
Index

- academic acquaintance network 416
- action orientation contagion (AOC) 304
 - activation of 304
 - bi-stability in 307–8
 - mechanism of 308–9
- action vectors
 - categorical representations of 290
 - in phase space 289–90
- active feedback loops 99
- actor coalitions, in policy issue networks 209–12
- Actor Opinions survey 463–4, 473
- adaptation
 - first-order 579
 - process of 11
 - second-order 579
- adapted and mis-aligned practice, pathologies of 430
- adaptive algorithms 568, 579
- adaptive capacity 436, 438, 580, 581–2, 587
- adaptive cycle, in natural ecosystems 533
- adaptive–exaptive model, of innovation 487–8
- adaptive landscapes 481, 573–80
- adaptive rank/frequency distributions 235–6
- adaptive tension 229–31
- Advocacy Coalition Framework (ACF) 200, 205, 209–10
- Africa Climate Change Resilience Alliance (ACCRA) 450
- agent-based computational models (ABMs) 222, 224, 247, 530, 534
- agent-based modeling (ABM) 531–2, 560
 - applications of 312, 317–21
 - caregivers for persons with Alzheimer’s disease 317–19
 - housing patterns of persons with disabilities 319–21
 - appropriateness framework to 443–4
 - benefits and limitations of 321–3
 - computational methodology of 313
 - for creating predictive simulations 323
 - Patton’s utilisation-focused evaluation 322
- agent-based simulations (ABS) 135, 200, 202
- A-landscapes, in psychopathology 568, 574–5, 580
 - changing of 583–4
 - dynamics of attractors in 577
 - interpenetrating therapist–patient 581
 - mapping of 583
 - topology of the patient’s 576
- analogic reasoning 496
- analysis of variance (ANOVA) 529
- andgeneralized synchronization (GS) 394
- antisocial behaviour (ASB) 58, 100, 105, 109
- Aristotle 496
 - idea of ‘five senses’ 254
 - notion of change 510
- artefact, definition of 497–8
- assortative mixing 416–19, 469
- Astronomia Nova* (Kepler) 497
- Atkin, R.H. 376
- attractor basins 134, 183–4, 186, 191, 302, 575, 577, 584
- attractor narrative analysis 75, 83–5, 87, 91, 93
- autocatalysis 480, 532, 538
- autocorrelation (AC) method 261–2, 320, 396
- autogenesis 532
- Automap (network text analysis tool) 135, 204–5
 - advantages of using 204
 - application of 205, 206–12
 - protocol for 216
 - steps in analysis using 216–19
 - tools available in 205
 - validity and reliability of 216
- autonomous agents and multi-agent systems (AAMAS) 443–4
 - real-world readiness of 445
- autopoiesis 532, 538
- Average Mutual Information (AMI) 390, 396
- Aynsley, David 109

- backcloth structure 376–7
- bankruptcy 27, 530
- Basalla, George 490, 496, 501
- Batty, Michael 456
- BCS theory of superconductivity 519–20
- Beacon Project 57, 96–7
 - Beacon Community Regeneration Partnership 97
 - complexity theory of 97–8
 - Falmouth Cornwall (1995–2000) 107
- Beacons for Public Engagement (BPE) 114
 - aims of 115
 - independent review of 115
- bed-blocking problem 381, 385

- Benard cells 516
 benchmarking 268
 bifurcation 236, 360, 395–6, 473, 495, 500, 569, 579
 big-data 268
 Big Picture 145, 153, 154 *see also* pictures and visual metaphors
 binning, of measurement series 258
 biochemical networks 5, 12–13
 biological evolution 484
 Campbellian epistemological approach for 499
 high-order predicates of 499
 selection in 499
 systematicity principle of 499
 variation in 499
 biological networks 189, 416
 biomedical systems, multiscale analysis of 13
 Bohm, David 152
 Boolean networks 179–88, 198
 characteristic of 186
 Cilliers's observation 183
 dynamic structure 186–8
 modularization of 186
 network of interest 183
 network structure 181–6
 power graphs analysis of 189–91
 rule and set of incoming connections 181
 rule table for node 10 181
 'Small World' network 134, 180, 182
 bootstrapped maximum likelihood estimation (MLE) 222, 228
 application of 239–46
 for linking complexity-science concepts to empirical samples 238–9, 244–5
 method of 237
 results and interpretations of 239–44
 for testing for mechanisms that drive PLDs 245–6
 Bortoft, H. 517–18
 bottom-up emergence 230, 231, 232
 boundary conditions 499
 boundary-spanning 116
 Boyle, Richard 512
 brain–mind divide 567–8, 572
 Britannia Bridge 490, 494
 butterfly effect 79, 140, 221, 224, 235, 485, 570
 Byrne, David 270

 Campbell, Donald T. 562
 capacity building 112, 153, 450
 capitalist economy 489
 care provision, psychobiological model of 572
 Cariani, Peter 521–2
 Carley, Kathleen 204

 Cartesian gap, between 'material brain' and 'immaterial mind' 570
 case-based complexity 223, 270
 CAS model, as meta-framework for psychiatry 568–70
 individual behavior of 575–6
 self-organization in 579
 category theoretic representational framework 293–4, 309
 causality
 complex systems science in 46–7
 definition of 45
 G-causality 46
 information theoretic measures of 47–50
 Mutual Information value 47–8
 Wiener-Granger framework of 45–6, 52
 causality measures, types of 3, 45, 47–50, 52
 causations
 Granger causations 48
 TE causation 48
 'cause–effect' mapping 449
 cause–effect relationships 573
 cellular automata 513, 530–31
 Center for International Earth Science Information Network (CIESIN), Columbia University 388, 392
 chaos sciences 77
 chaos theory 313, 394, 526, 534, 536
 chaotic attractors 25, 396–7, 399, 577
 climate change adaptation
 in Africa (2014) 449–50
 criteria for assessing 451
 clinical commissioning group (CCG) 100, 363
 clustering, of a graph 415–16
 co-creation, dynamics of 71
 co-evolution
 dynamics of 61
 notion of 117, 231
 of trust 98
 cognitive science 6, 223, 259–61, 260
 cognitive systems
 evolutionary complex models of 21
 gender studies using 259–61
 multiscale analysis of 13–14
 coherent conversations 75, 82–3
 characteristics of 83
 contribution to vorticity 87
 narrative data generation in 86–7
 co-learning 104–5
 programme for 102
 transferable 117
 collective thinking, idea of 151, 152
 communal group social interactions 574
 communicable diseases, spread of 328–9
 communication system

- communication gap 143
- corporate communication 149
- different languages 143–5
- one-way communication 143
- communicative connectedness
 - phenomena of 78
 - quality of 78
- Community Advisory Group 118, 121
- community detection algorithm 469
- community development
 - asset-based approaches to 115–16
 - community-building and 115
- community engagement 58–9, 91, 99, 104, 111, 114, 116–17, 121, 128, 131
- community-led partnerships 116, 128
- community of practice 115, 116
- Community Regeneration Evaluating Sustainable Transfer report 98
- community–university research partnerships
 - 59, 115–16, 121
 - conceptual framework of 116–17
 - research projects involving 117
- complete synchronization (CS) 360, 389, 394
- complex adaptive systems (CAS) 224, 313, 481, 530, 567
 - agent-based modelling of *see* agent-based modelling (ABM)
 - categories of change in 579
 - components of 313, 315–17
 - adaptation 316
 - agent-based 315–16
 - attraction and self-organisation 316
 - boundaries 316
 - emergent behaviour 316–17
 - feedback 316
 - heterogeneity 316
- complex analogy
 - advantage of founding 496
 - Astronomia Nova* (Kepler) 497
 - attributes and relations in 498–9
 - background of 496
 - concept of 484
 - empirical support to 500–501
 - evolution and systematicity in 499–500
 - Gentner's theory of 496–7, 498, 499
 - inherent relational structure of 497
 - modular exaptation and 496–501
- complex governance networks 199, 200–202, 206, 209
 - methods of conceptualization of 202
- complexity informed social research
 - application of 85–92
 - data analysis and synthesis 87–91
 - human experiential space 85
 - inquiry into community enabling 85
 - narrative data generation 86–7
 - in vortical postmodern ethnography 86
 - vorticity 87
 - attractor functions 79
 - communicative connectedness and 78
 - dynamism of 77
 - edge of chaos 79
 - emergence of 77
 - fitness landscape 79
 - fractal geometry 79
 - initial conditions of 75–6
 - macro-phenomena of 77
 - micro-phenomena of 77
 - paradigmatic orientation of 77–80
 - and qualitative research 77–8
 - self-organization of 77
 - sensitive dependence, on initial conditions 79
- complexity profile 10
- complexity science 32, 74, 139, 227, 237, 313, 525–6
 - American school of 534
 - boundaries of 538
 - catastrophe theory in 526–7
 - characteristics of 314
 - computational and mathematical models of 533–4
 - dissipative structures theory of 532
 - European school of 534
 - intersectionality in 256
 - linking with empirical samples 238–9
 - methodologies of 526–33
 - narrative and multi-method studies in 536–7
 - natural sciences and ideographic analogies of 534–6
 - phases in development of 229–31
 - philosophical and paradigmatic interests in 551–2
 - research studies of emergence across 527–8
 - for social programme evaluation 313–14
- complexity theory 116–17, 121, 179, 201
 - in business context 139–40
- complex living systems 77
- complex networks (CN) 359, 389
 - centrality of 419–21
 - data protocol and data processing in 392–3
 - formation of 391
 - synchronization of *see* synchronization, of complex network
 - types of 391
- complex systems 2, 3, 5, 510
 - definition of 46
 - exaptation in 484–9
 - formation of 11
 - 'Machiavellian' versions of 42
 - major directions of inquiry in 9–12

- choices and anticipated effects 11–12
- description and representation 10–11
- design of systems 9–10
- evolutionary dynamics 11
- games and agents 11–12
- generic architectures 12
- pattern formation 9–10
- self-organization 9–10
- micro–macro relationships in 202
- multi-agent 42
- nonlinear 65
- science of 46–7
- theory of 199
- compulsive anxiety 586
- computational emergence 510, 513–14
- Concordat for Engaging the Public with Research* (2010) 114
- concrete ideas, concept of 151
- Conditions for Self-Organizing in Human Systems* (2001) 186
- Connecting Communities (C2) programme
 - approach of 99–100
 - Beacon Project (1995–1999) 96–8, 107
 - challenges encountered by 110–12
 - on effects of poverty on behaviour change 111–12
 - health creation model 110
 - NHS bio-medical models of health 110
 - organizational resistance to change 110–11
 - ‘power crazed’ residents and service providers 111
 - clinical commissioning group (CCG) 100
 - code of conduct 111
 - co-learning programme 102
 - community impact outcomes of 107–10
 - Beacon Project 107
 - Greenfingers Project 108
 - Operation Goodnight 109
 - Redruth Enabling Active Community Health (REACH) 108
 - TR14ers Community Dance Team 109–10
 - Community Regeneration Evaluating Sustainable Transfer report 98
 - complexity principles of 100–107
 - connecting workshop for 102
 - consolidating relationships and ongoing co-learning 104–5
 - delivery support team 100
 - development of 98
 - ‘dynarod’ group 101
 - exchange visits 104
 - experiential learning programme 99, 104
 - ‘immersion’ and team-building course 104
 - Introductory Learning Programme 98
 - listening and feedback event 103, 105
 - listening event 98
 - and listening together to the community 102–3
 - long-term sustainability 106
 - neighbourhood hub 104
 - partnership meetings 105
 - Partnership Steering Group (PSG) 98, 101–2
 - people and services partnership 103–4
 - People & Provider Partnership 100
 - principles of 99–100
 - residents, as co-producers of services 105–6
 - seven-step framework of 98–100
 - Strategic Steering Group (SSG) 98, 100, 102
 - training opportunities 105
- consciousness
 - adaptive strategy for predicting and sharing 574
 - dualistic view of 572
 - epiphenomenalism of 571
 - paradox of 571
- Container/Difference/Exchange (CDE) model 186
- Cooper pairing 519
- corporate tax policy 241
- corporate values 150
- corruption 56, 70
- cost containment *versus* revenue growth 291, 296
- coupling force 362, 472
- coupling scale 472, 473
- coupling strength 389, 463, 472, 473
- creation of new order 227, 247
- creative destruction, idea of 32, 43, 489
- cross recurrence plot (CRP) 404
- Cuénot, Lucien 485
- cusp catastrophe model 286, 298, 299, 529
- Cusp of Change model 286–7, 288, 307–8
 - potential function for 298–9
- cyber-bullying 569
- cybernetics 313, 479–80, 508, 516, 529
- cyber security 268, 271
- cyberspace 447
- CyOog plugin for Cytoscape 189
- Darley, Vince 513–14
- Darwin, Charles 483, 485, 492
- Darwinian algorithms 574, 575
- Darwinists 29
- data analysis 556
 - techniques for 559–60
- data collection
 - challenges in 557–8
 - strategies to address 558
 - methods for 556–7

- data collection periods (DCPs) 537
 decision-making 314, 363, 376, 444, 530, 535
 nested system of 382
 Deep Water Horizon Oil Rig Disaster (2004) 431, 450–52
 degrees of freedom 223, 287–8, 291, 295, 297, 302, 304, 449
 Delta7 strategic narrative Big Picture 146
 de Mesquita, Bueno 472
 dendograms (hierarchical clustering diagrams) 210
 Descartes, Rene 567, 572
 dualism of brain/mind 571
 ‘descent with modification,’ theory of 483
 deterministic chaos theory 9, 526, 534, 536
 deterministic threshold (DT) model, of social contagion 307
 developmental adaptations 569
 dialogues
 benefits of 153
 Kantor’s four dialogical positions 152
 meaning of 151–3
 Dimitrov, Vladimir 77
 dissipative structures theory 532
 doctor–patient relationship 568, 570
Doctrine of Signatures (Stone’s hypothesis) 486
 Dodds and Watts general model 305–6, 309
 dynamical systems therapy (DST) 481, 567
 bifurcations in 584–5
 biopsychosocial orientation of 587
 case formulation algorithm 582
 categorical diagnoses and 580–81
 definition of 578
 fractal dynamics of 581–2
 generic treatment algorithms in 580–81
 map of the mind 587
 patient–provider interaction 579
 patient’s experience with 580–81
 PL-type I and II treatment 578
 for psychiatric treatment 580
 psychobiological perspective of 587
 self-awareness and relational dynamics in 580
 systemic psychobiology view of
 psychopathology 573–80
 trans-theoretical model 567
 dynamic network analysis (DNA) 134, 178
 dynamic robustness (DR) 184, 191

 Earth Observing System Data and Information System (EOSDIS), NASA 360, 388, 392
 ecological ascendency 533
 economic development, theory of 489

 ecosystems theory 313
 edge of chaos 79, 81, 117, 128, 130, 221, 230, 231, 535, 569
 edge of order 221, 229, 230, 231
 EEG, of musicians and audience 50–52
 eigenvector equation 419
 electric grid, complexity of 271–83
 Electric Power Industry 271
 electronic tracking technology 349
 emergence
 capacity for 510
 Cohen and Stewart’s existence theorem for 513
 complexification process of 518
 computational 513
 computational and mathematical models 533–4
 definition of 509–10
 epistemological *versus* ontological 511
 explanatory gap and radical novelty in 509–12
 logics of 508
 models of 507–9
 natural sciences and ideographic analogies 534–6
 principle of 58, 117
 radical 511
 real-time visualization of 537
 self-organization with 508–9, 536
 visual time series analysis of 538
 weak *versus* strong 511
 emergent behaviour 2, 21, 30, 117, 221, 224, 314, 316–17, 321, 322
 emerging infectious diseases (EIDs)
 antiviral optimization, on simple networks 344–5
 basic reproduction number (R_0), estimation of 339
 in real time 339–41
 case study for 348–9
 communicable diseases 328
 compartmental models for studying 328
 branching process 330
 dyad models 330
 individual-based 330
 Reed–Frost chain-binomial models 330
 SEIR model 329–30
 stochastic 330
 contact network epidemiology of 331–3
 Ebola outbreaks 327
 H1N1 influenza pandemic (2009) 333
 as hospital acquired infection 348–9
 hospital contact networks, mapping of 349–50
 influenza vaccination campaigns and 342

- intervention strategies, assessment of 342–4
- mathematical modeling of 329–31
- modes of transmission of 337–9
- multi-type networks 345–8
- physical contact network 338
- preparedness plans against 351
- real-time management of 327
- respiratory-borne pathogens 328
- Severe Acute Respiratory Syndrome (SARS) 327, 333
- super-spreaders 350
- transmission contact network 338
- transmission dynamics of 333–6
- Zika virus outbreak (2015–2016) 327, 331
- EMK complexity methodology
 - challenges associated with 70–71
 - co-evolving clusters 67
 - Enabling Environment (EE)
 - co-creation of 71
 - preparing for 69, 71–2
 - workshop 65, 66–8
 - essentials for success 72
 - examples of 72
 - Indonesia case 68–9
 - for multidimensional problem space 64
 - preparatory analysis of 64–6
 - problem space
 - analysis of 65, 66–8
 - identification of 68
 - Reflect Back Workshop 65
 - two fundamentals of 62–3
 - UN case 61–2
- emotional homeostasis 568
- Enablers' fractal narrative 89–91
- Enabling Environment (EE)
 - co-creation of 71
 - preparing for 69, 71–2
 - workshop 65, 66–8
- engagement cycle 59, 121, 128–9, 130, 131
- England's National Health Service (NHS) 348, 359
- Environments of Evolutionary Adaptedness (EEA) 575
- Eoyang, Glenda 186
- equilibrium 455
- equivalence class, notion of 291, 511
- ethnographic inquiry 81
- evolutionary biology–technological evolution
 - analogy 489, 491
- evolutionary complex models 21–3
- evolutionary drive, theory of 25, 32
- evolutionary dynamics 11, 56, 586
- exaptation, in complex systems *see also*
 - modular exaptation
 - concept of 484–5
 - function, functional modules, and modular 489–96
 - meaning of 485–6
 - as modular functional shift 500
 - natural sciences and ideographic analogies 534–6
 - perspective on R&D and inventions 488–9
 - as radical innovation 487–8
 - as source of selectable variation in the technosphere 486–7
 - strategy and entrepreneurship in 488
- exaptive–adaptive cycle 487
- exaptive bootstrapping 488
- Experiential Learning Programme (ELP) 99, 103–4
- factional dimensions (FD) 469, 471
- Fairbairn, William 494
- Falmouth Cornwall (1995–2000) 107
- False Nearest Neighborhood (FNN) 390, 396
- far-from-equilibrium 429, 508, 515, 532, 578–80
- feedback 316, 321
 - negative 529
 - positive 529
- fitness landscape, notion of 78–9, 159, 292, 485, 574, 577
- fixed-point attractors 577
- Food web model 396
- Formal System Model (FSM) 359, 379–86
- fractal narrative analysis 75, 83–4
 - findings of 87–91
- fractals 529
 - adaptive processes 233
 - diagnosis of interactions across scales 258–9
 - fractal geometry 79, 233
 - fractality, principles of 79–80
 - multifractal paths forward 258
 - and power laws 233–5
 - predator/prey dynamics 233
- free will 579
- fuel protests, in UK (2000) 453–4
- functional shift, process of 483, 485, 489, 491, 493, 500–501
- function in technology, etiological concept of 491–4
- Galen of Pergamon 517
- game theory 11–12
- Ganeri, Jonardan 517
- Gaussian distributions 24, 410
 - of homogeneous agents 224
- G-causality 46–8
 - generalization of 48
- gender dynamics, hierarchical patterns in 254

- gender-related topics, exploration of 261–3
gender theory 254, 256
gene expression networks 409
generalized synchronization (GS) 360, 389, 405
General Practitioner (GP) system 365
 action-flow description of 366
 as part-whole cone 366
generative mechanisms 222, 228, 245–7, 535, 538
generic architectures 12
genetic algorithms 530, 531
genetic coding, consequence of 260
Gentner, D.
 complex analogy, theory of 496–7, 498, 499
 structure-mapping theory 496
Gestalt psychology 202
global financial crisis 6
global systems, multiscale analysis of 14
Global Systems Science 385
Gödel's Incompleteness Theorem 360, 449
Granger causations 48
Granger, Clive 46
graph theory 178, 203, 409
Greenfingers Project 58, 108
Grint, Keith 148
Gross Domestic Product (GDP) 359, 388, 393
 country-level 410
 socio-economic networks of
 characterization of 410–21
 complex system of 409–10
group influence force 361, 472
grouphink effects 463
Guide Neighbourhoods (GNs) 104

H1N1 influenza pandemic (2009) 333, 342
 vaccination campaigns against 333, 342
Haken, Hermann 508
 enslaving principle 231
Hartman–Grobman theorem 395
health and welfare system 385
healthcare workers (HCWs) 224, 342, 347, 349, 350–51
health inequalities 58, 95, 108–9, 112
Heisenberg cut 571
higher education institutes
 involvement in community partnerships 115
 public engagement in 114
historicity 429
holism, notion of 571
Holland, John 11, 509
homeostasis 508, 515, 516, 574, 578, 586
homogeneous networks 410
homophily 416, 469
Homo sapiens phylogeny 574
‘homo-spatial’ stimuli 522

Hook's Law 378
Hopf bifurcation 395
Horizontal Genetic Transfer (HGT) 503
hospital-acquired infections (HAI) 348–9
 hospital contact networks, mapping of 349–50
human brain/mind 567
human experiential space 78, 84, 85, 92
human interaction dynamics (HID) 223, 286, 303, 306–9
 action vectors in
 categorical representations of 290
 phase space 289–90
 categorical representations of
 action vectors 290
 organizing systems 290–91
 cognitive benefits to organizing 287
 contagion in 286
 Cusp of Change model of 286–7, 288
 informational influence on 289–93
 integrated analytical framework of 293
 order and degrees of freedom 287–8
 order parameters of 291
 informational influence and 292–3
 phase transitions in 286, 288
 and stability in organizing systems 292
human-machine teaming 443
human systems, modelling of 26–34
 emergent market structure 26–9
 emergent supply chain performance 34
 organizational evolution 32–4
 three meta-strategies for 29–32
Humphries, Paul 514
Huygens, Christiaan 393–4

ideographic
 analogy 481
 mapping 535, 539
imitators 29
inclusion mapping 291, 294
infectious diseases, modeling of 224, 305, 327, 329–31, 348
Influence Network survey 463
information closure 377–8
information-exchange 141
information-sharing 138–9
infrared (IR) technology 349
infrastructures modeling, social complexity in 267–8
 analytic procedure of 273–83
 challenges of
 organizational modeling 272
 regulatory influences 273
 smaller and larger social factors 272
 time and change 271–2

- electric grid 271–83
 - grounded theory and snowballing of 274–5
 - reliability and resiliency 268–70
 - as smart territories 268
 - study on 270–71
- initial condition 10, 75–6
- inner complexity 133, 162
- inner skills
 - concept of 157–8
 - different kinds of 158–9
 - dimensions of 160
 - divergent 159
 - and operational management *versus* strategic change 166
 - patterns across management levels 170
- innovation 176
- intentional agents 568, 570, 579, 587
- interactions
 - accumulation of 513
 - process of 517
- inter-actor influence relationships 459, 469
- inter-actor network 460
- inter-connectivity 429
- Internal Controls and Management Practices (ICMP)* 271
- International Institute for Applied Systems Analysis (IIASA) 392
- International Organization for Standardization (ISO) 268
- intersectionality, in the sciences 256
- intra-brain networks 51
- Iran influence network
 - analyst survey of 463
 - case study of 460–63
 - community structures of 470
 - Guardian Council 475
 - integrated issue-network analysis metrics 471
 - KHAM's initial natural preference 475
 - nuclear decision-making 476
 - nuclear weapons and economic reform 467, 471
 - nuclear weapons issue simulation 474
 - P5+1 perspective on 476
 - Strong Restrictions zone 475, 476
 - structural analysis of 463–71
 - Weapons Capability policy 473, 475
- Isaacs, William 151
- issue positions 361–2, 463–4, 470, 472, 476–7
- joint recurrence plot (JRP) 390, 404–8
- Journal for Mixed Methods Research* 547, 564
- Kandel, Eric 570
- Kantor, David 151
 - four dialogical positions 152
- Kaplan, Abraham 507
- Kauffman Firm Survey (KFS) 238
- Kepler, Johannes 497
- knowledge creation, networks of 525
- Kohonen Self Organizing Map 280
- Kolmogorov–Smirnov test (*K-S*) 239, 241, 252
- lag synchronization (LS) 394
- 'laissez faire' approach 19, 59
- Landscape of the Mind (LoM)* 157, 159–61
 - in action 165–75
 - application of 168–75
 - basic first level globe 160
 - behavioural choices 165
 - case studies on 168–75
 - colour key globe 161
 - depth profiling 162–5
 - first level 162
 - inner skills patterns 170
 - operational management *versus* strategic change 166
 - operational sample *versus* improvers sample 167
 - profiling process of 161–5
 - rank ordered preferences in 169, 173, 175
 - serendipitous research findings 175
 - three first level profiles 163
 - and three levels of leadership 172
 - and working with the less-than-thrilled 170–74
- large-scale networks 413
- latitude of acceptance 472–3, 475
- law of requisite variety 303, 455
- leader–follower relationships, in complex systems 51
- leadership
 - distributed 62, 72
 - 'swallowtail' model of 529
 - three levels of 172
- leadership networks
 - analyst survey of 463
 - Iranian leadership case study 460–63
 - modeling of 459
 - structural analysis of 463–71
 - issue analysis 464–9
 - network analysis 469–71
- learners 29
- learning
 - by doing 101, 161, 436
 - quality of 143
- lever-point phenomena 232
- Levinthal, D. 487
- Likert scales 239
- linear aggregation 377
- linear innovation model 493

- linearity 74
 linear modeling 254, 255–6
 line of identity (LOI) 390, 399
 line of sight 145, 150
 link analysis (LA) 178
 living systems 41, 77, 231, 235, 569
 local operational activity 101
 locked-in behaviours 101
 locus of change 139, 140
 Lorenz, Edward 577
 Lorenz system 399–400
 LSE Complexity Group 73, 107
 Lyapunov Exponent (LE) 391, 396
- management information systems 323
 Mandelbrot Set 529
 man–machine interfaces 6
 map of the mind 568, 578, 587
 MATLAB software 252
 mean conditional recurrence (MCR) 359, 389, 390, 405, 421
 media, concept of 510
 mental illness, development of 568, 573, 574
 metabolic pathways 409, 570
 meta-network analysis software 204, 206
 methodological design, consistency and choice in 552–3
 microbial cell, modular tree of 490
 micro simulation 378
 Middle East Respiratory Syndrome (MERS) 327
 Millennium Project 440
 Mill, John Stuart 513
 Mitleton-Kelly, Eve 97
 Mivart, George, St. 483
 mixed-method research 271, 547
 - 3Ps framework in 553
 - aim of 562
 - availability of funding sources for 555
 - benefits of 560
 - case-to-case generalization in 560
 - components of 553
 - conferences and invitations 556
 - data collection for
 - challenges in 557–8
 - methods for 556–7
 - definition of 556
 - design of *see* research design
 - integrated 548
 - paradigms and 552
 - philosophical and paradigmatic interests in 551–2
 - researchers with established track-records 556
 - scope of 547
- signal accomplishments of 551
 strategies for
 - dimensions of 561
- techniques for 556–7
 - alignment of 557
 - data analysis 559–60
 - predictive 559
 - theoretical perspectives of 555
 - worldviews, design and methods of 554
- model of practice
 - for complex situations 428
 - review of 428–30
- modular exaptation
 - artefacts of 497–8
 - and complex analogy 496–501
 - concept of 480, 484, 494, 495–6, 501
 - definition of 497–8
 - functional module of 498
 - function and behaviour of 498
 - modular artefact of 498
- modularity, concept of 490–91
 Monte Carlo bootstrapped distributions 241
 Morgan, C.L. 517–18
 Mt. Druitt Enablers Program 85, 88–9, 91
 multi-agent systems (MAS) 178, 357, 426, 443–4
 multidimensional problem space 61, 64, 68
 multifractal organization, of presymbolic development 259–61
 multi-level influence networks 357, 449
 multilevel systems 363
 - backcloth structure at 376–7
 - bed-blocking problem 381, 384
 - classes by intension and extension 369–72
 - formal model of 379–86
 - health and social care accountability and funding structure 383
 - information closure and 377–8
 - and lowest level of representation 377–8
 - mathematical theory of 376
 - motif structure 381
 - multilevel part–whole social structures 365–8
 - NACE classification for construction 370, 371
 - naming elements of 369–72
 - synthetic micropopulations 378–9
 - systems thinking, modelling and policy 364–5
 - taxonomic aggregation *see* taxonomic aggregation
 - in traffic disaggregation 378–9
- multi-modal networks, for influencing change 448–9
 multiscale analysis
 - applications of 12–14

- in biomedical systems 13
 - in cognitive systems 13–14
 - in global systems 14
- method of 7–9
- multitrait-multimethod matrix 548
- Mutual Information 47–8
 - definition of 48
 - Mutual Information from Mixed Embedding (MIME) 48–9
 - analysis of EEG of musicians and audience 50–52
 - partial MIME (PMIME) 49–50, 52
- mysteries 435

- national not-for-profit organisation 171
- National Proficiency Tests Council (NPTC) 108
- natural complexity 430, 432, 445, 455
- natural novelty 512
- natural science
 - dualistic view of 572
 - and ideographic analogies 534–6
- natural selection, theory of 483, 485, 502
- navigating in uncertainty 157
- neighbourhood governance 100, 106
- nesting safety 288
- network modeling
 - contact 331–3
 - degree distribution 331
 - Poisson degree distribution 331
 - scale-free distribution in 331
 - steps in 331
- network of interest
 - phase space and state-time diagrams for 185
 - phase space characteristics of 186
 - state-time (or space-time) diagram for 184
 - topological metrics for 182
- network science 178, 360–61, 381, 459, 469, 472
- network structure 181–6
- network text analysis (NTA) 134, 199–200, 202–4
- neural Darwinism 577
- neural networks 12, 448, 567, 572–4, 581
- Newman algorithm 210
- Nicolis, Gregoire 229, 515–16
- NK landscape models 480, 525, 530, 531, 534, 538
- non-governmental organisations (NGOs) 63
- nonlinear dynamical systems (NDS) 360, 459, 472, 508–9, 567–8
- nonlinear dynamics 254
- Nonlinear Social Influence Simulation 361, 472
- nuclear weapons issue simulation 474
- observational commutativity 378
- one-way communication 143
- operational management 168
 - versus strategic change 166
- Operation Goodnight 57, 109
- ORA software 204–5
 - application of 206–12
 - 'Locate Subgroups Report' option 210
 - protocol for 216–19
 - steps in analysis using 218–19
- order parameters 291
 - for organizing system 295
- order-phase transitions 223
- organisational change 138–9
 - butterfly effect 140
 - command and control 143
 - and gap between employees and leaders 142–3
 - locus of 140
 - mutually dependent roles for 141
 - one-way communication for 143
 - protected time to make sense of 140–41
 - shared goals and systemic obstacles 141–2
 - stable 294
- organisational development 156
 - Visual Dialogue process for 137, 141, 145
- organisational flexibility 175
- organizational evolution 32–4, 481
- organizational learning 530–31
- organizing states
 - access to alternative 302
 - changing, on a potential surface 295–6
 - external complexity of 301–3
 - first control parameter of 301–3
 - internal complexity of 303
 - phase transitions between 293–304
 - potential function, for Cusp of Change 298–9
 - and relationship among them in organizing systems 293–5
 - requisite complexity among control parameters 303–4
 - second control parameter of 303
 - terminal instance as 294–5
- organizing systems
 - action orientation contagion
 - dynamics of 304–5
 - mechanism of 308–9
 - categorical representations of 290–91
 - model of contagion in 304–6
 - Dodds and Watts general model 305–6
 - dynamics of action orientation contagion 304–5
 - model of phase transitions in 306–9
 - first-order phase transition 307–8

- second-order phase transition 307
- order parameters and 295
- organizing states and relationship among them in 293–5
- outliers 175, 227–8, 236, 242–3, 245, 246, 247, 563
- pair-wise interactions 32, 36
- pandemic influenza, as a hospital acquired infection 342, 343, 348–9
- Panel Study of Entrepreneurial Dynamics II (PSED) 238
- paradigm incommensurability, notion of 551
- parent–child interactions 258
- Pareto R/F distribution 234, 235
- Partial Directed Coherence (PDC) 50–51
- partial MIME (PMIME) 49–50, 52
- part–whole aggregation 363, 372, 374, 386
- path-dependence 307, 429
- pathological attractors 576, 577, 581, 587
- patient's life experience 581
- patient–therapist dyad 575
- pattern formation 9–10
- Pearson correlation coefficient 45
- peer-to-peer interactions 286
- perceptual learning 257
- performance gaps 488
- performance potential 488
- periodic attractors 395, 577
- Perron–Frobenius theorem 419
- personal identity, properties of 574
- personal protective equipment (PPE) 337, 347
- phase space and phase space reconstruction, concept of 395–8
- phase synchronization (PS) 360, 389, 394, 402, 421
- phase transitions 236, 305
 - first-order 294
 - in human interaction dynamics 286, 288
 - model of, in organizing systems 306–9
 - in natural sciences 288
 - between organizing states 293–304
 - second-order 294, 307
- philosophical stance 549, 553
- phrase space, notion of 57, 78, 81, 83, 87
- pictures and visual metaphors
 - benefits of 150–51
 - as communication tool 147
 - corporate values 150
 - to engage staff in turning strategy into action 149–51
 - as tool for sense-making and meaning-making 147–9
 - versus* verbal language 148
- Poisson degree distribution 331
- Poisson's distribution 410
- Poisson time series regressions 536
- policy issue networks, actor coalitions in 209–12
- PORTEND (Political Outcomes Research Tool for Elite Network Dynamics) software
 - 360–61, 459–60, 476
 - algorithm employed in 469
 - for intra-community linking 469
 - Iranian leadership case study *see* Iran influence network
 - methodology overview of 461
 - network 'modularity' in 469
- possibility space 101–2, 104
- poverty, effects on behaviour change 111–12
- Power Graph Analysis (PGA) 134, 188–91, 197
 - benefits of revisualization using 189
 - of Boolean networks 189–91
 - of effective dynamic structures 190
 - examples of 189
 - practical relevance of 197
 - primitives of 188
- power grid 273
 - decomposing misoperations in 269
 - electric service areas of Ohio 274
- power-law distributions (PLDs) 222, 227–8, 232
 - difference with normal distribution 236–7
 - model significance of 240
 - parameter estimates of 240
 - testing for mechanisms that drive 245–6
- power laws (PLs) 221–2, 257–8, 529–30
 - fractals and 233–5
- practice for complex situations 428–30
 - actors' intentions and 430–31
 - appropriate practice over time 445–8
 - aspects of 431–2
 - approaches to change 436–8
 - perceptions of change 432–4
 - understanding of change 434–6
 - 'cause–effect' mapping 449
- climate change adaptation in Africa (2014) 449–50
- Deep Water Horizon Oil Rig Disaster (2004) 450–52
- fuel protests, in UK (2000) 453–4
- judging appropriateness for
 - appropriateness framework 440–42
 - autonomous agents and multi-agent systems 443–4
 - practice as synthesis 439–40
 - real-world readiness of AAMAS 445
- multi-modal networks, for influencing change 448–9

- phases of engagement 439
- principles for effective change in 454–5
- six main avenues available for change in 446–8
- state of 426–8
- ways-of-working 437, 453
 - in predictable situations 443
- preadaptation, notion of 485
- prediction, optimal means of 513
- presymbolic development, multifractal organization of 259–61
- Prigogine, Ilya 55, 221, 229, 508
- principal components (PCs) 467
 - of actor natural preferences 468
- principal components analysis (PCA) 361, 467
- prisoner's dilemma 12
- problem space 56, 61, 62, 64, 66–8, 72, 101, 103
- Problem Space Analysis 65, 66–8
- programme evaluation 224, 312–16, 318, 322, 323
- psychiatric treatment, definition of 571, 580, 586
- psychiatry 573, 581
 - CAS model as a meta-framework for 568–70
 - practice of 567, 572
- psychobiology
 - fractal landscape of
 - CAS model 568–70
 - minimal autonomous agents 569
 - reciprocal causation and 569
 - shifting paradigms 570–73
 - systemic 573
 - map of the mind 578
- psychological experiences
 - diversity of 256
 - hierarchies driving 256–8
- psychopathology
 - affective valence in 575
 - A-landscape model of 568, 574–5, 580
 - dynamics of attractors in 577
 - interpenetrating therapist–patient 581
 - topology of the patient's 576
- attractor basins in 575
- attractor/repellor states in 568
- component-process function of 580
- dancing landscapes of 575, 585–6
- dynamical systems therapy (DST) *see* dynamical systems therapy (DST)
- evolution of 569
- first-person perspective of 580
- language of 567
- linear models of 568
- maladaptive symptoms in 580
- 'mindless brain' model in 572
- multi-level reciprocal adaptation of 574
- patient-therapist system in 568
- and patterns of behavior 576
- repellor peaks in 575
- second-person perspective of 580
- strange attractors 577
- systemic psychobiology view of 573–80
- third-person perspective of 580
- psychotherapy
 - lightbulb moments in 580
 - practice of 481, 572
- public engagement, in research
 - Beacons for Public Engagement (BPE) 114
 - aims of 115
 - Independent Review of 115
 - case studies on 118–20
 - Community Advisory Group 118
 - complexity approach to 117
 - complexity-informed cyclical model of 127–30
 - Concordat for Engaging the Public with Research* (2010) 114
 - cross-cutting themes for 123–5
 - mutual benefit 125
 - staying the distance 124–5
 - time and rhythm 123–4
 - cycle of 129, 131
 - data collection and analysis of 120–21
 - findings on 122–30
 - in higher education institutes 114
 - key principles to 114
 - 'lead-in' and 'follow-on' periods of 124, 131
 - methods of 117–22
 - National Coordinating Centre for 118
 - negotiated feedback sessions on 121
 - phases of
 - follow-on 130, 131
 - lead-in 128–30, 131
 - project or delivery 130
 - project planning and outcomes 126–7
 - roles (functions) and responsibilities of 127
 - symposium on 121
 - systems and structures of 126
- public health plans 327
 - application of complex systems tools in 328–9
- public policy
 - definition of 201
 - making of 199
- public service delivery 199
- Public Utility Commission of Ohio (PUCO) 275, 276, 283
- puzzles 435
- qualitative research 74–8, 80, 85, 90, 93, 264, 548, 551, 559–60, 562

- qualitative social research 75, 77–8, 85, 93
 quantitative modeling 254, 258, 264
 quantitative research 536, 548, 551, 562
 quantum physics 571
 quantum waves 519
 quasi-mixed method 547
- radical emergence 511, 571
 radical novelty 517
 degree of 512
 of emergent phenomena 510
 explanatory gap and 509–12
 identifications of 512
 versus ordinary novelty 512
 of self-organization 515–17
 as uncomputability 513–15
- Radio Frequency Identification (RFID)
 technology 349
- Ragin, Charles 270
- rank ordered preferences 166, 168, 169, 173
 Head of Department's 175
- real-world-readiness 445
- reciprocal causation 569, 577
- reciprocity, principle of 115, 316
- recurrence plot (RP) 360, 389, 398–9, 404
- recurrence rate (RR) 390, 399
 τ – recurrence rate 390
- Redruth Enabling Active Community Health
 (REACH) 57, 108
- Redruth North Partnership 108
- reductive epiphenomenalism 571, 572
- redundancy 10, 514
- Reflect Back Workshop 65–6
- reflexivity, in social system 41–2
- relative novelty, notion of 511
- relativity, theory of 571
- repeller peaks 575, 577
- representation, process of 10–11
- Research Councils UK 114
- research design 549–51
 complementary 549
 embedded 549
 examples of 550
 explanatory 549–50
 exploratory 551
 influences on 553–6
 multi-phase 551
 other influences on 554
 selection of 554–5
 transformative 551
 triangulation 549
- research designs, for complexity science 538
- residents, as co-producers of services 105–6
- resilience, notion of 532–3
- Resource Dependency Theory (RDT) 205
- respiratory-borne infections 329
- risk management 268, 270, 436, 455
- Rothenberg, Albert 522
- SACS Toolkit 222–3, 270–71, 283
- scalability, theory of 235, 243, 323
- scale-free distribution 331
- Schumpeter, Joseph 27, 32, 487
 economic development, theory of 489
- scientific induction–deduction learning loop 18
- self-awareness 573, 574, 580
 properties of 574
- self-bias force 361, 472
- self-organization 128
 capacity for 84
 re-establishing 586
 command and control *versus* 137
 of complex living systems 77
 concept of 515
 definition of 532
 of emergence 508–9, 536
 emergent order creation by 235
 Goethe's work on 516
 as homeostasis 516
 idea of 509
 and need for transformation 517–20
 process of 9, 26
 radical novelty of 515–17
 resident 98
 and self-regulation 516
 of system 58
- self-organized criticality 24, 221, 222, 228,
 232–3, 238, 243–6, 509
- self-regulation, patterns of 508, 515–16, 578
- self-transcending construction (STC) 510–12,
 514, 520
- semantic network analysis 135, 203–5
- sense-making 137–8, 140, 143, 147–8, 151–2,
 154–5
- sensitive dependence, on initial conditions 78–9
- Severe Acute Respiratory Syndrome (SARS)
 327, 333
- sexually-transmitted infections 329
- Shannon Entropy (SE) 134
 for each node operating within each
 attractor basin 194
 effective dynamic layers based on 192
 future work 198
 as measure of activity 191–7
 node state sequence 191
 Shannon Entropy Signatures (SESs) 192–7
 for four attractors 196
 signature of various networks 198
- Shannon's information theory 10
- shared story 133, 145, 150, 154–5

- Simon, Herbert 331, 388, 491
- skewed distributions, basic causes of
 - adaptive rank/frequency distributions 235–6
 - adaptive tension 229–31
 - bottom-up emergence 231
 - fractals and power laws 233–5
 - self-organized criticality and adaptive variability 232–3
- skills acquisition, benefits of 563
- sloppy metaphors 480, 496
- small and medium-sized enterprises (SMEs) 63
- small-world properties 360, 391, 410, 413, 416, 421, 423
- ‘smart’ complex systems 268
- smart territory/grid 268
- Smith, Adam 26
- social capital, theories of 116, 206
- social complexity in infrastructures, modeling
 - of *see* infrastructures modeling, social complexity in
- social entrepreneurs 105–6, 523
- social influence simulation
 - nonlinear model of 472–3
 - nuclear weapons issue simulation 474
 - results of 473–6
- social learning 285
- social network analysis (SNA) 134–5, 178, 179, 199–200, 202–4, 219, 441
 - history of 202
 - softwares for conducting 204–5
- social networks 39, 206, 409, 416
 - analysis of *see* social network analysis (SNA)
 - composition of 203
 - method of collecting data on 203
- social programme evaluators 224, 313, 322
- social research 74, 77, 81, 85–92, 93, 199, 522, 545
- social science methodology, reflections on 35–43
- social simulation 178
- social systems 18
 - boundary of 21
 - dynamics of 23–4
 - evolutionary complex models of 21–3
 - interpretive frameworks of 19–26
 - reflexivity in 41–2
 - solutions of dynamical system 25–6
- social work orientation 314
- socio-economic data, complexity analysis of
 - by complex coupling 393–408
 - joint recurrence plot (JRP) 404–8
 - phase synchronization (PS) 400–404
 - recurrence plot (RP) 399
 - by complex network 408–21
- Soros, George 19, 41, 43
- South West Ambulance Service 108
- space of possibilities, exploration of 5, 9–10, 103, 426, 429, 431, 432
- space-time diagrams 184
- Special Report on Emissions Scenarios (SRES) 360, 388, 392, 410
- speciation, concept of 487
- Spencer, Percy 492
- Stace, W.T. 511
- State Children’s Health Insurance Program (SCHIP) policy 209–10
- state of practice, review of 426–8
- state-time diagrams 183–4, 186
- statistical and probability theory 203
- Stewart, Ian 513
- Stone, Reverend 486
- strange attractors 79, 292, 577
- strategic change 147, 166
- Strategic Steering Group (SSG) 98, 100
- Strawson, Galen 508
- structural attractors 32, 34, 37, 191
- Structural Equation modeling 529
- structure mapping, concept of 484, 502
- successive assumptions/simplifications, process of 20–26
- sui generis* novelty, of emergent phenomena 512, 517–18, 523
- summary statistic, concept of 246
- super-spreaders 350
- supply chain
 - organization of 530
 - performance of 34
- surveys 203
- ‘swallowtail’ model, of leadership emergence 529
- symptom-reduction treatment algorithms 581
- synaptic network complexity 574
- synchronization, of complex network
 - and generalized synchronization (GS) 394
 - complete synchronization (CS) 389
 - definition of 389, 394
 - generalized synchronization (GS) 389
 - lag synchronization (LS) 394
 - phase synchronization (PS) 389
- synchronized coupled chaotic system, classification of 394
- system dynamics 25, 200, 202, 307, 317, 521, 523, 530
- systemic psychobiology 570–73, 587
- systems thinking 26, 55, 313, 363, 364–5, 386
- Takens Model 360
- taxonomic aggregation 368–9
 - grounding and transitivity in 372–3
 - heterogeneous grounded 375

- homogeneous grounded 375
 - interleaved multilevel part–whole and 373–5
 - versus* structural aggregation 374
- team development 165
- technological artefact, modular tree of 490
- technological-biological evolutionary analogy 484
- technological change 483–4, 487, 489, 492–3, 501
 - evolutionary theory of 489
- technological innovation 483–4, 493, 502
- tension
 - autonomy/integration 307
 - notion of 229
 - opportunity/risk 307
- theoretical stances 553, 556
- therapist–patient A-landscapes, graphic representation of 581
- thinking together, process of 152
- time domain waveforms 280–81
- time series analysis 45, 47–8, 52, 390–91, 395, 526, 536
- tiny initiating events 230, 232
- tipping point 97, 238, 241, 244, 307, 309, 584
- TR14ers Community Dance Team 109–10
- transferable co-learning, phenomena of 58, 117
- Transfer Entropy (TE) 48
 - causation estimates of 48
- transformative capability, notion of 487
- transformative regeneration 128
- TRANSIMS systems 378
- transitivity, of a graph 415–16
- trauma-based disorders 577
- traumatic experience, definition of 568, 578
- τ – recurrence rate 390
 - phase synchronization (PS) by 400–404
- Turing, Alan 514
- UCINET network analysis software 204
- UK Funding Councils 114
- Ultra Wide Band (UWB) 349
- uncomputability
 - radical novelty as 513–15
 - theorem on 514
- unintended consequences 173, 329, 364, 387
- United Nations (UN) 392
 - Common Statistics Database (UNSTATS) 392
 - Security Council 462
- universal language 151
- unspokens 151
- urban governance network 135, 206–9
- variation-retention-selection epistemology 486, 499–500
- vector quantization technique 275, 277
- verbal languages
 - limitations of 150
 - versus* visual images 148
- viable system model, Beer’s work on 529
- viral transmission, modes of 337–9
- Visual Dialogue process 133, 137–9, 141, 145, 153–4
 - case study 154–5
 - key elements of 145
 - use of 145
- visual representations 133, 142, 153, 155
- vortical postmodern ethnography 75, 80–82
 - features of 86
 - five aspects of 81–2
 - research methodology of 86
- Weick, Karl 294
- Wellcome Trust 114
- weltanschauung (worldview), notion of 78
- Whitehead, Alfred North 1
- wicked problems, idea of 110, 138, 148
- Wiener–Granger framework, of causality 45–6, 52
- World Health Organization 327, 351
- World Wide Web 12, 267, 409, 419
- Zika virus outbreak (2015–2016) 327, 331

