

## 82 Assumptions About the Next 25 Years: Refining Our View

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Assumptions about the future are not like assumptions in a geometry exercise; they are not abstract statements from which consequences can be drawn with mathematical certitude and precision. They are highly probable statements about the future, forming a framework around which less-certain ideas can be tested and plans made.

We need to make assumptions about the future in order to plan it, prepare for it, and prevent undesired events from happening. The assumptions come from the author's analysis of hundreds of trends and emerging developments. Strong emphasis is on scientific and technological changes because they are the most reliable drivers of change in all sectors of society.

The assumptions that follow are in two broad categories: The first consists of scientific discoveries and technological developments along with their uses. The second is the context that those developments will shape or influence.

The reader need not accept all these assumptions or high-probability statements in order to find interest and value. The set is rich and robust enough that the reader may reject several or even many of them without undercutting the overall vision of the future implicit in the set.

### MANAGING OUR WORLD

1. Movement toward a totally managed environment will be substantially advanced at national and global levels. Oceans, forests, grasslands, and water supplies will be primary areas of the managed environment.

Macroengineering—planetary-scale civil works—will make up another element of that managed environment.

Finally, the more traditional business and industrial infrastructure—telecommunications, manufacturing facilities and so on—will be a part of managed systems and subsystems.

Total management does not imply full understanding of what is managed. But expanding knowledge will make management more practical. Total management also does not imply total control over systems. Consider the teacher in the classroom. She may manage it well but never has full control.

2. Everything, including houses, vehicles, buildings, furniture, machinery and garments, will be smart, that is, responsive to their external or internal environment. This will be achieved by embedding microprocessors and associated sensors (detectors) of physical variables such as light, heat, noise, odors, and electromagnetic fields in the structure or device.

### MANAGING HUMAN HEALTH

3. All human diseases and disorders will have their linkages, if any, to the human genome identified. For many diseases and disorders, the

intermediate biochemical processes that lead to the expression of the disease or disorder and its interactions with a person's environment and personal history will also be thoroughly explored.

4. In several parts of the world, the understanding of human genetics will lead to explicit programs to enhance people's overall physical and mental abilities—not just to prevent diseases.

We are likely to have new forms of Olympics specifically for biologically enhanced athletes.

5. The chemical, physiological, and genetic bases of human behavior will be generally understood. Direct, targeted interventions for disease control and individual human enhancement will be commonplace.

Brain-mind technologies to control or influence emotions, learning, sensory acuity, memory, and other psychological states will be in widespread use.

6. In-depth personal medical histories will be on record and under the individual's full control on a medical smart card, a disk, or in secure storage.

7. More people in advanced countries will be living to their mid-eighties, while enjoying a healthier, fuller life.

8. Prostheses (synthetic body parts or replacements) with more targeted, customized drug treatments will lead to radical improvements for people who are injured or impaired, or have otherwise degraded physical or physiological capabilities.

9. Within the United States, there will be national, universal health care.

10. Genetic screening and counseling will be universally available and its use encouraged through many incentives and wide options for intervention.

11. Radical cosmetics will leave no component of the body or mind beyond makeover. This will be accomplished by the melding of cosmetics, medicine, surgery and personal retraining.

### MANAGING ENVIRONMENT AND RESOURCES

12. Scientists will work out the genome of prototypical plants and animals, including insects and microorganisms. This will lead to refined management, control, and manipulation of their health and propagation or, if pests, to their elimination.

13. New forms of microorganisms, plants, and animals will be commonplace due to advances in genetic engineering as well as to complex chemicals, medicines, vaccines, and drugs.

These enhanced plants and microorganisms will be widely used in agriculture, mining, resource upgrading, waste management and environmental cleanup. There will be routine genetic programs for enhancing animals used for food production, recreation, and as pets.

In less-developed countries, work animals will be improved through these techniques.

14. Foods for human consumption will be more diverse as a result of agricultural genetics. There will be substantially less animal protein in diets in advanced nations, compared with the present.

A variety of factors will bring vegetarianism to the fore, including health, environmental and ethical trends. We will not only have new foods but also foods with crossed characteristics, for example, potatoes that taste like pears or tomatoes with built-in spices.

There will be synthetic and genetically manipulated foods to match each individual consumer's tastes, nutritional needs and medical status. Look for "extra-salty (artificial), low-cholesterol, cancer-busting french fries."

15. Restorative agriculture will be routine. Farmers will design crops and employ sophisticated techniques to optimize climate, soil treatments, and plant types. Synthetic soils will aid restoration of depleted terrain.

16. Remote sensing of the earth will lead to monitoring, assessment, and analysis of events and resources at and below the surface of land and sea. In many places, *in situ* sensor networks will assist in monitoring the environment. Worldwide weather reporting will be routine, detailed, and reliable.

Economic health will be measured in new ways, including considerations of environment, quality of life, and employment. These new measures will become important factors in governmental and private planning.

Gross domestic product and other macroeconomic measures will include realistic costs of such things as environmental degradation, accidents, disasters, and hours of true labor.

17. Sustainability will be the central concept and organizing principle in environmental management, while ecology will be its central science.

18. Many natural disasters, such as

floods, earthquakes, and landslides, will be mitigated, controlled or prevented—for example, by causing continuous small earthquakes to prevent very destructive big ones.

19. *Per-capita* energy consumption in the advanced nations will be at 66 percent of *per-capita* consumption in 2000. The rest of the world will be at 160 percent of *per-capita* consumption in 2000.

20. Resource recovery along the lines of recycling, reclamation, and remanufacturing will be routine in all advanced nations. Extraction of virgin materials through mining, logging, and drilling will be dramatically reduced, saving energy and protecting the environment.

### AUTOMATION AND INFO TECH

21. There will be a worldwide, broadband network of networks based on fiber-optics communication and wireless. Throughout the advanced nations and the middle class and prosperous crust of the developing world, face-to-face, voice-to-voice, person-to-data, and data-to-data communication will be available to any place at any time from anywhere.

22. Telecommunications within the United States and Europe will be so cheap as to be effectively free. Telecommunications costs will be integrated into rent or mortgage payments.

23. Robots and other automated machinery will be commonplace inside and outside the factory, in agriculture, building and construction, undersea activities, space, mining and elsewhere where people are too expensive, clumsy, or vulnerable.

24. There will be universal, on-line surveys and voting in all the

advanced nations. In some jurisdictions, this will include voting in elections for local and national leaders.

25. Ubiquitous availability of computers will facilitate automated control and make continuous performance monitoring and evaluations of physical systems routine. Totally automated factories will be common but not universal for a variety of reasons, including the cost and availability of technology and labor conflicts.

Customized products will dominate large parts of the manufacturing market. Manufacturers will offer customers unlimited variety in their products.

26. The ability to manipulate materials at the molecular or atomic level will allow manufacturers to customize materials for highly specific functions such as environmental sensing, information processing, physical resistance to wear and unprecedented strength.

27. Virtual-reality technologies will be commonplace for training and recreation, and will be a routine part of simulation for all kinds of physical planning and product design.

28. In text and—to a lesser extent—in voice-to-voice telecommunication, language translation will be effective for many specialized vocabularies such as medicine, engineering, or entertainment.

29. Artificial intelligence devices will flower as aids to professionals, as adjuncts to ordinary workers and as doers of routine tasks. These devices will also check on the functionality of software and complex systems, and be used in teaching and training.

30. Expert systems, a branch of artificial intelligence, will be developed to the point where the learning by machines, systems, and devices will mimic or surpass human learning. Some low-level learning will occur out of situations and experiences, as it does for infants. The toaster will “know that the person who likes white bread likes it toasted darker, and the person who chooses rye likes it light.”

31. The fusion of telecommunications and computation will be complete.

We will use a new vocabulary of communications as we televote, teleshop, telework and tele-everything. We’ll e-mail, tube or upload letters to mom. We’ll go MUDing in cyberspace and mind our netiquette during virtual encounters. The word “computer” will no longer be used.

32. Factory-manufactured smart housing will be the norm in advanced nations, with prefabricated modular units making housing more flexible and more attractive as well as more affordable.

33. In the design of many commercial products such as homes, furnishings and vehicles, the customer will participate directly with the specialist in that product’s design. You will be invited to the factory to witness the birth—that is, the manufacturing of your specific vehicle.

34. New infrastructures throughout the world will be self-monitoring. Already, some bridges have “tilt” sensors to gauge structural stress.

Magnetic-resonance imaging used in medical testing will also be used to examine materials for early signs of damage so preventive maintenance can be done.

35. Interactive vehicle-highway systems will be widespread, with tens of thousands of miles of highway so equipped. Rather than reconstruct old highways, engineers may retrofit them with the new technologies.

Privatization of many highways, particularly beltways and parts of the interstate system, will occur. This will be tied to the evolution of an intelligent vehicle-highway system.

36. Applied economics will lead to a greater dependency on mathematical models embodied in computers. These models will have expanded capabilities and will routinely integrate environmental and quality-of-life factors into economic calculations. One big problem will be how to measure the economic value of information and knowledge. A Nobel Prize will be granted to the economist who develops an effective theory of the economics of information.

37. Biocomputers will be in the early stage of development and use.

## POPULATION TRENDS

38. World population will be about 8.4 billion people.

World population will divide into three tiers: At the top, World 1, made up of advanced nations and the world’s middle classes, living in prosperity analogous to Germany, the United States, and Japan; at the bottom, World 3, people living in destitution; in the middle, World 2, a vast range of people living comfortably but not extravagantly in the context of their culture. We use the terms World 1, World 2, and World 3 for the emerging pattern of nations that moves us beyond the Cold War nomenclature “Third World.”

39. Family size will be at or below replacement rates in most of Worlds 1 and 2 nations but above replacement rates in much of World 3. The population of World 1's advanced nations will be older, with a median age of forty-two. Worlds 2 and 3 will be substantially younger. These countries will not stop growing until sometime after 2025.

40. Birth-control technologies will be universally accepted and widely applied.

41. Squaring off the death curve, by reducing premature deaths due to smoking, lack of exercise and obesity, will make substantial progress in World 1 and some progress in World 2, leading to most people living to around eighty-five years.

42. Critical experiments in life extension to move the average lifetime of our species from 85 to 105 will begin. Three hundred thousand people will be in lifelong monitoring programs. Massive numbers of other people will apply life-extension treatments on a nonexperimental, self-initiated basis.

43. The majority of the world's population will be metropolitan, including people living in satellite cities clustered around metropolitan centers.

44. A worldwide middle class will emerge. Its growth in World 2 and to a lesser extent in World 3 will be a powerful force for political and economic stability and for some forms of democracy.

### WORLDWIDE TENSIONS

45. There still will be worldwide unrest reflected in internal strife, border conflicts, irredentist movements and some ideologically based terrorism. The unrest will

have declined substantially after peaking about 2015.

46. Under international pressures, the United Nations will take on more peacemaking to complement its historic peacekeeping role.

47. Supranational government separately or as part of the United Nations will become prominent and effective, though not completely so, with regard to environment issues, war, narcotics, design and location of business facilities, regulation of global business, disease prevention, workers' rights, business practices and conflict control.

48. Widespread contamination by one or more nuclear devices will occur either accidentally or as an act of political/military violence. On a scale of 1 to 10 (with Three Mile Island a 0.5 and Chernobyl a 3), this event will be a 5 or higher.

49. Increasing economic and political instabilities will deter business involvement in specific World 3 countries.

50. Despite technological advances, epidemics and mass starvation will be common occurrences in World 3 countries.

51. There will be substantial environmental degradation, especially in World 3.

Governments will commit money to ease the problem, but many will sacrifice long-term programs for short-term gains.

52. Global environmental management issues will be institutionalized in multinational corporations as well as through the United Nations and other supranational entities.

53. There will be shifts in the pattern of world debtor and creditor countries. Japan's economic

downturn, the ever-growing U.S. debt and Germany's chronic unemployment problems are harbingers of things to come.

54. NIMBY ("Not In My Back Yard") will be a global-scale problem for a variety of issues, ranging from hazardous-waste disposal to refugees to prisons to commercial real-estate ventures.

55. Migration and conditions for citizenship throughout the world will be regulated under new international law, especially to redefine the status of children of aliens.

### THE ELECTRONIC GLOBAL VILLAGE

56. A global currency will be in use.

57. English will remain the global common language in business, science, technology, entertainment, and tourism.

58. Schooling on a worldwide basis will be at a higher level and longer than it is today. Education may approach universality at the elementary level and will become more accessible at the university level through electronic distance-learning technologies.

59. In the advanced nations, life-long learning will be institutionalized in schools and businesses.

60. Commuting to work will be history for a large percentage of people. By 2025, forty percent of the white-collar workforce will be working outside the traditional office.

61. The fully electronic home work/study center will be the core of the integrated, information-rich house or home.

Mom and Dad will work there, the

kids will reach out to the resources of the world, and the whole family will seek recreation, entertainment, and social contacts there.

62. Worldwide, there will be countless virtual communities based on electronic linkages and millions of blogs. A worldwide popular culture will flow in all directions from country to country. The global links of communications and trade will ensure that products and, more importantly, ideas and concepts will be available to all.

63. The multinational corporation will be the world's dominant business form.

64. Economic blocs will be a prominent part of the international economy, with many products and commodities moving between these porous blocs. The principal blocs will be Europe, East Asia, and the Americas.

65. To control illegal behavior, universal monitoring of business transactions on a national and international business basis will prevail.

66. Identification cards will be universal in World 1 and common in World 2. These smart cards will contain information such as nationality, medical history (even key data from one's genome), education and employment records, financial accounts, social security, credit status, and even religious and organizational affiliations.

#### **PUBLIC ISSUES AND VALUES**

67. In the United States, the potential collapse of the Social Security system will lead to a new form of old-age security based on need-only criteria.

68. There will be far more recreation and leisure time for the

middle class in World 1.

69. There will be a rise in secular substitutes for traditional religious beliefs, practices, institutions, and rituals for a substantial portion of the population of World 1 and the global middle class.

The New Age movement, secular humanism, and virtual communities built on electronics networking are early harbingers.

70. Socially significant crime—the crimes that have the widest negative effects in World 1 and 2—will be increasingly economic and computer-based.

Examples include disruption of business, theft, money laundering, introduction of maliciously false information, identity theft, and tampering with medical records and air traffic control or national-security systems.

#### **TECHNOLOGICAL CHANGES**

71. The absolute cost of energy will continually rise, affecting the cost of transportation, housing, and manufacturing.

Planners will reallocate terrain and physical space to make more efficient use of resources. Cities will be redesigned and rezoned to improve efficiencies of energy in transportation, manufacturing, housing, etc.

72. The greening of North Africa along the Mediterranean coast will begin, with technologies to promote rainfall and build soil.

73. Antarctic icebergs will be harvested for watering the west coast of South America, Baja California, the Australian outback, Saudi Arabia and other arid areas.

74. Inorganic chemistry will rise to parity with organic chemistry in

profit and importance in such familiar areas as ceramics and composites but especially in nanotechnology.

75. Biomimetic materials and products that imitate natural biological materials will be common.

76. Micromachines the size of a typed period will be in widespread use. Nanotechnology devices one thousand times smaller will have been developed and will be in use.

77. Ocean ranching and farming for food and energy will be widespread.

78. The asteroid watch will become a recognized institution. Among its most notable achievements will be several trial runs at altering an asteroid's path before it intersects Earth's orbit.

79. Restoration of aquifers (underground water bodies) will be a standard technology.

80. Fuel cells will be the predominant form of electro-mechanical energy generation.

81. Mastodons will walk the earth again and at least twenty other extinct species will be revived through genetic manipulation of recovered tissue.

82. 110-mile-per-gallon cars—as large, comfortable and safe as Year 2000 cars—will be in widespread use.

#### **WHAT TO DO**

Think about the future world that these assumptions present, and begin to explore career opportunities and occupations, and the level of education you will need to obtain a job in your chosen field.

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Adapted from *2025: Scenarios of U.S. and Global Society Reshaped by Science and Technology* by Joseph F. Coates, John B. Mahaffie and Andy Hines. (Oakhill Press, Greensboro, N.C., 1997)