, 139–140, 153
 - XYZ Packaging Company, 138
 - model validation (*see* Model validation)
 - paradigm, 137, 138
 - on parametric changes, 136
 - policy design (*see* Policy design)
 - policy experiments, 144
 - procurement
 - incremental savings, 182
 - loop gain, 182
 - loop polarity, 182
 - reinforcing and balancing
 - loops, 181
 - spend under management, 180
 - supplier negotiations, 180
 - value, 181
 - simulated model, 136
 - steps, 136
 - supply chain function, 185
 - sustainable procurement operation, 179
 - sustainable supply chain, 193, 194
 - time-dependent simulation, 225
 - wind-power supply chain, 204, 205
- System integrator (SI), 45
- System operating procedures
 - (SOPs), 148
- T**
 - Technique for order performance by similarity
 - to ideal solution (TOPSIS), 65
 - Testing, OncoMedSCM
 - model information, 244
 - potential omissions, 246
 - SDM-doc tool, 245
 - warnings, 244, 246
 - Timber industry, 318, 321
 - Timber supply chain, 11–12
 - Timber supply chain risks
 - complexity, 320
 - definition, 318
 - dynamic agents, 323
 - forest product, 320
 - globalization, 318
 - infrastructural risks, 318
 - KPI, 319
 - macroeconomic variables, 320
 - natural events, 318
 - political events and labor actions, 318
 - quantities, 328
 - relative fiber supply loss, 329, 330
 - relative risk, 329
 - resilient region, 329
 - robustness, 319
 - sawmill agents, 323
 - SCRES, 320
 - stationary agents, 323
 - supply chain disturbance, 319
 - supply chain visibility, 319
 - vulnerability, 319
 - Tourism, 337, 340
 - Tourism supply chain
 - definition, 264
 - demand management, 265
 - fixed costs, 280
 - globalization, 284, 285
 - information technology, 266
 - inventory management, 266
 - network structure, 265
 - partnerships, 283
 - product development, 266, 281, 282
 - pull system, 280
 - push system, 279
 - relationship management, 266
 - social enterprise, 281
 - supply chain coordination, 266
 - supply management, 266
 - trainer, 281
 - Training, model-based, 336
 - Training need analysis (TNA), 8, 140, 143, 149
 - Trainings_SCM model, 157–160
 - Triple bottom-line (TBL), 95

V

Validation, OncoMedSCM

- behavior reproduction tests, 247
- categories, 247
- data, 247
- extreme condition tests, 247–250
- tests, 247, 248

Value chain

- consumers operate, 307
- core value chain, 306
- economic, social, and environmental, 307
- governance structure, 306
- support providers, 306

W

Wind power in Brazil

- asynchronies policy
 - ANEEL, 202
 - growth rate, 202
 - performance measure
 - and security, 203
 - simulation, 201
 - structure, 203
 - sustainability, 204

transmission infrastructure and
renewables, 201

transmission network investment, 202
upstream and downstream, 203

dynamic hypothesis, 205–207

PROINFA, 200

renewable energy policies, 199

simulation

asynchronous energy policies, 213

coordinating investment policy, 215

delivery time, 215, 216

maintenance time, 216, 217

performance, 212

synchronous energy policies, 214

simulation approach, 207–210

supply chain management, 200

system dynamics, 204, 205

validation process, 211

Wind-power industry's supply chain, 9, 10

Wind-power supply chains, 200

World Food Programme (WFP), 292

Z

“Zero hunger”, 290, 292