

INDEX

- Abajian, Henry, 30
Ackoff, Russell, 10
Agena TFX fighter, 100
Agrell, Wilhelm, 394
Aigrain, Pierre, 458
Air Force
 Air Research and Development Command (ARDC), 264, 267
 Atlas Scientific Advisory Committee, 265–266
 development of ICBMS, 96, 265
 management structure for ICBM development, 256–257, 266
 Office of Statistical Control, 257
 reorganizations of scientific and technical units, 264
 response to Rubel philosophy, 103–104
 Rubel's model management programs (1961), 100–101
 Teapot Committee, 265–266
 Western Development Division (WDD), 96
 Wright Air Development Command (WADC), 268
 See also RAND Corporation
Air Force Systems Command (AFSC), 97
Akeru, Atsushi, 12–13
Alchian, Armen A., 15, 259–264, 266–269, 272–275, 277, 279, 283–285, 289–290
Alexander, Samuel, 192, 194–198, 208–209, 211, 212, 214
Antisubmarine Warfare Operations Research Groups (ASWORG), 4, 69, 72–73, 82
antitrust law
 Cellars-Kefauver antitrust act (1950), 113
 Clayton Act (1950), 113
 horizontal joint ventures to circumvent, 113
Armand, Louis, 139, 140, 145, 147, 148
Arnold, Henry H. “Hap,” 64–66, 72–73, 257–258, 313, 439–440
Arrow, Kenneth J., 15, 274–277, 279, 285, 291–292, 446
Asher, Harold, 260
Aspray, William, 228
Astin, A. V., 195, 198
Atlas missile program, 6–7, 96–97
attitude prospective, France, 146–147, 150
Augenstein, Bruno, 266
Bailey, C. E. G., 388
Bainbridge, Kenneth T., 30
Baker, Wilder D., 66, 68–69, 72
ballistic missiles
 as air force priority, 96–97
 air force regulations for 375-series, 97–98
 Gillette Committee, 96
 MMRBM program, 101
 mobile mid-range ballistic missile
 revival of concurrent methods in development of, 96
 See also intercontinental ballistic missiles (ICBMs)
Barrows, George, 72
Bator, Francis, 414
Bawdey Research Station, England, 59

- Bay Area Rapid Transit (BART)
 system, San Francisco, 7–8
 general obligation bonds for district,
 119
 joint ventures, 117
 special district for, 118
- Bechtel Corporation
 Bechtel Group, 121–122
 use of systems engineering
 techniques, 5
- Becker, Howard, 210
- Bell, Daniel, 464
- Bell Laboratories (BTL), 27–28
 M-9 gun director, 34–35, 47
 report on Radiation Lab radar, 48–
 49
- Bellman, Richard, 317
- Beniger, James, 95
- Berger, Gaston, 146–148
- Bernal, J. D., 62
- Bigelow, Julian, 466
- biology as information science, 470
- Bitter, Francis, 71
- Blackett, Patrick M. S., 59, 385, 388
- Blandy, William, 40
- Bloch-Lainé, François, 147
- BoB. *See* Bureau of the Budget (BoB)
- Bode, Hendrik, 36
- Boone, Richard, 329, 330, 331, 332
- Bowles, Edward L., 62–63, 66, 69,
 313
- Bowman, Edward H., 398
- Bowman, Isaiah, 60
- Brenner, Sydney, 476
- Brillouin, Leon, 463–464
- Bromley, Allan, 429
- Brooks, Frederick P., Jr., 169
- Brooks, Harvey, 413
- Brown, James P., 362, 364
- Brown, Michael, 94, 107
- Bugos, Glenn, 7–8
- Bundy, Harvey H., 62, 67, 69, 72
- Bundy, McGeorge, 413–415, 458
- Bunker-Ramo, 363
- Burchard, John, 4, 62, 68, 73, 76
- Bureau of Ordnance, U.S. Navy
 (BuOrd)
 blind firing concept, 40–42
 fire control radar designs, 38–39
 fire control systems, 38
 Getting's relations with, 44
- Bureau of the Budget (BoB)
 Interagency Committee reporting to,
 204
 Office of Management Organization
 (OMO), 205
 seeking control over Great Society
 welfare programs, 337–338
- Bush, Vannevar, 4–5, 28, 57–58, 60–
 63, 67–69, 197, 257–258
- Califano, Joseph, Jr., 338, 340–341
- Cannon, William, 331–332
- Capron, William, 279, 331
- Carbon dioxide
 monitoring atmospheric, 233, 240
 theory of global warming induced by,
 233
- cathode ray tubes, 31, 164
- Centre International de Prospective,
 146
- Chafee, Earl, 33
- Chandler, Alfred, 191
- Chargaff, Erwin, 473
- Charney, Jule, 228
- civil systems
 Ramo's promotion of, 364
 of TRW, 359–360
- Clark, William C., 413, 418, 428
- Clayton Act (1914), 113
- climate
 GCMs to study, 229, 231–232
 global warming theory, 233
 Study of Critical Environmental
 Problems (SCEP), 240–242
 Study of Man's Impact on Climate
 (SMIC), 240–242
- climate models
 during Cold War, 247
 global three-dimensional, 234–
 236
See also general circulation models
 (GCMs)
- Cloward, Richard, 329, 336

- Club of Rome
 conclusions related to population,
 pollution, and consumption, 245
 contribution of, 245
 first general meeting, 242–243
The Limits to Growth, 244–245
- Cold War
 climate and weather models during,
 247
 RAND contribution to fighting, 255
 research during, 313
- Collbohm, Franklin R., 17, 257, 265–
 266, 270, 278, 313–314, 315, 441–
 442, 447–448
- communication
 mathematical theory of, 468
 networks within organizations, 95
- Community Action Program (CAP),
 332–334
- Compton, Karl, 33, 60, 61, 68, 78–81
- computers
 development of digital (1945–1960),
 237
 ENIAC, 224–226
 Los Alamos Maniac, 473, 475
 as management tools, 161
 microprocessors, 161
 MIT Whirlwind digital computer,
 163–164, 229–230
 persistent distrust of, 183
 potential risks, 162–163
 random-access magnetic core
 memory, 164
 for systems approach (1960s), 10
 TRW applications, 369–370
 U.S. lead in use of, 437
See also microprocessors; SAGE
 (Semi-Automatic Ground
 Environment) system
- computer simulation
 modeling and simulation at RAND,
 317
 as technique for policy analysis, 245
See also simulation models
- computer systems
 application of deductive proof, 180–
 182
 fatal accidents related to failure of,
 170–171
 first real-time, 161
 installation of different backup
 systems, 179
 SABRE computerized airline
 reservation system, 161
 safety-critical, 171–173
 testing for safety, 175–178
See also programming computer
 systems
- Conant, James B., 61, 62, 67, 78
- concurrency
 origin of term, 96, 97, 264
 seen as threat by air force officers,
 104
 shift to phased planning from, 106
- concurrent method
 of building a system, 93–94, 96
 of procurement, 93–94
See also sequential method
- conglomerates
 development of (1960s), 114
 divestiture movement (1970s), 115
 organizational form, 114
- control
 as application of computers, 229–230
 military command-control systems,
 230
 SAGE system used for, 229–230
- Conway, Jack, 336–337
- Cowles Commission, 274–275
- Cramér, Harald, 389, 396, 398
- Crawford, Perry, 163
- Crick, Francis, 467, 470–471, 473,
 478–479, 483
- Critical Path Method (CPM), 93, 122
- cryptanalysis
 diamond code, 472–477
 of DNA structure and protein
 synthesis, 472
 information theory transformation of,
 472
- Dalenius, Tore, 401
- Dancoff, Sydney, 470
- Dantzig, George B., 317, 448, 449

- data
 - for climate models, 235
 - computer as tool to refine and shape, 229
 - conversion for SAGE system, 230
 - focus in SCEP and SMIC reports, 241–242
 - from IGY, 234
 - lacking in Forrester's systems, 238–239
 - paleoclimatic, 235
 - relationships between models and, 240–242
 - in world dynamics models, 244
- data collection
 - for global weather forecasting, 226–228
 - for SAGE system, 230
- data networks
 - of IGY, 234
 - for meteorological observation, 232–233
 - for weather and climate models, 247
- data sources
 - computer-related fatal accidents, 170–171
 - weather satellites, 235–236
- Davenport, Lee, 30
- Davidson, Ward F., 70–77
- defense policymaking
 - centralization at DOD, 326
 - criticism of U.S. (1958), 322
 - in *The Economics of Defense*, 318–319
- Defense Reorganization Act (1958), 98
- defense sector, Sweden
 - National Defense Research Institute (FOA), 385, 388–391
 - OR activities, 388–390
 - OR in, 394
 - during World War II, 387
- de Gaulle, Charles, 135, 137–138, 142
- DeLauer, Richard, 367
- Delbrück, Max, 467, 473, 475, 478, 480–482
- Delinquency and Opportunity* (Cloward and Ohlin), 329
- Department of Defense (DOD)
 - concerns related to centralization of management, 104–106
 - McNamara as Secretary, 321, 324
 - phased planning regulations, 106
 - Planning-Programming-Budgeting (PPB) system, 326–327
 - PPB program packages, 341–343
 - Reorganization Act (1958), 322, 324
 - Research and Development Board, 263
 - systems analysis and program budgeting in, 341–342
- Department of Health, Education, and Welfare (HEW)
 - Office of Management Policy (OMP), 199–201
 - Statistical Processing Branch (SPB), 201
 - systems analysis study (1958), 199–200
- Dibner conference, 2
- Dickins, B. G., 66
- Digital Radar Relay, 164
- Dijkstra, Edsger, 168, 175, 180–181
- districts, special
 - BART district, 118–119
 - in California, 118
 - new agency formation commissions to oversee, 119–120
- Douglas, Donald, 313
- Douglas, Walter, 120–122
- Draper, Charles Stark, 41
- Eaker, Ira C., 65–66
- earth systems models, 246
- Economic Opportunity Act (1964), Community Action Programs, 334–336
- economics
 - of innovation, 268, 293–295
 - of technical change, 256–257, 259–270
- The Economics of Defense in the Nuclear Age* (Hitch and McKean), 318–319, 324–326

- economists
 RAND economics of innovation project, 268, 293–295
 RAND economists' criticism of systems analysis, 257–270
 RAND economists during Sputnik crisis, 285–292
 RAND economists' study of R&D, 270–285
- Edsall, John, 467
- Edwards, Paul N., 13–14
- Edwards, Richard, 203
- Eisenhower, Dwight D., 98, 193, 212
- Eisenhower administration
 defense establishment during, 322
 enforcement of Clayton Act, 113
 ICBM development as priority, 96
- electronic data processing (EDP)
 introduction into federal bureaucracy, 191–194
- Elichirigoity, Irving, 244
- EMEP (Cooperative Programme for the Monitoring and Evaluation of Air Pollution in Europe) model, 421, 423–424
- engineering
 safety engineering, 172–173
 software engineering, 166–169, 180–182
 systems engineering, 1, 200, 214, 256–257
 systems-engineering management, 5, 96–97, 265, 360–362, 378
- engineers
 at heart of *l'action prospective*, 148
 mutual orientation of scientists and, 223, 230
- ENIAC computer
 computerized weather prediction by, 225–226
 initial applications, 224
- Enthoven, Alain, 6, 325, 338, 446, 448
- environmental simulators
 to test real-time systems, 175
- European Space Agency, Phased Project Planning, 106
- Everett, Robert, 163–164
- Everitt, William L., 67–68
- Fairchild, Muir, 66
- Fehrm, Martin, 390–391
- Feynman, Richard, 473
- FOA. *See* National Research Defense Institute (FOA and FOA P), Sweden
- Ford Foundation, "Grey Areas" programs, 328–330
- Forrester, Jay, 6, 14, 163–164, 222, 229–230, 236–237, 242–243, 247
- Foster, John S., 374–375, 377
- Foucault, Michel, 467
- France
 post-World War II role of state, 134–135
 systems analysis approach in, 19
une attitude prospective, 147–150
- Frenckner, Paulsson, 397–398
- Furer, Julius A., 62, 67, 75
- Futures Studies, Sweden, 402–405
- game theory, 317
- Gamow, George, 471–478, 483
- Gardner, Trevor, 265
- Garmisch conference. *See* Software Engineering Conference, Garmisch (1968)
- Geiger, Roger, 288
- general circulation models (GCMs)
 contribution to anthropogenic climate change theory, 229
 development (1959), 228–229
 GFDL models, 231
 to study climate, 231
 weather prediction, 228–229
- General Dynamics, Convair Division, 96
- genetic code
 governing heredity, 463
 as information system, 466, 469
 seen as computer program, 464

- Geophysical Fluid Dynamics
 Laboratory (GFDL), Princeton
 general circulation model (GCM),
 238
 global, three-dimensional general
 circulation models, 231
 geopolitical power
 technological achievements as, 142–
 143
 German systems analysis approach, 19
 Getting, Ivan, 3, 27, 28, 30–31, 36–
 37, 39–46
 Gilbert, Walter, 485
 Gill, William, 205–209, 214
 Gillette Committee, 96
 Gilpatric, Roswell, 324, 325
 Glass, Robert L., 169
 Glasser, Otto, 105–107
 Global Atmospheric Research Program
 (GARP), 234, 247
 global modeling
 as paradigm, 246
 global warming, 233
 Godet, Sidney, 30
 Golomb, Solomon, 480, 483
 Gordon, Basil, 480
 Gordon, Kermit, 339–340
 Gorman, Joseph, 378
 Goudsmit, Samuel, 78, 82
 Gregory, H. F., 287
 Griffith, John, 479
 Gruenberger, Fred, 175
 gun fire control
 Mark 56, 28
 SCR-268, 28, 31
 Gvishiani, Jermen, 414–416, 458

 Hackett, David, 329, 331, 332
 Haefele, Wolf, 449, 451
 Haldane, John B. S., 468
 Handler, Philip, 416, 458
 Haraway, Donna, 465
 Harris, Arthur, 66
 Harris, George, 30
 Harrison, George, 80–81
 Hart, David M., 240
 Hastings, R. C., 167
 Haveman, Robert, 343
 Hayes, Frederick, 332
 Hazen, Harold, 40–41
 Hecht, Gabrielle, 8–10
 Heller, Walter W., 327–328, 330, 339
 Helmer, Olaf, 316
 heredity
 as information transfer, 464
 similar to computer memory, 463–
 464
 Hetzel, William C., 175
 Hirsch, Etienne, 145–146
 Hirsch, Werner Z., 260
 Hitch, Charles, 6, 99–100, 288–289,
 317–319, 324–326, 338, 447, 448
 Hoare, C. A. R., 11, 163
 Holling, C. S., 449
 Hoos, Ida, 342, 344, 399–400
 Hoover, Herbert, 60, 192–193, 212
 Hoover Commission, 192–193, 204
 Hudson Institute, 403
 Hughes, Agatha, 494
 Hughes, Thomas, 465, 494
 Hulthén, Lamek, 388–389, 398
 Humphrey, Hubert, 16

 IIASA. *See* International Institute for
 Applied Systems Analysis (IIASA)
 Iklé, Fred, 446
 information
 biology as information science, 470
 in genetic code, 463–464
 in human chromosomes, 464
 information systems
 in disciplines, 463–465
 genetic code as, 466
 in molecular biology, 463–464
 information theory
 link to cryptanalysis, 472
 Ingelstam, Lars, 402–403
 Ingersoll, Royal E., 66
 innovation
 economics of, 268, 293–295
 Institute for Advanced Study (IAS,
 Princeton), Numerical Meteorology
 Project, 225
 Institute for Research on Poverty, 343

- institutions
 collaboration with IIASA, 457–458
 post–World War II new and reformed French, 135
 providing support to military sector, 443–444
- Interagency Committee on Automatic Data Processing, 204–207
- intercontinental ballistic missiles (ICBMs)
 program to develop, 6, 96–97
 U.S. decision to build, 256–257
- International Energy Workshop (IEW), 420
- International Geophysical Year (IGY)
 data network construction (1957–1958), 247, 232–233
- International Institute for Applied Systems Analysis (IIASA)
 Agenda for the Third Decade, 438
 connection to IEW, 420
 differences from RAND, 453–460
 formation, location, membership, and naming of, 413–414, 437–438, 449
 influence of, 420
 institutions collaborating with, 457–458
 interdisciplinary network, 420, 438
 multiple sponsors, 454–456
 RAINS model, 419, 421–427
 RAND experience applied to, 449–460
 research areas and research programs, 450–453
 research on water pollution and climate change, 428
 research projects undertaken by, 417–420
 systems approach, 5
 Transboundary Air Pollution (TAP) Project, 421, 427
- Internet
 RISK news group, 162, 182
 spread of, 161
- Jackson, Henry, 321
- Jacob, François, 463–464
- Jansky, C. M., 67–68
- Jardini, David R., 17
- Jennergren, Carl-Gustav, 391–392, 394
- Jewett, Frank, 61, 67, 72
- JNW. *See* Joint Committee on New Weapons and Equipment
- Johnson, Ellis A., 71
- Johnson, Leland, 279
- Johnson, Lyndon B., 327, 330, 332–333, 335, 339–341, 413
- Johnson, Stephen B., 6–7
- Joint Committee on New Weapons and Equipment (JNW), 63, 69–70
- Joint Venture Control Office (JVCO), 121–122
- joint ventures
 as approach to system building, 7–8
 increasing frequency of domestic (1950s, 1960s), 113–114
 new forms (1980s), 115
 parent contributions to, 116
 PBTB (Parson-Brinckerhoff-Tudor-Bechtel), 117, 120
 project-specific nature of agreements, 116
 risk factor, 117
- Jordan, Bud, 369
- Kahn, Herman, 403, 448
- Kaijser, Arne, 19–20
- Kay, Lily E., 23
- Kaysen, Carl, 414
- Keller, Evelyn Fox, 484
- Kennedy, George C., 223–224
- Kennedy, John F., 234, 320, 322–323, 329
- Kennedy, Robert F., 329
- Kennedy administration
 defense department reorganization during, 323
 President's Committee on Juvenile Delinquency and Youth Crime, 328–330
- Kershaw, Joseph, 338, 344
- Kessel, Reuben A., 269, 270–275, 279, 285, 289–290

- Kevles, Daniel, 258, 288
 Kiely, John, 122
 Killian, James R., 286
 King, Ernest J., 62, 71–72
 Kissinger, Henry, 446
 Kistiakowsky, George, 265
 Klein, Burton H., 15, 270–279, 283–285, 289–290
 Knight, John, 180
 Knight-Leveson programmer
 independence experiment, 179–180
 Kolence, K., 167
 Koopmans, Tjalling, 418, 449
 Kovar, Donald, 370
 Kravitz, Sanford, 330

 Langmuir, Irving, 224
 Larsson, Hugo, 390
 Leach, Walter Barton, 70–76
 Lederberg, Joshua, 467
 Ledley, Robert, 475–476
 Lee, W. A., Jr., 69–71
 LeMay, Curtis, 105, 314, 439
 Leveson, Nancy, 180
 Levien, Roger, 413, 443, 448
 Licklider, J. C. R., 164, 165–166, 183
The Limits to Growth (Meadows et al.),
 244–245
 Lindbergh, Charles, 265
 Logue, Edward, 328
 Lonnquest, John, 267
 Lovell, Clarence A., 48
 LRTAP (Convention on Long-Range
 Transboundary Air Pollution), 421,
 423, 426
 Lyotard, Jean François, 464

 MacArthur, Douglas, 80–81
 McClelland, Harold M., 66, 71
 McDonald, Alan, 413, 428
 McElroy, Neil H., 288
 McKean, Roland N., 317–319
 MacKenzie, Donald, 11–12, 155
 McMillan, Brockway, 103, 480
 McNamara, Robert, 6, 94
 advice to Task Force on Antipoverty,
 333
 in Army Air Force, 320
 contributions to organization
 restructuring, 320
 criticism of DOD management
 adopted by him, 342
 at Ford Motor Company, 320–321
 plan to reorganize DOD (1961), 98–
 100, 325–328
 Project 102 policy, 99, 102
 promotion of phased planning by,
 107
 as Secretary of Defense, 321, 324,
 437
 Mahoney, Michael, 12
 Majone, Giandomenico, 399
 Manabe, Syukuro, 232
 management
 concurrency as air force strategy for,
 97–98
 industrial management in Sweden,
 395–398
 management by objective, 114
 RAND-initiated analytical methods
 of, 311–312
 Taylor's concepts of scientific, 395
 Manhattan Project, 313
 Mark 56 Gun Fire Control System, 28
 Marschak, Thomas, 279
 Marshall, Lauriston C., 80–81
 Martin Company, 101
 Massé, Pierre, 140–141, 143, 147,
 153–154, 414
 mathematics
 early uses in systems approach, 435–
 437
 mathematical statistics in Swedish
 OR, 396–397
 mathematical theory of
 communication, 468
 mathematics, applied
 experience of RAND staff in, 316–
 317
 mathematical models, 435–437
 NBS applied mathematics lab, 194–
 195
 OSRD, 257, 315–316
 Matthaeci, Heinrich, 483–484

- Maxwell, Jewell, 104
 Meade, Frank C., 64, 67
 Meadows, Dennis, 243–244
 Meckling, William, 279, 284
 Mees, Kenneth, 290
 Mesthene, Emmanuel, 279, 284
 Metropolis, Nicholas, 475, 478
 Mettler, Ruben F., 361–362, 373–374
 Meyaud, Jean, 137–138
 M-9 gun director, 47
 microprocessors, 161
 microwave generation
 British cavity magnetron, 61
 NRDC research, 61–62
 military applications
 postwar mutual orientation, 223, 230
 using computers for control, 230
 weather prediction, 223
 military sector
 command-control systems, 230
 operations research in Britain, 59
 systems analysis, 1–2, 434–435
 weather prediction, 224
 See also procurement, military
 military sector, Sweden
 infiltration of civilians into, 393–394
 role of FOA P in, 390–393
 military sector, U.S.
 institutions providing operational and
 systems analysis support, 443–444
 NBS research funded by, 195–196
 use of operations and systems analysis,
 434–435
 Mindell, David A., 3
 Minuteman program, 103–104
 Missile Early Warning Radar, 164
 missiles
 Atlas missile program, 6–7, 96–97
 Fleet Ballistic Missile Program, 11
 phased planning for, 100–102
 Polaris Intermediate Range Missile, 6
 Titan missile development, 97
 See also ballistic missiles
 MIT (Massachusetts Institute of
 Technology)
 Radiation Lab, 27–28, 30–31, 62, 74
 Sloan School of Management, 236,
 241
 Systems Dynamics Group, 222, 244
 MITRE Corporation, 5
 Mobilization for Youth (MFY), 328–
 329
 models. *See* climate models; earth
 systems models; EMEP model;
 general circulation models (GCMs);
 RAINS model; simulation models;
 weather models; world dynamics
 models
 modem
 Digital Radar Relay as predecessor of,
 164
 Molander, Per, 401–402
 Monod, Jacques, 23, 463
 Monte Carlo methods, RAND, 317
 Moore's law, 165, 169
 Morgenstern, Oskar, 255, 317
 Morse, Philip M., 4, 5, 68–69, 76, 78,
 82–83
 Moses, R. G., 69–71
 Moynihan, Daniel, 327, 328, 331, 333,
 337
 Murphy, Emerson, 40
 mutual orientation
 of scientists and engineers, 223, 230
 weather prediction, 223
 Myrdal, Alva, 403
 National Aeronautics and Space
 Administration (NASA)
 Phased Project Planning, 106
 shrinking budget (late 1960s), 366
 National Bureau of Standards (NBS)
 advisory service on EDP
 procurement, 192, 196–199, 209–
 212
 computer procurement program, 195
 Data Processing Systems Division,
 208, 212
 Interagency Committee on
 Automatic Data Processing as rival
 to, 204
 involvement with computers, 194

- National Bureau of Standards (NBS)
 (cont.)
 military research and funding for
 (1950s), 195–196
 National Applied Mathematics
 Laboratory (NAML), 194–195
 PILOT project, 208
 SEAC stored program computer, 195,
 208
- National Center for Atmospheric
 Research (NCAR)
 climate, atmosphere, and ocean
 modeling, 231, 241
- National Defense Research Committee
 (NDRC)
 fire control division, 28–29
 London Mission, 62
 Microwave Committee, 28–29
 research contract development under,
 61
 role in development of OR in
 United States, 67–68
 V. Bush as chairman of, 60–61
- National Research Defense Institute
 (FOA and FOA P), Sweden, 385,
 388–393, 399
- NATO Air Defense Ground
 Environment (NADGE), 230
- Navy
 Bureau of Ordnance, 38–42, 44
 Fleet Ballistic Missile Program, 11
 Special Projects Office (SPO), 10–11
- NBS. *See* National Bureau of Standards
 (NBS)
- NDRC. *See* National Defense
 Research Committee
- Nelson, Richard R., 15, 276, 278–
 279, 284, 285, 290–292
- Nichols, Nathaniel, 37
- Nimitz, Chester, 80–81
- Nirenberg, Marshall, 483–484
- Nitze, Paul H., 326
- Nixon, Richard M., 366
- North Atlantic Air Defense Command
 (NORAD), 230
 nuclear power industry
 probabilistic risk assessment, 172–173
 nuclear weapons research, Sweden,
 393
 NWP. *See* weather forecasting
 Nyquist, Harry, 36
- Office of Economic Opportunity
 (OEO)
 Community Action Programs under,
 336–337
 funding for Institute for Research on
 Poverty, 343
 PPB system in, 343, 344
 Shriver as director of, 338
 TRW systems management, 366
- Office of Field Service (OFS), 79–83
- Office of Scientific Research and
 Development (OSRD)
 Applied Mathematics Panel (AMP),
 315–316
 level of involvement in OR, 75
 Office of Field Service (OFS), 5
 research and development functions,
 4–5
 Statistical Research Group, Applied
 Mathematics Panel, 257
 V. Bush as director, 57–58, 60
- Ohlin, Lloyd, 329
- Olmstead, Dawson, 64
- O'Neill, John W., 322
- Operations Analysis Division (OAD), 72
- operations research (OR)
 in Britain, 385
 British military uses during World
 War II, 59
 in British radar program, 62
 in civilian sector, 20
 early experiments in England, 59
 experience of RAND staff in, 316–
 317
 International Federation of
 Operations Research Societies
 (IFORS), 398–399
 objective, 57
 postwar spread of, 437
 post-World War II meaning, 1
 in Sweden, 385–388
 during World War II, 4–5

- operations research (OR), Sweden
 civilian, 395–404
 first period of, 399–400
 for military planning, 391–393
 in public sector, 400–401
 role of FOAP, 391–393
 used for industrial management, 396–398
 using mathematical statistics for, 396–397
 weapons systems analysis and development, 394–395
- Opler, A., 167
- organizations
 conglomerate organizational form, 114
 control and communication within, 95
 MIT Radiation Lab, 62
 restructuring of DOD, 98, 320–324
- Orgel, Leslie, 479
- oscilloscope displays, 31
- OSRD. *See* Office of Scientific Research and Development
- Page, Robert M., 41
- Palme, Olof, 403
- Parikh, Kirit, 451
- Parnas, David, 163
- Parsons Brinckerhoff, 5, 120–122
- Patent Office mechanization study (1950s), 197–198, 202
- Pauling, Linus, 473
- Paxson, Edwin W., 316
- PCJD. *See* President's Committee on Juvenile Delinquency and Youth Crime
- Peccei, Aurelio, 242–243, 414–415, 420
- Peirce, Charles Sanders, 213
- Penn v. Olin* (1964), 113
- Perlis, A., 168
- PERT. *See* Program Evaluation Review Technique
- Pestel, Eduard, 243
- Phillips, Norman, 228, 231
- Phillips, Samuel, 103
- Pitts, Walter, 37
- planning, phased
 for development of air force missiles, 100–102
 as sequential method, 94–95
- Planning Commission, France
 applying systems thinking, 134
 objectives and contributions of Fourth Plan, 150–152
 the Plans, 149–154
- Planning-Programming-Budgeting (PPB)
 BoB interest in, 338
 in Defense Department, 326–327
 implementation in federal bureaucratic structure, 341
- Plass, Gilbert, 233
- Polaris Intermediate Range Missile Project, 6
- policy analysis, United States, 386, 402, 435–437
- politics
 French technologists' view of, 141–142
 relation to technology, 154–156
- Poster, Mark, 465
- PPB. *See* Planning-Programming-Budgeting
- President's Committee on Juvenile Delinquency and Youth Crime (PCJD), 328–330, 332
- procurement, military
 concurrent, 93–94
 phased planning, 94
 sequential, 93–94
- Program Evaluation Review Technique (PERT), 6, 93
 computer program, 10–11
- programming
 dynamic programming at RAND Corporation, 255, 268, 317
 Knight-Leveson programmer independence experiment, 179–180
 linear programming at RAND, 255, 268, 317
 N-version, 179–180

- programming computer systems
 - creating software, 164–165
 - increased efficiency in development of, 169–170
- program specification, 180–182
- program testing, 175–176
 - automated testing, 178
 - random testing, 176–178
 - reliability growth modeling, 176–177
- proximity fuse (VT or variable time fuse), 47–48
- Putt, Donald L., 267

- Quade, Edward, 268–269, 392
- Quastler, Henry, 469–470, 473

- Rabar, Ferenc, 451
- Rabi, I. I., 286
- radar
 - Digital Radar Relay, 164
 - integration into British air defense system, 58–59
 - meteorologists using, 223
 - Missile Early Warning Radar, 164
 - MIT Radiation Lab, 48–49
 - rawinsondes (radar-tracked radiosondes), 223
 - See also* microwave generation
- radar systems
 - fire control, 38–46
 - Mark 56 Gun Fire Control System, 28
 - SAGE, 229
 - scanning XT-1 prototype, 31
 - SCR-268, 28
 - SCR-584, 32–33
 - in World War II, 434
- radar technology, British
 - during Battle of Britain, 63
 - cavity magnetron, 61
 - OR program in, 62
- Radiation Laboratory, MIT
 - airborne radar project, 30–31
 - automatic fire control project, 30, 33
 - Getting's transformation of, 44–46
 - losses to military during World War II, 74
 - Mark 56 Gun Fire Control System, 42–44
 - microwave research, 29
 - organization of, 27–28, 30–31, 62, 74
 - radar-controlled fire control system, 27–28
 - SCR-584, 31–33, 47
 - as system integrator, 49–51
 - radiosondes (rawinsondes), 223
- Raiffa, Howard, 413, 414, 417, 420, 448, 449
- RAINS (Regional Acidification Information and Simulation) model, 419, 421–427
- Ramo, Simon, 5, 6, 18, 176, 257, 266, 362–364, 375, 378
- Ramo-Wooldridge Corporation, 5, 96–97, 265, 360–362, 378
- See also* TRW
- RAND Corporation
 - assistance to Swedish OR development, 392, 400–401
 - contributions to various disciplines, 442
 - criticism of system analysis approach, 15–16
 - departments, 445–447
 - design and creation of, 257–258, 313–317, 439–441, 444–448
 - development of economics of technical change, 256–257
 - Dynamic Offensive Bombing Systems (DOBS), 260
 - economics of innovation project, 268, 293–295
 - experience applied to IIASA, 449–460
 - interdisciplinary systems analysis, 444–445
 - lessons (1948–1973), 443–448
 - as pioneer of systems analysis, 255, 264, 268
 - policy analyses, 442–443

- as Project RAND at Douglas Aircraft, 313–317, 439–441
- proliferation of management methods, 343
- role of economists, 257–295
- shift to civilian projects (1960s), 17
- systems analyses, 441–443
- systems analysis techniques, 5, 13, 14–15
- work in applied mathematics, 316–317
- See also* International Institute for Applied Systems Analysis (IIASA); research and development (R&D)
- Randel, B., 167
- random testing, 176–178
- Rau, Erik P., 4, 5
- Raymond, Arthur E., 313–315
- Reilly, Frank, 199–203
- reliability growth modeling, 176–177
- research
 - model during World War II, 312–313
 - RAND as model for Cold War research, 313
 - RAND as research center (1946–1962), 257–258
- research and development (R&D)
 - differences in decisions for procurement and, 261–264
 - RAND economics during Sputnik crisis, 285–292
 - RAND economists' study of, 270–285
 - seen as economic problem, 268
- Revelle, Roger, 233–234, 241
- Rich, Alexander, 473, 476
- Richardson, Robert C., 80–81
- Ridenour, Louis, 74, 76
- risk
 - associated with joint ventures, 117
- risk assessment
 - computer systems, 173–174
 - of computer system safety, 171–173
- risk assessment, probabilistic
 - component failure probabilities, 179
 - computer systems, 173–174
 - in safety engineering, 172–173
- RNA Tie Club, 473, 475
- Robertson, H. P., 62, 68, 73–74, 77–78
- Rohr, Incorporated
 - corporate control center, 126
 - maker of BART cars, 126–127
- Root, Elihu, 70
- Rosenblueth, Arturo, 466
- Rosenhead, J., 400
- Ross, D. T., 167
- Rossby, Carl-Gustav, 224
- Rowe, A. P., 59
- Rowen, Henry, 340, 342, 442
- Rubel, John, 100–102
- Ruiz, Al, 41
- safety engineering
 - fault trees, 172–173
 - hazard mode and effects analyses, 172–173
- SAGE (Semi-Automatic Ground Environment) system
 - Air Defense Project, 6, 11
 - building, 230
 - command-control systems, 230
 - computerized, real-time system, 161, 163
 - programs required for, 164–165
 - Singapore radar data to plot aircraft intercept, 229
 - Whirlwind as core of, 229–230
- Samuelson, Paul, 37
- Sapolsky, Harvey, 11, 286
- Sauvy, Alfred, 138–139
- Saville, Gordon P., 64–68
- Schlesinger, James, 446
- Schriever, Bernard, 5, 6–7, 96–97, 102, 104–107, 257, 264–265
- Schrödinger, Erwin, 466
- Schultze, Charles, 331, 337, 340
- Scripps Institute of Oceanography, 241
- sequential method, 93–94
- Servo Laboratory, MIT, 37, 42

- Shannon, Claude, 23, 468–469, 472, 480
- Shapiro, Stuart, 168–169
- Shepard, Horace, 373
- Shriver, Sargent, 333–336, 338
- Siegfried, André, 136
- Simon, Herbert, 446
- simulation models
 for industrial dynamics management, 237
 numerical models of weather and climate, 222, 223–236
 RAINS model, 419, 421–427
 world dynamics models, 222, 231–239
- Sinsheimer, Robert, 464, 482
- Sloan School of Management, MIT
 industrial dynamics approach (Forrester), 236–237, 243
- Smagorinsky, Joseph, 228, 231, 241
- Smith, Harold, 75, 78
- Smyth, H. D., 284
- Social Security Administration
 IBM punch card machinery (1940s), 193–194
- software
 approaches to engineering, 166–169
 reliability growth modeling, 176–177
 technical systems to support development of, 169–170
- Software Engineering Conference, Garmisch (1968), 166–168, 180–182
- Solomon, George, 367
- Spaatz, Carl, 65–66
- space program, U.S.
 use of systems analysis approach, 15
- Sperry, Elmer, 3
- Sperry Gyroscope Company, 33
- Spiegelman, Sol, 467
- Sputnik crisis, 98, 285–292
- Sputnik launch (1957), 321
- Staats, Elmer, 338
- Standards Eastern Automatic Computer (SEAC), 195
- Staples, Eugene, 414
- Statistical Research Group (SGF), Sweden, 389, 396, 401
- Staudenmaier, John, 20
- Staudhammer, Peter, 378–379
- Stenbit, John, 379–380
- Stevens, Mary Elizabeth, 13, 196–204, 209–211, 214
- Stewart, James, 102–103
- Stimson, Henry L., 62–64
- Strategic Air Command Control System (SACCS), 230
- Study of Critical Environmental Problems (SCEP) report, 240–242
- Study of Man's Impact on Climate (SMIC) report, 240–242
- Sues, Hans, 233
- Sullivan, Leo, 30
- Sundquist, James, 332
- Sutherland, Richard K., 80
- Svoboda, Tony, 42
- Sweden
 operations research, 19–20
 Swedish Operations Research Association (SORA), 386–387, 398–399
 systems analysis approach, 19–20
 See also defense sector, Sweden; Futures Studies, Sweden; military sector, Sweden; National Research Defense Institute (FOA and FOA P), Sweden; operations research (OR), Sweden; Statistical Research Group (SGF), Sweden
- Symington, Stuart, 323
- Symington Committee, 323
- System Development Corporation, 165
- system dynamics
 post–World War II, 1
 world dynamics models, 222
- System Dynamics Group, MIT, 222, 244
- systems
 industrial models of Forrester, 236–237
 insensitivity to parameter changes, 238

- modeling of relationships (Forrester), 238–239
- shift in meaning and goals of managing, 107
- urban models of Forrester, 238–239
- systems, conventional
 - fault tree, 172–173
 - hazard mode and effect analyses, 172–173
- systems analysis
 - allocation of resources in, 343–344
 - applied to HEW, 200–202
 - in civilian sector, 20
 - in computer engineering, 200
 - of conglomerate management, 114–115
 - criticism of RAND's, 259–260
 - in economic analysis of defense budgeting, 319
 - IIASA applied research, 418–430
 - international framework, 20–22
 - introduction in Sweden, 386
 - invented and developed at RAND, 255, 317, 319
 - in Japan and Europe, 19
 - for postwar military operations and defense, 434–435
 - post–World War II, 1
 - power of, 214–215
 - PPB reliance on, 338
 - RAND and MITRE in vanguard of, 100
 - RAND criteria for first-class, 444–445
 - RAND economists' critique (Alchian and Kessel), 257–270
 - as specialized technique, 214
 - task force to evaluate federal agency operations, 205–209
 - U.S. HEW study, 199
- systems analysis, Sweden
 - studies (1960s), 401–402
 - transition from OR to, 390–391
- systems approach
 - development in Sweden, 405–407
 - development in Sweden (1945–1980), 385–387
 - Dibner conference, 2–3
 - early uses of analytic tools and mathematical models, 435–437
 - military origins (1939–1960), 1–2
 - origins and development, 3–5, 8
 - post-1960 civilian applications, 2
 - in Swedish defense establishment, 387–395
 - systems engineering
 - post–World War II meaning, 1
 - as specialized technique, 214
 - U.S. Air Force management structure, 256–257
 - systems thinking
 - applied to French *attitude prospective*, 147–148
 - in France (1950s, 1960s), 134, 140
 - in the French Plans, 150–153
 - for French postwar goals, 154–155
 - Szilard, Leo, 463–464, 479
- TAP (Transboundary Air Pollution Project), 421, 423, 426, 429
- Task Force on Antipoverty Programs, Johnson administration, 333
- Tate, John T., 68
- Taylor, Frederick W., 203–204, 395
- technical change
 - economics of, 256–257, 259–270
- technical systems, computerized, 161–162
- technocracy
 - defined by French technocrats, 139–140
 - French view of and debates about, 135–137
 - Meynaud's perception, 137
- technocrats
 - French technocrats defend themselves, 138–139
 - perception of social scientists in France, 137–138
 - as planners, 149
 - in post–World War II France, 135
- technologists
 - characteristics of, 140–141
 - in France after World War II, 136

- technologists (cont.)
 - national goals sought by French, 142–143
- technology
 - phased planning to control development of, 95
 - relation to politics, 154–156
- Teller, Edward, 286
- Thiesmeyer, Lincoln, 76, 83
- Thompson Products, Inc., 360–361
- Tiberg, Joar, 19–20
- Titan missile, 97, 100–101
- Tizard, Henry, 58–59
- Tizard Mission, 29, 61
- TRW
 - Center for Automotive Technology (CAT), 378–380
 - civil systems, 359–360, 364–365, 377
 - civil systems applied to War on Poverty programs, 366
 - Civil Systems Center, 371–373
 - civil systems ventures, 367–371, 377–378
 - effect of aerospace recession on, 366–367
 - Energy Systems Group, 374–377
 - formation of, 360–361
 - growth and diversification strategy, 361
 - hiring for Systems Group, 366
 - sale or liquidation of civil systems ventures (1970s), 374
 - Space Technology Laboratories (STL), 361–362
 - System 4000, 370
 - Systems Application Center, 369–370
 - Systems Group applied R&D, 367
 - Systems Group business ventures, 367
 - Systems Integration Group, 379–380
 - transfer of systems techniques, 17
 - transfer to civilian projects, 18–19
 - variable-thrust rocket motor, 367
- Tudor, Ralph, 121
- Tudor Engineering, 121
- Tuve, Merle, 47
- Ulam, Stanislaw, 478
- United Nations
 - weather and climate data gathering agencies, 247
- Urban Area Task Force (1964), 336
- Urban Institute, 343
- Vaupel, James, 417
- Veblen, Thorstein, 191
- Voclor, David G., 240
- von Neumann, John, 224–225, 228, 229, 255, 265, 317, 467–469, 478
- V-1 robot bomb, 47–48
- War on Poverty program, 327, 366
- Waterman, Alan T., 74, 77–78, 81–82
- Watson, James, 470–471
- Watson-Watt, Robert, 64
- weapons
 - American creation of fusion, 96
 - gunfire control, 28, 31
 - M-9/SCR-584/VT radar-activated fuse, 48–49
 - radar-driven fire control systems, 38–46
 - See also* missiles
- Weather Bureau, General Circulation Research Section, 228
- weather forecasting
 - with electronic digital computers, 222
 - GCMs as numerical weather prediction (NWP) models, 231
 - link to military issues, 224
 - numerical, 222, 224–226
- weather models
 - during Cold War, 247
 - differences from climate models, 235
- Weaver, Warren, 27, 29, 33, 36–37, 40, 44, 68, 73, 76–77, 315–316, 468
- Weeks, Sinclair, 197
- Western Development Division (WDD)
 - Atlas program, 97
 - Ramo-Wooldridge as systems engineering contractor for, 96–97
 - Titan missile development, 97
- Wettestad, Jorgen, 427

- Wexler, Harry, 228
- Whirlwind digital computer, 163–164,
229–230
- Whitehead, Rennie, 415
- Wiener, Norbert, 22–23, 464, 466–
469
- Wiesner, Jerome, 265
- Williams, John D., 259, 315–316
- Wilson, Carroll L., 75–78, 241, 243
- Wilson, Charles E., 286, 288
- Winter, Sidney M., 292, 448
- Woese, Carl, 484
- Wohlstetter, Albert, 448
- Wood, Robert, 344
- Wooldridge, Dean, 5, 176, 257
- world dynamics models
World 1, World 2, and World 3
models, 243–244
- World Meteorological Organization
(WMO), 226–227, 233, 247
- World War II
adoption of OR during, 57–84
operations analysis during, 434
radar detection and defense systems,
434
- World Weather Watch (WWW), 234,
247
- World Wide Military Command and
Control System (WWMCCS), 230
- Wright, J. David, 361
- XT-1 radar
prototype, 31
standardized as SCR-584, 31
- Yarmolinsky, Adam, 333–336
- Yashin, Anatoli, 417
- Yates, JoAnn, 95
- Ycas, Martynas, 473, 476–479, 483
- Ylvisaker, Paul, 328
- York, Herbert F., 326
- Zachrisson, Lars-Erik, 389, 399
- Zuckerman, Solly, 62, 414–415, 420,
458
- Zwick, Charles, 344
- Zworykin, Vladimir, 224