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## 0.3 Evidence in policy-making and the “science of science, technology, and innovation policy”

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### Abstract

In recent years, the necessity of evidence-based policy-making has been frequently emphasized, and in Japan as well, efforts toward institutionalization have rapidly begun, though many challenges remain. After providing an overview of what constitutes evidence in policy-making, this paper introduces the background behind the emergence of the 'Science of Science, Technology and Innovation Policy' and its key characteristics.

### Keywords

Evidence; science of science, technology, and innovation policy; coevolution

## 1 Introduction

Section 0.1 provided an overview of the evolving roles and nature of science, technology, and innovation, along with changes in the framework encompassing the scope, objectives, and targets of science, technology and innovation (STI) policy. In fact, in the Fourth Science and Technology Basic Plan enacted in 2011, the framework expanded from the conventional R&D-centered science and technology policy to a more integrated approach that combines science, technology, and innovation. In 2014, the Council for Science and Technology Policy (CSTP) was reorganized into the Council for Science, Technology and Innovation (CSTI).

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Furthermore, in June 2020, the Basic Act on Science and Technology was revised and renamed the Basic Act on Science, Technology, and Innovation, incorporating the promotion of the humanities and social sciences as well as the creation of innovation added as new objectives under the Act.<sup>1</sup> In line with this, the 6th Basic Plan was implemented in April 2021 as the Science, Technology and Innovation Basic Plan.<sup>2</sup> The revised plan clearly states that STI policy aims to address human and societal challenges by using “integrated knowledge” —combining insights from both the humanities and social sciences and the natural sciences to generate social value.

Alongside these changes, the importance of evidence in policy formation has also come to be recognized. In the field of STI policy, the Fourth Science and Technology Basic Plan, launched in 2011, made the following recommendation:<sup>3</sup>

The government promotes the “Science of Science, Technology and Innovation Policy,” aiming to formulate policies based on objective evidence, reflect evaluation and verification results in policy-making, and establish a process for evaluating policy assumptions and incorporating them into planning. In so doing, we seek participation not only from natural scientists but also broadly from researchers in the humanities and social sciences, thereby fostering personnel involved in policy-making through these initiatives.

Amidst this momentum, the Science for REdesigning Science, Technology and Innovation Policy (SciREX) Project was launched in 2011. Through initiatives such as human resource development, network formation, data and information infrastructure development, and open-call R&D, the program aims to achieve co-evolution between policy and science, and to build the interdisciplinary research field of the 'Science of STI Policy' (CRDS, 2011a).

Launched in 2016, the Fifth Science and Technology Basic Plan<sup>4</sup> went further than its predecessor, setting key indicators and targets<sup>5</sup> to understand the outcomes and progress of national policy efforts. Incidentally, the term “objective evidence” was used in the Fifth Plan. The Cabinet Office has also gathered evidence on research, education, and fund acquisition at universities and other research institutions. It has also developed various analytic functions and established the evidence data platform constructed by the Council for Science, Technology and Innovation (e-CSTI). This platform, open to the public in September 2020, shares analytic functions and data with relevant ministries and agencies, national universities, and research and development organizations.<sup>6</sup>

The Sixth Science, Technology and Innovation Basic Plan, launched in FY2021, recommends systematic and coherent planning based on evidence, development and promotion of national strategies based on

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1 <https://www8.cao.go.jp/cstp/cst/kihonhou/mokuji.html>

2 <https://www8.cao.go.jp/cstp/kihonkeikaku/index6.html>

3 <https://www8.cao.go.jp/cstp/kihonkeikaku/index5.html>

4 <https://www8.cao.go.jp/cstp/kihonkeikaku/index4.html>

5 <https://www8.cao.go.jp/cstp/kihonkeikaku/5sanko.pdf>

6 <https://e-csti.go.jp/>

evidence, and the thorough implementation of objective evidence-based policy-making (EBPM) in STI administration. It proposes that all relevant ministries and agencies carry out EBPM by FY2023.<sup>7</sup>

Enhancing the momentum for EBPM is a government-wide policy. While EBPM has spread across Europe and the US since the late 1990s,<sup>8</sup> the term “evidence” began appearing in Japan’s Basic Policy for Economic and Fiscal Management and Reform since 2013. By 2017, a government-wide policy to promote EBPM had been declared.

In addition, the 2014 statistical reform—that is, the fundamental reform of official statistics—clearly positioned official statistics as the foundation supporting EBPM. In accordance with the Basic Act on the Advancement of Public and Private Sector Data Utilization (2016), the EBPM Promotion Committee was established as an organization responsible for cross-governmental EBPM functions. From 2018, EBPM promotion officials (i.e., Deputy Director-General for Policy Planning or Policy Planning Counselor) were placed within each government ministry.

While understanding of EBPM and related institutional structures has progressed within the government, there remains considerable confusion over what constitutes evidence in policy-making, along with issues such as data and personnel shortages—challenges that cannot be resolved overnight.<sup>9</sup> The EBPM Promotion Committee is conducting investigations into the current level of EBPM adoption within the government and identifying associated issues, while also developing a roadmap for future directions focused on the dissemination and penetration of EBPM, improving its quality, and securing, developing, and utilizing human resources.<sup>10</sup>

The evidence-based policy-making targeted by the SciREX program from its inception has a broader scope than the current EBPM, which mainly focuses on the use of logic models and enhancement of administrative reviews within government. SciREX places emphasis on the long-term development of human resources, communities, and networks as its foundation. Therefore, while not always in sync with internal government movements, it is part of the broader trend toward EBPM.

At the same time, attempts to introduce scientific and objective elements into policy-making have been repeatedly tried in the past, and it has also been pointed out that there remain many challenges to be overcome and significant gaps between ideals and reality. Accumulated research in individual fields does not necessarily translate directly into practical policy-making. The low mobility of personnel between government, academia, and industry hinders knowledge transfer. Additionally, due to entrenched practices in policy-making, the use of internal knowledge is prioritized, and policy research outcomes are underutilized. Recognizing the gap between the science of policy and the practice of policy-making, it is necessary to design institutional mechanisms to bridge it.

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7 <https://www8.cao.go.jp/cstp/kihonkeikaku/index6.html>

8 Examples from other countries are introduced in Kanemoto (2020) and others.

9 For a summary of the characteristics and challenges of EBPM in Japan, see Kanemoto (2020), Kobayashi (2020), and the National Diet Library (2020).

10 Summary of EBPM Study Working Group, EBPM Promotion Committee (June 2021).  
<https://www.kantei.go.jp/jp/singi/it2/ebpm/dai7/siryou1-1.pdf>

This paper provides an overview of what constitutes evidence in policy-making, followed by a discussion on why the 'Science of STI Policy' has become necessary and what its key features are.

## 2 What is evidence in policy-making?

The term *ebidensu ni motodzuku seisaku keisei* in Japanese is translated from terms such as evidence-based policy-making or evidence-informed policy-making. Internationally, initiatives aiming at evidence-based policy-making were pioneered in healthcare policy and later expanded to education policy, development aid policy, and broader social policies. Projects such as the Cochrane Collaboration in healthcare and the Campbell Collaboration in social and education policy conduct systematic reviews—a series of processes including defining research questions, collecting studies, conducting meta-analyses, and reporting—to collect and organize related evidence.

Additionally, the concept of evidence levels—which classifies the quality of evidence based on its reliability, bias, and how it was generated—has been introduced primarily in the healthcare field.

To start with, what is evidence? In Japanese, the term ‘evidence’ is commonly translated or expressed using various terms, including *ebidensu* (エビデンス, evidence), *konkyo* (根拠, grounds), *shōko* (証拠, proof), *kyakkanteki konkyo* (客観的根拠, objective evidence), and *kagakuteki konkyo* (科学的根拠, scientific evidence). Clearly, there are multiple definitions of evidence, with the term used in multiple senses. For example,

- Evidence refers to facts or phenomena with scientific grounds—that is, facts and phenomena objectively observed based on logical systems, etc. This encompasses not only quantitative data but also qualitative information. In the context of forming STI policy, necessary evidence includes, for instance, the structure and dynamics of the economy and society, manifest and latent social issues, societal expectations of science and technology, and the current status and potential of science and technology (CRDS,2011a).
- Evidence is systematically organized facts or information available to assess whether a given belief or claim is valid (Evidence Collaborative: <http://www.evidencecollaborative.org/>).
- Scientific evidence is an argument supported by information produced according to a set of formal processes (Gluckman, 2016).
- Evidence is not merely data but refers to a causal relationship in which a policy (A) has influenced an outcome (B).<sup>11</sup>

The term 'evidence' is used broadly—from being treated as synonymous with data or indicators to being scrutinized strictly for quality—leading to confusion due to this multiplicity of meanings. Since the applicability of social experiments and other methodologies differs depending on the nature of the policy

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<sup>11</sup> [http://home.uchicago.edu/ito/pdf/RIETI\\_BBL\\_2016\\_1025\\_Ito\\_Final.pdf](http://home.uchicago.edu/ito/pdf/RIETI_BBL_2016_1025_Ito_Final.pdf)

issue, the means of obtaining evidence and the definition of what constitutes evidence (e.g., whether qualitative elements are included) vary by policy area. Furthermore, differences in the degree of uncertainty surrounding policy targets also result in varying scopes of application in policy-making practice (CRDS, 2011a).

There are significant differences across fields regarding how easily experiments can be conducted to generate evidence. Additionally, the questions themselves and their scope are often inherently complex, making it challenging to strictly define evidence in social sciences and policy—this issue requires further study and validation. Beyond the academic discourse on rigor, robustness, and generalizability, the pressing challenge is how to define and share practical evidence in the context of STI policy.

### 3 What is the “science of science, technology, and innovation policy”?

#### 3.1 Background

Why has the 'Science of Science, Technology and Innovation Policy' come to be seen as necessary? Let us look back on the discussions at the time when the SciREX Program was launched in 2011.<sup>12</sup> The fundamental reason was the growing global expectation that innovation could serve both as a foundation for long-term international competitiveness and a means of solving societal problems. Amid rapid demographic and social structural changes and an increasingly complex global economy and society, governments around the world pursued the promotion of science and technology and the creation of innovation, even while facing fiscal challenges. To achieve this, evidence was needed to demonstrate how policy could contribute effectively and efficiently.

Underlying these efforts was a growing demand for governments—regardless of policy area—to ensure transparency in policy-making and fulfill their accountability to society based on evidence. New methods of policy-making were being explored to encourage public participation, and ensuring access to evidence was also necessary in this context. The need to address these issues heightened expectations for the broader field of the 'Science of Policy'.

Moreover, advancements such as big data analysis based on information technology, data visualization, and the development of social experiments grounded in empirical and experimental social sciences further raised expectations for the potential of the 'Science of Policy'. The growing emphasis on open access—not only scientific data but also administrative data—also provided a tailwind for the 'Science of Policy'.

Initiatives related to the 'Science of STI Policy' in the West also had a significant impact on Japan. In the United States, a key turning point came in 2005 when former Director of the Office of Science and Technology Policy and Presidential Science Advisor John Marburger called for building a practice community to produce the data, tools, and methodologies needed to support decision-makers in science policy.<sup>13</sup> Subsequently, an interagency task group was formed, and in 2007, the National Science

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<sup>12</sup> CRDS (2011a), National Graduate Institute for Policy Studies (2014), Okamura (2013), and so on.

<sup>13</sup> For US trends, see CRDS (2019).

Foundation (NSF) launched the Science of Science and Innovation Policy (SciSIP) program to promote scholarly research. In 2008, the 'Science of Science Policy: A Federal Research Roadmap'<sup>14</sup> was published, followed by a handbook in 2011 (Fealing et al., 2011). In 2019, the SciSIP program was renamed the Science of Science: Discovery, Communication, and Impact (SoS:DCI) program as part of NSF's program restructuring.<sup>15</sup>

Although there were no flagship programs in Europe similar to those in the U.S., the EU had long maintained research funding programs related to STI policy and innovation studies, with strong researcher communities and networks. Efforts to build common data infrastructures were also pursued.<sup>16</sup>

At that time, major initiatives emerged in various countries against a common backdrop: increasing demands for accountability, pressure to use public funds efficiently due to fiscal constraints, and urgency to address social issues. In response, funding programs to promote related research were launched, reflecting senior policy-makers' fundamental concern—namely, the difficulty of readily obtaining evidence to inform policy decisions. In every initiative, the importance of interdisciplinary collaboration and mechanisms to connect science and policy was recognized.

Given this background, what characteristics does the 'Science of Science, Technology and Innovation Policy' have? The following are its main points.

### 3.2 Policy for science and science for policy

The 'Science of Science, Technology and Innovation Policy' encompasses both policy for science and innovation (Policy for Science) and the scientific study supporting policy-making itself (Science for Policy). While it is expected to address various challenges in policies for STI, it also emphasizes the need for the advancement and sophistication of policy-making itself, which in turn requires scientific foundations. In doing so, it is important not only to accumulate hard evidence such as data and tools, but also to recognize—as revealed through public discourse during the Great East Japan Earthquake and the ongoing COVID-19 pandemic—that scientific knowledge is only one part of policy-making. The role of evidence and approaches to building social consensus must also be considered.

### 3.3 Cooperation between diverse academic disciplines

The 'Science of STI Policy' is expected to evolve by integrating knowledge from various fields of natural sciences and the humanities and social sciences, while building on existing research in STI and innovation policy to form a new academic field.

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14 National Science and Technology Council (US); Subcommittee on Social, Behavioral, and Economic Sciences (2008).

15 <https://www.nsf.gov/pubs/2020/nsf20128/nsf20128.jsp> and <https://beta.nsf.gov/funding/opportunities/science-science-discovery-communication-and-impact-sosdci>

16 [https://www.mext.go.jp/b\\_menu/shingi/chousa/gijyutu/025/shiryo/\\_icsFiles/afiedfile/2017/](https://www.mext.go.jp/b_menu/shingi/chousa/gijyutu/025/shiryo/_icsFiles/afiedfile/2017/)

## 0.3 Evidence in policy-making and the “science of science, technology, and innovation policy”

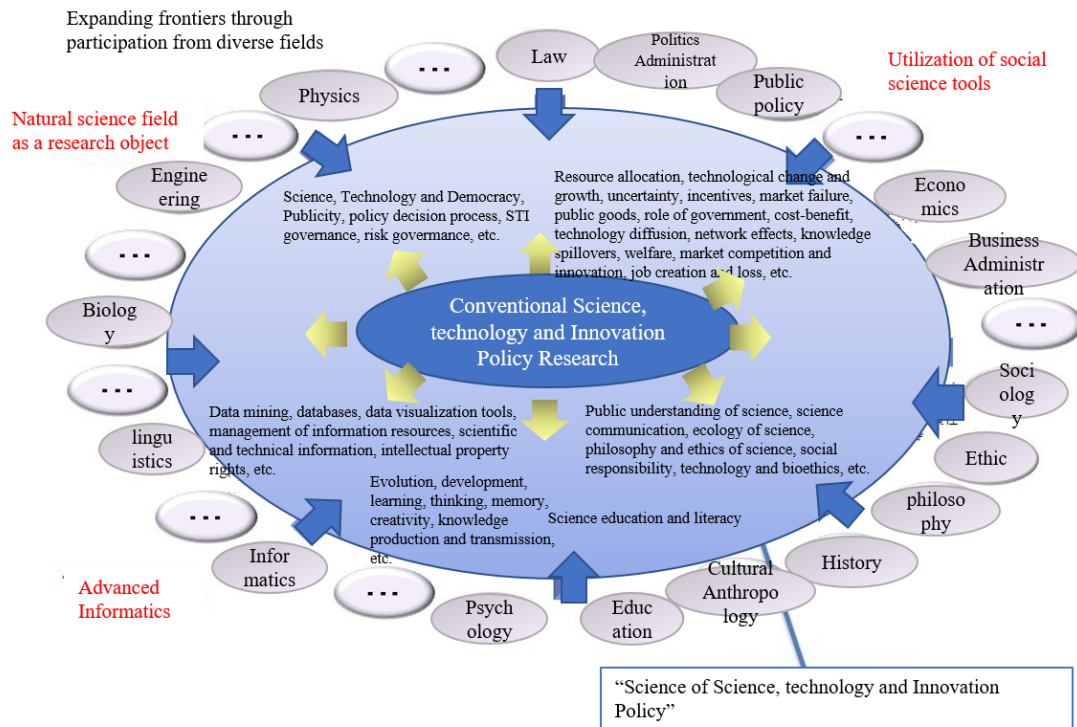


Figure 1. The development of “Science of Science, Technology, and Innovation Policy” through collaboration among various academic disciplines

Source: CRDS (2011a)

Accurately understanding the current state of science and technology and anticipating its future potential requires specialized knowledge from various fields of the natural sciences. At the same time, to comprehensively and cross-sectionally understand real-world economic and social structures, and the interrelations between science, technology, society, and policy, insights from the humanities and social sciences are also indispensable. The importance of creating a collaborative 'Science of STI Policy' that integrates knowledge from both the natural and social sciences is growing.

This raises the question: what kind of research is needed? The special issue of the Journal of Science Policy and Research Management (“Science of Science and Technology Innovation Policy” Special Issue, Vol. 27 [2013], No.3/4 and Vol. 28 [1]) summarized expected contributions to the field from various perspectives—including trends in science and technology policy research and innovation policy research, as well as approaches from economics, business management, sociology, political science, information science, and public policy.<sup>17</sup>

In the SciREX program, efforts have been made to identify key science questions that span both research and policy, and to map and structure the entire research field, thereby clarifying how the 'Science of STI

<sup>17</sup> [https://www.jstage.jst.go.jp/browse/jsrpm/28/1/\\_contents/-char/ja](https://www.jstage.jst.go.jp/browse/jsrpm/28/1/_contents/-char/ja) and [https://www.jstage.jst.go.jp/browse/jsrpm/27/0/\\_contents/-char/ja](https://www.jstage.jst.go.jp/browse/jsrpm/27/0/_contents/-char/ja)

Policy' is evolving as an interdisciplinary domain.<sup>18</sup> Based on these efforts, core knowledge components have been compiled in this 'Science of STI Policy Core Content' (<https://scirex-core.grips.ac.jp/>).

The core content covers the following topics:

- Dynamics of Science, Technology and Innovation (STI)
- STI Governance and Policy-making Processes
- STI and Society
- Socioeconomic Impact Assessment of STI Policy
- Historical and International Contexts of STI Policy

### 3.4 Aspects of analysis, design, and implementation

Research outcomes in the 'Science of STI Policy' are expected to be applied in policy formation and societal practice, ultimately contributing to the evolution of policy-making mechanisms. However, it is rare for individual research outcomes to be directly applicable to policy-making practice.

First, research must be available that identifies both explicit and implicit issues in STI policy from a comprehensive and structured perspective to support policy-making. To achieve this, one approach is for policy-makers and researchers to collaborate in setting the research agenda. In the SciREX's 'Co-evolution Realization Program',<sup>19</sup> researchers and policy-makers engage in dialogue to jointly set research topics based on specific policy challenges, conducting collaborative research from the agenda-setting stage—an example of EBPM in practice.

Second, it is also important that individual research outcomes be structured into knowledge systems that are easily usable in policy formation. Conducting meta-analyses - collecting and integrating multiple individual studies based on specific criteria—could be one such method.<sup>20</sup>

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<sup>18</sup> The history of the discussion is summarized in CRDS (2011b) and CRDS (2017).

<sup>19</sup> <https://scirex.grips.ac.jp/project/list.html>

<sup>20</sup> For instance, a meta-analysis of relevant research on innovation policy by the Manchester Institute of Innovation Research (MIOIR) at the University of Manchester is a helpful reference, see: <http://www.innovation-policy.org.uk/compendium/>



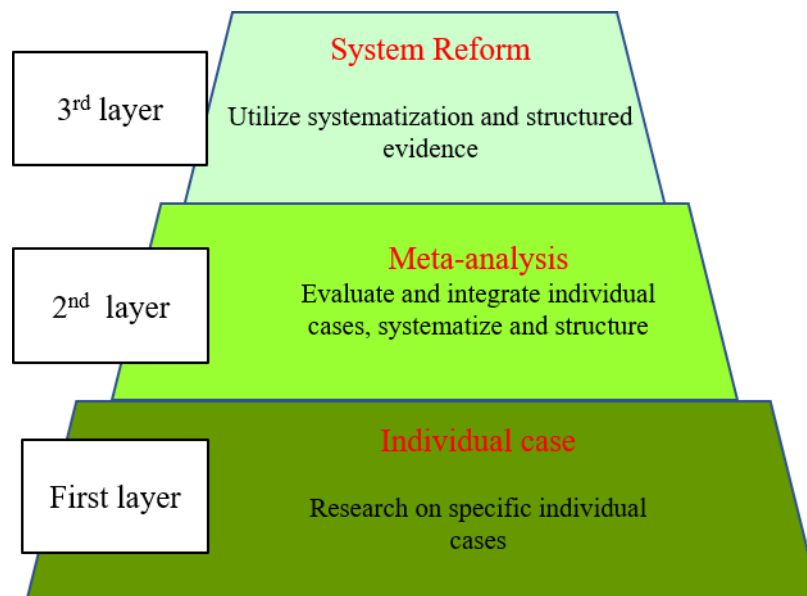


Figure 2. Structuring individual research into a knowledge system that can be readily used for policy-making.  
Source: CRDS (2011a)

However, these alone are not sufficient. It is necessary to recognize the uncertainties and limitations of evidence and to use it appropriately at various stages of the policy-making process. There are several possible patterns in the utilization of evidence in policy-making. In one case, policy-makers or decision-makers may directly reference research outcomes to create new policies or revise ineffective ones. Alternatively, highly impactful research may have an enlightening effect on the public, influencing awareness and behavior, which in turn can lead to policy or institutional change. It is important to strengthen these various potential pathways that connect research and policy.

At the same time, it is essential to deepen understanding among policy-makers and society at large of evidence-based policymaking, including its limitations, and to promote a shift in mindset. Since the late 2010s, awareness among policymakers and the public regarding the concept and necessity of 'evidence' has significantly advanced. Despite many practical challenges, further progress is anticipated.

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