Plenary Session 2 :

Areas and Visions for Setting Moonshot Goals

Dec. 17, 2019

KITANO Hiroaki

Member of the Visionary Council, and

President and CEO, Sony Computer Science Laboratories, Inc. (Sony CSL)

Status of Visionary Council's Review

- ✓ CSTI established the Moonshot Research and Development Program to challenge resolving hard societal problems. CSTI will also plan to decide the ambitious MS goals.
- ✓ To decide MS goals, the Visionary Meeting has gathered opinions from industry as well as received proposals from the general public (about 1,800) and relevant ministries and discussed the future visions and specific goals.

Visionary Council Members

Hiroaki Kitano	President and CEO, Sony Computer Science Laboratory
Yoichi Ochiai	Media Artist, Assoc. Professor, University of Tsukuba
Marissa Ozaki	Artist ("Sputniko!"), Project Associate Professor, The University of Tokyo
Yoshimitsu Kobayashi (Chair of the council)	Mitsubishi Chemical Holdings Corporation
Naohiro Nishiguchi	Executive Officer, Japan Innovation Network
Taiyo Fujii	SF Writer
Makiko Eda	Chief Representative Officer, The World Economic Forum Japan

Review Status & Future Plans

March 29: 1st Meeting
- Consultation on the important points for determining MS goals

April 22: 2nd Meeting
- Requests from the academia and industry
- Consultation on the elements of MS goals

May 23: 3rd Meeting
- Discussion on the direction for determining MS goals

June 14: Round Table Conference (private)
- Discussion on the examples of the MS goals

July : 4th Meeting

Key points of MS Goals

- ✓ The government sets ambitious targets and concepts for a social agenda that are difficult to tackle but will have profound impact once resolved.
- ✓ Identifies future visions based on societal issues facing the world.
- ✓ Translates future visions into missions as MS goals.

MOONSHOT
RESEARCH & DEVELOPMENT PROGRAM

INSPIRING

IMAGINATIVE

CREDIBLE

Human centric is the basic concept of MS goals.

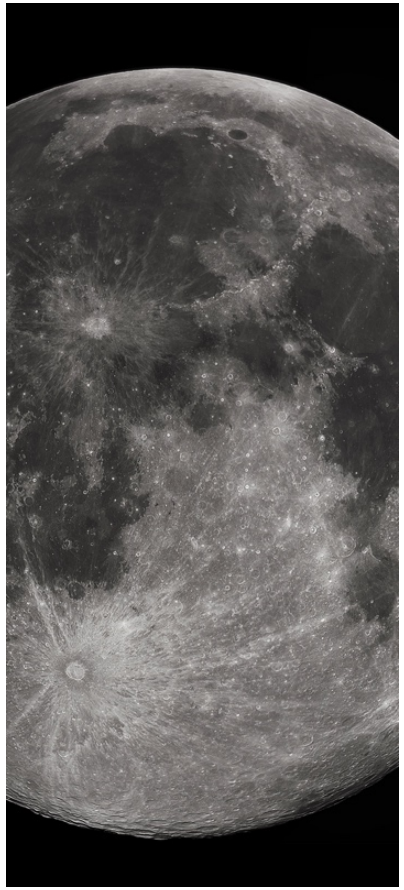
Modalities of Research and Development

Moonshot

“We chose to go to the Moon”

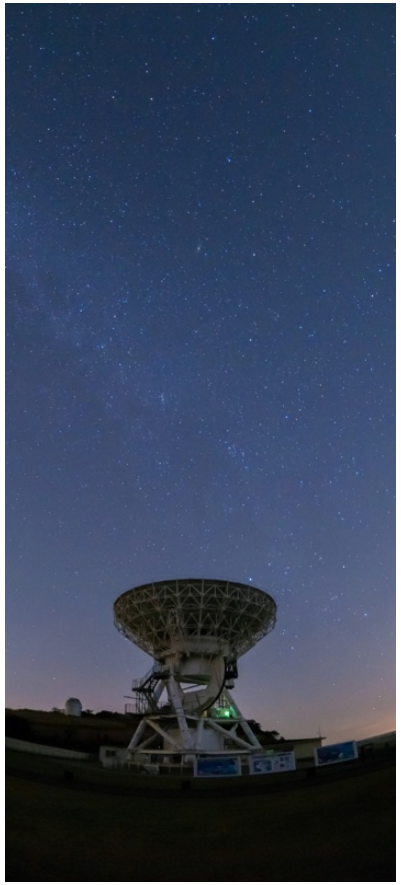
Focused Area

Comprehensive understanding



Exploratory Research

Curiosity-driven basic research



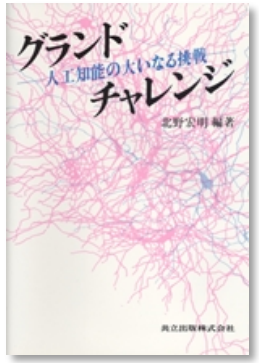
Images from NASA

Characteristics of Moonshot R&D Program

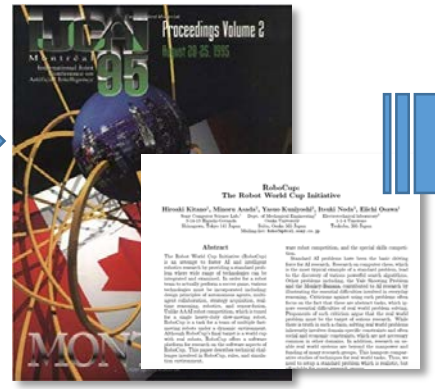
	Apollo Project	Moonshot R&D Program
Number of Goals	**1 (We choose to go to the Moon)**	**25 Goals**
Duration	**10 years to the first Moon landing**	**30 years**
Nature of the Program	**Engineering and execution challenges for scientific exploration**	**Techno-social transformation**
Needs for scientific discovery	**Mostly technology development**	**Less for initial milestones, essential for the final goal**

Case Study: RoboCup
By 2050, develop a fully autonomous humanoid team to win FIFA World Cup champion in Soccer

Inception
1992



Announcement
1995



Project Started
1997

High quality scientific research
(many award winning papers)

2050

The challenge was announced at International Joint Conference on Artificial Intelligence (IJCAI) in 1995

KIVA Systems®

ALDEBARAN Robotics

amazonrobotics

SoftBank Robotics

High impact start ups

Moonshot Mission Areas

1. Leveraging the Aging Society

Solving issues Japan is facing, and leverage them to transform Japan

2. Save the Earth and our Civilization

Solving global agenda issues affecting the future of civilization

3. Exploring frontiers with science and technology

Making wildest imaginations in to Reality

Proposed Moonshot Goals

MOONSHOT RESEARCH & DEVELOPMENT PROGRAM

Area1

1.Leveraging the Aging Society

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

Labor shortage

Soaring medical issues

Domestic consumption↓

Anyone can participate in the society

Automating Industries

Increase birth rate (long term solution)

Proposed Moonshot Goals

MOONSHOT RESEARCH & DEVELOPMENT PROGRAM

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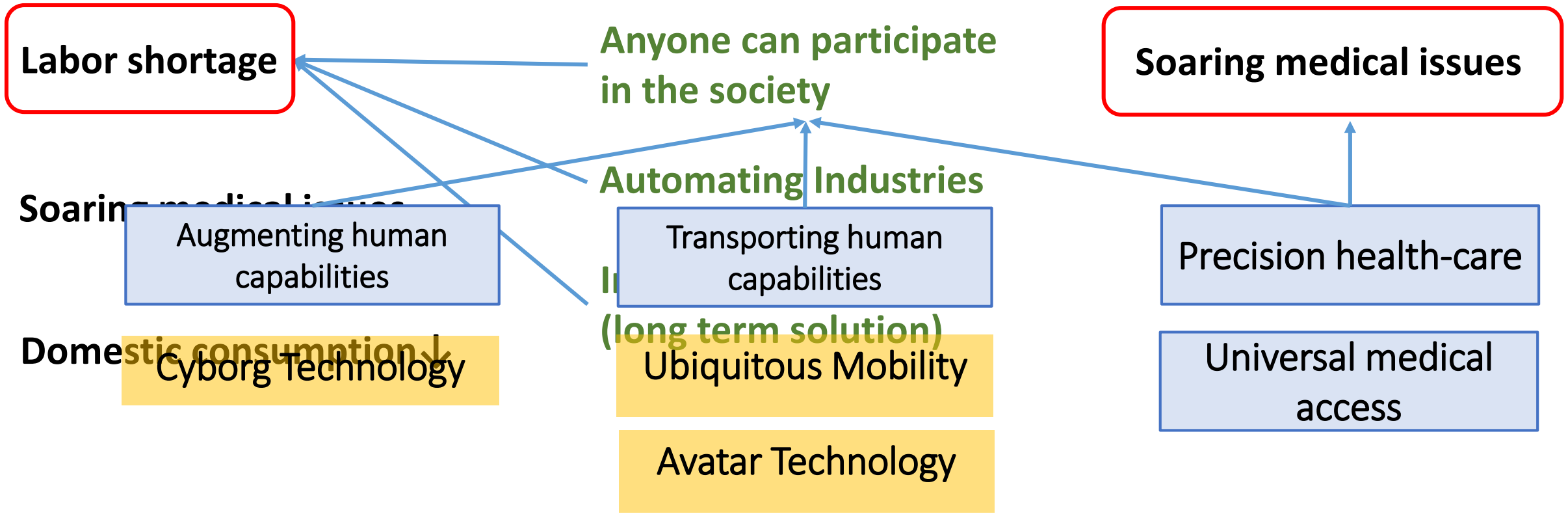

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Industrial innovations by complete automation

Domestic consumption↓

Full automation of agriculture, forestry & fisheries

Full automation of construction work

Proposed Moonshot Goals

MOONSHOT RESEARCH & DEVELOPMENT PROGRAM

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Domestic consumption↓

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Automating Industries

Increase birth rate (long term solution)

Area3

Complete digital mapping and externalization of the entire reproductive processes (by 2050)

Proposed Moonshot Goals

MOONSHOT RESEARCH & DEVELOPMENT PROGRAM

Area1

Area

Visions

Examples of MS goals

1.Leveraging the Aging Society

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

Inclusive Society :
anyone can pursue their dreams
(inclusion & innovation)

Society without health anxiety :
everyone can enjoy life until 100 years old
(achievement of well-aging)

Industrial innovations by complete automation

- Augmenting human capabilities
- Transporting human capabilities
- Precise and automatic health-care
- Universal medical access
- Novel industrial model for complete automation

1) Create and deploy "Cyborg technology" to augment human capability (by 2050)

2) Fully ubiquitous and inclusive mobility (by 2040)

3) Create and deploy advanced avatars enabling most daily life can be done through avatar (by 2040)

4) Dramatic improvement of QOL among the elderly (by 2035)

5) Preventive measures to maintain wellness (by 2040)

6) Universal medical access at the global scale (by 2040)

7) Full automation of agriculture, forestry & fisheries (by 2040)

8) Full automation of construction work (by 2040)

Area2

2. Save the Earth and our Civilization

- Recovery for global environment and growth of civilization -

Fundamental Recognition

We are overloading the earth, creating imbalance of material circulation, and biodiversity was lost

Reduce Resource Demands

Reuse Materials and Energy

Restore Global Biodiversity

Area2

2. Save the Earth and our Civilization

- Recovery for global environment and growth of civilization -

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Proposed Moonshot Goals

MOONSHOT RESEARCH & DEVELOPMENT PROGRAM

Area2

2. Save the Earth and our Civilization

- Recovery for global environment and growth of civilization -

Reduce Resource Demands

- Reduction of resources losses to 1/100th (by 2050)
- Reduction of energy consumption for computing to 1/1000th (by 2040)

Reuse Materials and Energy

- 100% energy self-sufficiency with sustainable energy source (by 2060)
- Full recycle system for resources and materials (by 2050)
- Construction of environmental-neutral city model (by 2050)

Restore Global Biodiversity

- Elimination of garbage on the earth (by 2050)
- Harmonization between agriculture and biodiversity (by 2050)
- Elimination of food loss (by 2030)
- Terraforming technology (by 2050)

Proposed Moonshot Goals

MOONSHOT RESEARCH & DEVELOPMENT PROGRAM

Area2

Area

Visions

Examples of MS goals

2. Save the Earth and our Civilization

- Recovery for global environment and growth of civilization -

Natural resources

- Significant reduction of resources requirements
  - Improvement of QoL with 1/10th of the current resources requirement
    - 9) Reduction of resources losses to 1/100th (by 2050)
    - 10) Reduction of energy consumption for computing to 1/1000th (by 2040)
- Sustainable Resources Circulation
  - Environmentally-neutral industries and life cycles on a global scale
    - 11) 100% energy self-sufficiency with sustainable energy source (by 2060)
    - 12) Full recycle system for resources and materials (by 2050)
  - Environmentally-neutral food supply & demand cycle on a global scale
    - 13) Elimination of food loss (by 2050)
    - 14) Elimination of garbage on the earth (by 2050)

Cities

- Environmentally-neutral cities
  - Nature-harmonized and environmentally-neutral city with highest quality of life
    - 15) Construction of environmental-neutral city model (by 2050)

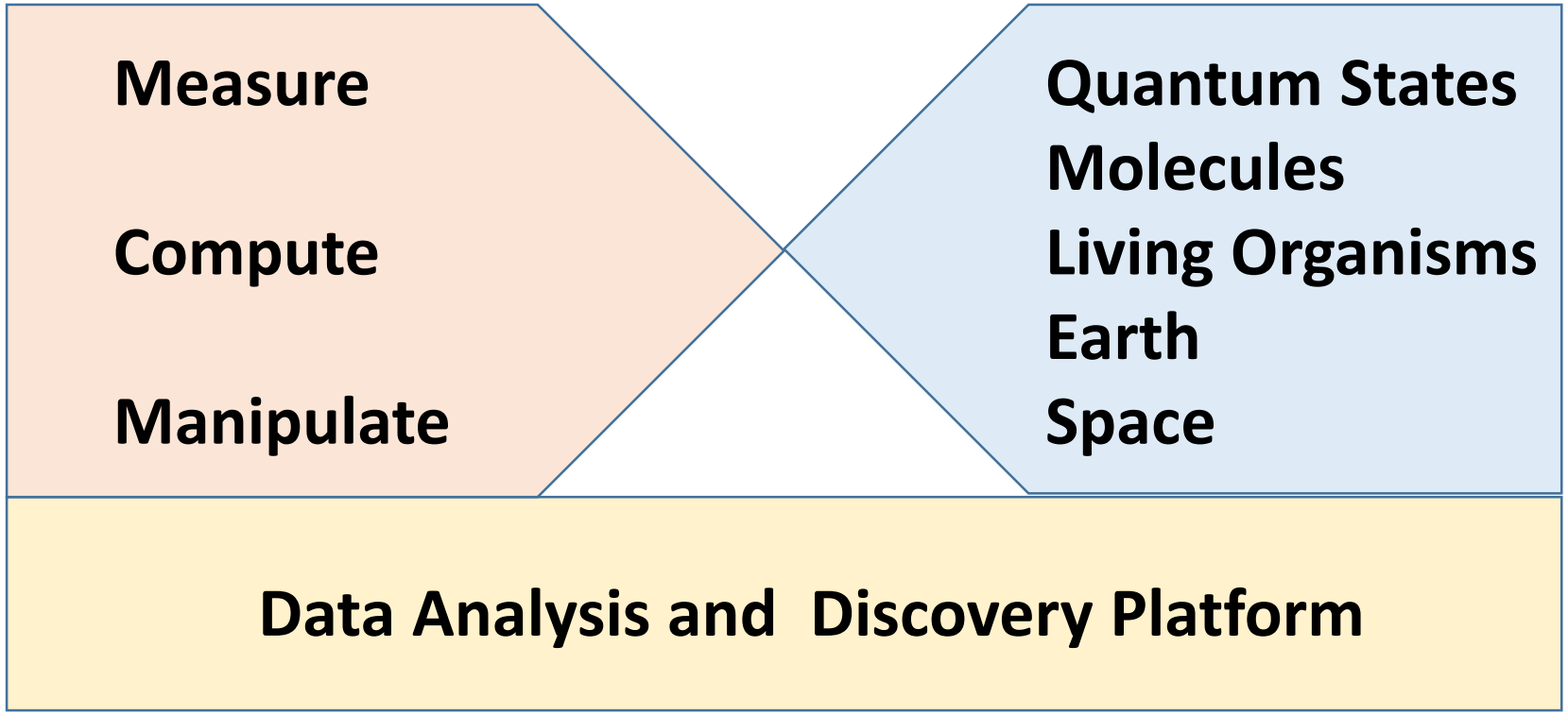
Global environment

- Harmonization with nature
  - Conserve and/or increase biodiversity
    - 16) Harmonization between agriculture and biodiversity (by 2050)
    - 17) Terraforming technology (by 2050)

Area3

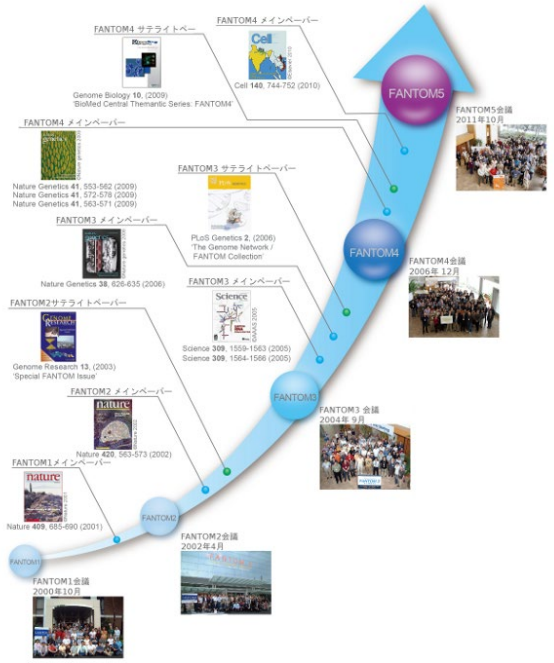
3. Exploring frontiers with science and technology

Intensive and Integrated Technology Developments and Resource Building to accelerate scientific discoveries



Case Study – FANTOM and iPS:
A large-scale project and enabled BlueSky research

FANTOM
FUNCTIONAL ANNOTATION OF THE MAMMALIAN GENOME



A comprehensive annotation of mammalian genome

Ecat1
Dppa5(Esg1)
Fbox15
Nanog
Eras
Dnmt31
Ecat8
Gdf3
Sox15
Dppa4
Dppa2
Fthl17
Sal14
Oct3/4
Sox2
Rex1
Utf1
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Dppa3
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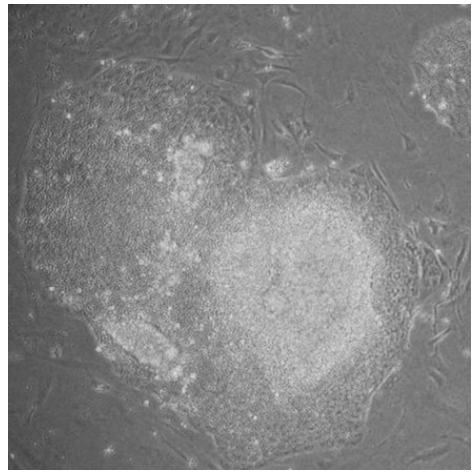
Gdf3
Esrrb

Oct3/4
Sox2
Klf4
c-Myc



Discovery of iPS Cell

Proposed Moonshot Goals

MOONSHOT RESEARCH & DEVELOPMENT PROGRAM

Area3

Area

Visions

Examples of MS goals

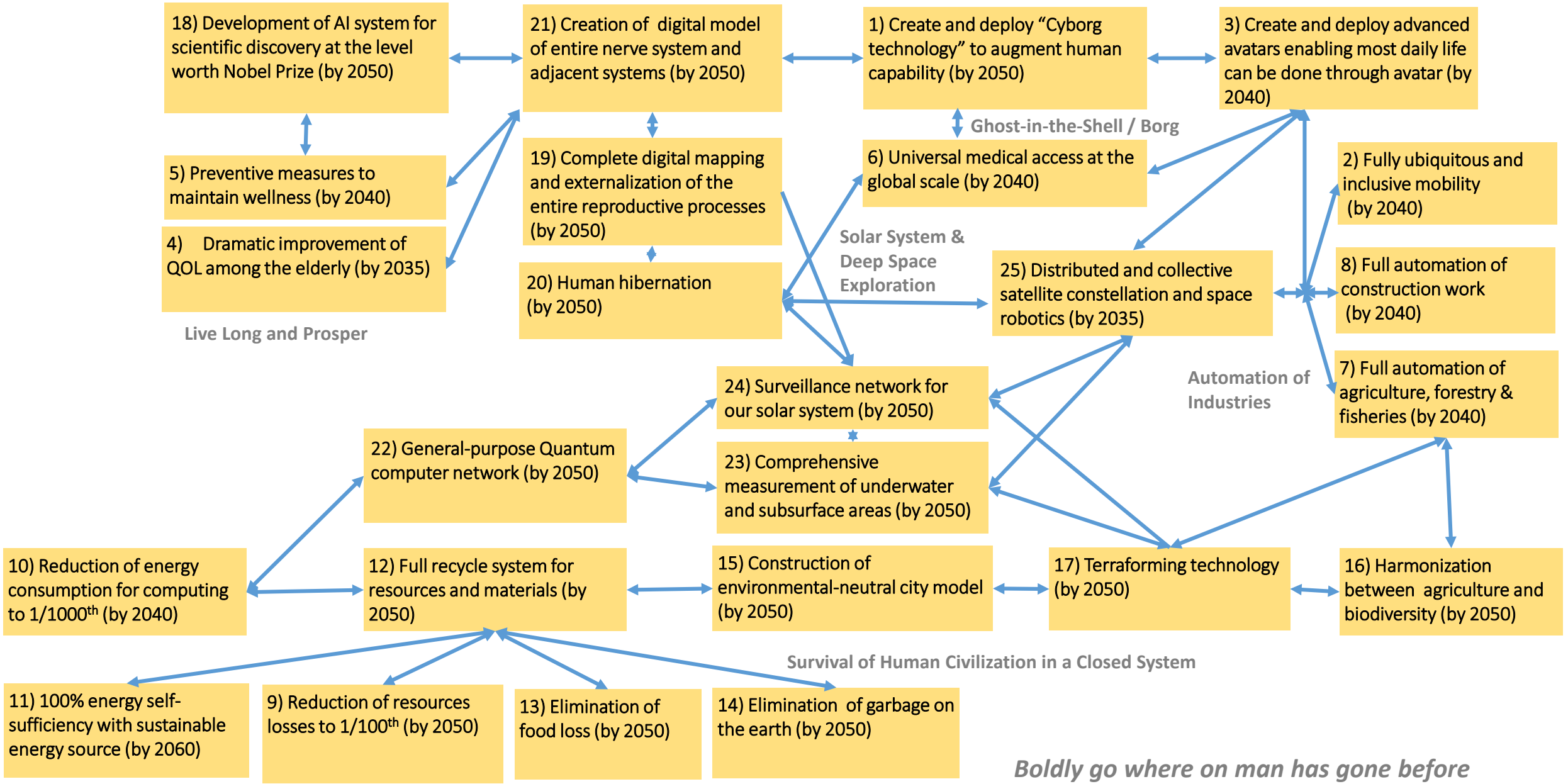
3. Exploring frontiers with science and technology

- Automation of Scientific Discovery (AI/Robotics)
- Reproducing and controlling key biological processes (biotech)
- In-depth understanding of neural and associated systems (brain/nerve system)
- Measuring, computing, and visualizing unexplored spaces (from quantum to Earth)
- Permanent presence in space (space)
- Millennium Challenge (public call for Vision & Goals)

Examples of MS goals

- 18) Development of AI system for scientific discovery at the level worth Nobel Prize (by 2050)
- 19) Complete digital mapping and externalization of the entire reproductive processes (by 2050)
- 20) Human hibernation (by 2050)
- 21) Creation of digital model of entire nerve system and adjacent systems (by 2050)
- 22) General-purpose Quantum computer network (by 2050)
- 23) Comprehensive measurement of underwater and subsurface areas (by 2050)
- 24) Surveillance network for our solar system (by 2050)
- 25) Distributed and collective satellite constellation and space robotics (by 2035)

An Interactive Network of 25 Moonshot Goals



Boldly go where on man has gone before

Working Group Discussion

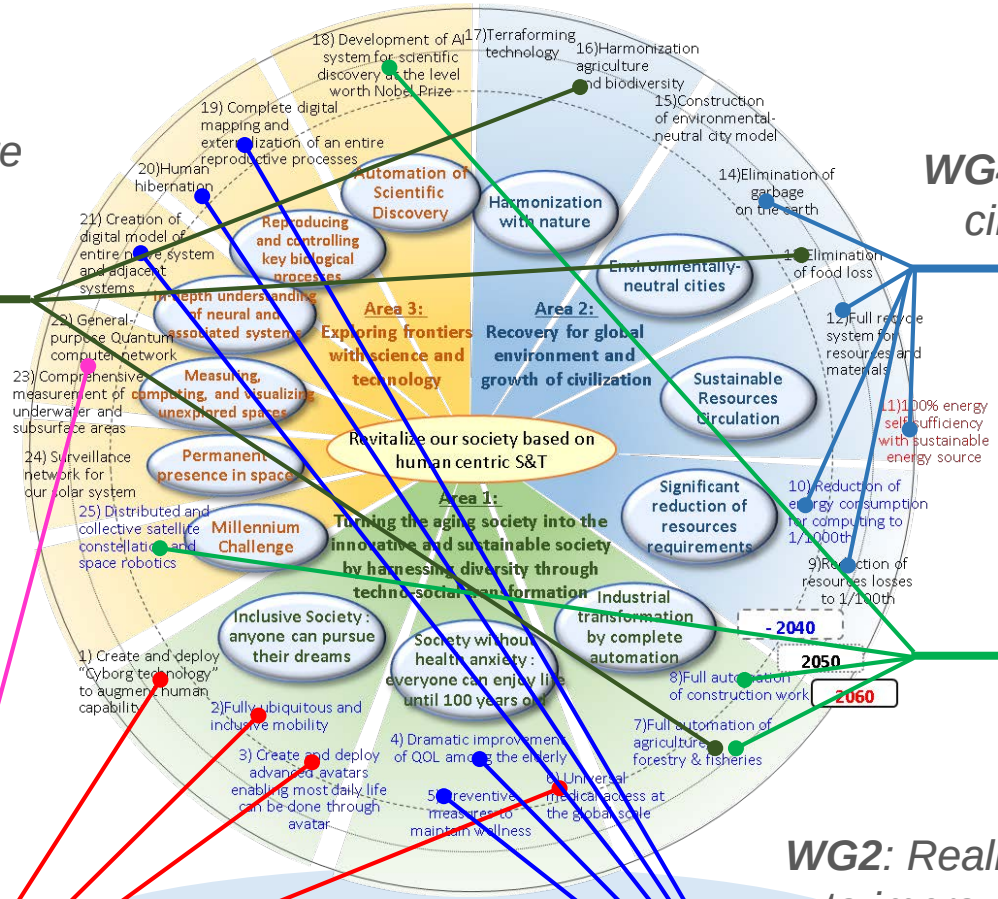
Organized 6 (+1) Working Groups for discussing about specific MS goal candidates and scenarios for achieving them.

***WG5**: Innovation for future agriculture –satisfying both food production and environmental conservation*

***WG4**: Sustainable resources circulation for global environment*

***WG6**: Creating innovative non-traditional sciences and technologies based on quantum and related phenomena*

***WG3**: Expanding frontiers through co-evolution of AI and robots*



***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*

***WG7**: Cross sectional issue*

Modalities of Research and Development

Moonshot

“We chose to go to the Moon”

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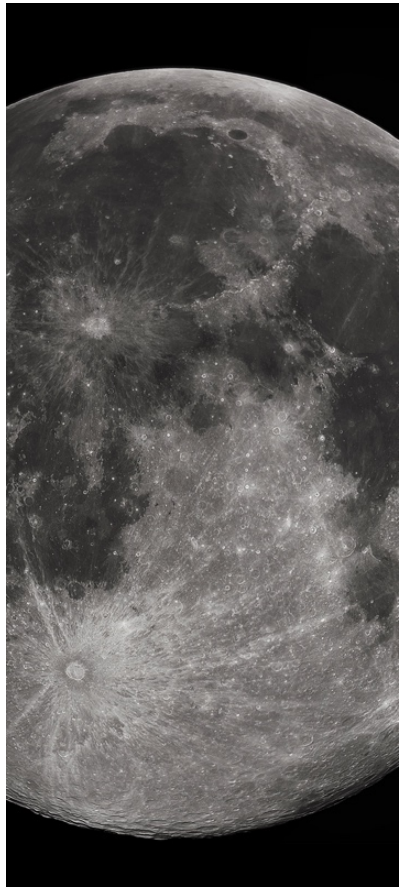

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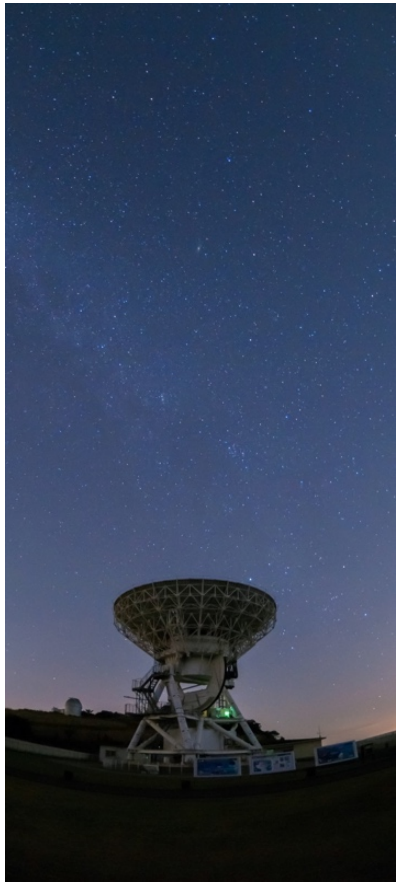


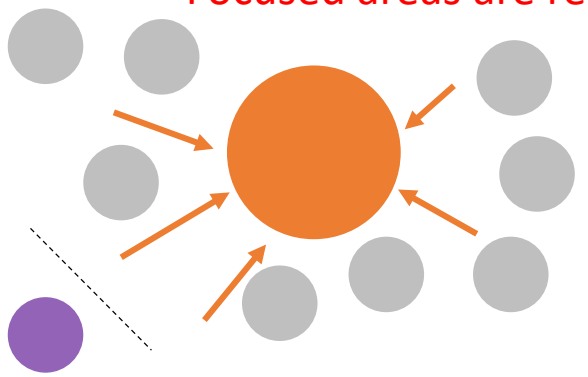
Images from NASA

Research funding policy reflecting the modalities of R&D

Focus and concentration Funding

選択と集中

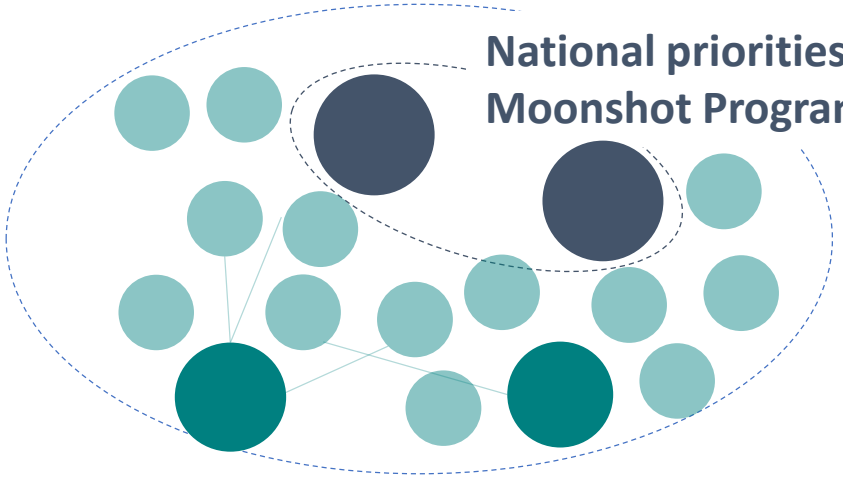
Focused areas are red ocean



Disruptive innovations are triggered from unexpected areas

Strategic and Exploratory Funding

戦略と創発

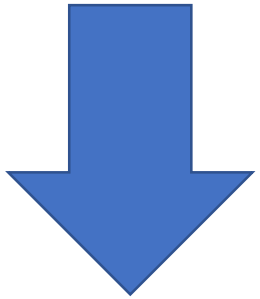


Blue-Sky Research Funding to ensure diversity of basic research in all areas

Forecast

Many moonshot projects proposed will hit the wall at the 50-80% achievement. In most of projects, the breakthrough to reach the goal will come from unexpected researches unrelated to its project.

The difference from Apollo project :
(1) Longer-term plan
(Higher ratio of science over technology)
(2) Success requires social transformation



Potential Key Areas:
(1)Humanities, Social Sciences, behavioral psychology
(2) Progress of basic science in material, chemistry, biology, etc.
(3) Major contributions of art and design

To increase the chance of Moonshot R&D program to achieve the final goals, Japanese government should dramatically increase longer-term blue-sky research funding and improve a research environment in universities.
The funding size for the blue-sky research support shall be comparable to Moonshot R&D Program though public fund, donation, academic-industrial collaboration.

The Government announced establishment of Blue-Sky fund* at the scale of 500M USD

* Tentative name

Conclusion

“the people who are crazy enough to think they can change the world are the ones who do”.

Steve Jobs

The visionary council proposed 25 goals in three areas to be catalyst of transformation of approach to the problem we are facing and to explore new horizon of science and technologies.

These challenges are formidable. However, it provides us with an opportunity to create a new set of technologies, scientific discoveries, and to transform the society for better world.