Enhancing Science Communication Quality Through Scientific Research Project Management: Postprint

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Date: 2018-06-24T00:00:00+00:00

Abstract

Conducting science communication constitutes a crucial instrument for enhancing public scientific literacy and fostering societal advancement. Serving as a pivotal vehicle for research activities, scientific projects exert a pronounced propulsive effect on science communication. This article, exemplified through the research management of the Strategic Priority Research Program (Category B) "Atmospheric Haze Tracing and Control"at the Chinese Academy of Sciences, elucidates the advancement mechanisms and initiatives for synergistic management of research projects and science communication, and probes into strategies and modalities for expanding the expression of scientific research outcomes via multifaceted channels and perspectives, set against the contextual backdrop of profound convergence between traditional and new media alongside increasingly pluralistic knowledge demands.

Full Text

Improving Science Communication Quality through Research Project Management

Science communication is a crucial means to enhance public scientific literacy and promote social progress. As a primary vehicle for scientific activities, research projects play a significant role in advancing science communication. This article uses the management of the Chinese Academy of Sciences' Strategic Priority Research Program (Category B) "Formation Mechanism and Control Strategy of Haze in China" as a case study to elaborate on the collaborative management mechanisms and initiatives that integrate research project management with science communication. We explore multi-channel and multi-angle communication strategies for disseminating scientific research findings against

the backdrop of deepening integration between traditional and new media and increasingly diverse public knowledge demands.

Keywords: research project management, science communication, Strategic Priority Research Program, media integration

The Role of Research Project Management in Boosting Science Communication

In recent years, despite active promotion of science communication by science and technology authorities at various levels through dedicated popular science projects, the number and funding intensity of such projects remain insufficient to meet societal needs. Integrating science communication effectively with research project management can help enhance content supply, broaden communication channels, and deepen impact. The 19th National Congress Report included "promoting scientific spirit and popularizing scientific knowledge" as an important component of strengthening socialist ideological and moral construction. In May 2016, President Xi Jinping emphasized at the National Conference on Science and Technology that scientific innovation and popularization are the two wings of innovative development, and that science popularization should be placed on an equal footing with scientific innovation.

Science communication requirements are increasingly being incorporated into research project funding criteria. Research projects represent the main organizational form through which scientists conduct research and serve as powerful drivers of scientific output. As public demand for knowledge grows, the importance of science communication in research project management continues to strengthen. Japan' s Ministry of Education, Culture, Sports, Science and Technology stipulated in its 2008 Science White Paper that 3% of research funding should be allocated to popular science programs [1]. NASA, the Department of Energy, and the National Science Foundation in the United States all require research proposals to include science communication tasks, with detailed descriptions of content, format, target audiences, and budget allocation [2]. In China, the National Basic Research Program (973 Program) incorporated science communication into its project evaluation criteria, requiring each project to publish at least one popular science article in newspapers or magazines introducing relevant scientific frontiers and research characteristics. The National Key R&D Program has also included in its management measures provisions that "units obtaining intellectual property rights should actively apply and orderly disseminate project results, and spread and popularize scientific knowledge."

Research projects possess unique advantages in supporting science communication:

First, **reality orientation**. National science and technology programs, particularly those under the National Key R&D Program, target major social welfare research issues affecting national economy and people's livelihood, as well as major scientific and technological problems concerning industrial competitiveness,

independent innovation capacity, and national security. These projects focus on breaking technological bottlenecks in national economic and social development. Even basic research programs like the 973 Program emphasize solving major scientific problems in economic construction, social development, national security, and scientific progress. Consequently, research project topics and outcomes are closely aligned with the needs of government departments and the public, making them readily accessible and of interest to diverse audiences.

Second, **knowledge advancement**. The purpose of scientific research is to explore the unknown and discover new knowledge. In today' s rapidly developing scientific landscape, existing knowledge systems are constantly being updated. The source of new knowledge often originates from the frontlines of scientific research. Timely dissemination of innovative research outcomes can enhance the quality of science communication content from the supply side. Major original achievements—such as quantum communication and dark matter research—typically generate more profound and far-reaching impacts during dissemination, and these breakthroughs are driven by significant research projects. Science communication, in turn, further boosts scientific innovation activities on a broader scale and at a deeper level, creating a virtuous cycle. Moreover, as times change, new problems emerge that exceed the scope of existing knowledge systems. For example, with intensifying air pollution, the haze issue has become prominent, and explanations for its causes require continuous scientific research to approach the truth.

Third, **enhancing understanding**. Most major projects are funded by central finance—derived from taxpayers' contributions. Through science communication, conveying information about project management and research progress, and explaining the scientific understanding and pursuits involved, serves both the need for information transparency and public supervision, and helps the public understand the exploratory journey of scientific research. This fosters love and aspiration for science and generates spontaneous support for scientific endeavors. Meanwhile, the scientific community can enhance its sense of social responsibility through interaction with the public, continuously adjusting scientific objectives and research content to better align with societal needs. A study published in *The New England Journal of Medicine* found that if a paper from that journal was reported by *The New York Times*, its citation count would increase by 72% within one year [3].

Collaborative Management of Research Projects and Science Communication

In 2012, the Chinese Academy of Sciences launched the Strategic Priority Research Program (Category B) "Formation Mechanism and Control Strategy of Haze in China" (hereinafter referred to as the "Haze Program"). The program aims to address key scientific questions about atmospheric haze through controlled experiments, field observations, and numerical simulations, focusing on the Beijing-Tianjin-Hebei region, the Yangtze River Delta, and the Pearl

River Delta. Its objectives include identifying haze pollutant composition and sources, elucidating key physical and chemical mechanisms of regional haze formation, recognizing critical pollutants and emission sources, developing independent intellectual property rights for haze monitoring technologies and predictive warning and control decision models, and researching source and process control technologies for key haze-causing pollutants to provide scientifically viable technical and policy solutions for haze pollution control. Throughout the program' s implementation, we have deeply integrated science communication with research management, achieving excellent results through coordinated efforts.

Establishing Standardized Management Mechanisms Effective science communication requires systematic planning and meticulous arrangements. Through standardized management, we unify understanding in conceptualization and implement actions solidly to achieve tangible results. CAS leadership has attached great importance to the Haze Program' s science communication work, repeatedly listening to relevant work plans and progress reports. At the operational level, research management departments, science communication departments, and program key members have established working groups with clearly defined responsibilities to jointly advance communication efforts. Detailed annual science communication activity plans are formulated based on research project progress, with regular reviews and supervision. WeChat groups facilitate full discussion and strengthen exchange and sharing of viewpoints. During heavy pollution events, emergency consultation mechanisms are activated to timely analyze pollution causes and countermeasures and make appropriate public statements.

Scientific research requires collaborative 攻关, and science communication also benefits from teamwork. Traditional science communication often relies on individuals working in isolation. Due to limitations in individual knowledge structure and understanding, deviations may occur in cognition. Research projects, however, typically involve interdisciplinary expert teams working together to address key scientific and technological problems. This team strength can also play an effective role in science communication. Following the severe haze pollution event in the Beijing-Tianjin-Hebei region in January 2013, we immediately organized expert group discussions and, based on professional expertise and research specialties, provided judgments and explanations from physical, chemical, and meteorological mechanism perspectives through collective creation of relevant opinions and popular science articles. This model of collective research and division of labor has been consistently applied in subsequent science communication activities. For example, the documentary *The Truth Behind Haze* produced in cooperation with China Central Television analyzed and presented the issue from multiple perspectives, achieving excellent communication impact.

Scientists are creators of scientific knowledge and achievements, and thus hold important authority in science communication. Their participation is crucial to communication effectiveness. The absence of scientists' voices can lead to delays,

misinformation, and reduced credibility in science communication [4]. Surveys reveal that one important reason for scientists' reluctance to engage in science communication relates to existing scientific evaluation systems. Current evaluation systems primarily recognize academic research achievements but do not incorporate science communication effectiveness into assessment criteria. To address this issue, the Haze Program vigorously encourages scientists to actively participate in science communication by including the writing of consultation reports, public education activities, and various popular science activities in performance evaluations, assigning them equal importance to scientific research. In the Haze Program, not only chief scientists and project leaders lead by example, but participating researchers and graduate students also contribute to science communication to the best of their abilities. The program has cultivated a group of research backbone members enthusiastic about promoting science communication, creating a favorable work atmosphere.

Scientists' research tasks are heavy, and engaging in science communication inevitably occupies valuable research time. This requires research management departments to provide support services and create favorable conditions for scientists' communication work. During the Haze Program' s implementation, the science communication management department actively helped contact media platforms, communicated with media professionals in advance, arranged venues for popular science lectures, assisted with meeting logistics, submitted research reports on behalf of scientists, and conducted content review and format optimization, enabling scientists to devote themselves to science communication with minimal distractions and integrate their knowledge creation into the broader effort to enhance citizens' scientific literacy.

Ensuring Rigor in Science Communication Content Science tolerates no falsehood, and the same holds true for science communication. In today' s era of convenient information exchange, disseminating incorrect information can cause tremendous confusion. In 2013, an online article misinterpreted research results published by Chinese Academy of Sciences researchers, claiming that "traffic emissions"(primarily "motor vehicle emissions") contributed less than 4% to PM2.5, triggering heated debate. Under the organization of the CAS Bureau of Science Communication, Haze Program experts systematically introduced atmospheric pollutant source apportionment methods and research progress at a press conference, answering media questions and clarifying current progress, acknowledging existing cognitive limitations, and outlining future research plans, quickly quelling the online controversy. Science communication effectiveness is related to the authority and credibility of the source—higher credibility yields better communication outcomes [5].

To strengthen the rigor and scientific validity of CAS haze-related news publicity, in 2014 the relevant departments and the Haze Program issued a notice designating specific personnel to conduct academic review of relevant reports published on the CAS website and in news media, thereby ensuring information

accuracy and eliminating academic and expressive errors to avoid unnecessary misunderstandings.

In addition to science communication products directly produced by researchers, relevant journalists and editors also constitute an important pathway for science communication through primary or secondary processing of content. Therefore, during content processing, the Haze Program has established standardized review procedures before publication, broadcasting, or release, enabling full communication and close cooperation between researchers and media professionals to jointly ensure accurate public reception of scientific information.

Synchronizing Science Communication with Research Progress Research projects typically involve overall design and phased implementation, with each stage from project selection and initiation to execution and acceptance being interconnected and progressively advancing. Following process management principles, we determine science communication methods and priorities based on the work objectives and content at different project stages. Communication during project initiation focuses on introducing the project' s design and objectives, helping various sectors understand the significance of launching the Haze Program. During project execution, the emphasis is on communicating emerging results and progress.

Following this approach, the Haze Program collaborated closely with the *Bulletin of Chinese Academy of Sciences* to publish two special issues on "Formation Mechanism and Control Strategy of Haze in China" in 2013 and 2017, featuring series of articles on program implementation plans, achievements, and insights. During the program period, relevant progress was introduced periodically. Experts published articles in the *Bulletin* on topics such as "How to Preserve APEC Blue" and evaluation of PM2.5 control effectiveness since the implementation of the "Atmospheric Ten Articles"in Beijing-Tianjin-Hebei [6,7], which were widely reprinted by other media. The program also adopted a livelihood perspective, producing effective public science communication on socially concerning issues such as Beijing' s heavy pollution weather in 2013, motor vehicles' contribution to haze, frontiers in haze research, and cause analysis.

Actively Submitting Relevant Achievements and Recommendations

Since its establishment, the Haze Program has regularly reported work progress and achievements to relevant departments in the form of special information reports and consultation documents, providing scientific recommendations on core issues in pollution control. Following the severe haze event in northern China in January 2013, the Chinese Academy of Sciences organized experts to produce several reports adopted by higher authorities, including *Analysis and Emergency Policy Recommendations on the Severe Haze Pollution Event in Beijing-Tianjin-Hebei in January 2013*, *Analysis of Recent Air Pollution Conditions in Beijing by CAS Experts*, *Analysis and Prediction of Haze Trends in Central and Eastern China This Autumn and Winter by CAS Experts*, and *As-*

sessment of Haze Trends in Beijing-Tianjin-Hebei This Winter by CAS Experts. Reports on topics such as the impact of fuel quality on vehicle emissions, ozone pollution and prevention, and heavy metal pollution in mountain air have also attracted attention from relevant departments.

Conducting Timely Public Education and Popularization

Using media, television, popular science articles, and press conferences as channels, the Haze Program actively organized science popularization activities to provide strong support for guiding public opinion and helping people form correct understanding of haze. In 2014, the program hosted the Science and Technology Frontier Forum on "Formation Mechanism and Control Strategy of Haze in China," inviting several authoritative experts to communicate scientific knowledge face-to-face with the public. During the program' s implementation period, relevant researchers delivered hundreds of lectures to ministries, local governments, universities, and primary and secondary schools. Meanwhile, key Haze Program researchers repeatedly gave interviews to CCTV News, Xinhua News Agency, People' s Daily Online, and other media, promptly answering public concerns. Additionally, experts personally wrote popular science articles published in authoritative media. For example, the article *Scientifically and Rationally Understanding China' s Haze Problem* published in *Qiushi* magazine generated positive social response.

Leveraging New Media to Disseminate Knowledge and Debunk Rumors

Research on Chinese citizens'channels for obtaining scientific information reveals that television remains the primary channel, with 93.4% of citizens obtaining scientific information through TV. However, 53.4% of citizens now obtain scientific information via the internet and mobile internet, surpassing newspapers and ranking second [8]. In response to this trend, the Haze Program has capitalized on new media' s unique advantages in its communication work. In 2014, the program established a webpage on the "China Science Expo" website to publicize haze-related knowledge. When the CAS WeChat public account "Voice of CAS" launched, it produced a cartoon-style feature titled "The Transformation of an 'Internet Celebrity' ." The program also leveraged research institute new media platforms to create synergy. Li Ting, science communication director at the Institute of Atmospheric Physics, Chinese Academy of Sciences, has actively disseminated knowledge on atmospheric environmental protection, accumulating 6.41 million followers on her Weibo account. On January 5, 2017, her post *What Happened to Linfen' s Air Yesterday?* analyzing high SO2 concentrations at Linfen monitoring stations attracted tremendous social attention, particularly being forwarded and praised by local citizens and media in Linfen. The post received 40,000 forwards, 10,000 comments, 10,000 likes, and 9.4 million views, also drawing attention and follow-up from local government.

During heavy haze in Beijing in December 2016, a video titled *Beijing Haze Filmed with a Macro Lens Under 4000 Lumens* circulated online, receiving nearly

10,000 forwards and causing psychological anxiety among those unaware of the facts. Haze Program researchers responded promptly, using the Institute of Atmospheric Physics'official Weibo account to clarify that the particulate matter shown in the video was dust, not PM2.5, debunking the rumor within a short time. The relevant content received over 4 million views on Weibo and WeChat combined and was reported by CCTV News and other media. Additionally, an interview with the Haze Program' s chief scientist published in the *Bulletin of Chinese Academy of Sciences* was posted on its WeChat platform and Tencent Video, receiving over 200,000 views.

Emphasizing Precise Communication of Research Results Different audiences have different concerns about the same issue. Government departments focus on technology to meet work needs, enterprises focus on technology for development purposes, the scientific community focuses on academic exchange, while the public is driven by curiosity and personal relevance. This necessitates adopting different communication methods and presentation forms tailored to different groups to implement precise and effective communication. When providing policy recommendations to relevant departments based on research results, attention must be paid to content accessibility, feasibility of suggestions, and proper formatting. When communicating with academic peers, academic rigor should be emphasized. When promoting to the general public, knowledgeability, interest, and practicality should be highlighted.

For example, after achieving research results on fuel quality and air pollution, the Haze Program produced different communication products for different audiences. Policy consultation reports based on national conditions focused on analyzing the economic feasibility of fuel upgrading technologies with emphasis on operability. Articles in the *Bulletin of Chinese Academy of Sciences* [8] followed academic conventions, highlighting strategic significance and international perspectives with detailed analysis of important viewpoints. An article titled *How Fuel Quality Affects Air Quality* published in *Guangming Daily* was accessible and relevant to daily life, using down-to-earth language to address public concerns and answer questions.

Scientific knowledge and research results, as wealth belonging to all society, should be known and utilized by the public to the greatest extent possible. During the Haze Program' s implementation, we have deeply felt the strong public and governmental demand for scientific knowledge. Engaging in science communication should increasingly become a social responsibility that scientists must undertake. As traditional and new media accelerate their integration, newspapers, websites, WeChat, Weibo, and mobile clients provide us with diversified media channels and richer expression forms including graphics, audio, and video. In research project management, we must be adept at using communication methods to tell scientific stories well and convey more positive scientific energy to society.

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Executive Editor: Liu Tianxing

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