

DISCUSSION PAPER No.183

The 11th S&T Foresight: S&T Foresight 2019
Horizon Scanning Report

June 2020

Science and Technology Foresight Center
National Institute of Science and Technology Policy

The DISCUSSION PAPER series are published for discussion within the National Institute of Science and Technology Policy (NISTEP) as well as receiving comments from the community.

It should be noticed that the opinions in this DISCUSSION PAPER are the sole responsibility of the author(s) and do not necessarily reflect the official views of NISTEP.

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Summary

1. Objective and Method

National Institute of Science and Technology Policy (NISTEP) has been conducting “Science and Technology Foresight” every five years since 1971. Since the Science and Technology Basic Law was established in 1995, the study has been conducted according to the formulation schedule of the Science, Technology, and Innovation Basic Plans. Since around the year 2000, back casting or seeking for solution to social challenges has become the mainstream attitude toward science and technology policymaking. To meet requirements from policymakers, there was a change in the study framework from technology or seeds driven approach, where they consider the future of society based on science and technology developments, to society or needs driven approach, where they discuss the better society before identifying relevant scientific and technological issues.

“The 11th Science and Technology Foresight: S&T Foresight 2019” (hereinafter referred to as the 11th Foresight) conducted an examination into science and technology development and the desired society in the future, aiming to provide fundamental information that contributes to the discussion of science, technology, and innovation policies including the 6th Science, Technology, and Innovation Basic Plan.

The structure of the 11th Foresight is outlined in Figure 1. In consideration of the increased complexity of the relationship between technology and society, the study is promoted from the dual viewpoints of science and technology, and society. It is configured to examine “future of society” and “future of science and technology” separately before integrated discussion of both futures for “future images of society brought about by the development of science and technology.”

Horizon scanning was adopted and clearly positioned within the study framework for the first time in the 11th Foresight. It aims to capture signs of changes in science, technology, and society with the objective of responding to increased uncertainty in the future. Table 1 shows the information that was collected according to their types. We prepared a system to search for trends and signs of changes in science, technology, and society on a regular and continuous basis. The information was provided as a reference for the examination of “future of society” and “future of science and technology.”

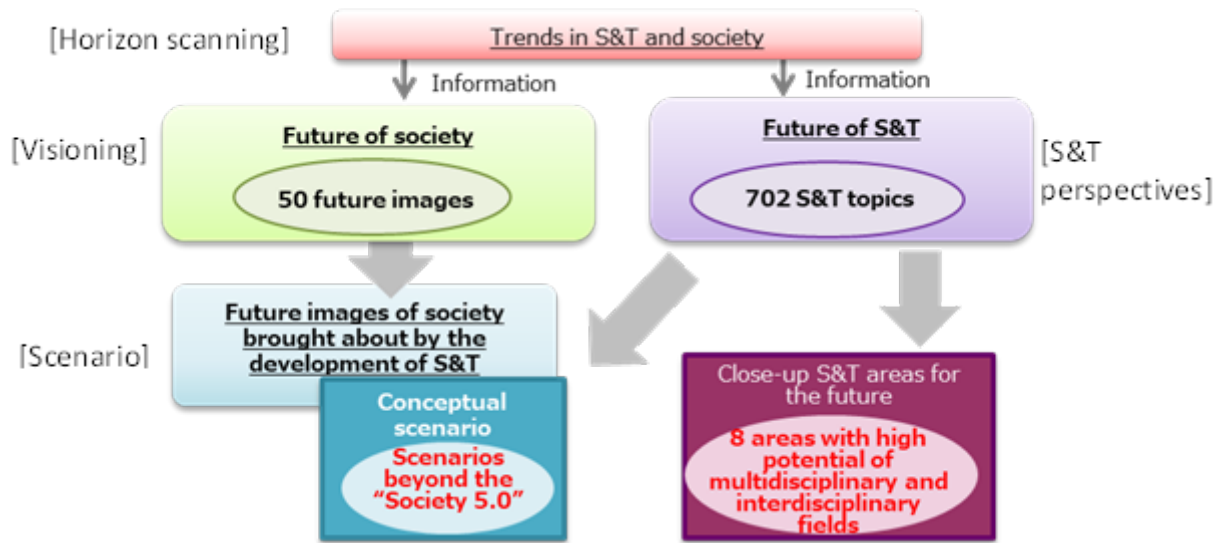


Figure 1. Structure of the 11th S&T Foresight

Table 1. Information collected in Horizon Scanning

Type	Awareness ^{*1}	Direction ^{*2}	Contents	Category	Utilization ^{*3}
Society	Outlook	Prediction	✓ Extracted trends related to society, economy, science and technology, environment, and politics from existing materials	Trends	Society
		Aim	✓ Desired future of domestic regions (regional workshop results)	Future vision of regions	Society
			✓ Extracted description of the intended direction from plans and strategies of the government and related organizations	Policy trends	Society
	Signs	Prediction	✓ Possible changes in society (International workshop results)	Future trends of the world	Society
			✓ Collected opinions of specialists and experts ✓ Collected information through routine horizon scanning by NSITEP	KIDSASHI stories	Society
Science and technology	Outlook	Prediction	✓ Extracted trends related to society, economy, science and technology, environment, and politics from existing materials	Trends	Society
		Aim	✓ Extracted information from related reports ^{*4}	Information by field	S&T
			✓ Crawled information from meeting minutes of the national diet, etc. ✓ Crawled information of themes and resource distribution of top-down competitive research funds		
	Signs	Prediction	✓ Collected opinions of specialists and experts ✓ Collected information through routine horizon scanning by NISTEP	KIDASHI stories	Society
			✓ Extracted themes from Grant-in-Aid for Scientific Research Database KAKEN ✓ Crawled themes of R&D-related press releases	Information by field	S&T

*1 Awareness is classified into “outlook (a certain degree of common awareness among experts/experts or in general society)” and “signs (individual or partial understanding)”.

*2 Direction is classified into “prediction” (an objective direction that does not include values and desires) and “aim” (normative direction to aim for).

*3 “Society” means that it was used to examine the future vision of society, and “S&T” means that it was used to examine the science and technology perspectives.

*4 “The 10th Science and Technology Foresight: Future Perspectives on Science and Technology by Field” (NISTEP), “Science Map 2016” (NISTEP), “Panoramic View Report” (Center for Research and Development Strategy, Japan Science and Technology Agency (JST)).

2. Collected information

(1) Information for the discussion of the “future of society”

◆ Trends

Key elements regarding society's macro environment that are likely to have major impacts on the future were extracted from existing sources.

The declining birthrate and aging population in Japan are mentioned, contrasted with the expected increase of the global population. Climate change is regarded as one of the big issues from the global point of view. Political or economic issues are also mentioned such as changes in the economic environment due to globalization and networking, changes in the balance of power in the world, and instability and uncertainty in the political and economic situation. Alterations in the relationship between people and machines are pointed as technologies show rapid progress.

◆ KIDSASHI Stories

These documents describe changes in science, technology, and society, with a total of 140 pieces of information prepared by the Science and Technology Foresight Center and participants in the vision workshp that examined the future vision of society.

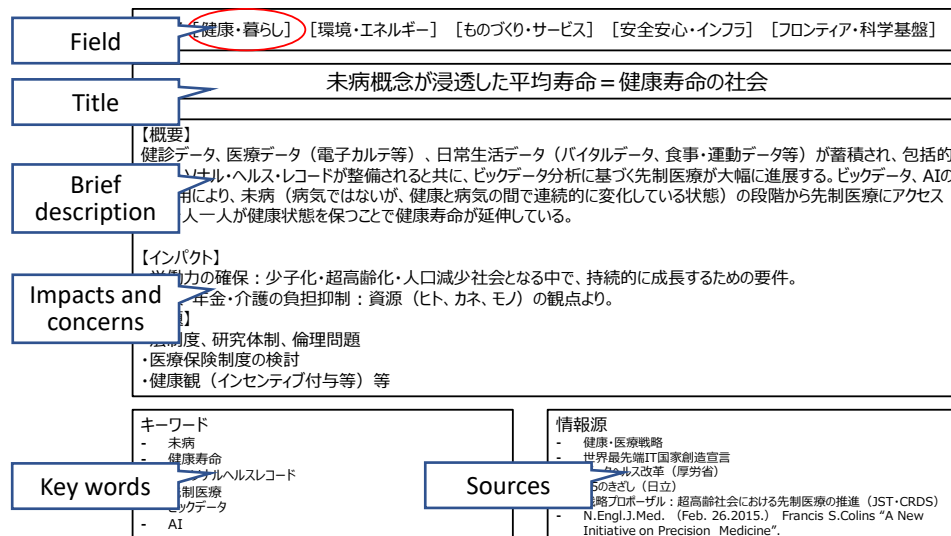


Figure 2. Format of KIDSASHI stories

The following items are mentioned for each of the categories:

General issues: major shifts in values, structural changes, etc.

Health and lifestyle: changes in attitudes to life and death, extending healthy life expectancy, human diet, artificial intelligence, and virtual reality, etc.

Environment and energy: circular economy, low carbon society, etc.

Manufacturing and innovation in the local regions: collaboration with artificial intelligence and robots, digital manufacturing, etc.

Safety, security, and infrastructure: energy infrastructure, natural disasters, self-renewal, etc.

Frontier: space and deep-sea exploration, resource exploration, etc.

◆ Policy Trends

The directions and goals for the future are identified in plans, strategies, visions, etc. by governmental organizations, economic organizations, and alike. Keywords are mentioned, such as sustainable development, safety, improved quality of life, health, industrial revitalization, improvement of productivity, global environment, energy, mobility, cities, etc.

◆ Future Vision of Regions

This summarizes the results of the study on the medium- to long-term vision of society in regions in Japan. A unique vision of the future was drawn up in line with the characteristics of each region, such as attracting people with the region's uniqueness, utilizing the power of the community, cherishing a relaxed lifestyle, making the most of local resources, and connecting the region to the world.

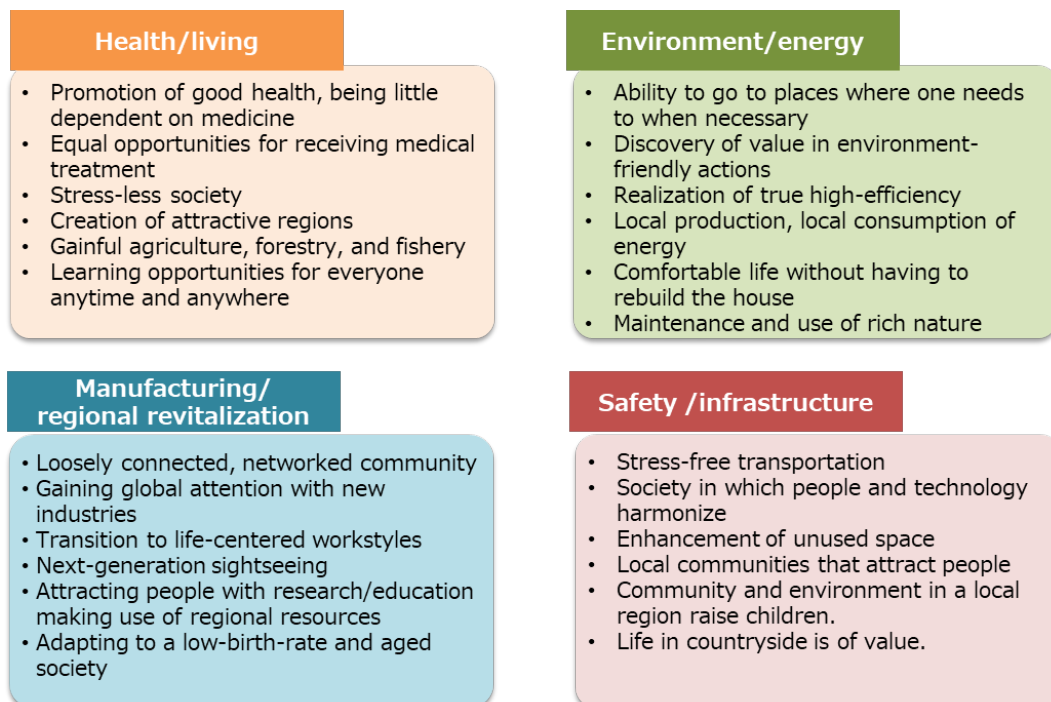


Figure 3. Summary of the regional workshops

◆ Future Trends of the World

The results of the international workshop on social trends up to 2040 are summarized, through group discussions with about 60 participants from 14 countries including Japan, and international organizations. While the development of science and technology has brought about a paradigm shift and the realization of a higher quality of life, it has also uncovered the potential for inequality and division.

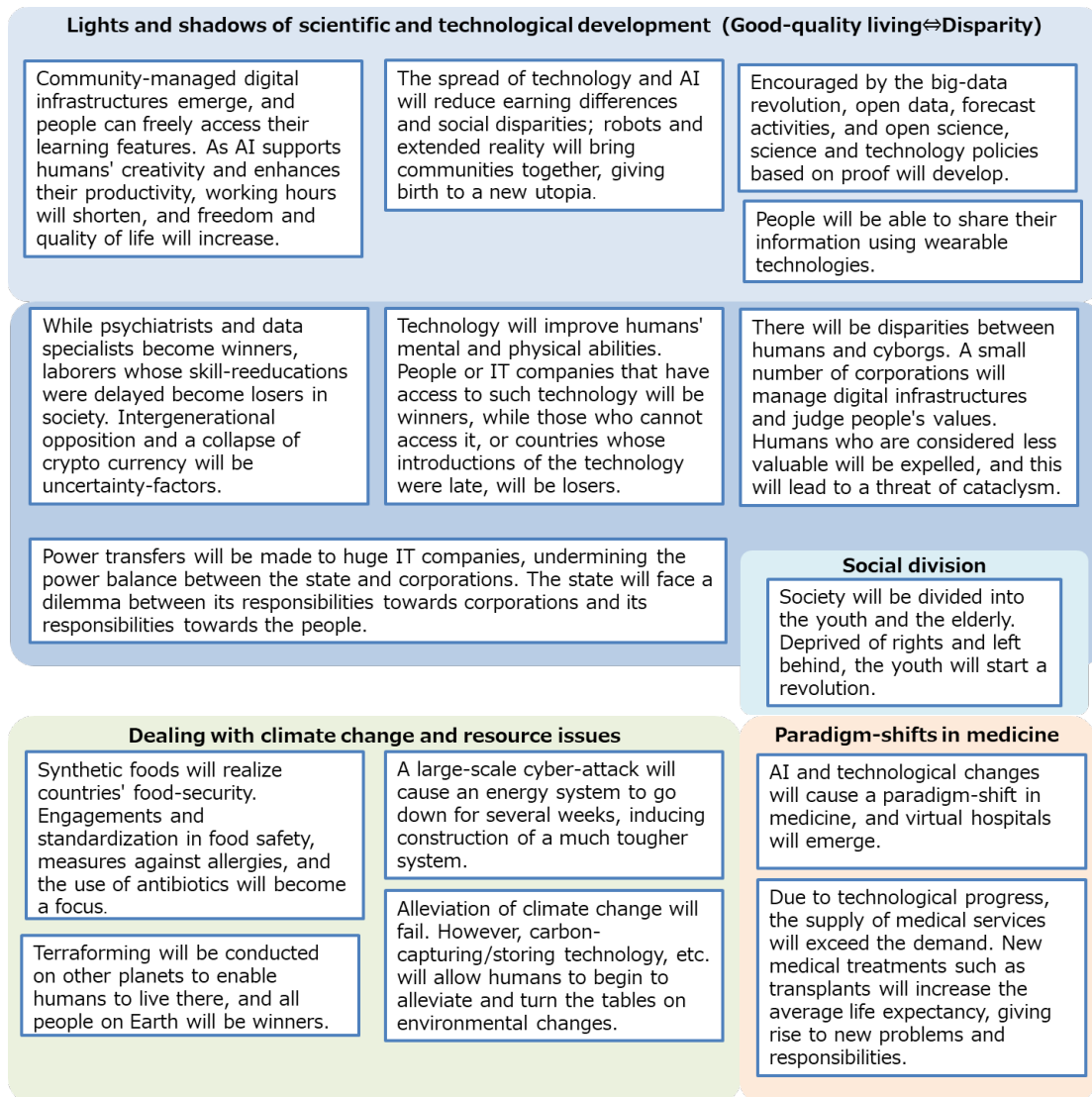


Figure 4. Summary of the international workshop

(2) Information for the discussion of the “future of science and technology”

Information by technological field was created for each category of the Delphi survey conducted to examine the potential of science and technology development. Table 2 shows the information that was collected. Tentative keywords for search were set by the Science and Technology Foresight Center. Research and policy information was

automatically extracted by NISTEP’s search system, and output in order of relevance to the keywords. Specifically, nouns were extracted from the collected data by morphological analysis, and their distributed representation were obtained to create a distributed representation of the document. The degree of similarity was judged according to the cosine similarity of the distributed representation. As for “Science Map 2016,” the information was provided to the survey fields according to their relevance to Science Map’s academic fields.

Table 2. Classification of S&T-related information and its sources

Category	Item	Sources
Research	S&T topics	a) Extracted from a total of 932 science and technology topics in the “10th Science and Technology Foresight” (10 with high relevance)
	Research Areas	b) Extracted from “Science Map 2016” c) Extracted from “Panoramic View Report 2017” (JST) (10 cases with high relevance)
	Research themes	d) Extracted from press releases of universities and other research institutions collected using crawling (10 cases with high relevance) e) Extracted from Grant-in-Aid for scientific Research database KAKEN (100 cases with high relevance) f) Information on top-down competitive research funds (MEXT, JSPS, JST, NEDO, etc.) (Number of cases with high relevance, according to amount of money, sample subjects)
Policy		g) Extracted from the minutes of government councils, etc. collected by crawling (10 cases with high relevance)

3. Discussion

In examining the future of society, participants drew up the future images of the society that they are aiming for in 2040, based on the information provided. By first understanding the directions that are beginning to appear and the direction of policy, it became possible to discuss the images based on the current situation. But the use of this information was limited due to limited time for sharing opinions. For more effective use of information and meaningful discussion, it may be necessary to identify issues in advance by providing information to the participants to summarize their thoughts.

In the examination of science and technology perspectives, data showing the current progresses of research and development was provided for discussion at the subcommittees. However, due to the large amount of information and the lack of time-series data, the use of the information was limited to certain areas. Automatic or semi-automatic information collection and analysis is found to be useful in the Science and Technology Foresight, which covers a wide range of science and technology fields, but it is necessary to consider more effective ways of showing results to support judgements by experts. Another challenge is continuous and regular collection, analysis, and accumulation of information on new developments.

As science, technology, and society undergo rapid changes, the usefulness of horizon scanning will continue to grow. The collection and extraction methods and the means of visualization are expected to improve, and it is also necessary to construct a system for accumulating useful information in a usable form for regular activities.

[The 11th S&T Foresight: S&T Foresight 2019 series]

Summary:

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