

Holistic and timely monitoring of a Japanese science and technology innovation system through an annual panel survey of experts and researchers

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ABSTRACT

The National Institute of Science and Technology Policy (NISTEP) expert survey on Japanese science, technology and innovation (STI) system is an annual panel survey administered to Japanese experts and researchers at universities, public research institutions, and private firms. It intends to track the status of STI in Japan through 57 questions related to Japanese STI system. The survey provides a holistic view of the STI system in timely manner and qualitative information such as diversity in basic research and usability of research funds, which is generally difficult to gauge based on research and development statistics. Owing to the originality of the data, various governmental councils and committees have referenced the survey's results in their official documents, including planning the fifth Science and Technology Basic Plan (STBP). This paper provides an overview of the survey's methodology and design, and discusses changes that have occurred in Japanese STI during the fourth STBP's implementation period between 2011–2015. Finally, directions for the survey's future development are discussed.

1. Introduction

Japan's science and technology policies are promoted based on a Science and Technology Basic Plan (STBP) that is formulated every five years. The fourth STBP (2011–2015) focused on the period between FY2011 and FY2015, and served as the basis upon which a variety of policies was implemented. The fifth STBP was launched in 2016. The effective implementation of the plan-do-check-act cycle in science, technology, and innovation (STI) policies requires evidence regarding how Japanese STI has changed over time.

Monitoring the status of STI is a challenging undertaking. First, its status does not change overnight, thereby necessitating continuous monitoring in order to identify changes (i.e., continuity). Second, assessing the national STI system requires a comprehensive point of view (i.e., comprehensive understanding). Third, there are often instances wherein quantitative data documenting STI's status are unavailable (i.e., measurability). Fourth, the timely monitoring of the impact of various policies is needed (i.e., timeliness).

To determine the status of Japanese STI while taking continuity, comprehensive understanding, measurability, and timeliness into consideration, the National Institute of Science and Technology Policy (NISTEP) conducted a panel survey that targeted Japan's leading researchers and experts, whose views were assessed by means of a set of questions intended to gauge their levels of satisfaction regarding issues related to STI. This survey can be likened to a health monitoring system, wherein the status of Japanese STI is the subject being monitored, and the sensor used to monitor this subject is the recognition of the country's leading researchers and experts (i.e., combined wisdom).

A well-known and similar survey is the Bank of Japan's Tankan survey (also known as the Short-Term Economic Survey of Enterprises in Japan), which examines how companies perceive their business performance, status, and prospects in relation to economic conditions. The survey's results are critical, and greatly impact the stock market and policies related to it. The Cabinet Office's Economy Watchers Survey is similar. Hence, the methodology adopted in the present study's survey is widely used (i.e., the qualitative assessment of phenomena through cooperation with individuals capable of observing those phenomena).

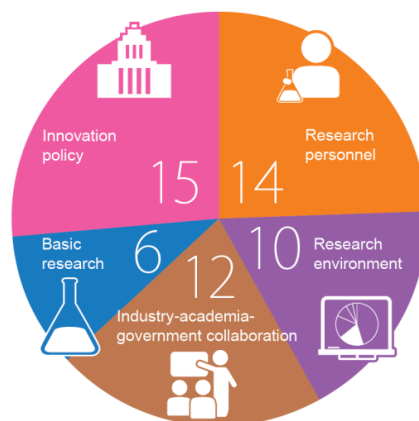
This paper provides an overview of NISTEP Teiten survey (also known as the NISTEP Expert Survey on Japanese S&T and Innovation System), and discusses changes in the Japanese STI system during the fourth STBP. Potential directions are then discussed for the future development of the NISTEP Teiten survey.

2. Overview of NISTEP Teiten surveys conducted during the fourth STBP

2-1. Questions

The NISTEP Teiten surveys conducted during the fourth STBP attempted to determine the status of Japanese STI and its situational changes according to 57 questions asked annually, in addition to questions specific to certain years. The 57 questions can be categorized into either of research personnel; research environment; industry-academia-government collaboration; basic research; and innovation policy (see Figure 1). The survey was designed so that respondents would answer each question based on a six-point scale ranging from “insufficient” to “sufficient.” Responses in the previous year were fed back to respondents. When respondents changed their answer from the previous year, we asked them to provide a short description indicating why they changed their position.

Figure 1: Composition of the 57 NISTEP Teiten survey questions



2-2. Respondents

The survey's respondents comprised two groups. The first included approximately 1,000 individuals who were presidents of universities or public research institutions (PRIs), principal investigators of large funding programs, or researchers nominated by department heads at universities or PRIs. To obtain an intergenerational perspective, we asked each department head to nominate three candidates: a professor, associate professor, and assistant professor (or their equivalents). Additionally, respondents were nominated to monitor how conditions differed according to university size and department field.

The second group, the innovation overview group, comprised approximately 500 industry experts (e.g., members of science and technology policy-related councils or subcommittees, executives in charge of research and development at private firms, representatives of small or medium-sized enterprises), individuals who bridge research and development with innovation, and those involved in science and technology think tanks or mass media.

Based on the responses of the aforementioned researchers and experts, how did the status of Japanese STI change between 2011–2015? The section 3 focuses on items wherein there were significant increases or decreases in satisfaction when compared to the 2011 NISTEP Teiten survey. It should be noted that the yearly response rates for these surveys were extremely high, averaging 86%.

2-3. Examples of questions and aggregate results

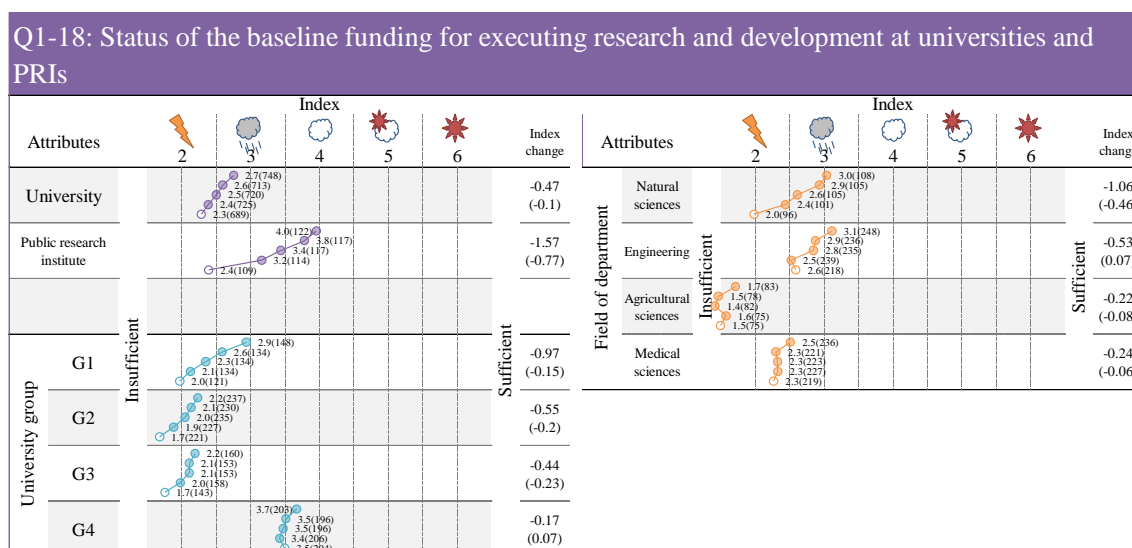
Figure 2 shows an example of a question and their aggregations. This example asks about the status of the baseline funding for executing research and development at universities and PRIs (Q1–18).

Figure 2(a) includes aggregation results for a given question broken down according to attribute; the values at the top and bottom are for 2011 and 2015, respectively. The results show that the satisfaction indices (i.e., values denoting satisfaction on a scale of 1–10) declined for many attributes, especially in the public research institute. In Figure 2(b), respondents indicated why their levels of satisfaction changed between years. By analyzing their responses, it is possible to understand the specific contexts in which respondents' attitudes changed.

The NISTEP Teiten survey report contains an analysis of all 57 questions. More detailed aggregations according to attribute, as well as all open-ended responses, have been published in the form of supplementary materials¹.

Figure 2: Examples of questions and their aggregate results

(a) Aggregate results according to attribute



Note: Categorization of university group was done by scientific publication share in Japan. Group 1: 5% or more; Group 2: 1% or more and less than 5%; Group 3: 0.5% or more and less than 1%; Group 4: 0.05% or more and less than 0.5%.

¹ <http://www.nistep.go.jp/research/scisip/nistep-teiten-data> (in Japanese)

(b) Reasons for change in opinion

Reasons for increased satisfaction	Reasons for decreased satisfaction
<ul style="list-style-type: none">• Increased funding made available by the president or dean of university• Initiatives by the university's executive directors.• Changes in circumstances owing to a respondent transferring to a different institution.	<ul style="list-style-type: none">• President of university forced to decrease spending, thereby resulting in less funds being allocated to departments and academic staff for research purposes.• Management expenses grants decreased considerably over time, necessitating budget cuts.• Sufficient money for research cannot be procured through facility maintenance funds alone.• Insufficient funding for conducting experiment based research activities.• Increased cost of electricity and consumption taxes have forced researchers to bear an increasing proportion of expenses related to the use of common facilities.• Funds are being depleted to cover just printing and postage costs.

3. Situational changes of Japanese STI system during the fourth STBP

3-1. Questions for which respondents felt circumstances had improved

Table 1 shows the top 10 questions in terms of positive change with respect to satisfaction when compared to the 2011 NISTEP Teiten survey. The fourth STBP identified important issues that must be tackled. The integrated promotion of science and technology/innovation policies intended to resolve such issues is a fundamental objective of the basic plan.











Increases or positive trends were observed in the satisfaction indices for questions related to innovation policy (e.g., cooperation beyond the boundaries of natural sciences to address technical issues in resolving important problems [Q3-4]; unified public-private efforts to implement Japanese technology and systems overseas [Q3-12]; concentration on core competence in government-led research and development [Q3-3]; implementation of strategies and national projects to resolve important issues through cooperation between industry, academia, and government [Q3-2]; introduction or relaxation of regulations and/or enhancement or establishment of systems [Q3-7]).

With respect to reasons for higher levels of satisfaction when compared to previous years, respondents mentioned specific national research and development programs (e.g., “the Cross-ministerial Strategic Innovation Promotion Program (SIP)”, “the Impulsing Paradigm Change through Disruptive Technologies Program (ImPACT)”, and “the Center of Innovation (COI) Program”). Concerning the introduction or relaxation of regulations, specific initiatives were mentioned (e.g., the New Regenerative Medicine Act, Revision of the Pharmaceutical Affairs Act, and the easing of regulations related to fuel-cell vehicles).

From these results, it is apparent that respondents felt that some progress was made in resolving

important issues during the fourth STBP. However, the satisfaction indices' absolute values indicate that there were many questions for which a strong feeling of insufficiency remained, thereby suggesting that further improvement is needed.

Table 1: Top 10 questions in terms of positive change with respect to satisfaction between 2011–2015

Rank	Question No.	Category	Question	Index change	Index value 2015
1	Q1-19	Research environment	Usability of research expenses in Grants-in-Aid for Scientific Research (KAKENHI)	0.79 (0.13)	 5.4
2	Q1-22	Research environment	Fostering and securing of specialized personnel to handle operations necessary for the smooth execution of research activities (URAs) (in universities and PRIs)	0.35 (0.09)	 2.4
3	Q3-04	Innovation policy	Cooperation beyond the boundaries of the natural sciences to address technical issues for resolving important issues	0.34 (0.07)	 3.6
4	Q3-12	Innovation policy	Unified public-private efforts to implement Japanese technology and systems to overseas	0.32 (0.04)	 2.8
5	Q3-03	Innovation policy	Concentration on core competence in government-led research and development	0.30 (0.10)	 3.9
6	Q3-02	Innovation policy	Implementation of strategies and national projects to resolve important issues through cooperation between industry, academia, and government	0.24 (0.03)	 3.6
7	Q1-13	Research personnel	Number of foreign researchers (in universities and PRIs)	0.23 (0.09)	 2.8
8	Q1-20	Research environment	Effectiveness of the multi-year funds for executing of R&D	0.23 (0.04)	 7.3
9	Q3-07	Innovation policy	Introduction or relaxation of regulations and/or enhancement or establishment of systems	0.16 (-0.04)	 2.8
10	Q2-02	Industry-academia-government collaboration	Interests for the needs of private companies (technical issues, etc.) (in universities and PRIs)	0.15 (0.03)	 4.8

Note 1: Darker shades in the “index change” column indicate greater change in satisfaction. The top and bottom figures in each row indicate the degree of change in satisfaction between 2011–2015 and 2014–2015, respectively.











Note 2: The satisfaction index values are on a scale of zero (insufficient) to 10 (sufficient). Values of 5.5 or greater are considered “unproblematic” (★), 4.5–5.4 “not generally problematic” (★), 3.5–4.4 “insufficient” (⚙️), 2.5–3.4 “generally insufficient” (⚙️), and less than 2.5 “extremely insufficient” (⚡).

Note 3: KAKENHI is the largest competitive fund for academic research in Japan.

3-2. Questions for which respondents felt circumstances had worsened

Although progress was achieved in some areas during the fourth STBP, there were also questions indicative of growing concerns when compared to the 2011 NISTEP Teiten survey (see Table 2). Questions that exhibited the largest satisfaction index declines were those regarding baseline funding for executing research and development at universities and PRIs (Q1–18). Based on the “Basic Policies for Economic and Fiscal Policy Management and Structural Reform 2006”, the management expenses grants of the national university corporations were reduced by 1%, and have been consistently reduced for about ten years. Respondents expressed that the reduction of the management expenses grants had large impact of research and development at university.

Table 2: Top 10 questions in terms of negative change with respect to satisfaction between 2011–2015

Rank	Question No.	Category	Question	Index change	Index value 2015
1	Q1-18	Research environment	Baseline funding for executing research and development at universities and PRIs	-0.62 (-0.19)	 2.3
2	Q1-06	Research personnel	Whether or not individuals with the required capabilities are applying to doctoral programs	-0.57 (-0.17)	 3.0
3	Q1-24	Research environment	Research facilities and equipment for innovative and advanced R&D; and the training of high-quality human resources (in universities and PRIs)	-0.49 (-0.07)	 4.4
4	Q2-22	Basic research	Degree of diversity in Japanese basic research as the source of future innovation	-0.43 (-0.14)	 3.0
5	Q2-23	Basic research	Degree of originality in Japanese basic research as the source of future innovation	-0.40 (-0.16)	 3.0
6	Q2-17	Research environment	Amount of indirect funding related to the government's public appeal-based research funds (competitive research funds, etc.) (in universities and PRIs)	-0.36 (-0.07)	 4.0
7	Q1-16	Research personnel	Multi-faceted evaluation of researchers, rather than a single indicator related to scientific publications (in universities and PRIs)	-0.35 (-0.03)	 4.5
8	Q1-21	Research environment	Efforts to secure researchers' time allocated to R&D activities (in universities and PRIs)	-0.31 (-0.06)	 2.2
9	Q2-19	Research environment	Circumstances of intellectual and research information infrastructure in Japan (in universities and PRIs)	-0.30 (-0.03)	 4.2
10	Q2-16	Research environment	Government's S&T budget, taking account of current S&T situation in Japan	-0.28 (-0.16)	 2.7

Note 1: Darker shades in the “index change” column indicate greater change in satisfaction. The top and bottom figures in each row indicate the degree of change in satisfaction between 2011–2015 and 2014–2015, respectively.

Note 2: The satisfaction index values are on a scale of zero (insufficient) to 10 (sufficient). Values of 5.5 or greater are considered “unproblematic” (★), 4.5–5.4 “not generally problematic” (★), 3.5–4.4 “insufficient” (⦿), 2.5–3.4 “generally insufficient” (⦿), and less than 2.5 “extremely insufficient” (⚡).

There was also growing concern regarding a lack of diversity and/or originality in basic research. Detailed questions were conducted in the 2014 NISTEP Teiten survey to examine changes in research activities and behaviors among researchers at universities and PRIs (see Figure 3 and Figure 4). According to the results, respondents believed that there was growth in research for (a) the direct purposes of resolving social issues and creating economic value, (b) to fulfill organizational goals (e.g., regional or social contributions), and (c) to achieve integration between different disciplines. In examining the behavior of researchers, there was a growing awareness that they were producing output other than scientific publications, such as patents and prototypes. Given that the resolution of important issues was emphasized in the fourth STBP, these changes can be considered the result of various policies that were promoted under the plan.

The results likewise show that respondents were increasingly aware that research pursuing temporary trends was growing, whereas exploratory research to find new research themes and pioneering research toward producing new research fields were in decline—albeit at a minimal rate. With respect to the behavior of researchers, respondents were aware that most researchers were strongly inclined to (a) produce short-term results, (b) conduct research with a high probability of

success, and (c) emphasize the number of scientific publications as research output (in response to evaluation). In contrast, there was a decline in terms of researchers addressing themes emphasizing long-term research strategies. None of these changes is desirable with respect to ensuring research diversity.

Generally speaking, it is clear from the 2011–15 NISTEP Teiten survey results that there is growing concern regarding fundamental research activities at universities and PRIs.

Figure 3: Changes in research activities at universities and PRIs over the past ten years categorized according to respondent group and content

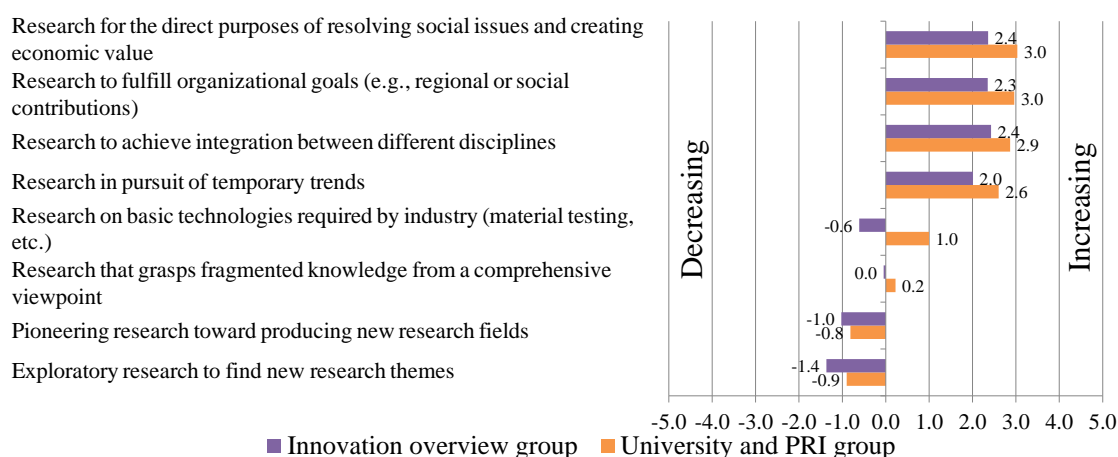
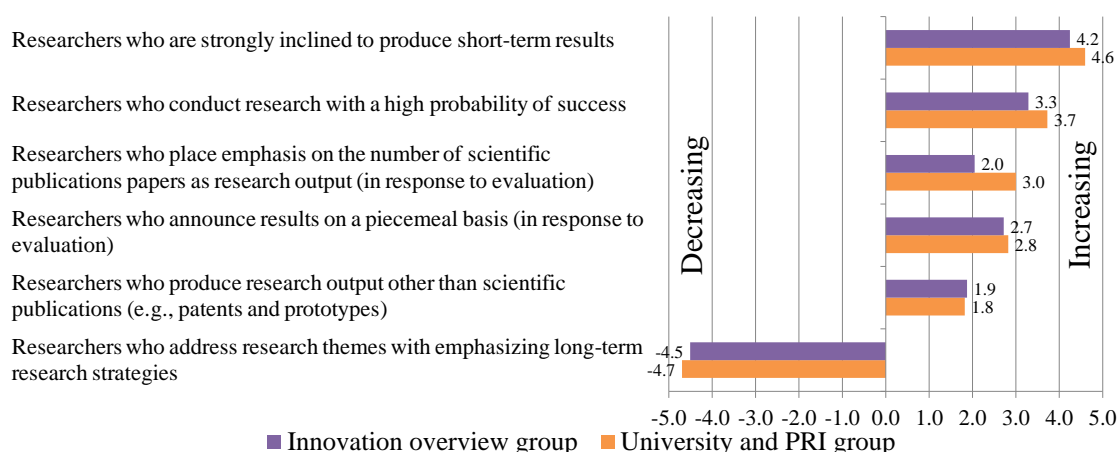


Figure 4: Changes in research activities at universities and PRIs over the past ten years categorized according to respondent group and researchers' behaviors



Note: Respondents were asked to indicate the degree of change compared to 2005 by selecting “decreased greatly,” “decreased,” “no change,” “increased,” and “increased greatly.” The results obtained after indexation were as follows: “decreased greatly” (-10 points), “decreased” (-5 points), “no change” (0 points), “increased” (5 points), “increased greatly” (10 points).

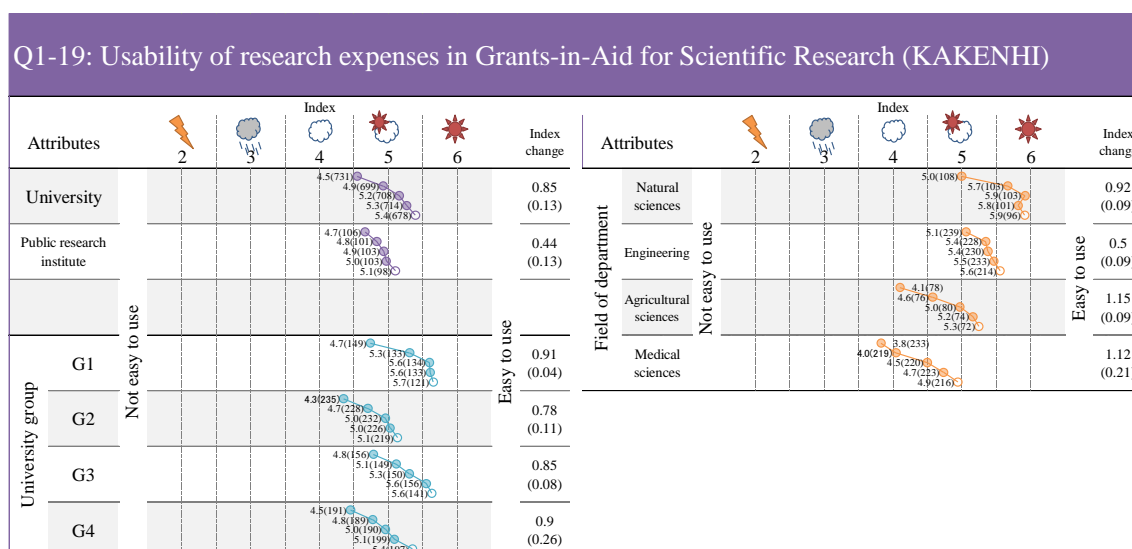
4. In-depth analyses of selected questions

4-1. Monitoring the breadth of the effects of policy measures implementation

Breaking down the NISTEP Teiten survey results according to attribute widens an understanding of the breadth of the effects of policy measures implementation. Figure 5 shows the aggregate results by attribute for the usability of research expenses in Grants-in-Aid for Scientific Research (KAKENHI), the item for which improvement of the satisfaction indices were highest.

As the results show, satisfaction indices increased for each attribute. The stated reasons for this change included smoother annual carryover, and increased convenience owing to the introduction of multi-year funds. Grants-in-Aid for Scientific Research (KAKENHI) is the largest competitive fund in Japan; hence, alterations to it influence many of the country’s researchers. However, it requires elaborative efforts.

Figure 5: Usability of Grants-in-Aid for Scientific Research (KAKENHI)



Note: Categorization of university group was done by scientific publication share in Japan. Group 1: 5% or more; Group 2: 1% or more and less than 5%; Group 3: 0.5% or more and less than 1%; Group 4: 0.05% or more and less than 0.5%.

An in-depth analysis of a question regarding university research administrators (URAs), an item with the second-highest satisfaction index rise, was conducted. URA universities were compared to other universities in terms of whether differences existed in circumstances related to Q1–22 (i.e., the fostering and securing of specialized personnel to handle operations necessary for the smooth execution of research activities (URAs)).

For this analysis, URA universities were defined as those that adopted the 2011–2014 Initiative for ‘the Developing a System for Fostering and Recruiting URAs’ or the 2013–2023 Initiative for ‘the Strengthening of Research Universities,’ as well as members of the Association of Research Administrators. Of the 36 universities that fell into these categories, 32 were targeted in the

NISTEP Teiten survey².

Figure 6(a) shows the difference between URA universities and other universities regarding changes in satisfaction indices with respect to fostering and securing of URAs (Q1–22). The two sets of universities showed similar satisfaction indices in 2011; however, the satisfaction index for URA universities increased each year, such that by 2015 it was 0.79 points higher than in 2011. In contrast, the satisfaction index for the other universities barely changed.

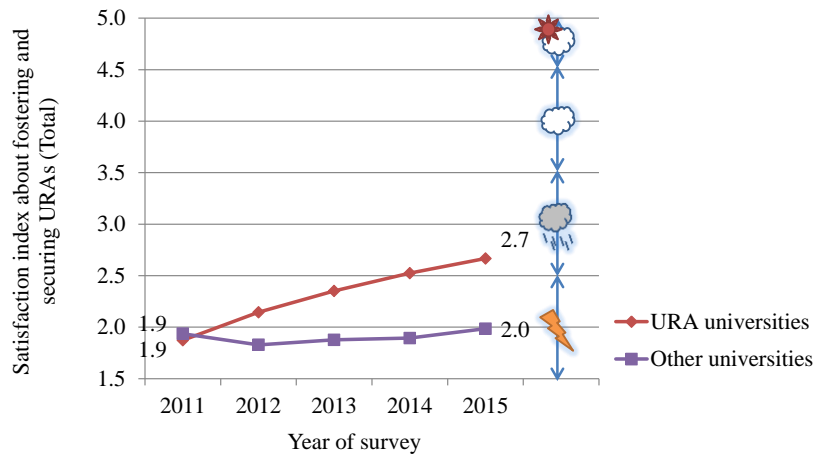
Furthermore, the change in the satisfaction index varied according to respondents' duties. Figure 6(b) contains the aggregate results for respondents whose duties were management related. Among URA universities, the satisfaction index was 1.9 for the 2011 NISTEP Teiten survey. Nevertheless, between 2011–2013 the index increased sharply, reaching 4.4 in 2015. Given that between 2011–2013 these universities adopted 'the Initiative for Developing a System for Fostering and Recruiting URAs' and/or 'the Initiative for the Strengthening of Research Universities,' the commencement and adoption of these programs were reflected in the form of changes in the satisfaction index.

The satisfaction index for respondents whose duties were not managerial (see Figure 6(c)) rose between 2011–15, albeit markedly less than for their manager counterparts. This finding suggests that although universities are progressing in fostering and securing URAs, these advances are not having a substantial impact within institutions. Indeed, in this question, one of the reasons cited for a decline in satisfaction level was "the benefits have not yet been felt at a department level."

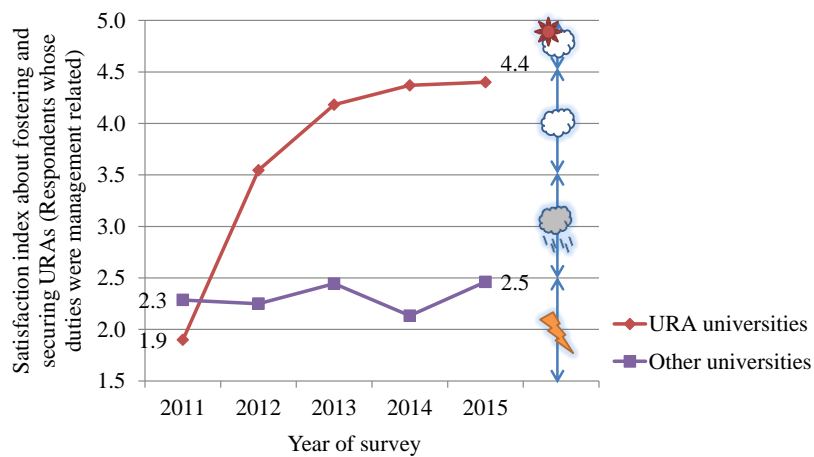
² Data from the following websites (each accessed on February 27, 2016) were used to prepare the list of URA universities: Initiative for Developing a System for Fostering/securing URAs (http://www.mext.go.jp/a_menu/jinzai/ura/detail/1315871.htm), Initiative for the Strengthening of Research Universities (http://www.mext.go.jp/a_menu/kagaku/sokushinhi/1338460.htm), Association for Research Administrators (<http://www.rman.jp/aboutus/memberlist.html>).

Figure 6: Comparison between URA universities and other universities

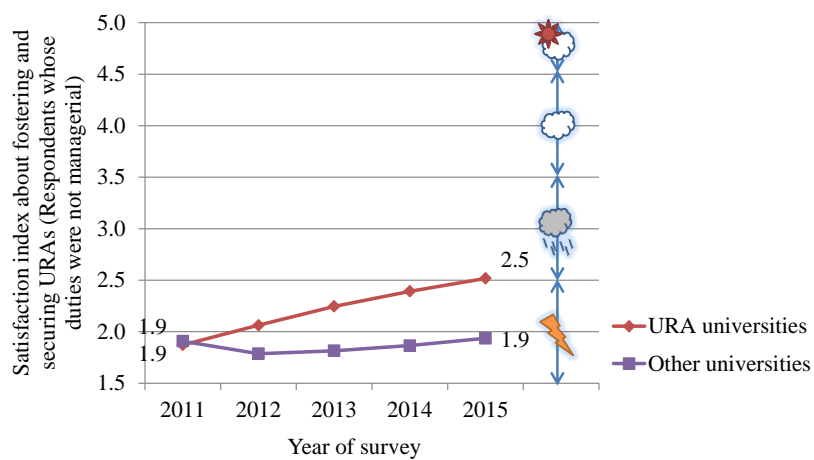
(a) All respondents



(b) Respondents whose primary duties are management related



(c) Respondents whose primary duties are not management related

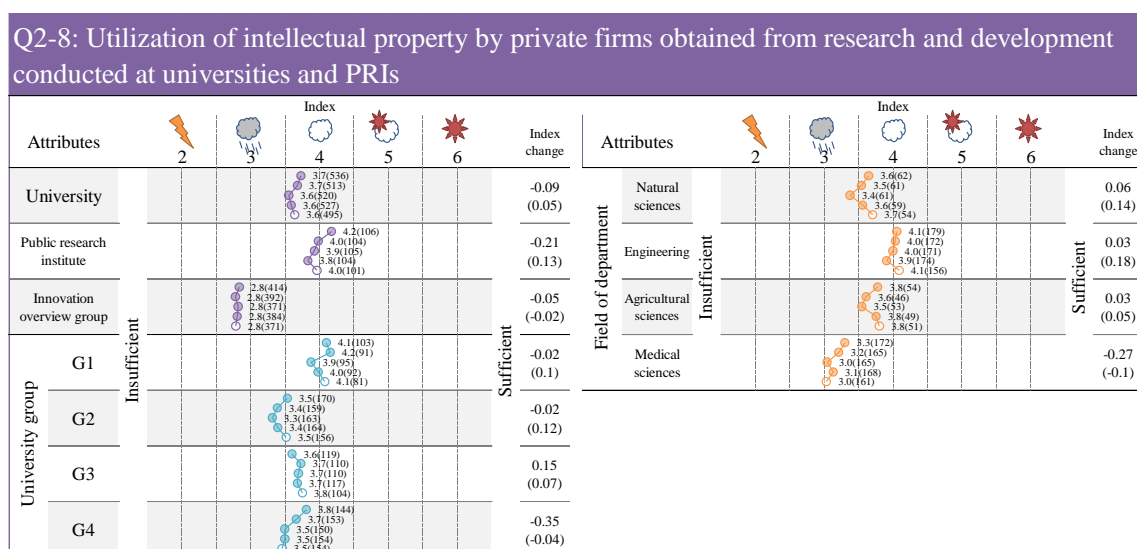


4-2. Monitoring attitudinal differences between actors

Analyzing the aggregate results by attribute makes it possible to ascertain attitudinal differences between actors. Respondents at the private firm, university, and government all expressed dissatisfaction regarding the utilization of intellectual property by private firms obtained from research and development conducted at universities and PRIs (see Figure 7). Individuals in the innovation overview group were particularly dissatisfied: their satisfaction index was 0.8 and 1.2 points lower than university and PRI respondents, respectively.

Respondents from private firms indicated that the quality of universities' granted patent was low, and furthermore that universities were unable to fund international applications pursuant to the Patent Cooperation Treaty; consequently, the most of patent applications were domestic rather than international. In contrast, university respondents pointed out that there was significant apprehension and an unwillingness to take risks in product development at private firms, which prevented knowledge transfer from universities to private firms.

Figure 7: Example of a question showing attitudinal differences between actors



Note1: Categorization of university group was done by scientific publication share in Japan. Group 1: 5% or more; Group 2: 1% or more and less than 5%; Group 3: 0.5% or more and less than 1%; Group 4: 0.05% or more and less than 0.5%.

Note2: Innovation overview group comprised approximately 500 industry experts (e.g., members of science and technology policy-related councils or subcommittees, executives in charge of research and development at private firms, representatives of small or medium-sized enterprises), individuals who bridge research and development with innovation, and those involved in science and technology think tanks or mass media.

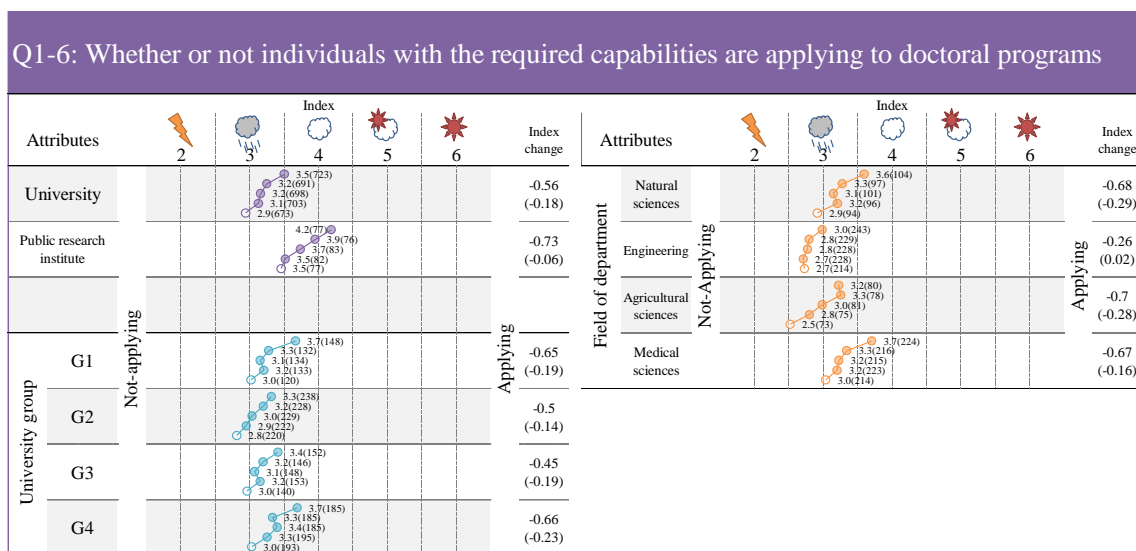
4-3. Complementary analysis along with quantitative data

Analyzing the NISTEP Teiten survey results in conjunction with qualitative data facilitates an understanding of the underlying causes of changes in the quantitative data.

Respondents from universities and PRIs were of the strong opinion that individuals with the required capabilities were not applying to doctoral programs (see Figure 8). In examining changes since the 2011 NISTEP Teiten survey, the satisfaction indices for all attributes either declined or

exhibited a declining trend. With respect to individual university groups, the satisfaction indices for groups 1 and 4 declined by more than 0.6 points; as for various university departments, the satisfaction indices for natural sciences, agricultural sciences, and medical sciences declined by nearly 0.7 points. Engineering showed a smaller decline when compared to other departments, although its dissatisfaction level was already relatively high in 2011.

Figure 8: Aggregate results by attribute for the quality of applicants to doctoral programs

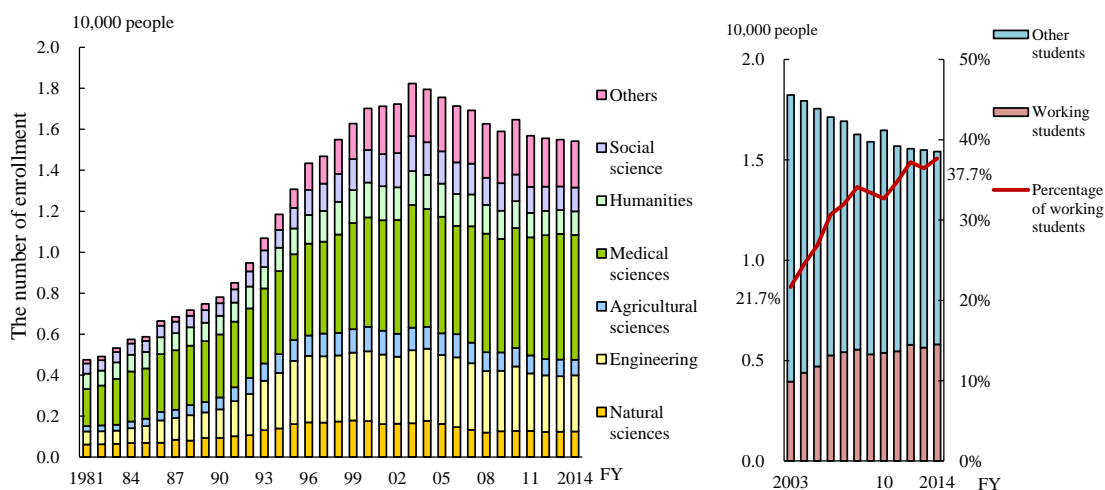


Note: Categorization of university group was done by scientific publication share in Japan. Group 1: 5% or more; Group 2: 1% or more and less than 5%; Group 3: 0.5% or more and less than 1%; Group 4: 0.05% or more and less than 0.5%.

Figure 9: Number of students enrolled in doctoral programs

(a) Change in the number of enrollees by course

(b) Change in proportion of working enrollees



Note: "Other" includes courses that do not fall under the umbrella of engineering, agriculture, health, the humanities, or social/physical sciences.

Source: National Institute of Science and Technology Policy (2015). Japanese science and technology indicators 2015. *Research Material No. 229*.

Figure 9 shows the change in the number of students entering doctoral programs according to the Ministry of Education, Culture, Sports, Science, and Technology's Basic School Survey. After peaking in 2003, the number of enrollees entered a declining trajectory; by 2014, the number had fallen to a level nearly identical to the late 1990s (see Figure 9(a)). The temporary rise that occurred in 2010 could be attributable to the 2008 financial crisis.

The proportion of working students enrolled in doctoral programs rose from 21.7% in 2003 to 37.7% in 2014. Whereas the number of working students has remained relatively flat since the late 2000s, the number of non-working students has declined. As for why satisfaction dropped with respect to the question regarding the quality of doctoral program applicants (Q1–6), respondents cited the absence of reliable financial support or feasible career paths. Making such statements suggest that the result of NISTEP Teiten survey likely reflects the declining number of enrollees among non-working students (Figure 9(b)).

5. Conclusion and future works

It can be deduced that the NISTEP Teiten surveys are effective in comprehensively monitoring the STI system's status. The data provided by these surveys are useful in formulating science and technology policies, and have been referenced in official documents by various governmental councils and committees. Likewise, the survey's results were referenced in science and technology white papers, in planning the fifth STBP, and in media such as newspapers. The fifth STBP outlines initiatives to strengthen fundamental capacities, particularly with respect to fostering and promotion of young researchers, as well as reforming and strengthening the functions of universities. When policymakers were establishing the direction of these policies, they referred to the NISTEP Teiten survey results as one of evidence. Hence, it is clear that the NISTEP Teiten survey provide useful information that others cannot. Looking forward, it should be possible to build data that are even more useful in policy formation and evaluation by implementing surveys and related analyses wherein the following three points are emphasized.

5-1. Understanding the relationships between questions

As mentioned previously, the NISTEP Teiten survey results can be employed in various ways; nevertheless, they are often used in a partial manner. The survey's 57 questions should be examined in an interrelated fashion. For instance, in attempting to improve upon one item, its relationship to others ought to be considered. This requires a comprehensive understanding of the relationships between all questions.

5-2. Further analysis of the open-ended responses

The NISTEP Teiten surveys include open-ended questions regarding to various STI issues. The total responses to these questions between 2011–2015 exceeded 2.5 million Japanese characters.

Through text mining or machine learning, it is possible to extract words used in specific contexts. Currently, this is a manual and time-consuming process. Hence, a methodology based on computerized text mining or machine learning should be developed in order to identify new issues, as well as those that have not been discussed previously.

5-3. Analysis of the extent to which the effects of policies spread

There are some questions for which no significant changes were observed in the satisfaction indices between 2011–2015 that means the effects of the policies were not felt by researchers, perhaps because of a lack to implement relevant ones, or to do so on a limited scale. Accordingly, continuous monitoring is necessary that goes beyond the STBP's five-year framework, since a sufficient amount of time is needed for conditions to improve. However, the NISTEP Teiten survey includes identical respondents each year, and their ages obviously increase. Consequently, the use of respondent groups and surveying methods that facilitate long-term chronological monitoring while simultaneously maintaining respondent continuity should be examined.

5-4. Determining question content and identifying target respondents

The NISTEP Teiten surveys are effective in assessing the state of STI in Japan. Nevertheless, the results depend largely on the content of questions and to whom they are directed. For instance, some individuals argue that because the NISTEP Teiten surveys comprise many questions related to research environment, that the results tend to emphasize dissatisfaction among researchers. It should be possible to solve this problem by analyzing attitudinal differences between actors and setting questions that examine researchers' own efforts.

This paper presented a method for qualitatively determining the status of STI through a panel survey administered to researchers and experts. Of course, determining the status of STI based on qualitative data alone is insufficient. Hence, utilizing qualitative data from the NISTEP Teiten surveys in conjunction with various research and development statistics would promote a fuller understanding of STI systems.

Currently, preparation for the new NISTEP Teiten survey, which will be conducted during fifth STBP, is undergoing. Fifth STBP identified numerical targets/indicators that should be monitored during the basic plan; therefore, we believe that original evidence that NISTEP Teiten survey provides is getting more important in order to understand a context of changes of the indicators.

To author's knowledge, the NISTEP Teiten surveys are unique in their focus on monitoring the status of STI systems, we hope that our experience will be useful for the development of new STI indicators and widens our collective knowledge for the measurement of STI activities.

References

- National Institute of Science and Technology Policy (2016). Analytical report for 2015 NISTEP expert survey on Japanese S&T and innovation system (2015 NISTEP TEITEN survey). *NISTEP Report No. 167 (in Japanese)*.
- National Institute of Science and Technology Policy (2015). Japanese science and technology indicators 2015. *Research Material No. 229*.