# The Advisory Mechanism and Policy Effects of the President' s Council of Advisors on Science and Technology in the Obama Administration and Its Implications for China (Postprint)

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## Abstract

[Purpose/Significance] The construction of national science and technology decision-making consultation systems has entered a new stage, facing many new issues, and thus needs to draw upon development experiences from other countries worldwide. [Method/Process] This paper selects the President' s Council of Advisors on Science and Technology (PCAST) of the Obama administration as a case study. Based on meeting records and original reports about PCAST from the Obama administration' s website, it adopts methods primarily based on textual analysis and case study to examine PCAST' s consultation mechanism from the aspects of consultation topic sources, work conduct, and feedback on work results. [Results/Conclusions] Through analysis of successful PCAST cases, the ways in which PCAST consultation work influences decision-making are categorized into four types: collaborative-sustained, strategic-guidance, problem-solving, and science-supported. This paper summarizes several conclusions regarding PCAST' s success and proposes several recommendations for the construction of China' s national science and technology decision-making consultation system.

## Full Text

### A Study on the Advisory Mechanism and Policy Effects of the President' s Council of Advisors on Science and Technology of the Obama Administration and Its Implications for China

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## Abstract

[**Purpose/Significance**] China' s construction of a national science and technology decision-making advisory system has entered a new stage, facing many new challenges that require learning from the development experiences of other countries. [**Method/Process**] This paper selects the President' s Council of Advisors on Science and Technology (PCAST) of the Obama administration as a case study. Based on PCAST meeting records and original reports from the Obama administration' s website, this research employs text analysis and case study methods to examine PCAST' s advisory mechanism from three perspectives: the origins of advisory topics, the conduct of its work, and feedback on its results. [**Result/Conclusion**] Through analysis of PCAST' s successful cases, this study classifies the ways in which PCAST' s advisory work influences decision-making into four types: ongoing synergy, strategic guidance, problem-solving, and scientific support. This paper summarizes several conclusions regarding PCAST' s success and proposes recommendations for building China' s national science and technology decision-making advisory system.

**Keywords:** science and technology decision-making advice; national science and technology decision-making advisory system; U.S. President' s Council of Advisors on Science and Technology

## 1. Functions and Composition of the Obama Administration' s PCAST

### 1.1 Functions of the Obama Administration' s PCAST

PCAST was established by President George H.W. Bush in 1990 through executive order to provide a "critical link between industry and academia," serving as the President' s highest-level science advisory body. Its predecessor was the President' s Science Advisory Committee (PSAC) during the Eisenhower administration. Unlike PSAC, which consisted primarily of scientists, PCAST includes not only academic scientists but also industry experts and engineers. Each subsequent president must establish their own PCAST through executive order.

On April 27, 2009, President Obama announced the establishment of the President' s Council of Advisors on Science and Technology, which was formalized a year later through Executive Order 13539 on April 21, 2010. This executive order stipulated that PCAST would have no more than 21 members, including

the President' s Assistant for Science and Technology (the "Science Advisor" ) and 20 outstanding individuals from outside the federal government, appointed by the President. These non-federal members must represent diverse fields and aspects of science, technology, and innovation. The President' s Science Advisor serves as a co-chair, and the President designates at least one but no more than two non-federal members as additional co-chairs.

According to Executive Order 13539, PCAST provides advice to the President through meetings or via the Science Advisor. Its recommendations include, but are not limited to, policies promoting science, technology, and innovation development, as well as scientific and technical information needed for public policies concerning economics, energy, environment, public health, and national and homeland security. PCAST must meet regularly to respond to requests for information, analysis, evaluation, and advice from the President and the Science Advisor. It must solicit information and ideas from a broad range of stakeholders, including but not limited to the research community, private sector, universities, national laboratories, state and local governments, foundations, and non-profit organizations. Additionally, PCAST must respond to requests from the National Science and Technology Council (NSTC). The executive order specifies that, to the extent permitted by law, executive departments and agencies must provide necessary scientific and technical information when requested by PCAST co-chairs for fulfilling PCAST' s functions. PCAST has the authority to establish subcommittees that can provide information directly to PCAST.

The executive order also assigned PCAST the advisory committee functions stipulated in the High-Performance Computing Act of 1991 (Public Law 102-194) and the 21st Century Nanotechnology Research and Development Act (Public Law 108-153). When performing the former function, PCAST is designated as the President' s Innovation and Technology Advisory Committee; when performing the latter, it is designated as the National Nanotechnology Advisory Panel.

The Office of Science and Technology Policy (OSTP) provided funding for PCAST (later changed to the Department of Energy through Executive Order 13596). However, PCAST members receive no compensation beyond travel expenses.

### 1.2 Composition of the Obama Administration' s PCAST

During its tenure, PCAST had 19 members, with a total of 25 experts serving as PCAST members over the eight-year period. John P. Holdren, the President' s Science Advisor and OSTP Director, served as a co-chair. The other two co-chairs were Harold Varmus (2009-2010), a Nobel laureate in Physiology or Medicine and former NIH Director, and Eric Lander (2009-2017), a biology professor at MIT and professor at Harvard Medical School who was also a key leader of the Human Genome Project. Other members came from universities, research institutes, and high-tech enterprises. Compared to the previous Bush

administration, this PCAST had a higher proportion of members from universities and a lower proportion from industry.

PCAST established several subcommittees, including: Health and Life Sciences Committee, Science, Technology, Engineering, and Mathematics (STEM) Education Committee, Interdisciplinary Committee, Energy-Climate Change-Environment Committee, Innovation and Technology Committee (PITAC), Economic Development Committee, and International Security Committee. These subcommittees were composed of PCAST members.

## 2. Working Methods and Areas of the Obama Administration' s PCAST

### 2.1 Meetings

According to Executive Order 13539 establishing PCAST, meetings constitute a primary working method. Over eight years, PCAST held 45 meetings, averaging five to six meetings annually, including a few teleconferences. Meeting topics fell into several categories: (1) discussions on the implementation of existing national S&T programs, such as the National Nanotechnology Initiative (NNI) and advanced manufacturing programs; (2) discussions on research activities of major federal research agencies, such as DARPA and NIST research programs; (3) discussions on important advisory studies from other organizations, such as reports from the National Research Council (NRC); (4) discussions on PCAST' s own research reports and related scientific developments; and (5) exchanges on PCAST committee activities.

Participants included not only PCAST members but also heads of federal S&T departments such as the National Science Foundation, Department of Defense, NASA, Department of Commerce, Department of Agriculture, and NIH; personnel from research institutions and S&T policy-related departments; and representatives from major corporations such as IBM and Google. Committee discussions covered a wide range of disciplines and fields, including scientific disciplines like life sciences, materials science, space exploration, oceanography, and forensic science; technologies such as health information technology, advanced manufacturing, IT, nanotechnology, agriculture, big data, and antibiotics; and practical issues including energy and environment, STEM education, food, epidemics, science diplomacy, S&T talent, innovation incentives, and aging. Meetings included public comment periods, and all content was made public. After 2015, PCAST meetings could be live-streamed online.

### 2.2 Research Reports

Most PCAST reports were submitted directly to the President under the title "Report to the President" (reports required by law to assess nanotechnology and information and communications technology were also submitted to Congress under the title "Report to the President and Congress") and were simultaneously

released to the public. Each report was typically completed by a dedicated working group. Over eight years, PCAST submitted 36 reports to the President, including 7 letter reports—a new report type introduced in Obama's second term that was much shorter than regular reports. Reports constitute PCAST' s main output and have significant influence on both policy and scientific communities.

Most PCAST reports resulted from their own research, with a few exceptions: (1) "Capturing Domestic Competitive Advantage in Advanced Manufacturing" (July 2012) was led by the Advanced Manufacturing Partnership (AMP) steering committee, and "Accelerating U.S. Advanced Manufacturing" (October 2014) was led by the AMP 2.0 steering committee. PCAST adopted these two reports and submitted them to the President as PCAST reports. (2) Although "Ensuring Long-Term U.S. Leadership in Semiconductors" was nominally completed by a PCAST working group, most members were industry technology leaders, prominent researchers, and former policymakers, suggesting relatively independent work. PCAST reviewed and adopted this report.

### 2.3 Working Areas of PCAST

Based on reports submitted during the two terms, PCAST' s main advisory areas included healthcare, information technology, advanced manufacturing, education, nanotechnology, and energy/environment, as shown in .

**** The main fields of PCAST advisory work

| Field | Topics |
|---|---|
| Disease and Crisis Response | H1N1 influenza, vaccines, pharmaceutical innovation, antibiotic resistance, anti-biological attack |
| Healthcare & Life Sciences | Health information technology, health engineering, hearing technology, technology and aging |
| Information Technology & Related | Cybersecurity, big data and privacy, future cities, spectrum |
| Energy & Environment | Energy policy, energy technology, ecosystem and economy, environmental capital, climate change, private sector and climate change, drinking water technology |
| S&T Enterprise & Related Education | Higher education, vocational education K-12 STEM education, first two years of college STEM, higher education, vocational education |

*Source: Summary of Obama administration PCAST reports*

## 3. Advisory Mechanism of PCAST

### 3.1 Sources of Topics

PCAST report topics originated from four main sources: presidential requests; legal requirements; federal department or official requests; and self-selected or unspecified sources.

**3.1.1 Presidential Requests** Presidential requests were an important source of PCAST research topics, made in several ways: explicit presidential requests; presidential memoranda; responses to issues mentioned by the President; or topics raised in presidential conversations or speeches.

Important studies initiated by presidential request included: Two reports on STEM education—"Prepare and Inspire: K-12 Education in Science, Technology, Engineering, and Math (STEM) for America' s Future" (September 2010) and "Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics" (January 2012). These originated from the President's fall 2009 request for PCAST to recommend important actions needed for the U.S. to achieve leadership in STEM education over the next decade.

"Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth" (July 2012) addressed questions raised in the President' s 2010 memorandum. "Report to the President on Propelling Innovation in Drug Discovery, Development, and Evaluation" (September 2012) responded to a presidential request. "Climate Change" (March 2013) was requested in November 2012 when the President mentioned the administration was developing climate change strategies for the second term. "Education Technology—Higher Education" (December 2013) emerged from post-election conversations about barriers to economic mobility, particularly in higher education. "Combating Antibiotic Resistance" (September 2014) was requested in January 2013. "Letter Report: Private Sector Efforts in Adaptation to Climate Change" (November 2015) built on the 2013 climate change report in response to the President' s March 2015 inquiry about government support for private sector climate adaptation. "Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods" (September 2016) responded to the President' s 2015 question about new scientific methods beyond those in the 2009 NRC report to ensure validity of forensic evidence in the legal system. "Report to the President: Science and Technology to Ensure the Safety of the Nation' s Drinking Water" (December 2016) addressed the President' s March 2016 inquiry about how science and technology could more effectively address national drinking water safety challenges.

**3.1.2 Federal Department or Official Requests** Studies requested by federal officials or departments included: "Reengineering the Influenza Vaccine Production Enterprise to Meet the Challenges of Pandemic Influenza" (August

2010), requested by the President' s Executive Office to evaluate current vaccine production processes. "Accelerating the Pace of Change in Energy Technologies Through an Integrated Federal Energy Policy" (November 2010) originated from the Energy Secretary' s fall 2009 request for PCAST to assess the energy technology innovation system and identify methods to accelerate energy transformation. "Agricultural Preparedness and the Agriculture Research Enterprise" (December 2012) stemmed from requests by Catherine Woteki, Under Secretary for Research, Education, and Economics at USDA, and Roger Beachy, Director of the National Institute of Food and Agriculture, in January 2011, and from the Agriculture Secretary in March 2012, asking PCAST to examine critical areas of U.S. agricultural R&D. "Big Data and Privacy: A Technological Perspective" originated from Presidential Advisor John Podesta' s request to PCAST in response to the President' s January 17, 2014 requirement.

**3.1.3 Legal Requirements** According to Executive Order 13349, PCAST is responsible for evaluating the National Nanotechnology Initiative (NNI) under the 21st Century Nanotechnology Research and Development Act, completing four evaluation reports. Under the High-Performance Computing Act of 1991 (Public Law 102-194) and related acts, PCAST is responsible for evaluating the federal Networking and Information Technology Research and Development (NITRD) program, completing four assessment reports.

**3.1.4 Self-Selected or Unspecified Sources** Thirteen reports were self-selected or had unspecified sources. Notably, "self-selected" means the advisory topics were chosen based on PCAST' s own mission. For example, "Transformation and Opportunity: The Future of the U.S. Research Enterprise" (November 2012) was a rare study on the future of U.S. research. This does not mean these studies were unaffected by decision-making needs; rather, their origins were not explicitly stated, making complete judgment impossible. Some studies can be inferred to have been commissioned in some manner, such as the 2011 report on advanced manufacturing. Others show clear influence from policy needs, such as two reports on aging— "Aging America & Hearing Loss: Imperative of Improved Hearing Technologies" (October 2015) and "Independence, Technology, and Connection in Older Age" (March 2016)—which originated from a White House conference in 2015, the 50th anniversary of Medicare, Medicaid, and the Older Americans Act, discussing future directions and new ideas for aging policy.

### 3.2 Working Methods

**3.2.1 Establishment of Working Groups** PCAST typically established a working group or invited expert panels to conduct advisory research for each report. Among the 36 reports, except for "Capturing Domestic Competitive Advantage in Advanced Manufacturing" (July 2012) and "Accelerating U.S. Advanced Manufacturing" (October 2014), which were led by the Advanced Manufacturing Partnership (AMP) steering committee, several studies did not estab-

lish working groups: "Ensuring American Leadership in Advanced Manufacturing" was based on workshops organized by PCAST and its PITAC with manufacturing leaders and innovation experts; "Climate Change,""Education Technology —Higher Education," "Information Technology for Targeted Skill Training and Talent Matching," and "Letter Report to the President and Congress: Sixth Assessment of the National Nanotechnology Initiative" did not have dedicated working groups. All other studies established working groups, typically including one or two chairs, several members, and one or two staff members. Working group chairs were usually PCAST members, while group members included both PCAST members and external experts.

The role and function of each advisory report' s working group varied, roughly falling into two categories: reports completed entirely by the working group; and reports where the working group completed the initial draft while PCAST completed revisions and final approval. For the latter, a disclaimer stated: "Working group members participated in preparing the initial draft of this report. Non-PCAST working group members are not responsible for, and do not necessarily endorse, the final report as modified and approved by PCAST."

**3.2.2 Meeting Discussions** Progress updates, final revisions, and voting approval of advisory work were important components of PCAST meetings. Some topics appeared multiple times in PCAST meetings, such as STEM education and forensic science. Report discussions typically involved presentations by committee members responsible for the report, followed by Q&A sessions. After discussion, committee members decided whether to revise the pending report or approve it. Most reports required one or two rounds of discussion and revision before submission, except for urgent matters like epidemics. To date, all votes on report revisions and approvals have been unanimous, indicating strong internal consensus. Perspectives raised by external members during meetings might also be incorporated into final reports.

### 3.3 Feedback on Research Results

Most reports requested by the President received direct feedback. After the 2012 spectrum report' s release, the President' s Executive Office announced corresponding government actions to support wireless technology and stimulate economic growth. Following the 2014 antibiotic resistance report, the Obama administration announced actions to combat antibiotic resistance.

## 4. Ways PCAST Advisory Work Influenced Decision-Making

Regarding PCAST' s impact on policy, PCAST itself, the White House' s "100 Examples of President Obama' s Leadership in Science, Technology, and Innovation," the summary of the Obama administration' s two-term contributions, and OSTP' s work summary all provided evaluations. Through analysis of these

successful cases and other examples, this paper classifies PCAST' s influence on decision-making into four types: ongoing synergy, strategic guidance, problem-solving, and scientific support.

### 4.1 Ongoing Synergy Type

Ongoing synergy refers to advisory work that serves as an organic part of national policy measures, continuously providing relevant advice during implementation. A typical example is PCAST' s advisory support for the Obama administration' s education innovation initiative.

In fall 2009, President Obama asked PCAST to recommend the most important actions the government should take to ensure U.S. leadership in STEM education over the coming decades. In response, PCAST decided to first conduct K-12 level research, followed by college and university level research. The October 2009 PCAST meeting specifically discussed STEM education issues. In November, President Obama announced the launch of the "Federal Science, Technology, Engineering, and Mathematics (STEM) Education Initiatives,"seeking nationwide funding and partnerships to help achieve the goal of elevating U.S. students' science and math literacy from middling to top-tier within a decade. The October PCAST meeting provided important guidance for the education innovation initiative launched in November. On September 15, 2010, after PCAST released "Prepare and Inspire: K-12 Education in Science, Technology, Engineering, and Math (STEM) for America' s Future," President Obama announced the launch of Change the Equation on September 16. As part of the "Education Innovation Initiative," Change the Equation had three goals: improving STEM teacher quality at all grade levels; inspiring student interest, particularly among women and minorities; and achieving long-term, sustained improvement in STEM education. These goals adopted PCAST' s main recommendations. On February 7, 2012, PCAST published its second report, "Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics." On the same day, President Obama made presidential commitments based on PCAST' s two STEM education reports.

### 4.2 Strategic Guidance Type

Strategic guidance refers to PCAST' s advisory work providing implementation guidance for the development of important national strategic fields. A prime example is the advanced manufacturing initiative, where several PCAST reports guided U.S. advanced manufacturing development. In June 2011, PCAST and its PITAC jointly completed "Ensuring American Leadership in Advanced Manufacturing." On the same day the report was released, President Obama announced the launch of the Advanced Manufacturing Partnership (AMP), aiming to combine industry, universities, and other federal departments to develop new technologies, create high-quality manufacturing jobs, and strengthen U.S. international competitiveness. The second advanced manufacturing report was

released in July 2012, while the White House simultaneously announced its advanced manufacturing initiatives to drive innovation and encourage companies to invest in the United States. The third report was released in October 2014, the same day President Obama announced several new actions that, together with previous measures, would strengthen U.S. manufacturing capabilities.

### 4.3 Problem-Solving Type

Problem-solving refers to PCAST' s advisory work directly providing solutions to problems raised by the government. Such advisory research constituted a large portion of PCAST' s work. Problems were proposed by the President, presidential initiatives, executive departments, or PCAST itself, plus emergency topics (such as the 2009 H1N1 influenza study). Examples with direct policy impact include: presidential proposals like "Combating Antibiotic Resistance" (September 2014); presidential memoranda like "Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth" (July 2012); departmental requests like "Accelerating the Pace of Change in Energy Technologies Through an Integrated Federal Energy Policy" (November 2010), requested by the Energy Secretary; and PCAST-initiated research based on national needs, such as "Aging America & Hearing Loss: Imperative of Improved Hearing Technologies" (October 2015). Similar research by the National Research Council (NRC) produced comparable recommendations, and both directly influenced FDA policy changes regarding over-the-counter hearing aids.

### 4.4 Scientific Support Type

Scientific support refers to providing scientific backing for already-proposed initiatives. A typical example is PCAST' s research on smart cities. The Smart Cities Initiative was announced by the Obama administration in September 2015 to help communities address local challenges and improve city services. For this purpose, PCAST studied how various technologies could enhance future cities and urban residents' quality of life. In September 2016, the Obama administration announced a new round of $80 million investment in Smart Cities and doubling the number of participating communities. The administration also recognized PCAST' s role, stating that PCAST' s work helped identify areas where science and technology could assist cities and helped clarify the responsibilities of numerous federal departments in the Smart Cities Initiative.

## 5. Conclusions and Implications

Based on the above study of the Obama administration' s PCAST, several conclusions can be drawn about its successful advisory work, with implications for building China' s national science and technology decision-making advisory system.

### 5.1 Conclusions

Clear legal provisions and institutional frameworks form the foundation of PCAST' s successful advisory work. PCAST was established under Presidential Executive Order 13539. While not law, executive orders have legal effect. Executive Order 13539 not only specified PCAST' s composition, functions, and working areas but also defined PCAST' s relationships with relevant parties—the President, OSTP, NSTC, and various departments—providing a legal basis for its work and forming the foundation of its success.

Close coordination with decision-makers and focusing on issues of concern to the nation and decision-makers are key to PCAST's success. Some PCAST advisory work had substantial impact on policy formulation and implementation, such as energy policy, STEM education, antibiotic resistance, and spectrum issues. These succeeded because they addressed major national concerns—either presidential initiatives, issues on the presidential agenda needing resolution, legal requirements, or departmental requests. Even self-selected topics often addressed urgent national issues, such as hearing loss and hearing aids among the elderly. PCAST' s close integration with decision-making owed much to institutional advantages: PCAST is located in the White House, directly serving the President, and one co-chair is the President' s Science Advisor and OSTP Director. This role serves as a critical link between PCAST and the President and S&T executive agencies, effectively connecting advisory work with decision-making needs.

Good mechanisms and working methods are necessary conditions for PCAST' s success. PCAST' s use of regular meetings and working groups proved highly effective. PCAST meetings covered broad topics and participants, providing extensive new ideas and information for advisory work. For example, on STEM education, beyond direct discussions, multiple meetings also explored education issues in related topics like energy technology and advanced manufacturing. PCAST could also arrange for more stakeholders to participate in discussions, enriching understanding of advisory topics.

Collaborating with the nation's relevant S&T forces to conduct advisory research ensures success. Most PCAST advisory research used working groups that organized appropriate experts nationwide based on topic requirements. PCAST also collaborated with organizations like AMP and exchanged ideas with NRC to better serve decision-making.

### 5.2 Recommendations for China

PCAST' s successful experience offers several recommendations for building China' s science and technology decision-making advisory system:

1. **Establish a charter** for the national science and technology decision-making advisory committee that clearly defines its functions, composition, working scope, and operational mechanisms, as well as its relationships

with decision-makers and S&T management departments.

2. **Create a mechanism** for connecting advisors with decision-makers to ensure policymakers' needs are fully reflected in advisory work.
3. **Establish a feedback mechanism** for applying S&T decision-making advisory results, providing appropriate feedback to advisors when decision-makers adopt advisory results to promote better advisory work.
4. **Clarify relationships** between the national S&T decision-making advisory committee and other S&T advisory institutions and organizations to gain broader support and ensure better results can reach decision-makers through the committee.
5. **Establish a support mechanism** for the national S&T decision-making advisory committee.

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*Note: Figure translations are in progress. See original paper for figures.*