Reference Materials

Reference 1

Examples of the technology necessary to realize the "Japan in 2025: A Nation Based on the Exploitation of Innovation" vision

1. Society wherein all can stay healthy throughout life

【Constant health checks and remote medical services】

- Micro-machine technology for health management devices
- Technology which enables home health management and diagnosis at a time of emergence of abnormalities
- Advanced security technology capable of making a card available for use which records individual medical data such as health check results, clinical history and prescriptions.
- Technology that supplements vital functions such health condition monitoring or pacemakers through the use of bioenergetics such as body temperature or bloodstream
- Highly reliable network technology that enables doctors to make diagnoses via the Internet based on medical data measured at home
- Advanced security technology for wide-range information systems which provides individuals with access to their own electronic charts at home
- Various sensor and manipulator technology for performing surgery via remote-controlled micro machines

【Overcoming three major lifestyle-related diseases】

- Technology for tailored cancer therapy
- Gene therapy technology enabling localized treatment approaches for arteriosclerosis focus
- Technology for gene therapy for cancer
- Technology to produce bioceramics, which have nearly the same functions as human bones
- Gene therapy technology for familial hypercholesterolemia

【Drastic decline in bedridden patients】

- Regenerative medical technology for transplantation of neural stem cells in order to enhance recovery from motor paralysis
- Technology for voluntarily control prosthetic limbs without use of spinal cord/peripheral nerves by way signalizing and conveying motor-related brain activity
- Technology for nursing robots that help a person in need of care to take a bath, etc., without giving the person discomfort or anxiety.
- Permanent cure for Alzheimer's disease
- Technology for quantification of psychological stress applicable to mental illness/dementia

2. Safe and secure society

【Safety of living environment】

- Automated security systems designed to detect suspicious activity before anything happens through networked surveillance cameras
- Technology that helps locate wanted criminals/material witnesses by analyzing the descriptions, behavior, facial features and voices of people captured by surveillance cameras installed in public spaces
- Community security systems that interconnect home security systems through the use of home life support robots that provide various services to users, in addition to fire/crime prevention and in-home care support functions
- Technology that allows objects to detect the presence, characteristics and status of other objects so as to automatically avert dangerous situations and conduct collaborative work (for instance, when a car and a bicycle or a heater and a sofa come into close proximity of each other, the two objects can communicate with each other in order to avert danger by setting off alarms, stopping, or extinguishing fire.)

【Food safety】

- Technology for home food freshness testing kits
- Technology to produce allergy free food based on allergen measurement technology
- Tracing technology that links electronic information rendered to electronic tags placed on products or foods with distribution/POS/home delivery services (ingredients and recycling, etc.)

【Longer life of structures/safety of products】

- Housing and building technology that is responsive to changes in needs and deterioration over the course of time due to generational change, changes in life stage, changes in working patterns and changes in urban environment, etc.
- Monitoring, evaluation, conservation technologies for structural/environmental performance
- Seismic isolation/control technologies that bring about dramatic improvement in building safety and property protection
- Maintenance and control technology that extends the life of infrastructure assets
- Sensor network technology designed to monitor fatigue and deterioration by embedding IC tags into all building materials for houses and buildings, which also enables recycling or separation of recyclable materials

【Countermeasures against mudslide/flood】

- River flow measurement and flood forecasting technology using satellite observation to prevent the sudden occurrence of disasters
- Long-range disaster monitoring network technology using satellite images/radar with an emergency evacuation guide system
- High performance precipitation forecast technology/short-period precipitation forecast technology and rainwater management technology (transport/storage/treatment) and advanced technology for warning /evacuation/regulation systems
- Positioning and communication technologies that can identify the location of individuals and communicate with them anytime and anywhere (regardless of whether they are indoors or outdoors), in order to provide accurate emergency positioning information and messages, including evacuation calls to hazardous areas.

【Anti-earthquake measures】

- Highly precise earthquake forecasting technology (for both ocean trench type earthquakes and inland earthquakes) to predict the occurrence of potentially devastating earthquakes of magnitudes greater than 7 (time and place) (2021/2030)

- Seismo-geodetic sensor technology designed to predict earthquake several minutes before they occur
- Technology to predict the occurrence of medium-term (within 5-10 years), large-scale (greater than M8) earthquakes
- Comprehensive control technology for buildings equipped with earthquake detection systems
- Technology for disaster prevention message networks achieved by way of detecting seismic shockwaves prior to their reaching the surface
- Personal mobile computer-based information transmission/navigation technology with the potential to assist with evacuation activities
- Technology to detect risks prior to rockslides, base on elucidation of the mechanisms of rockslides

【Road traffic safety】

- Systems designed to prevent accidents such as intersection collisions through the use of car-to-car communication technology
- Technology to prevent collisions by way of car surroundings recognition through the use of various sensors such as image recognition devices
- Automated driving technology that allows for safe/smooth driving on highways, etc. by way of setting destinations

【All-purpose card】

- Highly reliable network technology and advanced security (personal verification, etc.) technology for multifunctional smart cards with electronic settlement functions that are usable in almost all transactions and trade setting worldwide
- Advanced security (personal verification) technology for electronic money that allows for anonymous financial transactions with the same level of reliability as conventional money

3. Society with diverse lifestyles

【Collaboration with overseas human resources】

- Speech-recognition technology/artificial intelligence technology that allows for speech input/output
- High precision image recognition/image processing technology that can ascertain the intentions of a person based on biological information as well as non-verbal traits such as facial expressions and eye movement
- Technology for international communications designed to promote mutual understanding by way of outlining the cultural traits, customs and social norms that underpin speeches on a screen as opposed to basic linguistic translation
- Search engine technology designed to facilitate multilingual Internet searches in specific languages and Data Base (DB) technology aimed at establishing a knowledge repository system allowing for instantaneous extrapolation of the necessary information from around the world

【Childbirth/childrearing support, work-life balance (harmony of work and personal life)】

- Highly reliable network technology which allows doctors to make diagnoses based on medical data measured at home, allowing for safe and secure childbirth and pediatric care anytime and anywhere
- Advanced security technology for wide-area information system allowing individuals to have access to their own electronic charts at home
- Home helper robots to assist with cleaning, washing, gardening, and caring for sick persons in the home
- Home security systems that includes home helper robots designed to ensure safety of children at home
- High-speed network technology, three-dimensional/super high-vision technology that offers multi-station teleconference connection in realistic settings together with information sharing and natural language conversation functions

【The elderly/handicapped persons】

- Ubiquitous computing technology that provides information so that elderly and handicapped persons (with visual impairments) can safely and freely move about in urban public spaces
- Human interface technology, such as information-oriented computers and software, that

allows elderly and handicapped persons to gain access to information networks

- High performance mobility/walking-aid device control technology capable of drastically expanding the social lives of elderly and handicapped persons
- Mechatronic, regenerative and bio-interface technology designed to supplement the five senses, including vision and hearing, aimed at overcoming the handicaps of the elderly and handicapped persons
- Regenerative medical technology for neural stem cell transplantation aimed at enhancing recovery from motor paralysis
- Technology for voluntarily control of prosthetic limbs without use of spinal cord/peripheral nerves by way of signalizing and conveying motor-related brain activity
- ITS (Intelligent Transportation Systems) technology that supplements the driving ability of those who have difficulty in driving regular cars due to aging, etc.
- Tracing technology that links electronic information rendered to electronic tags on products or food with distribution/POS/home delivery services (ingredients, recycling, etc)

【Advancement of life-long education system】

- Search technology that enables the use of networked and various globalized information sources (websites, etc.) in the form of an encyclopedia
- Technology designed to automatically extract meta-data (structured data pertaining to data) from visual and sound content
- Simulation technology that allows one to experiment with and experience events which would be hard to accomplish in a real life in virtual reality space, in order to improve scientific thinking
- Search technology that satisfies advanced access needs, such as search technology allowing a person watching a video and wants to search information relevant to the video to receive tailored search results by way of an amassing of information on the searcher, such as the person's interests, skills and search contexts, by way of sensors

4. Society contributing to the solution of global issues

【CO_2 Reduction】

- Small cogeneration system technology for home use

- Artificial photosynthesis technology with a solar-energy conversion rate of 3% or more (that of plant photosynthesis is around 1%)
- Technology for large area film solar cells with high conversion efficiency (more than 20%/year)
- Fuel cell mounting technology for modes of transportation such as automobiles and ships
- Power generation and synfuel production technology through gasification of colas, biomass, and waste materials
- Technology for burying CO2 at the ocean floor
- Relatively small nuclear system technology usable in the production of hydrogen
- Technology related to nuclear fusion reactors

【Waste treatment】

- Recycling technology for the effective collection and reuse of resources/energy from waste materials
- Eco-material technology with low environmental loads such as easily recyclable plastics and photocatalytic materials
- Plant/microorganism utilization technology designed to purify polluted soil/underground water/air
- Technology designed to produce polylactide plastic from ordinary wastes
- Technology designed to produce recyclable composite materials from wood

【Water/food】

- Compact waste water treatment technology designed to eliminate wastes generated from water treatment by effectively treating persistent substances and hazardous substances and by completely and effectively utilizing generated sludge
- Economic and practical technology for desalination of sea water and purification of polluted water by way of reverse osmosis membranes
- Genome technology designed to develop groundbreaking plants with high yields even under poor conditions and disease–resistant plants that do not require pesticides

【Promotion of contact with- and interest in the natural environment】

- Technology for comprehensive management of river basins that ensures the quality and quantity of water necessary to allow persons to swim in local rivers
- Visualization technology for environmental information, such as comprehensive monitoring/report systems for air pollution substances through sensors installed in houses and on the streets

5. Society open to the world

【Automatic translation】

- Speech-recognition/artificial intelligence technology designed to allow for automatic translation with speech input/output capabilities
- Technology for international communication aimed at promoting mutual understanding by way of outlining the cultural traits, customs and social norms that underpin speeches on screens as opposed to simple linguistic translation
- Search engine technology designed to facilitate multilingual Internet searches in specific languages and Data Base (DB) technology aimed at establishing a knowledge repository system allowing for instantaneous extrapolation of the necessary information from around the world

【Virtual reality】

- Technology that allow us to enjoy art or music in remote areas, allowing one, for example, to enjoy art as if actually walking around an exhibition hall and to listen to live music as if sitting in a concert hall
- Simulation technology allowing one to experiment with and experience events which would be difficult to accomplish in a real life in virtual reality space, in order to improve scientific thinking
- Three-dimensional/super high-vision technology for the home that does not require glasses
- Technology designed to automatically extract meta-data (structured data pertaining to data) from visual and sound contents
- High-speed network technology, three-dimensional/super high-vision technology that offers multi-station teleconference connection in realistic settings together with information

sharing and natural language conversation functions

Reference 2

Examples of improvements in productivity / economic effects of innovations

1. Labor force

Life expectancy will be extended as a result of people becoming free from diseases like cancer/cardiac infarctions/cerebral strokes as well as slower aging of bones thanks to regenerative medicine. Work patterns will be diversified due to the promotion of telework. There will be fewer household chores along with the full-fledged introduction of robots into people's homes. Thus, the non-working population (females and elderly persons) will join the labor force, all of which will contribute to an increase in the labor force population despite the population decline, thus increasing the GDP as a result.

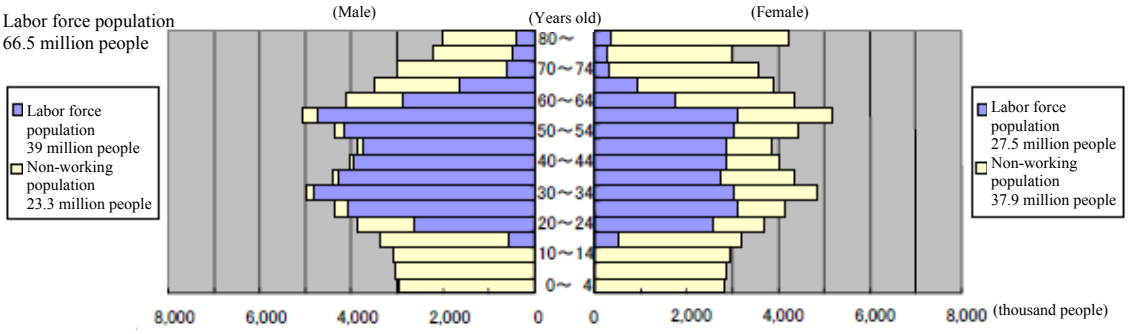
If half of the non-working population (female and elderly persons aged between 60 and 75) joins the labor force in 2025:
2005: approximately 66 million people ⇒ 2025: approximately 70.5 million people
(In the case wherein participation in labor market is slow, this total would be around 5.9 million people, resulting in an increase of 11.5 million people (male:2.8 million people/female:8.7 million people))

(Reference) Average life expectancy
1947: Male 50.06 years, Female: 53.96 years
2005: Male 78.53 years, Female: 85.49 years
Due to these changes, it would be more realistic to change the definition of population of productive age from the current 15-65 to, for example, 20-75.

Source: Population is based on the "Estimated Population Data Base," the National Institute of Population and Social Security Research
Labor force population for the year 2005 is based on "Annual Report on the Labour Force Survey 2006," Statistics Bureau, Ministry of Internal Affairs and Communications

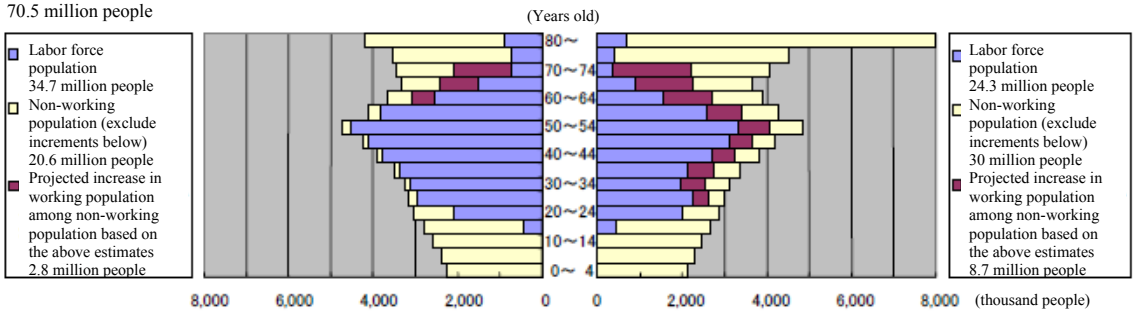
○ Year 2005

Labor force population
66.5 million people



○ Year 2025

Labor force population
70.5 million people



2. Traffic

It is possible to dramatically reduce economic losses from traffic accidents (human and physical damages) and traffic congestion due to progress and introduction of advanced information network technologies for both vehicles and roads.

- Economic loss from traffic accidents: approximately 4.3 trillion/year
- Economic loss from traffic congestion: approximately 12 trillion yen/year

Source: Traffic accident statistics, "Research Paper on Economic Loss from Traffic Accidents 2001", Cabinet Office
Traffic congestion statistics, "Outline of Congestion Data 2002", Road Bureau, Ministry of Land, Infrastructure, Transport and Tourism

3. Tourism

The amount of spending on tourism in Japan is expected to increase to approximately 2.7 trillion yen (estimation of FY 2005) if the number of foreign tourists visiting Japan increases at the same level as the number of Japanese tourists visiting foreign countries due to a reduction of language barriers facilitated by automatic translation devices and the enhancement of the branding and message framework necessary in order to propagate information on Japanese culture (animation/food).
New service businesses, etc. aimed at attracting increasing numbers of foreigners are also expected to emerge.

- Amount spent on tourism by foreign tourists visiting Japan: Approximately 1.6 trillion yen
- Number of foreign tourists visiting Japan: 6.73 million people
（Per-capita spending: approximately 244,000 yen）

Number of Japanese tourists visiting foreign countries: 17.4 million people

Source: "Research Paper on Economic Effects of Tourism Industry (December 2006)", Ministry of Land, Infrastructure, Transport and Tourism
"White Paper on Tourism FY 2006" Ministry of Land, Infrastructure, Transport and Tourism

4. Employment and Commuting

Economic predictions include an increase in teleworkers due to the introduction of IT, the reduction of commuting costs, the reduction of the global environmental load, the promotion of the employment of women and the elderly, the alleviation of difficulties in returning home at times of disaster and local revitalization due to an increase in employment in non-urban areas. Reclaimed commuting time will be converted into free time, learning opportunities will increase and lifestyle diversity will be promoted, leading to an activation of life as a whole.

When the proportion of teleworkers increases from 6.1% to 20%,

- Volume of commuting traffic: 45 million trips/day ⇒ 42.88～41.33 million trips/day
- CO_2 reduction: 3.21～4.42 million/year (equivalent to 2.0～2.7% of the emission of the travel sector)
- Female teleworkers: 1.04 million people⇒4.57 million people
- Elderly teleworkers: 220,000 people⇒1.11 million people
- Number of people faced with difficulties in returning home at times of disaster: 4.18 million people⇒ 3.85～3.52 million people

Source: "The Telework Guide Book (2005)," Japan Telework Association

The proportion of teleworkers in 2005: 10.4% (Ministry of Land, Infrastructure, Transport and Tourism)

(Reference) Average commuting time of four prefectures in Tokyo metropolitan areas (Tokyo, Saitama, Chiba, Kanagawa): 1 hour 18 minutes
(Male: 1 hour 30 minutes, Female: 1 hour 1 minute)

Source: "2001 Survey on Time Use and Leisure Activities," Statistics Bureau, Ministry of Internal Affairs and Communications

5. Disaster reduction

Using the 15-odd seconds that it takes for the large seismic waves of an ocean trench-type large-scale earthquake to reach the surface, bullet trains will be stopped and large-scale construction work will be immediately suspended, which will drastically reduce damage. Also by using this time to prepare for prompt post-earthquake response operations, the magnitude of

the ensuing disaster will be reduced substantially.

Disaster reduction goals for the next ten years concerning estimated economic damage from Tokyo metropolitan earthquake (North Tokyo Bay Earthquake: M7.3/wind velocity 15m/s), based on the current level of technologies.
112 trillion yen ⇒ 70 trillion yen (reduction of 42 trillion yen)

Source: "Earthquake Disaster Reduction Strategies for the Tokyo Metropolitan Earthquake (April 2006)

6. Environment

According to the Stern Review[15], it will be necessary for the world to spend 1% of its GDP on a yearly basis by the year 2050 in order to stabilize greenhouse gases. If this is not done, long-term economic losses would amount to 5-20% of the global GDP. However, when looking at this from a different perspective, this can serve as a good opportunity for Japanese industries that possess strength in environmentally friendly technology.

7. Medical Care

(1) Dissemination of medical IT systems

Use of electronic data in medical institutions, such as electronic medical charts, will spread and the handling of health data will be made easier, contributing to increased availability of remote healthcare.

・Market size of medical IT technologies in Japan : Approximately 1.2 trillion/pear (2010)

Source: Compiled from "Healthcare Information Systems", BCC Research (US research company): the figure is based on the size of medical IT technology market in the US (US$34.7 billion) and the size of the medical device market in Japan (about 1/3 of the US).

[15] See footnote 4 in the main text of the Interim Report (page 32)

(2) Market expansion through regenerative medicine and nursing-care robots, etc.

The spread of regenerative medicine for bones, cartilage, skin and teeth, and of technology designed to cultivate and transplant autologous tissue will enable the elderly to maintain the healthy body of a 50 years old.

- Size of regenerative medicine market in Japan: approximately 620～855 billion yen/year (2020)
- Size of nursing-care robot market in Japan: 93.2 billion yen (2025)

Source: According to a market survey (questionnaire) conducted jointly by Nikkei Inc. and Mitsubishi Research Institute, Inc., it is estimated that the size of the markets for artificial organs and regenerative tissues in Japan will be 855 billion yen in 2020, and that of the world will be 3.26 trillion yen. An estimation by another marketing company arrived at a total of 620 billion yen. (Improvements in labor productivity from the application of regenerative technology were not taken into consideration in these surveys.)

The size of nursing-care robot market was based on the "Report of Next Generation Robot Vision Group (2004)", Ministry of Economy, Trade and Industry

(3) Countermeasures against lifestyle-related diseases

Worries about diseases such as cancer, heart attacks and strokes will be eliminated; for example, the development of groundbreaking medicine with few side effects suitable for individual constitutions will allow for surgery-free cancer treatment.

- Effects from reduction of medical expenses due to countermeasures against lifestyle-related diseases : approximately 2 trillion/year (2025)

Source: Documents used for deliberations on medical systems by the Ministry of Health, Labor and Welfare (2006)

(4) Decline in the number of bed-ridden elderly

It is estimated that the number of bed-ridden people or those heavily in need of nursing-care will reach 2.7 million by 2025. However, with the advancement of regenerative medicine and

the development of specific drugs for dementia, many of them will be able to live without becoming bedridden or needing care.

Given that the number of people requiring nursing care will be reduced by one million and assuming that the benefits for a person heavily in need of nursing-care is about 300,000 yen/month, the social cost reduction due to the reduction of the number of bedridden elderly people would be approximately 4 trillion yen/year (2025)

Source: The projected number of people in need of nursing care, such as those with dementia, in 2025 is based on documents from the Ministry of Health, Labor and Welfare

Reference 3

Process of Deliberations of the "Innovation 25 Strategy Council"

- Fist meeting : October 26, 2006 (Thursday)
- Second meeting: November 9, 2006 (Thursday)
  - ➢ Presentation
    - ✧ Mr. Toshiaki Ikoma: Director-General, Center for Research and Development Strategy, Japan Science and Technology Agency
    - ✧ Mr. Ken Sakamura: Member, Innovation 25 Strategy Council

- Third meeting: November 30, 2006 (Thursday)
  - ➢ Presentation
    - ✧ Mr. Kazuhito Hashimoto: Professor, Research Center for Advanced Science and Technology, The University of Tokyo
    - ✧ Mr. Ikujiro Nonaka: Professor Emeritus, Hitotsubashi University

- Forth meeting: December 21, 2006 (Thursday)
  - ➢ Presentation
    - ✧ Mr. Tadashi Okamura: Member, Innovation 25 Strategy Council
    - ✧ Mr. Ichiro Kanazawa Member, Innovation 25 Strategy Council

- Fifth meeting: January 16, 2007 (Tuesday)
- Sixth meeting: January 31, 2007 (Wednesday)
  - ➢ Presentation
    - ✧ Ms. Chiyono Terada: Member, Innovation 25 Strategy Council
    - ✧ Mr. Koichi Kitazawa: Vice Chairperson, Committee for the Investigation of Innovation Promotion, Science Council of Japan
    - ✧ Mr. Minoru Kuniya: Director General, National Institute of Science and Technology Policy, Ministry of Education, Culture, Sports, Science and Technology
- Seventh meeting: February 19, 2007 (Monday)
- Eighth meeting: February 26, 2007 (Monday)