Moonshot Goals for the Moonshot Research and Development Program
To realize “Human Well-being”, six Moonshot goals (MS goals) were decided in the area of society, environment, and economics. (Council for Science, Technology and Innovation. Jan. 23, 2020)

Outline of the Program and Moonshot goals

6 MS goals to be achieved by 2050

**Goal1:** Realization of a society in which human beings can be free from limitations of body, brain, space, and time by 2050.

**Goal2:** Realization of ultra-early disease prediction and intervention by 2050.

**Goal3:** Realization of AI robots that autonomously learn, adapt to their environment, evolve in intelligence and act alongside human beings, by 2050.

**Goal4:** Realization of sustainable resource circulation to recover the global environment by 2050.

**Goal5:** Creation of the industry that enables sustainable global food supply by exploiting unused biological resources by 2050.

**Goal6:** Realization of a fault-tolerant universal quantum computer that will revolutionize economy, industry, and security by 2050.

Outline

To develop radical solutions for difficult societal challenge, the Government of Japan (GOJ) set inspiring and ambitious goals for challenging R&D.

Goals

To realize “Human Well-being”, six Moonshot goals (MS goals) were decided in the area of society, environment, and economics. (Council for Science, Technology and Innovation. Jan. 23, 2020)

**Society**

Turning the aging society into the innovative and sustainable society by harnessing diversity through techno-social transformation

**Environment**

Recovery for global environment and growth of civilization

**Economics**

Exploring frontiers with science and technology

**Moonshot for Human Well-being**
Realization of a society in which human beings can be free from limitations of body, brain, space, and time by 2050.

**Target of Moonshot Goal**

Cybernetic avatar*¹ infrastructure for diversity and inclusion

- Development of technologies and infrastructure to carry out large-scale complex tasks combining large numbers of robots and avatars teleoperated by multiple persons by 2050.

- Development of technologies and infrastructure that allow one person to operate more than 10 avatars for one task at the same speed and accuracy as one avatar by 2030.

Cybernetic avatar life

- Development of technologies that will allow anyone willing to augment their physical, cognitive, and perceptional capabilities to the top level, and spread of a new lifestyle that will be welcomed by society, by 2050.

- Development of technologies that will allow anyone willing to augment their physical, cognitive, and perceptional capabilities for specific tasks, and proposal of a new lifestyle that will be welcomed by society, by 2030.

*¹ Cybernetic Avatar is a concept that includes not only remote avatars using robots and 3D images as proxies but also empowerment of the physical/cognitive abilities of humans using ICT and robotics. Cybernetic Avatar aims to be active not only in the physical world, but also in the cyber-physical world, i.e. Society 5.0.
Realization of ultra-early disease prediction and intervention by 2050.

<Target of Moonshot Goal>
- Establishment of a system for disease prediction and evaluation of pre-symptomatic states in order to suppress and prevent disease onset, through integrated analysis of the entire functional network between human organs, by 2050.
- Establishment of a strategy that enables the conversion of a pre-symptomatic state to a healthy state, by clarification of functional changes in human physiology along life course considering the comprehensive network between organs, by 2050.
- Identification of disease-related network structures and establishment of innovative prediction and intervention methods by 2050.
- Understanding of the comprehensive network between human organs by 2030.

(Reference: Future Visions to be achieved)

- Development of technologies preventing serious diseases such as dementia and cancer by analyzing unclear networks between organs such brain and intestines, by 2050.
Realization of AI robots that autonomously learn, adapt to their environment, evolve in intelligence and act alongside human beings, by 2050.

*<Target of Moonshot Goal>*

- Development of AI robots that humans feel comfortable with, have physical abilities equivalent to or greater than humans, and grow in harmony with human life, by 2050.
- Development of AI robots that behave well with humans under certain conditions, and allow over 90% of people to feel comfortable with them, by 2030.
- Development of an automated AI robot system that aims to discover impactful scientific principles and solutions, by thinking and acting in the field of natural science, by 2050.
- Development of an automated AI robot system that aims to support the process of discovery for scientific principles and solutions to specific problems by 2030.
- Development of AI robots that autonomously make judgements and act in environments where it is difficult for humans to act by 2050.
- Development of AI robots that operate unattended under human supervision in specific circumstances by 2030.
Realization of sustainable resource circulation to recover the global environment by 2050.

<Target of Moonshot Goal>
Solutions to the global warming problem (the Cool Earth) and environmental pollution problem (the Clean Earth) through realization of sustainable resource circulation for the global environment.

Cool Earth & Clean Earth
- Global deployment of commercial plants or products utilizing circulation technology by 2050.

Cool Earth
- Development of circulation technology on a pilot scale for reducing greenhouse gases that is also effective in terms of life cycle assessment (LCA) by 2030.

Clean Earth
- Development of technology on a pilot scale or in a form of prototype that converts environmentally harmful substances into valuable or harmless materials by 2030.
Creation of the industry that enables sustainable global food supply by exploiting unused biological resources by 2050.

<Target of Moonshot Goal>
- Technical development of the circular food production systems by biological measures, e.g. utilizing microbes and insects, by 2050.
- Development of technical solutions for eliminating food loss and waste and for achieving both healthy life and sustainable food consumption by 2050.
- Evaluation of the technical achievements and discussion on the ethical, legal and social implications (ELSI) matters will be done by 2030, for global spread of the technology by 2050.
Realization of a fault-tolerant universal quantum computer that will revolutionize economy, industry, and security by 2050.

(Target of Moonshot Goal)
- Achievement of the large-scale integration required for fault-tolerant universal quantum computers*1 by around 2050.
- Development of a certain scale of NISQ computer*2 and demonstration of the effectiveness of quantum error correction by 2030.

*1 Fault-tolerant universal quantum computer is a quantum computer that realizes large-scale integration while guaranteeing on sufficiently high accuracy for various applications.
*2 NISQ(Noisy-Intermediate Scale Quantum) is a small to medium scale quantum computer that does not have a function to correct errors.
The Visionary Council*1 proposed areas, visions, and MS Goal Examples.

Dec., 17-18, 2019
Discussed MS goal candidates in MS international symposium.

Jan., 16, 2020
Discussed MS goal drafts in CSTI*2 experts meeting.

Jan., 23, 2020
Decided MS goals in a plenary meeting of CSTI.

After Feb., 2020
Started Call for the Project Managers (PMs) (by research promotion agencies).

After Jul., 2020
Projects will be started.

After start of projects
Implement external evaluation in the 3rd and 5th years from the start of project. Projects evaluated to be continued are supported up to 10 years.
References
We choose to go to the Moon.

John F. Kennedy

The Moonshot Research and Development Program sets ambitious goals to attract people, and promotes challenging R&D projects with the aim of resolving difficult societal issues while bringing together the wisdom of researchers from all over the world.

Moonshot for Human Well-being
Successful Moonshot Goals

(1) The government sets ambitious goals and concepts for societal issues that are difficult to tackle but will have profound impact once resolved.

(2) Opens call for domestic and foreign top-class researchers as PM's under the direction of the PD who oversees multiple projects. *1 Project Manager, *2 Program Director

(3) Builds a portfolio overlooking the program and promotes challenging R&D without fear of failure.

(4) Reviews a portfolio flexibly by stage-gates and actively encourages utilization of the R&D results.

(5) Establishes the most advanced research support system by utilizing a data management infrastructure.

(6) 100 billion yen was appropriated in the supplementary budget for FY2018, and a fund was created. 15 billion yen was appropriated in the supplementary budget for FY2019.

(7) Supports the program up to 10 years.
The Visionary Council was established to discuss ambitious MS goals. It received proposals from the general public (about 1,800) and relevant ministries. It discussed the future visions and specific goals to be aimed in this Moonshot program.

**Visionary Council Members**

EDA Makiko  
Chief Representative Officer, The World Economic Forum Japan

OCHIAI Yoichi  
Media Artist, Assoc. Professor, University of Tsukuba

OZAKI Marissa  
Artist (“Sputniko!”), Project Associate Professor, The University of Tokyo

KITANO Hiroaki  
President and CEO, Sony Computer Science Laboratory

KOBUYASHI Yoshimitsu  
(Mirror of the council)  
Mitsubishi Chemical Holdings Corporation

NISHIGUCHI Naohiro  
Chief Executive Officer, Japan Innovation Network

FUJII Taiyo  
SF Writer

**Discussion Points**

1st Meeting (Mar. 29)  
- Important points for deciding MS goals

2nd Meeting (Apr. 22)  
- Requests from academia and industry  
- The elements of MS goals

3rd Meeting (May 23)  
- Proposals from general public (about 1,800) and relevant ministries

4th Meeting (Jul. 31)  
- The future vision and MS goals
Discussion of the Visionary Council

- Identifies future visions based on societal issues facing the world.
- Translates future visions into missions as MS goals.

Elements of MS Goals

**Inspiring**
- Clarity of MS objectives and their necessity
- Strong impact on our future society and industries
- Intellects brought together from all over the world

**Imaginative**
- Innovative and radical change of our future societal system
- Clear image of our future direction

**Credible**
- Not only ambitious but also scientifically feasible
- Validity of progress toward MS goals
- Consistency with relevant strategies and policies

Note: Human centric is the basic concept of MS goals
The Visionary Council recommended 3 Target Areas of
- aging society,
- global environment, and
- exploring frontiers,
and 13 Visions.

The council also proposed 25 examples of Moonshot Goals.
Organized 6 (+1) Working Groups based on 25 MS goal examples. 6 WGs discussed about specific MS goal candidates and scenarios for achieving them in Moonshot International Symposium held on Dec. 17-18, 2019.

**Moonshot Goal Candidates**

- **WG1**: Expanding human potential for a society where everyone can pursue their dreams
- **WG2**: Realizing a human life that “continues to improve both physically and psychologically” through complete understanding of biological functions
- **WG3**: Expanding frontiers through co-evolution of AI and robots
- **WG4**: Sustainable resources circulation for global environment
- **WG5**: Innovation for future agriculture – satisfying both food production and environmental conservation
- **WG6**: Creating innovative non-traditional sciences and technologies based on quantum and related phenomena
- **WG7**: Cross sectional issue