European Journal of Futures Research (2018) 6:4
https://doi.org/10.1007/s40309-017-0130-8

ORIGINAL ARTICLE

A proposal of a new foresight platform considering of sustainable development goals

Miki Kuribayashi[1] · Kazuhiro Hayashi[1] · Shinichi Akaike[1]

Received: 31 July 2017 / Accepted: 6 December 2017

Abstract
The National Institute of Science and Technology Policy (NISTEP) has conducted foresight activities for decades. In recent years, the speed of social change has increased and the complexity in politics and economics has also increased. As such, it has become difficult to look forward appropriate in a timely manner using only conventional methods, and thus the development of various methods is encouraged. Conversely, the formation of a sustainable society faces many difficulties on the international front and many goals for global issues have been set. However, efforts and results for sustainable development are not necessarily desirable. In this study, we examined whether we could effectively solve social problems by combining the development of a foresight approach with Sustainable Development Goals (SDGs). First, we reviewed the concepts of sustainable development. Next, we examined the target of SDGs appropriately to convert our foresight activities. Finally, we propose a future public platform (FPP) for scenario planning in foresight. As a result, we found the importance of considering the SDGs in foresight. We also examined the concept of sustainable development, considering how to integrate the SDGs into foresight, and propose the FPP with SDGs. This FPP effectively involves five SDG targets and appears to be highly executable. Though the system of FPP has a certain difficulty, we could exchange information among experts who are studying SDGs and foresight. Thus, as a case study of connections between foresight and SDGs, it would be helpful for other countries.

Keywords Foresight · Delphi · Sustainable development · SDGs · Stakeholder

Background

We need to effectively grasp dynamic changes in society as they are becoming increasingly uncertain and complex. For that, it is important to link the core phases in the foresight process and combine methods to innovate analyses (Popper [1]). Loveridge [2] emphasized that active participation by wide spread stakeholders shapes future society. In addition, Yokoo [3] stated the creation of societal values, the social or economic conditions for their promotion, and reformation of the stakeholders thought processes are significant to science and technology policy. Kondo [4] and others developed measures to realize demands of local agents and co-design the solution by digitalization through an action research. Mauser [5] and others emphasized that researchers and societal stakeholders collaborate on the co-production of knowledge and dissemination of outcomes for sustainable development. With that, the scenario of current activities, which is applicable to societies in which large companies possess considerable technological and human resources, could mitigate tensions between companies, the state, and its citizens (Heinonen [6]). As such, it has become increasingly important to integrate methods and involve stakeholders in foresight.

Our Delphi survey was conducted to identify key S&T topics to realize a societal vision, which consider the structure of future societies. The Delphi topics pertaining to business ethics issues seek to reach consensus on what should be done to resolve ethical dilemmas (San-Jose [7]). Duckett [8] revealed the demand for high accountability and to be self-critical through participatory stakeholder engagement scenario

✉ Miki Kuribayashi
miki.kuribayashi@nistep.go.jp

Kazuhiro Hayashi
khayashi@nistep.go.jp

Shinichi Akaike
akaike@nistep.go.jp

[1] Ministry of Education, Culture, Sports, Science & Technology (MEXT), National Institute of Science & Technology Policy (NISTEP), Tokyo, Japan

Published online: 16 January 2018

planning processes based on Habermas' concept of ideal speech in the public sphere. Stakeholders can be considered participants in the production of knowledge [9]. In any society, it is necessary to clarify the meaning of science and technology with probability of importance and uncertainty. Walsh [10] and others suggested that innovative processes engage multiple stakeholders to envision a more sustainable future infrastructure and co-design the transition towards construction.

Additionally, we would like to contribute to solving global issues with international collaboration through foresight activities. Sustainable development refers to various global problems such as economic development in developing countries, cross-border environmental problems, resource constraints, and economic disparity between developed and developing countries. The goals set for sustainable development such as the Millennium Development Goals (MDGs) and the Sustainable Development Goals (SDGs) were presented by the United Nations (UN) [11].

Conversely, improvements in foresight methods and activities are rapidly progressing throughout the world to detect emerging issues. Thus, we thought there must be a way to fill this gap. Though several studies linking SDGs and foresight have been conducted, it is still not enough, as for instance van der Hel states [12], focusing on strategies employed by science institutions as well as Butler [13], stating the lack of examples of transformative innovations, which linked human and environmental outcomes. Therefore, we aim to develop a new proposal that effectively synthesizes the two. We believe it is necessary to realize the SDGs and successfully implement them.

Introduction: Results of the 10th foresight

In Japan, a large-scale Science and Technology (S&T) foresight survey has been conducted every five years since 1971, along with an examination of the evolution of the Science, Technology and Innovation (STI) policy framework. Since the fifth survey, S&T foresight has been implemented by the National Institute of Science and Technology Policy (NISTEP). Since 1996, the five-year interval for the S&T foresight survey has been selected to synchronize with the cycle for the S&T Basic Plans in Japan. In addition, we attempted to contribute to the process of formulating the S&T Basic Plan, which was determined by the Cabinet, by submitting our foresight survey report. The 10th S&T foresight, the latest survey, was conducted from 2013 to 2015. Figure 1 outlines the 10th foresight, which is comprised three parts. Part 1 involves future societal vision. Part 2 is the conventional Delphi survey to identify key S&T topics needed to realize the societal vision. Based on the results of the Delphi survey, Part 3 covers scenario planning towards the year 2030 from a globalization perspective. The globalization perspective was adopted from international perspectives on

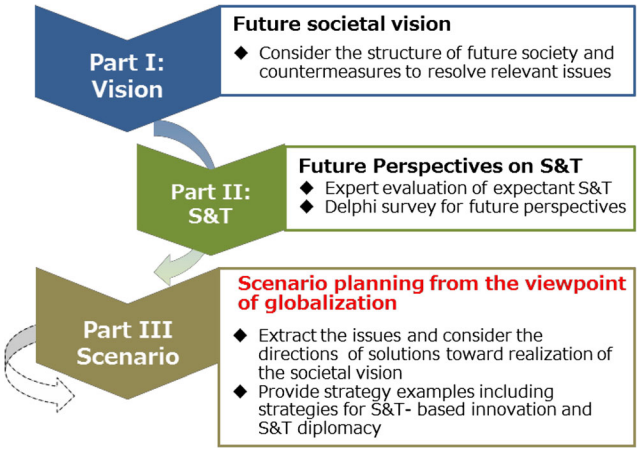

Fig. 1 Outline of the 10th S&T foresight (Source: NISTEP [14])

leadership, international harmonization and collaboration, and autonomy (Fig. 2).

The following are the key points from a review of the last foresight survey:

- Identify a goal-oriented direction for society.
- Detect weak signals and wild cards to sense changes in society.
- Organize workshops with members from different fields to gain a multifaceted perspective.

In this study, we considered these key points and applied the new approach introducing SDGs.

Approach: Sustainable development goals workshop in Japan

Until now, NISTEP did not emphasize SDGs, although we should have. Therefore, the researcher of NISTEP participated in order to deepen understanding SDGs in a workshop on SDGs entitled "Work and Lifestyle in 2030," which was organized by the Sustainability Forum Japan (SFJ).

Sustainability forum Japan (SFJ)

The SFJ was established as the GRI Japan Forum in 2002 to promote the spread of the Global Reporting Initiative (GRI) guidelines and realize a sustainable society. The GRI is a non-profit organization dedicated to creating international standards on sustainability. As an official body of the United Nations Environment Program (UNEP), the GRI formulated international standards in the "Sustainability Reporting Guidelines." Furthermore, the GRI Japan Forum signed a Memorandum of Understanding as a member of the GRI and is working towards understanding and disseminating the guidelines by translating and distributing materials and

Fig. 2 Scenarios as the themes for manufacturing (Source: NISTEP [14])

sponsoring events. Thus far, more than 3250 people have participated in the study meetings and symposia organized. In 2007, the GRI changed its name to the current SFJ. To improve the sustainability of society and enterprise, the forum supported (1) the non-promotion of financial information disclosure; (2) involvement in standards for disclosure; and (3) training personnel to become actively involved in the forum. Currently, 98 active groups and individual members support the forum.

The "work and lifestyle in 2030" workshop

This workshop took place over three days: April 13, May 15, and June 5, 2017. The study group was comprised of 15 people including personnel from the SDGs and corporate social responsibility (CSR). (Fig. 3).

The title, "Work and Lifestyle in 2030" means that while Artificial Intelligence (AI) replaces human labor, need for people and company with diverse values, skills and management are increasing. This is based on the idea that a social economy is sustainable. This study group discussed the possibility of future efforts to create a sustainable society under the present circumstances, which predicts that the production population will change, as a consequence of the low birthrate and aging population. Furthermore, the occupation of the producing population will also change.

The study group developed a list of issues to consider when preparing for the co-existence of humans and AI in the future. These issues address how to:

- Evaluate worker performance in this environment.
- Plan a human resource strategy to enhance corporate value in the future.
- Comprehensively strengthen management and fostering of human resources.

In the following sections, we show how we created Delphi topics [15] and what we tried using it.

This survey is the 10th field-specific S&T foresight since the first technical foresight survey was published in 1971. Its purpose is to gather a broad selection of perspectives from experts in S&T that are thought to be important in society in the future, and to provide recommendations that can be used to guide innovation in S&T. It is a national project that aims to

	STI Researcher Administrator	General Specialist, Staff	
		SDGs	CSR
Laboratory	2		
Corporation	4		3
Government	1		
Organization	2	3	
total	9	3	3

Fig. 3 The participants of workshop

build the significance, international competitiveness, feasibility, and promotion of Japan's S&T policy.

1) First of all, regarding field composition, integration and division were conducted based on the structure of the previous survey. The feature is that enormous data were obtained because of the rapid development of ICT, and the viewpoint of data science was adopted in each field. Also, with the trend of service conversion, importance of information processes and new trends of manufacturing represented by Industry 4.0, which is a necessity in a service-oriented society, new fields were established and the following eight fields were set up.

- ICT and analytics
- Health, medical care and life Sciences
- Agriculture, forestry and fisheries, food and biotechnology
- Space, ocean, earth and science infrastructure
- Environment, resources and energy
- Material, device and process
- Social infrastructure
- Service-oriented society

2) The field-specific committee was in charge of the examination of each field, and detailed items and topics were examined. The chairpersons and committee members of each committee consulted with the experts in that field and the head of the institution. In order to incorporate the viewpoints of a larger number of experts, we organized a group separate from the field committee in some fields and examined the topic draft. Thus, 932 topics were set up.
3) The respondents were experts recommended by association members, researchers from related research institutes, and sectoral committees with network experts (about 2000) of NISTEP. We have compiled responses from about 4300 people.

In the 10th S&T foresight, 932 S&T topics were listed and evaluated in 8 fields (for further details, see Annex). Table 1 created in the following procedure (see Tables 2 and 3).

a) In this study, we looked for S&T topics related to "robot," "AI," and "people" across the fields.
b) Among these, researcher scoped and extracted topics where robots and AI coexist with people at work.
c) The 22 issues extracted in b) were presented in descending order of the importance index scores.

Next, we extracted topics with an affinity towards the issues described in the workshop on SDGs. In Table 1, No. 9 "Development of a framework to achieve efficiency" and No. 19 "Social consensus about the relationship between machines (e.g., robots) and humans" are similar to the issues from the workshop on SDGs. The envisioned result is a stable society and economy in which humans and robots cooperatively coexist.

Then, we explored potential solutions and drafted approaches integrating issues for the co-existence of humans and AI in the future with the Delphi topics. Finally, we suggested approach based on the Delphi survey with regard to the need for proper management and a related framework (Fig. 4).

The scoring was derived from the results of the Delphi survey.

We selected one value from very high, high, low, and very low and calculated the score by digitizing the response (very high: 4 points; high: 3 points; low: 2 points; and very low: 1 point). Since we used the average, 3.58 or 2.19 are the average scores of the responses.

The time horizon was also derived from the results of the Delphi survey.

We obtained responses of the "year" (a certain year between 2015 and 2050), arranged them in a chronological order, and used half of the values in the middle, excluding one quarter of both ends. Both ends of the intermediate 1/2 were set as the width of the responses, and the median value was used as a representative value.

Through the workshop, input from the SDGs and CSR presented us with new insights on how to cope with issues arising from the interaction between humans and AI in a sustainable society. It means that we need the theory, which makes effective use of time by carrying out productive activities and methods to optimize ways of humans and AI cooperation. It will take another three to eight years to appropriately develop the theory and methods required for a comprehensive framework for these issues (Fig. 4).

Our past survey focused on methods for managing natural disasters, aftercare in hospitals, and support equipment related to humans and AI. Considering by balancing the benefits of elderly care with the ethical costs, we need to introduce careful guidelines to improve the lives of the elderly [16]. Ruotsalainen [17] and others emphasized that the emerging impacts on the changing nature of work and workers' movements means that key institutions will have to revise their agendas and re-evaluate their managerial practices. The core ideas revealed that an inspiring work community with everything needed should be designed to be completely separate from society [18].

Sustainable development and sustainable management

The foresight was identified a goal-oriented direction for society based on a review of the 10th S&T Foresight Report. This way, we can clarify the concept of sustainable

Table 1 Delphi topics related to the co-existence of humans and AI

No.	Field	Topics	Importance	Uncertainty	Discontinuity	Morality	Global Competitiveness	Technological realization	Real-world implementation
1	Service-oriented society	The generalization of robot inspection technology to inspect buildings or infrastructures that would be more dangerous or costly for humans to inspect.	3.68	3.23	2.45	2.36	2.32	2020	2025
2	ICT and analytics	Technology to ensure that critical systems which could malfunction and endanger people's lives or health.	3.63	2.71	3.17	2.67	2.70	2025	2030
3	ICT and analytics	A robot which conducts dangerous work such as road, railroad, or electrical maintenance in cooperation with workers with specialized knowledge and skills.	3.61	3.13	2.68	2.49	2.48	2025	2025
4	Service-oriented society	Intelligent robots that can be remotely controlled by family members in order to provide lifestyle support to elderly and mildly disabled people living in remote areas becomes widespread.	3.61	3.09	2.70	2.52	3.17	2024	2026
5	Service-oriented society	Introduction of technologies to communication and nursing care robots that both ensure human safety and shorten the amount of time humans and robots are in contact during operations.	3.59	3.19	2.50	2.59	3.32	2020	2025
6	ICT and analytics	True portable artificial intelligence enabled by high performance computer technology that can be used in machines such as robots.	3.58	3.19	2.94	3.02	2.42	2025	2030
7	Social infrastructure	Robots capable of successfully rescuing people from rubble or providing emergency transport inside buildings.	3.58	3.16	2.45	2.38	2.40	2024	2026
8	Service-oriented society	Laws on agricultural corporations will be amended, opening the door to the creation of new agricultural businesses such as fully automated robot farm work.	3.55	2.80	2.50	2.65	2.35	2023	2025
9	Service-oriented society	Development of a framework to achieve efficiency without sacrificing quality when services are provided by IT or robots in the service industry.	3.44	3.11	2.56	2.44	3.22	2030	2033
10	Social infrastructure	Disaster relief robots to identify and rescue survivors at disaster sites.	3.39	3.21	2.89	2.60	2.57	2025	2030
11	Health, medical care and life Sciences	Treatments for restoring lower limb functions that were lost due to spinal cord injuries by using walking-support robots.	3.37	3.44	2.19	2.15	2.41	2021	2025
12	Health, medical care and life Sciences	A surgical robot which transmits the texture of tissues and organs to the hand of the operator through high sensitivity haptic detection and feedback functions.	3.33	3.00	2.63	2.71	2.33	2022	2025
13	Agriculture, forestry and fisheries, food and biotechnology	Robotic technology to automate farm work completely.	3.33	3.36	2.75	2.67	2.33	2023	2028
14	Service-oriented society	Establishment of advanced residential building design technology that enables the elderly and people with disabilities to have a 'natural life,' in which barrier-free design is improved and made compatible with coexisting with robots.	3.33	2.86	2.33	2.33	2.67	2025	2028
15	Social infrastructure	Housing incorporating robots and other equipment to help elderly people and the handicapped eat, bathe, use the bathroom, and enjoy recreation on their own without the help of a caregiver.	3.30	3.07	2.49	2.41	2.94	2025	2025
16	Social infrastructure	Life support robots which provide users with disaster prevention, crime prevention, and nursing support functions.	3.30	3.00	2.68	2.71	3.00	2025	2030
17			3.29	2.94	2.91	2.81	2.91	2025	2030

Table 1 (continued)

No.	Field	Topics	Importance	Uncertainty	Discontinuity	Morality	Global Competitiveness	Technological realization	Real-world implementation
	Health, medical care and life Sciences	An intention communication device (brain machine interface, or BMI) that directly reflects brain activity to support the daily activities of patients suffering from severe motor function disability due to amyotrophic lateral sclerosis (ALS).							
18	Social infrastructure	Intelligent robots to work on construction sites instead of humans.	3.28	3.22	2.53	2.58	2.54	2024	2025
19	ICT and analytics	Social consensus about the relationship between machines (e.g. robots) and humans.	3.27	3.00	2.85	2.85	3.69	2025	2030
20	ICT and analytics	Artificial Intelligence capable of understanding conversation and the relationship between speakers so that it is able to participate in the conversation naturally.	3.20	2.83	2.98	2.76	2.55	2028	2030
21	ICT and analytics	A robot which first possesses infant- level intelligence, physical, and learning abilities, then through human education and external information develops until it obtains adult-level work skills.	3.09	2.77	3.20	3.10	3.06	2030	2037
22	Social infrastructure	Robots which clear snow from roofs, around houses, and on roads safely and efficiently.	3.00	2.82	2.28	2.09	2.25	2025	2028

development. In the foresight introducing the SDGs, we need to deepen our understanding of transition and concept regarding sustainable development.

We describe sustainable development as a societal vision, although the concept has various meanings. The understanding of sustainable development differs according to one's position. Therefore, we recognize that the roles of companies and communities become important in the foresight survey on STI. As such, we must focus on sustainable management. Kuribayashi [19] shows the difference in "Sustainable Development" and "Sustainable Management".

Sustainable development

Based on international trends from the 1970s, the term sustainable development has appeared in various activities related to UN since the early 1980s. Specifically, this concept became commonly known as a momentum triggered by the World Commission on Environment and Development (WCED) founded in 1984. In 1987, the WCED [20] established the concepts of meeting the needs of the present generation without sacrificing the needs of future generations, as well as sustainable development in relation to environmental conservation activities and development. Since then, sustainable development has referred to various global problems such as economic development in developing countries, cross-border environmental problems, resource constraints, and economic disparity between developed and developing countries.

In the mid-1980s, the impact of environmental destruction had spread on a global scale, and even in developing countries, environmental destruction was severe. Under these circumstances, people recognized that development without compromising the surrounding environment would lead to sustainable development. As such, the concept of sustainable development will expand. In the background, the influences of environmental problems is already observed in human society across the globe in the form of economic disparity, poverty, and concerns about local pollution and natural destruction. Essentially, the purpose of sustainable development as an ideal was to illustrate how global environmental issues are deeply related to various problems.

Therefore, discussions related to the concept of sustainable development erupted in various disciplines and practical fields. Based on these discussions, Morita and Kawashima [21] organized the definitions of sustainable development as they appeared in major literature into the following categories: "Definition that emphasizes natural conditions," "Definition emphasizing fairness among generations," and "High-level perspectives such as social justice and quality of life." Subsequently, they summarized the characteristics within each category. Below are the summaries and comparisons of the representative assertions.

Table 2 R&D characteristics

Variables	Definitions	Options
Importance	Comprehensive importance from both S&T and societal perspectives	Select one from: Very High / High / Low / Very Low * Responses are coded as Very High = 4, High = 3, Low = 2, Very Low = 1
Uncertainty	Involving many stochastic elements and needing methods to tolerating failures and multiple approaches to be considered during R&D	
Discontinuity	The result of R&D is not merely an extension of current state but is market-destructive and innovative	
Morality	Needing to consider morality and societal acceptance during R&D	
Global competitiveness	Enabling Japan to have global competitiveness over other countries	

(1) Definition that emphasizes natural conditions

This definition emphasizes engaging in human activities under natural environmental constraints such as protection of biodiversity, environmental capacity restrictions, and the conservation of natural resources. From this perspective, human activities are positioned inside or below the environment, and the continuity of the environment and natural resources is prioritized. Pearce [22] and others stated: "For sustainable development, we should not reduce natural capital forever." In addition, Pearce stated that "weak sustainability" replaces the decreasing natural capital with artificial and technological capital, while "strong sustainability" complements natural capital with artificial and technological capital so that natural capital is not lost or reduced. However, this perspective shifts the emphasis from natural capital to fairness among generations. Kuik [23] and others noted that even in the case of renewable resources, limited locations and lifetimes should be considered in terms of their use.

(2) Definition emphasizing fairness among generations

This definition emphasizes that "goal setting to sustain economic growth does not only prioritize the current generation's economic growth, but also ensures the economic growth of future generations." This viewpoint focuses on continuous economic growth. Representatives such as Howarth [24] and Norgaard abided by this definition, highlighting the "fairness in allocating resource rights among generations concerning the use of natural resources," rather than nature, as there is an interest in the development of the human race. In measuring this development, the focus is often on economic development.

In addition, Goodland [25] and others emphasized maintaining the structure that maximizes the currently enjoyed economic and social benefits for future generations, and that human beings will distribute economic well being permanently for generations. Accordingly, by achieving this structure, society should demonstrate that sustainable development would be achieved. However, this does not mean that stocks of current natural resources and assets are stored as they are; rather, as development progresses, the composition of the required natural resources and assets will change [26].

(3) High-level perspectives such as social justice and quality of life

In contrast to (2), this definition emphasizes fairness within generations. In other words, even if one generation has developed smoothly as a whole, the social condition in which there

Table 3 Timing of realization and implementation

Variables	Definitions	Options
Technological realization	When technology is expected to be achieved (somewhere in the world including Japan) When technological environment is ready such as achievement of anticipated performance. (e.g., when prospect of technology development becomes clear in stage of R&D in a lab) When a theory or phenomenon becomes scientifically established in case of fundamental science	Select one from: Achieved / Achievable / Not Achieved/ Not Sure If "Achievable" selected, additional question will be asked to identify the year that will be achieved between 2015 and 2050
Real-world implementation	When it's applied in the Japanese society or internationally led by Japan When achieved technology is available to be used as a product or service (or when it's diffused widely) When a framework, ethical standard, values, or societal consensus is established in case of non-S&T topics	

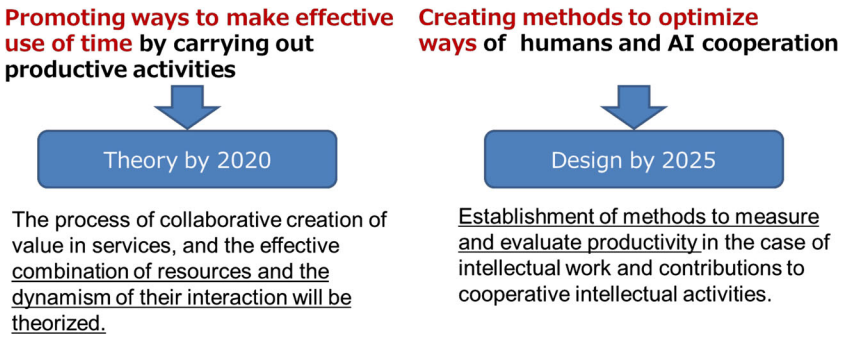

Fig. 4 Approaches derived from the Delphi survey

is a difference between rich and poor among the same generation is never favorable. Barbier [27] states:

> The concept of sustainable development is to rescue poor people from poverty by providing permanent and stable supplies of living goods, rather than being presented in quantitative economic growth. We are concerned that with the supply we must meet basic needs such as minimizing resource consumption, environmental deterioration and social unrest.

Barbier emphasized that the principle element of sustainable development was that supply must meet the basic needs of the current generation. In other words, sustainable development considers not just the next generation from the perspective of the sustainable development of human beings, but also considers social equity in the current generation.

In addition, Liverman [28] and others reported that to live sustainably does not simply mean to live ecologically, but also to live qualitatively, as it is necessary to maintain basic living support systems such as air, water, and soil. Furthermore, they reported a prospective need for the system framework to be a foundation from which basic living support can be distributed. Likewise, Sen [29] suggested that the lack of economic instruments impairs the ability of the impoverished to pursue a better life.

Sustainable management

Sustainable management is a keyword used to link sustainable development to private enterprise activities. However, this keyword is not always used synonymously in practice. The meaning is different for each applied entity and intended purpose. Below is a review of how to use the term sustainable management, its genealogy, and how to categorize it.

(1) Emphasis on continuity and development of activities in the corporate economy

The term sustainable management and related concepts are not necessarily limited to those developed through sustainable development. Scholars discussed the continuity of management activities for the purpose of an enterprise's economic profit before the global environment became a problem. For example, in Schumpeter, development is not a change in the economy moved by external shocks or a continuation of the conventional, but a change that occurs in the economy created from within itself, regarded as a completely new phenomenon [30]. This theory was presented before global environmental issues were considered; however, recent discussions centered on technological progress and reform involve mainstream ideas on how to survive the economic growth of companies.

With regard to the discussion on corporate continuity or development, Schumpeter asserted that companies should not maintain existing technologies and organizations, but use completely different technologies and organizations. This way, innovation advances by repeating innovation. Without such actions, companies insist that other companies will replace them (Schumpeter [30]). As companies create products and services, they constantly develop innovative challenges through which they will develop and survive. During the course of technological innovation in the twentieth century, although Schumpeter's ideas have been endorsed, another scholar, Christensen, presented a different theory. He suggested that through such a process, even if the product provided to the market is sophisticated, if the company exceeded the required performance level, the customers' interests would shift towards products that are easy to use. In the market, a phenomenon exists in which products with low added value are swiftly purchased at low prices; thus, sophisticated technology alone cannot survive market competition [31]. In addition, using Schumpeter's theory, Stuart [32] considered sustainability as a destructive force that transforms the structure of industry completely, improving without fundamentally changing the manner of products, processes, and services. Therefore, only companies relying on continuous improvement will suffer a disadvantage, as they will replace companies that undertake drastic reform and innovation. Even if pursuing only technological development, these are the concepts in which the existence of a company is bound.

In Levitt [33], corporate sustainability involves retaining day-to-day courtesy without forgetting honesty and good intention, while pursuing long-term profit maximization. Levitt

insisted that there should not be distractions from social obligations, employment, and welfare, about which he was concerned from the early days of capitalism.

In the 1960s, Marris [34] noted that the total assets and demand, along with the growth rate of production capacity, should measure a company's sustainable growth. This is because the growth rate of production capacity changes, as do gross profit or total sales. Galbraith [35] stated that large companies aim to produce goods and income by using advanced technology ahead of other companies. However, if people are concerned about CSR or a greater purpose in society, large companies must respond.

On the other hand, Barney's theory [36] is a way for companies to take advantage of resources such as human resources, organization, reputation, brand, and intellectual property in competition with others. Similarly, companies with high economic performance suggest that the optimization of these resources has led to company development. Concurring, the idea that innovation and technological development—from building knowledge in the organization to enhancing organizational capabilities and forming and developing capabilities that other companies cannot imitate—are necessary factors for company sustainability [37].

(2) Emphasis on the impact of corporate economic activities on the natural environment categorized here is the concept of sustainable management born during the reform of corporate awareness as international interest in global environmental issues rose. The concept focuses on the relationship between corporate profit-oriented activities and the global environment.

In economics, many studies have discussed the relationship between human economic activities and ecosystems rather than individual companies. Daly [38] used economics to show the limits of human economic activity, terming the level of optimal economic activity with recognition of its sustainable limits as a state of sustainable management. In the macro-economy, sustainability is not included in the cost, because growth can only reach the optimum total resource utilization scale, or it will deplete resources and destruct the environment. In this discussion, human economic activity is defined by the regenerative power of the ecosystem (e.g., the ability of the forest to regenerate once timber has been cut) and absorbency (e.g., the ability of the atmosphere and ocean to take in and cleanse pollutants). Sustainability will be prescribed by the capability of the smaller power. The optimal scale can be assumed as a human-centered optimum and life-centric ideal; however, no matter which concept is used; it is compatible with sustainable development if it does not exceed the upper limit.

Costanza [39] found that measuring the impact of ecosystems on human economic activity or measuring the impact of the economy on ecosystems is extremely beneficial to understand how to maintain environmental systems. Therefore, Constanza suggested the importance of measuring the relationship between ecosystems and the economy in a pluralistic way.

Conversely, many concepts focus on the relationship between the activities of individual companies and the ecosystem. For example, the Coalition for Environmentally Responsible Economies (CERES) pointed to the Exxon Valdez accident in 1989, which caused a large volume of crude oil to spill into Alaska's Prince William Sound. Within this frame of focusing on individual companies and the ecosystem, researchers rely on the Celise Principle, which consists of 10 principles including protection of the biosphere, sustainable use of natural resources, waste disposal and reduction, energy saving, risk reduction, safe products and services, environmental restoration, information disclosure, management commitment, and environmental responsibility.

Meanwhile, Porter [40] and others said that environmental regulations promote corporate technological innovation and improve the quality of products manufactured by companies, which leads to economic development and enhances competitive advantage. In particular, Porter argued that corporate efforts to regulate the environment positively influenced corporate performance. This concept became known as the "Porter hypothesis." Mohr [41], who supported the Porter hypothesis, argued that obligations under environmental regulations are similar to trade protection policies. In addition, Mohr stated that even if companies invest in technological innovation for only a brief time, they would benefit from technological innovation in their initial stages of development.

Moreover, to prevent pollution, instances in which strategic partnerships are formed among different companies to contribute to technical solutions are increasingly emerging. The exchange of energy and materials among different industries in the vicinity, review of processes aimed at zero emissions, evaluation of all production processes, and use of state-of-the-art technology are all solutions that can be considered. Working on such a wide range of activities improves companies' efficiency and competitiveness [42].

(3) Focusing on the impact of corporate activities in society

Part of the development pathway for companies' sustainable management was inspired by sustainable development, which includes both the environmental and social perspectives, the latter emphasizing equity among people. For example, the Natural Step, established in 1989, aims at a society in which the environment, economy, and society develop in a well-balanced manner without considering environmental conservation activities as a cost. In 1994, The Natural Step presented four principles as a vision to be reached [43].

Elkington [44] concentrated on enhancing the economic aspect of the company and improving environmental and social

aspects to balance these three aspects. Elkington further advocated that companies should aim for sustainable development. To illustrate the need to consider the environment and society's activities, Elkington presented his theory as the triple bottom line, in reference to a financial statement bottom line, which represents the a company's financial results. In his theory, the results of the three aspects above would represent the triple bottom line. He also emphasized the involvement of stakeholders and companies in society. This concept of the triple bottom line, advocated by Elkington, has become the basis of organizational assessments that measure sustainability.

Giddens [45] presented a modernized idea of sustainable development that includes environmental friendliness and expects voluntary cooperation by industries. However, in the modern world, people urge others to engage in scientific advancement and respond to risks. Thus, Giddens suggested that citizens should acquire the ability to cope with risks, acquire value by undertaking risks, and participate in the decision-making process.

Recently, Muff [46] and others noted that the concept of "true business sustainability" is intended to refine shareholder value and reflect a triple-bottom line approach, as well as introduce an issue-centered perspective to contribute to the resolution of large sustainability challenges. Accordingly, companies now possess higher aspirations.

As a result of the reviews from (1) to (3) above, even if we use the term sustainable management, it is not necessarily used in a sense linked to the concept of sustainable development. However, chronologically, many older definitions focus on the economic prosperity of the enterprises indicated in (1), while more recent ones such as in (2) and (3), discuss companies' activities and their relevance to environmental problems and society. As such, society's demands for businesses will continue to evolve over time.

Although following sustainable development and sustainable management will have a significant impact, in reality, their corresponding processes are challenging to implement.

Here, we describe the goals set for sustainable development such as the MDGs and SDGs presented by the UN.

MDGs and SDGs

The UN Summit on the Millennium Development Goals concluded with the adoption of a global action plan to achieve the Millennium Development Goals (MDGs). These goals promote the cooperation between the private sector, foundations, international organizations, civil society, and research organizations.

The UN proposed the action-oriented 2030 Agenda for SDGs. These goals were established to complete the unfinished business of MDGs and include new challenges. These goals consist of global priorities for sustainable development that will integrate economic, social, and environmental aspects. The goals support development action over the next 15 years in areas of critical importance for humanity and the planet.

While the MDGs were created for experts and focused on developing countries, SDGs are formulated for the world and encourages everyone's participation.

In 2001, MDGs were introduced with eight goals and 21 targets. Among these objectives, the following two targets were accomplishments noted in the Millennium Development Goals Report [47].

- In 2010, the target to "Eradicate extreme poverty and hunger" was achieved, reducing the number of people living in extreme poverty by half.
- Between 2000 and 2015, the target to "Achieve universal primary education" saw an increase in the net enrollment rate for primary education.

Other targets were harder to reach even with the experts' help. Therefore, SDGs were set to proceed toward the goals with all as subject of action. The movement for implementing SDGs began in 2015. However, the speed of the implementation has been slow.

Next, we examined the SDGs goals and targets refer to our activities. Then, we created the foresight platform with respect to SDGs as interim surveys towards next foresight. In the next chapter, we describe these processes.

Method

(1) Deepen the understanding of SDGs.

To examine the SDGs, we selected those we regarded as related to our activities through the workshop, which was organized by the Japan Innovation Network [48] and the United Nations Development Programme (UNDP) [49].

The procedure in workshop was as follows:

1) Overview of 17 goals and 169 targets are provided by experts.
2) Participants select the goals and the targets that are relevant to their activities through an evaluation sheet (strong, somewhat, irrelevant).
3) Participants discuss their evaluation with others.
4) Reconsider the goals and targets based on importance and influence on our activities.
5) Decide what actions are appropriate.

Based on the workshop, we determined the values from the goals and targets, which we were previously unable to detect.

We discussed the findings in our institution from the perspective of the relation with STI and organized them (Fig. 5).

Fig. 5 Selected goals and targets on SDGs

Goal N0.	Outline of Goal	Target No.	Outline of Target
4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	4.7	By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development
10	Reduce inequality within and among countries	10.2	By 2030, empower and promote the social, economic and political inclusion of all
12	Ensure sustainable consumption and production patterns	12.a	By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature
16	Promote just, peaceful and inclusive societies	16.6	Develop effective, accountable and transparent institutions at all levels
		16.7	Ensure responsive, inclusive, participatory and representative decision-making at all levels

After the discussion, our prime interest narrowed to the following five key points:

a) Develop accountable and transparent institutions.
b) Empower and promote the social, economic and political inclusion of all.
c) Ensure people everywhere are informed and aware.
d) Acquire knowledge and skills.
e) Ensure responsive, inclusive, participatory, and representative decision-making. The integration of these five targets is explained as follows.

(2) Determine issues from previous foresight and next challenges

We reviewed previous foresight in terms of whether it was suitable for SDGs or not. And we discussed issues and next challenges by authors as follows.

Issues:
- Typically, our foresight group is comprised of experts and scientists. We noticed that participants consistently provided insufficient diversity to adequately detect trends and signals.
- We merged different participant perspectives through international cooperation in order to have a broader view of foresight activities.
- With our Delphi survey, we strengthened our ability to extract topics that influence and promote social change.

Challenges:
- At what stage of the foresight activity process it is effective to involve stakeholders?
- How can we introduce the results of Delphi and lead to scenario planning?

(3) Synthesize SDGs and foresight

We completed the following procedure:

1) Consider which process of foresight is appropriate to realize the target of the selected five SDGs by using introduction slides for each step of our activities (affinity activities).
2) Create ideas on what kind of initiatives will lead to solutions to the problems of foresight (solution activities).
3) Refer to the goals of the five SDGs and the activities of the foresight, grasp the overall picture (Fig. 6).

Based on the five key points of SDGs and issues and challenges from previous foresight, we converted issues and challenges into more specifically.

- SDGs: a) Develop accountable and transparent institutions.
  Foresight: Make the process transparent and publish the contents.
- SDGs: b) Empower and promote the social, economic and political inclusion of all aspects.
  Foresight: Promote the platform through the public relations.
- SDGs: c) Ensure people everywhere are informed and aware.
  Foresight: Widely disseminate Delphi topics to all.
- SDGs: d) Acquire knowledge and skills.
  Foresight: Have a participatory gamification and maximize the user experience

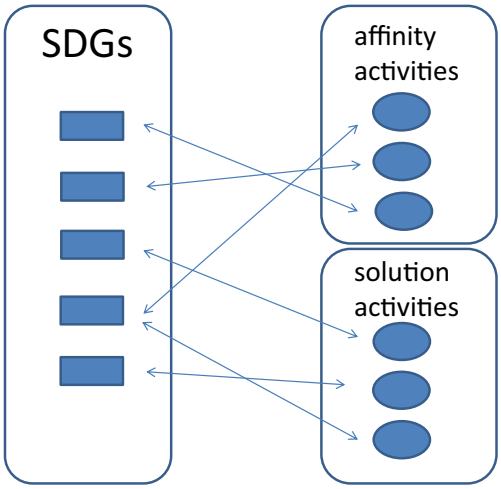

Fig. 6 Synthesize SDGs and foresight

- SDGs: e) Ensure responsive, inclusive, participatory, and representative decision-making.
  Foresight: Before decision-making by the government, users can participate and reflect on the results.

Results

From viewpoints of synthesizing SDGs and foresight, we propose the "Future Public Platform (FPP)" as an authors' conceptual model (Fig. 7).

For example, one goal of SDGs is "By 2030, ensuring that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature." However, to approach this independently, it is necessary to consider whether information on sustainable development should be provided and, if so, decide how this information should be collected, extracted, and provided. Furthermore, to organize this information, expert knowledge and authorization are required. Thus, the preparation and execution of SDGs requires considerable investment of money and time. Conversely, in the independent approach to Delphi, there are committees that decide S&T topics and response questionnaire to evaluate the S&T topics. It is difficult to involve citizens in discussions with experts in the field and evaluation of S&T topics. It is necessary to acquire scientific knowledge and understand S&T topics in advance, which is time consuming and costly.

In the Delphi survey, we set seven variables (Importance, Uncertainty, Discontinuity, Morality, Global competitiveness, Technological realization, and Real-world implementation) for S&T topics and got experts to evaluate them. The variables "Uncertainty," "Discontinuity," and "Technological Realization" apply to "uncertainty, complexity, and ambiguity". In the FPP, we can use Delphi to provide information with those expert evaluation. Moreover, citizens and experts can directly and effectively access information on S&T from anywhere, without increasing time and cost investment. The FPP also presents numerical values of these evaluation indices as a user's judgment material.

We propose the FPP to open the Delphi assets and encourage stakeholders to utilize them effectively. We aim to be accountable and transparent. The FPP will be open to all people including citizens, foreigners, and experts, and ensure that they are informed and aware. The Delphi survey is being conducted every five years. The FPP is based on the input of the entire Delphi survey result. Using the data source of Delphi result, the FPP can be conducted many times while changing multiple stakeholders. We implement the thesaurus system based on the past Delphi survey. The platform displays the Delphi topics related to keywords through the thesaurus system. An automatic filter refers to display not only S&T topics related to keywords entered by the user but also S&T topics derived from keywords and the context of topics. Thus, it helps in expanding the user's interest. Furthermore, people can acquire knowledge on the STI and skills to assemble technology. Finally, this inclusive and interactive platform enhances individuals' decision-making.

The FPP procedure is as follows:

1) Individuals enter their information (age, gender, residence, occupation).
2) Individuals input keywords into the platform related to the societal vision in which they are interested.
3) The platform displays the Delphi topics related to keywords through an automatic filter.
4) The scenario is created as a near future (short term), a medium future (midterm), and a distant future (long term) in consideration of the combination from the displayed topics. Individuals select short, mid, and long-term Delphi topics from the list.
5) The selected topics form a Delphi set.

This process should include gamification elements. We consider that gamification elements are necessary for such behavior. It is difficult for us to get citizens to be interested in S&T, and therefore we designed the gamification to increase engagement. Heinonen [50] pointed that it was more effectively to introduce interactivity roll playing at the stage of drafting a scenario and in future studies, game-based forecasting is closely related to the concepts of experimental and immersive forecasting.

Additionally, we propose to combine the FPP and scenario planning. Currently, we've designed scenario planning to be drafted by experts. Experts generate more unique scenarios and include more diverse referenced articles than did non-experts [51]. The procedure is as follows:

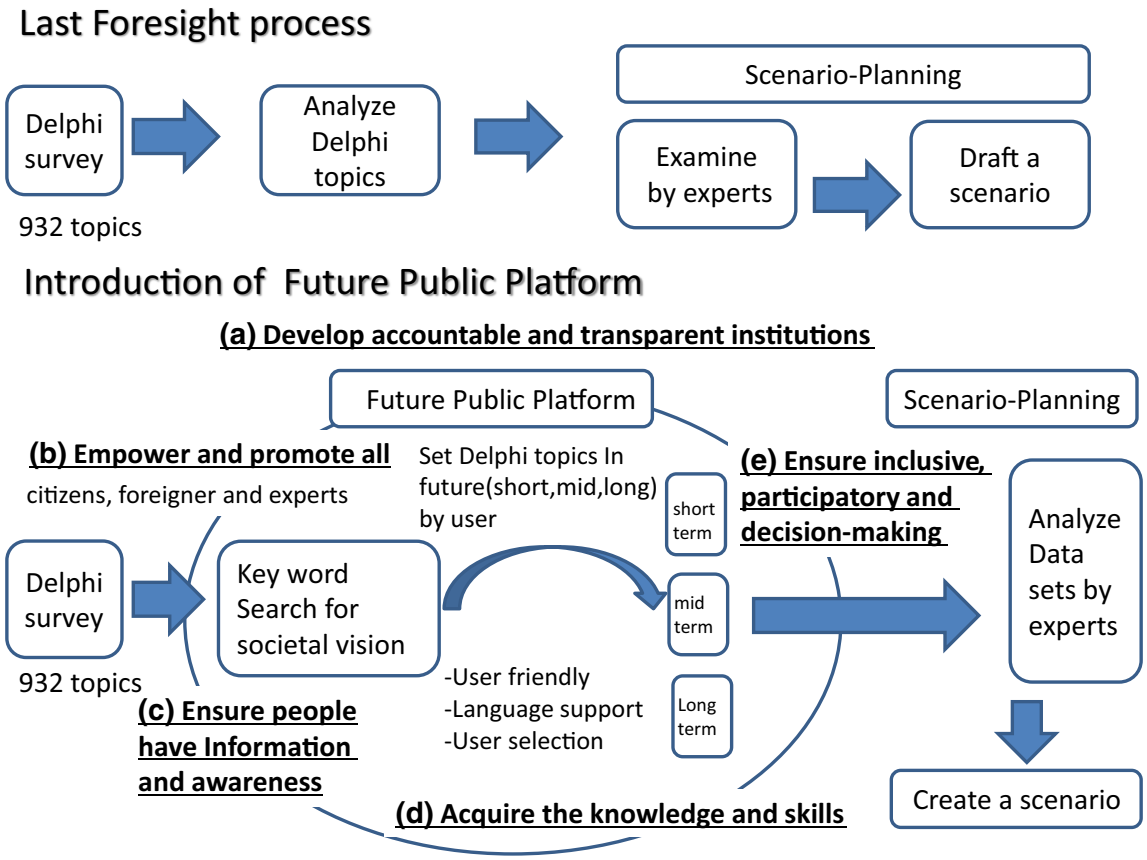

Fig. 7 The Future Public Platform and scenario planning

1) The database collects feedback from individuals.
2) Analyze these data sets and examine them with experts.
3) Draft a scenario introducing the FPP results.

Consideration

There have been sophisticated platform precedents such as the Real-Time Delphi (RTD) by the Millennium Project [52] in Europe and X Project [53] in Korea. The RTD focuses on the process of synthesizing expert opinions effectively and provides a multiple-round platform through which respondents' results are updated and recorded in real time. Conversely, the X Project provides a semi-open platform in which citizens selected to the national R&D project can participate. In addition, several other foresight platforms have been implemented worldwide.

The FPP will incorporate the ideas from the RTD and X project and provide a complete public platform open to all. Anyone can participate in the FPP, which will create the future through use of topics in the Delphi. These data will be accumulated and formulated for scenario planning. Through these innovative processes, we can share our societal vision and strategically plan for and manage our complex and uncertain future.

As the verification of the FPP, four participants from the workshop was organized by SFJ were surveyed to collect feedbacks on the concept of FPP. Their comments are as follows:

"I would like to know about the future. However it is hard to predict it comprehensively.
So the FPP is an interesting tool to visualize the future."
"Rather than coming up with keywords, I would like to have a list to choose."
"In the future, will the FPP become completely run by AI without personal preference taken into consideration?"
"The FPP is ineffective because individual future paths can't be shown as some users will choose the same topics and get the same results."

Based on the participants' reviews, we have acknowledged the need to add more topics and enhance the platform's flexibility by filtering the topics regularly.

The FPP will address the gap between science and society by promoting people's interests, and will increase people's awareness and interest in science. Using the knowledge and skills obtained through the FPP, participants will design a roadmap for their future. The analysis of data collected from the FPP participants will enable us to discern the core technologies needed for the societal vision. Furthermore, the platform would open doors for participants to better contribute to SDGs. Ramirez indicated that civil society's participation level is a driving force [54]. Provided this process is realized, we could utilize the

system for decision-making for individuals, groups, organizations, and even government bodies.

In addition, on the FPP, cooperation with international organizations is strengthening. Pfotenhauer [55] noted that it was important to enhance interaction to build capacity through international collaboration.

Conclusion

We noted the importance of considering the SDGs in foresight. Therefore, we examined the concept of sustainable development, considering how to integrate the SDGs into foresight, and propose the FPP as the authors' conceptual model. This FPP effectively involves five SDG targets and appears to be highly executable. Though the system of the FPP has a certain difficulty, we could exchange information among researchers and experts who are studying SDGs and foresight. Additionally, we need to gather and analyze more public opinions on the FPP. Thus, as a case study of connections between foresight and SDGs, it would be helpful for other countries.

Ultimately, the combination of the FPP and scenario planning will gradually bridge the gap between science and society to construct our future.

Acknowledgement The authors would like to gratefully thank Professor Yuichi Washida at Hitotsubashi University and Dr. Yoshiko Yokoo at NISTEP for comments and suggestions. The authors also wish all those who participated in workshops in this paper.

Annex

Delphi survey

We have organized discipline-based expert committees for the Delphi survey, fully utilizing our S&T expert network and major science associations. Approximately 100 experts have joined the survey committees and listed 932 S&T topics in eight fields to be surveyed. We have conducted a traditional yet web-based Delphi survey, to which 4309 experts in each S&T discipline have responded. The questionnaire timing and collection status are as follows:

- Original questionnaire execution period: September 1–30, 2014
- Target audience: 4309 people
- The second questionnaire execution period: October 6–24, 2014
- Target audience: 1933 people

The Delphi field

Field	Sub field	The number of topic
ICT and analytic	Artificial intelligence	9
	Vision and language processing	7
	Digital media and database	9
	Hardware and architecture	10
	Interaction	10
	Network	12
	Software	10
	HPC	9
	Theory	11
	Cyber security	7
	Big data, CPS and IoT	9
	ICT and Society	11
Health, medical care and life Sciences	Pharmaceuticals	13
	Medical device and technology	18
	Regenerative medicine	17
	Common disease	36
	Intractable and rare disease	13
	Psychiatry and neuropathology	18
	Emerging and re-emerging infectious disease	12
	Health and medical information and epidemiology	25
	Enabling technology	10
	others	9
Agriculture, forestry and fisheries, food and biotechnology	Agriculture: Advanced production	8
	Agriculture: Crop development	25
	Agriculture: Disease control	4
	Agriculture: Biomass utilization	6
	Agriculture:Environmental conservation	3
	Food: Advanced production	1
	Food: Distribution and processing	4
	Food: Food safety	6
	Food: Food functionality	6
	Fishery: Resource conservation	7
	Fishery: Breeding and production	7
	Fishery: Environmental conservation	7
	Forestry: Advanced production	4
	Forestry: Biomass utilization	6
	Forestry: Environmental conservation	5
	Common: Information service	21
	Common:Others	12
Space, ocean, earth and science infrastructure	Space	14
	Ocean	13
	Earth	12
	Earth observation and prediction	11
	Accelerator, elementary particle and atomic nucleus	17
	Beam application: synchrotron radiation	13
		14

(continued)

Field	Sub field	The number of topic
	Beam application: neutron, muon, charged particle etc.;	
	Computational sciences and simulation	13
	Mathematical sciences and big data	14
	Measurement infrastructure	15
Environment, resources and energy	Energy production	15
	Energy consumption	10
	Energy distribution, transformation, storage and transportation	11
	Resources	9
	Reuse and recycle	7
	Water	11
	Global warming	7
	Environmental conservation	4
	Environment analysis and forecasting	5
	Environment creation	9
	Risk management	5
Material, device and process	Creation of new substance, material and function	17
	Advanced manufacturing	13
	Modelling and simulation	12
	Measurement and analysis method of advanced material and device	12
	Application device and system in the fields of ICT	12
	Application device and system in the fields of nanotechnology environment and energy	21
	Application device and system in the fields of nfrastructure	5
Social infrastructure	Land development and conservation	9
	City, architecture and environment	12
	Infrastructure management and maintenance	4
	Transportation and distribution infrastructures	11
	Automobile, rail, vessel and aviation	27
	Technology for disaster prevention and reduction	16
	Information of disaster prevention and reduction	14
Service-oriented society	Management and policy	9
	Knowledge management	11
	Product Service Systems (PSS)	9
	Society design and simulation	8
	Service sensing	11
	Service Design	10
	Service Robots	12
	Service theory	10
	Analytics	10
	Basic research in humanities	11

References

1. Popper R (2008) How are foresight methods selected? Foresight 10(6):62–89
2. Loveridge D, Saritas O (2009) Reducing the democratic deficit in institutional foresight programmes: a case for critical systems thinking in nanotechnology. Technol Forecast Soc Chang 76(9):1208–1221
3. Yokoo Y, Okuwada K (2013) Identifying expected areas of future innovation by combining foresight outputs. Foresight 15(1):6–18
4. Kondo Y, Miki K, Kuronuma T, Hayakawa YS, Kataoka K, Oguchi T (2016) Concurrent and sustainable development of a local-scale digital heritage inventory through action research at bat, Oman. Journal of cultural heritage management and. Sustain Dev 6(2):195–212
5. Mauser W, Klepper G, Rice M, Schmalzbauer BS, Hackmann H, Leemans R, Moore H (2013) Transdisciplinary global change research: the co-creation of knowledge for sustainability. Curr Opin Environ Sustain 5:420–431
6. Heinonen S, Balcom Raleigh N, Karjalainen J, Minkkinen M, Parkkinen M, Ruotsalainen J (2015) Causal layered analysis game on neo-carbon energy scenarios. CLA GAME REPORT, Finland futures research Centre (FFRC):31-38
7. San-Jose L, Retolaza JL (2016) Is the Delphi method valid for business ethics? A survey analysis. European Journal of Futures Research 4:19
8. Duckett DG, McKee AJ, Sutherland LA, Kyle C, Boden LA, Auty H, Bessell PR, McKendrick IJ (2016) Scenario planning as communicative action: lessons from participatory exercises conducted for the Scottish livestock industry. Technol Forecast Social Chang 144:38–151
9. Hage M, Leroy P, Petersen AC (2010) Stakeholder participation in environmental knowledge production. Futures 42:254–264
10. Walsh CL, Glendinning S, Castán-Broto V, Dewberry E, Powell M (2015) Are wildcard events on infrastructure systems opportunities for transformational change? Futures 67:1–10
11. United Nations https://www.un.org/
12. van der Hel S, Biermann F (2017) The authority of science in sustainability governance: a structured comparison of six science institutions engaged with the sustainable development goals. Environ Sci Policy. https://doi.org/10.1016/j.envsci.2017.03.008
13. Butler JRA, Bohensky EL, Suadnya W, Yanuartati Y, Handayani T, Habibi P, Puspadi K, Skewes TD, Wise RM, Suharto I, Park SE, Sutaryono Y (2016) Scenario planning to leap-frog the sustainable development goals: an adaptation pathways approach. Climate Risk Management 12:83–99
14. NISTEP (2015) The 10th science and technology foresight: scenario planning from the viewpoint of globalization. NISTEP REPORT no.164 summary
15. NISTEP (2015) The 10th science and technology foresight: future perspectives on science and technology by field. RESEARCH MATERIAL no.240
16. Sharkey A (2012) Granny and the robots: ethical issues in robot care for the elderly. Ethics Inf Technol 14:27–40

17. Ruotsalainen J, Heinonen S, Karjalainen J, Parkkinen M (2016) Peer-to-peer work in the digital meaning society 2050. European Journal of Futures Research4:10. doi:https://doi.org/10.1007/s40309-016-0092-2
18. Heinonen S, Minkkinen M (2016a) Interpreting built cityscape: deconstructing the metaphorical messages of futuristic buildings. Futures 84:173–175
19. Kuribayashi M (2011) A Study on Concept and Indicators of Sustainable Management in Small and Medium-sized Enterprises (SMEs). Ph.D. thesis. Tokyo University
20. World Commission on Environment and Development (WCED) (1987) Our Common Future. Oxford University Press, Oxford
21. Morita T, Kawashima Y (1993) Concept and measurement of sustainable development. Keio. J Econ 85(4):532–561
22. Pearce D, Markandya A, Barbier E. B (1989) Blueprint for a green economy. Earthscan Publications, London
23. Kuik O, Verbruggen H (1991) In search of indicators of sustainable development. Kluwer Academic Publishers, The Netherlands
24. Howarth RB, Norgaard RB (1990) Intergenerational resource rights, efficiency, and social optimality. Land Econ 66(1):1–11
25. Goodland R, Ledec G (1987) Neoclassical economics and principles of sustainable development. Ecol Model 38:19–46
26. Repetto R (1986) World enough and time. Yale University Press, New Haven
27. Barbier E (1987) The concept of sustainable economic development. Environ Conserv 14(2):101–110
28. Liverman DM, Hanson ME, Brown BJ, Merideth Jr RW (1988) Global sustainability: toward measurement. Environ Manag 12(2):133–143
29. Sen AK (1992) Inequality reexamined. Clarendon Press, Oxford
30. Schumpeter JA (1912) Theorie der wirtschaftlichen Entwicklung (Nakayama, Tohata, Shionoya: Iwanami, 1997)
31. Christensen CM (1997) The innovator's dilemma: when new technologies cause great firms to fail. Harvard Business Press, Boston
32. Stuart LH (2005) Capitalism at the crossroads: the unlimited business. Wharton School Publishing, Philadelphia
33. Levitt T (1958) The dangers of social responsibility. Harv Bus Rev 36(5):41–50
34. Marris R. L (1964) The economic theory of 'Managerial'Capitalism. Macmillan, London
35. Galbraith JK (1967) The new industrial state. Houghton Mifflin, Boston
36. Barney JB (1986) Strategic factor markets: expectations, luck and business strategy. Manag Sci 32:1512–1514
37. Leonard-Barton D (1995) Wellsprings of knowledge: building and sustaining the sources of innovation. Harvard Business School Press, Boston
38. Daly HE (1996) Beyond growth: the economics of sustainable development. Beacon Press, Boston
39. Costanza R (1989) What is ecological economics? Ecol Econ 1:1–7
40. Porter ME, Van der Lind C (1995) Toward a new competition of the environment-competitiveness relationship. J Econ Perspect 9(4):97–118
41. Mohr RD (2002) Technical change, external economies, and the porter hypothesis. J Environ Econ Manag 43(1):158–168
42. Berry MA, Rondinelli DA (1998) Proactive environmental. Management: a new industrial revolution. Acad Manag Exec 12(2):38–50
43. Natural Step http://www.thenaturalstep.org/our-approach/
44. Elkington J (1997) Cannibals with forks: the triple bottom line of 21st century business. Capstone Publishing, Oxford
45. Giddens A (1998) The third way: the renewal of social democracy. Polity press, Cambridge
46. Muff K, Kapalkaa A, Dyllickb T (2017) The gap frame - translating the SDGs into relevant national grand challenges for strategic business opportunities. The International Journal of Management Education 15:363–383
47. Millennium Development Goals Report http://www.undp.org/content/undp/en/home/librarypage/mdg/the-millennium-developme nt-goals-report-2015/
48. Japan Innovation Network https://ji-network.org/en/. Accessed 01.11.2017
49. United Nations Development Programme http://hdr.undp.org/
50. Heinonen S, Minkkinen M, Karjalainen J, Inayatullah S (2016b) Testing transformative energy scenarios through causal layered analysis gaming. Technol Forecast Soc Chang 124:101–113
51. Honda H, Washida Y, Sudo A, Wajima Y, Awata K, Ueda K (2017) The difference in foresight using the scanning method between experts and non-experts. Technol Forecast Soc Chang 119:18–26
52. Millennium Project http://millennium-project.org/millennium/RTD-general.html
53. X Project http://eng.stepi.re.kr/
54. Ramirez R, Mukherjee M, Vezzoli S, Matus Kramer A (2015) Scenarios as a scholarly methodology to produce "interesting research". Futures 71:70–87
55. Pfotenhauer SM, Wood D, Roos D, Newman D (2016) Architecting complex international science, technology, and innovation partnerships (CISTIPs): a study of four global MIT collaborations. Technol Forecast Soc Chang 104:38–56