

Research Method Innovations of World-Class Think Tanks: A Post-Print

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Abstract

World-class think tanks universally emphasize the innovation and development of research methodologies. Research methodology innovation has accompanied think tanks since their inception. Such innovation is not only essential for the survival and development of think tanks, but also serves as a powerful method and tool for effectively conducting high-quality, normative strategic and policy research, while simultaneously constituting a significant research output of high-level think tanks. The innovation and application of research methodologies in world-class think tanks primarily encompass four categories: original new theories and methods, indicator systems and index-based methods, modeling and simulation methods, and the innovation and application of distinctive methods. This article examines the development of research methodology innovation and application in world-class think tanks through case studies of institutions such as the RAND Corporation of the United States, the Joint Research Centre of the European Union, and the National Institute of Science and Technology Policy of Japan. Finally, it proposes recommendations for research methodology innovation to support China's construction of new-type think tanks with Chinese characteristics and international influence.

Full Text

Introduction

World-leading think tanks universally emphasize the innovation and development of research methodologies. Methodological innovation has accompanied think tanks since their inception, serving not only as a necessity for their survival and development but also as a powerful instrument for conducting high-quality, normative strategic and policy research. Moreover, such innovation constitutes an important research output of top-tier think tanks. The methodological innovations and applications of world-leading think tanks can be classified into four

main categories: original theories and methods, indicator systems and index-based methods, modeling and simulation approaches, and the innovation and application of specialized methods. This paper examines cases including the RAND Corporation, the European Commission's Joint Research Centre (JRC), and Japan's National Institute of Science and Technology Policy (NISTEP) to analyze the development of methodological innovation and application in world-leading think tanks. Finally, the paper offers recommendations for methodological innovation in building internationally influential new-type think tanks with Chinese characteristics.

In today's world, characterized by deepening multipolarization, economic globalization, social informatization, cultural diversification, and complex challenges, decision-makers at all levels of government and various social actors increasingly rely on think tanks. The number of think tanks worldwide continues to grow rapidly, and these institutions have become opinion leaders that support and influence government and societal decision-making while shaping public opinion, with their social influence expanding continuously. World-leading think tanks exhibit a series of distinctive features and clear markers [1]. A think tank's status as world-class is not determined by a single factor but results from the favorable combination and synergistic interaction of multiple elements. Among these, high-quality strategic and policy research constitutes the most important factor in shaping think tank influence, with key academic support for such quality research including high-standard analytical research norms and quality management mechanisms [2] and the innovation and normative application of research methods.

Domestic think tanks have paid insufficient attention to the high-quality research standards and quality control mechanisms of world-leading think tanks, particularly the crucial role of methodological innovation in shaping think tank influence. As the saying goes, "To do a job well, one must first sharpen one's tools." Innovative research methods serve as a common language for the academic community. Building internationally influential new-type think tanks with Chinese characteristics requires serious attention to methodological innovation and application. Chinese new-type think tanks should make contributions in developing innovative theories and methods for strategic and policy research.

The Importance of Methodological Innovation for Think Tank Survival and Development

The fundamental function of think tanks is research and consultation on strategic and policy issues, and they demonstrate and consolidate their professionalism by providing a scientific foundation for policy formulation. As modern decision-making theory increasingly emphasizes "evidence-based scientific decision-making," using scientific research methods to study public issues based on substantial facts and data has become the standard procedure for policy analysis. High-quality think tank products inevitably rely on scientifically grounded research methods. With the continuous emergence of new environments, new

problems, and new data, research work has become increasingly complex, making traditional research methods inadequate. This necessitates the continuous creation of new methods to accumulate new methodological cornerstones for think tank development.

Methodological Innovation as a Developmental Gene of World-Leading Think Tanks

Modern think tanks originated from the social sciences, representing public policy research institutions that apply the knowledge and skills of experts, scholars, and managers to solving social and economic problems [3]. The Brookings Institution, considered the first independent organization in the United States dedicated entirely to public policy research, has relied on renowned scholars engaged in empirical, academic, and objective public policy research in social science fields since its founding, forming the “Brookings model” that profoundly influenced public policy research institutions for decades thereafter. Its charter states that it “will conduct scientific research in broad fields of economics, government management, political science, and sociology,” clarifying its interest in applying scientific principles to government management research. It proposed establishing Brookings as a research center bringing together social scientists and policymakers, thereby enabling the “scientific method” to be applied to government management [3].

The RAND Corporation, from its inception, possessed the gene of methodological innovation and serves as a model of think tanks emphasizing research methods. However, its application and innovation of research methods differed from other think tanks rooted in social science research by pioneering the “research and development” model for think tanks, applying methodological skills from the R&D process to solving public policy problems, and creating and expanding the application of numerous influential research methods such as the Delphi method, game theory, and systems analysis [4].

Methodological Innovation as an Important Research Output of Think Tanks

While think tank policy consultation outcomes primarily influence decision-makers or the public, the research methods and tools developed by think tanks can be widely applied across other institutions (including both think tank and non-think-tank research organizations) and different fields. These methods can become shared knowledge and skills within the academic community, thus representing another more vital form of research output for think tanks. A distinctive marker of internationally renowned think tanks is their ability to develop and create widely disseminated, enduring scientific research methods. The development and innovation of research methods have become powerful instruments for establishing and maintaining the reputation and sustained influence of internationally famous think tanks such as RAND.

Main Types of Methodological Innovation in World-Leading Think Tanks

Through in-depth observation and analysis of internationally renowned think tanks, their methodological innovations and applications can be categorized into four main types.

Original New Theories and Methods

Original new theories and methods are new guiding theories and analytical methods created by think tanks for strategic and policy research. These theories and methods are either entirely new or involve the application and further development of methods from mathematics and other fields to think tank research. The most representative think tank in this regard is the RAND Corporation. RAND has created numerous new methods for policy analysis and research and has consistently maintained this innovative tradition and advantage. For example, it proposed “Rational Choice Theory” as the basic thinking mode for decision-making and a matrix rule for Western society [4]; developed decision theory and techniques under conditions of uncertainty, making fundamental contributions to game theory; invented and created famous linear programming methods, nonlinear programming methods and optimization techniques, mathematical modeling and simulation research methods, as well as network theory and cost analysis. Among its most famous methods are the Delphi method, systems analysis, and scenario planning.

Quantitative Indicator Systems and Index-Based Methods

Quantitative indicator systems and index-based methods are relatively easier to develop compared to original research theories, methods, and tools. However, creating scientific and appropriate indicator systems or indices to accurately characterize and evaluate research problems based on actual needs remains relatively difficult. Internationally renowned think tanks have developed countless indicator systems and index-based methods, with only a few academically recognized and authoritative examples mentioned here.

(1) Indicator systems for evaluating national innovation capacity and competitiveness. Examples include the “World Competitiveness Index” developed by Switzerland’s International Institute for Management Development (IMD) since 1989, the “Global Competitiveness Index” developed by the World Economic Forum (WEF) since 1979, the “European Innovation Scoreboard” (EIS) developed by the EU since 2001, the “Global Innovation Index” (GII) jointly developed by the World Intellectual Property Organization (WIPO) and INSEAD since 2007, and science and technology indicators from the Organisation for Economic Co-operation and Development (OECD). These institutions use their developed indicator systems to quantitatively evaluate national innovation capacity, competitiveness, and development levels annually, with results receiving high attention from governments and academia worldwide.

(2) Indicators for evaluating national human development progress. Examples include the “Human Development Index” from the United Nations Development Programme (UNDP).

Model Simulation Methods

Model simulation methods involve creating a similar model based on the main characteristics of a prototype and then indirectly studying the prototype through the model. According to the similarity relationship between model and prototype, model simulation can be divided into physical model simulation and mathematical model simulation. While model simulation is commonly used in think tank policy research, creating new models and applying them to strategic and policy problems represents a major invention and contribution of world-leading think tanks.

A most famous and widely influential example of model simulation research is the World System Dynamics Model—World 3 Model—proposed in 1972 by the Club of Rome, an international non-governmental think tank organization based in Rome, Italy, in its first research report *The Limits to Growth* [5]. The report’s authors used this model to predict world development scenarios for the coming decades, and its predictions’ foresight and astonishing accuracy in retrospect changed global human development concepts, making the report a tremendous success. Additionally, the U.S. Millennium Institute developed the Threshold 21 Model (T21) to support and monitor the UN Millennium Development Goals, which can predict future national development under different policies and scenarios and evaluate relevant policy packages. After more than 20 years of in-depth research and application, this model has been widely used in sustainable development research by relevant international organizations and countries.

Innovation and Application of Specialized Methods

Conducting high-quality policy analysis requires think tanks to develop and apply scientific research methods. As research paradigms and methodological systems in natural and social sciences have become increasingly mature and complete since the 20th century, innovating entirely new research methods has become more difficult. Therefore, while original research methods remain the goal for world-leading think tanks, most think tanks adapt existing methods through improvement, refinement, integration, and combined application according to problem-solving needs.

Typical examples include: Japan’s National Institute of Science and Technology Policy (NISTEP) applies technology foresight methods to identify medium- and long-term science and technology development trends and innovatively develops “Science Maps” using scientometric methods to analyze and identify hot research directions in scientific fields. The EU Joint Research Centre uses foresight and horizon scanning methods to observe long-term impacts of policies and technolo-

gies, forming the “Future-Oriented Technology Analysis” (FTA) methodological system. While scientometrics and future-oriented technology analysis methods are not original to these two institutions, they have continuously improved and innovatively applied these methods in their research, developing them into characteristic research methods.

Typical Cases of Methodological Innovation and Application in World-Leading Think Tanks

RAND Corporation’s Innovative Methods Research and Application

RAND was formally established in 1948 as a scientific research and development center, a factory of theoretical knowledge, and a think tank funded by the U.S. military. Its initial goal was “to promote and advance science, education, and charitable development, all for public welfare and U.S. national security,” with the fundamental task of providing the U.S. government, especially the Air Force, with advice on how to better wage and win wars [4].

RAND treats innovative methodology research as an important research task and has structurally established the “Pardee Graduate School and Emerging Policy Research and Methods Department,” which includes six “Methods Centers” responsible for developing various innovative, interdisciplinary research methods and tools needed for public policy research. These six Methods Centers are: (1) Center for Applied Network Analysis and Systems Science, focusing on visualization, network metrics and descriptive statistics, and network statistical pattern modeling; (2) Center for Qualitative and Mixed Methods, focusing on semi-structured interviews and focus groups, cultural domain analysis, terminology-based thematic methods, and corpora; (3) Center for Game Theory, focusing on gaming, simulation, and modeling; (4) Center for Causal Inference, focusing on difference-in-differences, instrumental variables, propensity scores, randomized learning, and regression discontinuity; (5) Center for Decision Making Under Uncertainty, focusing on foresight, decision support, mental models, behavioral experiments, and modeling and behavioral experiments; (6) Center for Scalable Computing and Analysis, focusing on modern big data technologies, algorithms, and implications []. RAND’s organizational design and pursuit of “Methods Centers” are rare among other think tanks.

RAND’s methodological innovations have undoubtedly played an important role in establishing its global reputation in the think tank community. RAND pioneered a series of methods and models for forecasting and decision analysis, including forecasting methods, systems analysis methods, decision-making methods, and other methods (Table 1).

EU Joint Research Centre' s Methodological Innovation and Application

The European Commission' s Joint Research Centre (JRC) is a science and knowledge service department that provides independent scientific advice for EU policies. Its mission is to support EU policy-making by providing evidence throughout the policy process— “science for policy.”

JRC has developed a series of new methods and cutting-edge technologies to aid decision-making: (1) **Foresight**. Using an integrated set of qualitative and quantitative methods and techniques to identify future science and technology development fields most likely to bring transformation and promote future economic, environmental, and social development in the next 5-30 years. Additionally, JRC developed the “Online Foresight Guide” system for conducting science and technology foresight online. (2) **Horizon Scanning**. Used to collect information on emerging issues and trends in policy areas including political, economic, social, technological, and environmental domains. (3) **Modeling**. Developing specialized models and model scenarios to help decision-makers identify the strengths and weaknesses of possible policy scenarios. JRC' s modeling methods include various specific approaches such as simulation, optimization, economic estimation, life cycle analysis, input-output analysis, and process flow analysis. (4) **Behavioral Foresight**. Behavioral research, including behavioral economics and psychology, foresees human behavior such as how people process information and make decisions. When applied to decision-making behavior foresight, it can increase policy effectiveness and explain policy domain relevance, such as consumer protection and energy taxation [].

Future-Oriented Technology Analysis (FTA) Method System From 2004 to 2014, JRC organized five “Future-Oriented Technology Analysis” (FTA) conferences to discuss and develop methods for planning, strategy, policy, and decision-making, and for shaping future development. JRC unified various future-oriented technology analysis methods and practices under the “umbrella concept” of FTA, forming a research boom. The future-oriented technology analysis method has formed a systematic methodological system (Table 2) [6-9].

NISTEP' s Methodological Innovation

Japan' s National Institute of Science and Technology Policy (NISTEP) participates in Japan' s science and technology policy planning. Its seven major research activities—R&D and innovation; science and technology systems; S&T human resources; relationships between science, technology, and society; S&T indicators and scientometrics; S&T foresight and trends; and science of science, technology, and innovation policy—are all closely related to methodological development. NISTEP attaches great importance to the application of normative research methods in S&T policy research and has accumulated characteristic research methods, most notably technology foresight and “Science Maps.”

NISTEP's Technology Foresight Japan has conducted national-scale technology foresight surveys since 1971, repeating the exercise every five years and completing its 10th survey by 2015. NISTEP has accumulated rich experience in technology foresight, with its organizational models, operational mechanisms, and corresponding foresight methods becoming increasingly mature. The purpose of technology foresight is to identify medium- and long-term S&T trends and obtain future S&T landscapes. Each foresight activity provides direction and targets for S&T development for the next 15-30 years, characterized by: medium- to long-term observation perspectives (20-30 year forecasting periods), large expert participation, extensive discussions between natural science (supply-side) and humanities and social science (demand-side) experts, and comprehensive application of various methods. NISTEP provides an “ideal” vision of future society in its technology foresight and then “identifies” the science and technologies that can realize this vision. It emphasizes strengthening international cooperation networks, participating in international projects, and training young researchers from emerging countries to become a global leader in technology foresight. NISTEP also focuses on developing new methods that may be needed in the future, making its technology foresight work rank first in the world in terms of continuity, systematicity, improvement, and consultation.

When conducting each technology foresight survey, NISTEP does not simply replicate the previous foresight model but continuously improves the foresight process and methods. The first four technology foresight activities (organized by Japan's Science and Technology Agency, with NISTEP conducting the 5th foresight since 1992) applied the Delphi method, improving the survey process through two rounds of questionnaires. The 5th-7th foresight activities further improved and optimized the selection of survey participants and questionnaire design. The 8th foresight activity added demand analysis and bibliometric methods as supplementary approaches to the main Delphi method. The 9th foresight activity simultaneously used scenario planning to display future S&T development through future scenarios and organized workshops to study regional green innovation capabilities. The 10th foresight activity simultaneously employed the Delphi method, bibliometric methods, and benchmarking methods, using high-citation papers as indicators in bibliometric methods to rapidly identify frontier fields [].

NISTEP's “Science Maps” NISTEP attempts to quantitatively analyze R&D trends and S&T levels in Japan and other countries through scientometric methods, particularly focusing on scientific papers, patents, and other research activity outputs. Its purpose is to comprehensively and quantitatively display S&T trends. NISTEP uses the Essential Science Indicators (ESI) database to analyze each country's R&D trends and S&T levels, such as time-series analysis of each country's scientific strengths and weaknesses and institutional-level analysis. Since 2004, it has published “Science Maps” every two years to identify hot research areas and their characteristics in scientific fields [].

“Science Maps” identify internationally concerned research fields through highly cited papers (scientific papers ranking in the top 1% by citation rate in each discipline), then reveal international research trends and quantitative changes within and between disciplines by analyzing these research fields. The research method involves: based on ESI database citations over six years, selecting the top 1% of highly cited papers annually from all 22 research fields for co-citation analysis to identify hot research fields of certain scale; then conducting cluster analysis based on co-citation relationships among highly cited papers to obtain clusters of similar research papers and identify research fronts.

NISTEP has continuously optimized and improved the “Science Maps” method. In *Science Map 2006* [Figure 2006: see original paper] released in 2008, it improved visualization methods—on the basis of cluster analysis using co-citation relationships of highly cited papers, research fields were displayed through topographic maps. *Science Map 2008* released in 2010 added inter-institutional co-authorship network analysis. *Science Map 2012* [Figure 2012: see original paper] redefined core papers and citing papers—papers in the top 1% that constitute research fields remain called core papers, while papers citing these core papers are called citing papers; it added the top 10% of citing papers, i.e., the top 10% of highly cited papers. *Science Map 2014* [Figure 2014: see original paper] not only increased analysis points but also improved visualization representation methods, adding Dot-link visualization diagrams and Trajectory diagrams in addition to topographic map visualization. NISTEP’s “Science Maps” research results are valuable for macro-level decision-making in scientific fields.

Implications and Recommendations

The values that world-leading think tanks attach to methodological innovation and their contributions in this area have important reference and promoting significance for building internationally influential new-type think tanks with Chinese characteristics. A new-type think tank with Chinese characteristics should be one with international influence, and the ability to contribute new research methods should be a common and recognized element in shaping international influence. To a certain extent, the effectiveness and influence of building new-type think tanks with Chinese characteristics must rely on progress in strategic and policy analysis methods.

Methodological Innovation Should Become an Important Component in Shaping the Influence of New-Type Think Tanks with Chinese Characteristics

Compared with world-leading think tanks, Chinese think tanks rarely form authoritative and distinctive advantageous fields in strategic and policy research with significant international influence. Taking technology foresight as an example, NISTEP has continuously conducted 10 national-level technology foresight

studies since 1971, continuously improving and perfecting its research methods. The foresight results have become a primary basis for government decision-making and have successfully exported this technology foresight research method internationally. China has also conducted national-level technology foresight research, but as the saying goes, “Everything has a beginning, but few have an end” —these efforts failed to gain momentum and fizzled out, let alone achieve methodological innovation. Therefore, strengthening methodological innovation should become an important component in building new-type think tanks with Chinese characteristics.

Changes in Information Environment and Research Paradigms Call for Think Tank Methodological Innovation

The current network and big data information environment is undergoing and will continue to experience major changes: the Internet of Everything has greatly facilitated the generation and transmission of data information; the “5V” ecology of big data—Volume (large data quantity), Variety (diverse types and sources), Value (relatively low data value density), Velocity (fast data growth rate), and Veracity (data accuracy and trustworthiness)—is comprehensively transforming and subverting traditional structured data analysis and computation methods; big data and open science are reshaping scientific communication patterns, making in-depth and precise data mining capabilities a core competency for data-related institutions. Big data mining itself has become part of the decision-making process and knowledge discovery process. This big data information environment and the new data-driven research paradigm pose new and higher requirements for think tank methodological innovation.

Most traditional Chinese think tanks originate from the social sciences, where qualitative research has long been dominant, relying mainly on literature review, personal experience, and expert wisdom. In the new data-driven scientific big data paradigm environment, this traditional research model must change to establish a new data-driven think tank research paradigm. Think tanks can no longer rely solely on literature review but must depend on specialized databases and their computational analysis methods accumulated over the long term, conducting fact-based, data-driven, case-based, model-based, and pattern-based analysis to produce well-founded policy planning and recommendations. This is the foundation for successful construction of new-type think tanks with Chinese characteristics.

Recommendations for Think Tank Methodological Innovation Development

Think tanks serve as bridges between the academic and decision-making communities, specializing in integrated knowledge analysis to serve policy decision-making. The tremendous changes in knowledge analysis objects and information environmental conditions pose new problems and directions for think tank methodological tool innovation. Overall, in terms of methodological innovation,

think tanks should strengthen future-oriented method research and innovation, primarily based on big data and data mining methods and their applications. They should also strengthen the development, accumulation, and improvement of specialized databases and case databases for specific policy problems. Focusing on methodological innovation for S&T think tanks, five directional recommendations are proposed:

1. **From “Small Data Analysis Paradigm” to “Big Data Prediction Paradigm.”** This involves moving from structured small data (databases) to unstructured big data (systems); from data causality explanation to data correlation mining and prediction; and from simple linear analysis to complex nonlinear network analysis.
2. **From Bibliometrics to “Internet+” and “Big Data+” New Scientometrics.** This involves moving from relatively static bibliometrics to dynamic scientometrics; from macro-level measurement and statistical analysis (e.g., journal impact factors) to meso-level (e.g., research teams) and micro-level (e.g., evaluating individual scientists; mining research frontier topics) measurement and statistical analysis; from single-indicator measurement to multi-indicator integrated measurement; and from measurement in natural sciences to humanities and social sciences. Quantitative measurement analysis should be combined with qualitative professional analysis, conducted cautiously, scientifically, and rigorously, without absolutizing or exaggerating measurement results, and without blindly following measurement results.
3. **From “Closed Science” to “Open Science.”** This involves moving from limited interactive communication patterns to open interactive scientific communication patterns; from measurement based on citation and co-authorship networks to measurement and evaluation of the “science footprint” ultra-complex relationship networks based on “open science” ; and from describing and evaluating traditional scientific evolution to revealing new laws and patterns of open science.
4. **From Information Analysis and Policy Research in Specialized Disciplines to Discipline Informatics and Knowledge Discovery, Policy Informatics and Policy Knowledge Discovery in Specialized Fields.** This involves identifying emerging research frontiers and technology evolution trends; moving from first-order data mining (quantity trend analysis) to second-order data mining (quantity connotation discovery); and moving from describing correlation relationships and system modeling in disciplinary big data to professional knowledge discovery in disciplinary fields.
5. **From Knowledge Analysis Technology Development to Knowledge Visualization and Knowledge Mapping Technology Development.** This involves forming a methodological and technical system for knowledge analysis and visualization; moving from individual knowledge

analysis methods and tools to integrated knowledge analysis platforms and systems [10].

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Analysis on Methodology Development of World-leading Think Tanks

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Abstract: Methodologies serve as both helpful methods and tools for research on strategic and policy issues and as important outputs of think tanks, having evolved continuously since the emergence of modern think tanks. The innovation and application of methodologies by world-leading think tanks can be classified into four categories: original innovation of single theory/method, indicator or index-based methods, modeling and simulation approaches, and specialized method innovation and application. This study examines cases such as the RAND Corporation, the EU Joint Research Centre, and NISTEP to explore methodological innovation and application in detail. Based on this analysis, suggestions for methodological innovation for China's new-type think tanks are proposed.

Keywords: think tank, methodology, method innovation and application

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