Evaluation of Basic Research-Oriented Scientific Research Institutions: Practice and Implications from the Max Planck Society, Germany - Post-print

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Abstract

Basic research institutions constitute a vital component of national strategic scientific and technological capabilities. Effectively evaluating their development status represents a critical step in advancing China's basic research standards and facilitating the achievement of high-level scientific and technological self-reliance and strength. To this end, this study examines the evaluation system constructed by the Max Planck Society for the Advancement of Science (Max Planck Society)—a premier basic research institution—for its numerous affiliated institutes. The article first delineates the evaluation content and distinctive features of various evaluation stages within the specific assessment process. Subsequently, it conducts a comparative analysis of key evaluation focuses across different periods to investigate the evolutionary trajectory of its evaluation system. Finally, grounded in China's actual circumstances, the article proposes recommendations for the evaluation practices of basic research institutions in China.

Full Text

Evaluation of Basic Research Institutions: Practice and Inspiration from the Max Planck Society in Germany

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Abstract

Basic research institutions constitute a crucial component of a nation's strategic scientific and technological strength. Effectively evaluating their development status is essential for enhancing China's basic research capabilities and achieving greater self-reliance and strength in science and technology. This study examines the evaluation system constructed by the Max Planck Society for its affiliated institutes, a premier basic research organization. We first outline the evaluation content and characteristics of different stages in the evaluation process. Second, we compare and analyze the key evaluation contents across different periods to explore the evolution of the evaluation system. Finally, based on China's actual circumstances, we propose recommendations for evaluating basic research institutions in China.

Keywords: basic research, research institutions, institution evaluation, the Max Planck Society

1. The Max Planck Society's Institute Evaluation System

The Max Planck Society currently operates over 80 institutes conducting basic research across natural sciences, life sciences, humanities, and social sciences. Its evaluation system focuses on the scientific excellence of each institute within its respective basic research field and the development prospects of research areas. The evaluation involves multiple stakeholders, including the Senate, Scientific Advisory Boards, and relevant administrative departments, with the Scientific Advisory Boards playing a particularly important role in assessing scientific standards and providing recommendations. Based on the Society's strategic objectives, the evaluation system comprises three stages for each institute: ex-ante evaluation, ex-post evaluation, and extended evaluation, each with distinct focuses. For analytical convenience, we categorize extended evaluation within the ex-post evaluation framework.

1.1 Ex-ante Evaluation

1.1.1 Evaluation Content Selection of Scientific Directors. The selection of scientific directors represents the most critical component of ex-ante evaluation. The Max Planck Society believes that appointing top scientists as directors is essential for ensuring internationally leading achievements in corresponding basic research fields. Consequently, the selection process is extensive and rigorous. The Society first establishes an appointment committee composed primarily of current institute directors, scientific members, and external experts to assess the development prospects of specific research fields and potential candidates, while collecting written reports from at least ten internationally renowned scientists as references. Only after the appointment committee approves both the candidate and the research field do scientific members from

relevant departments conduct in-depth discussions of the candidate's proposal. Additionally, the Society adheres to the "Harnack Principle"—if an institute director retires without a successor, the Society will decisively close that institute and transfer its resources and personnel to other Max Planck Institutes.

Establishment of Max Planck Institutes. The Society maintains that only after securing a scientific director can a new institute be established in the identified academic field. Therefore, the establishment of new institutes typically proceeds in parallel with director selection, and candidate assessment simultaneously evaluates the institute's scientific concept. The establishment process occurs in two stages: first, the candidate director forms a project group, which the Society's expert panel evaluates for research prospects and plans; if approved, the group undergoes a five-year pilot phase. After pilot completion, the Society reconvenes an evaluation committee comprising external top scientists to assess the group's performance, development prospects, and the candidate's capabilities. Only when the committee endorses both the group's work and the candidate does it recommend formal institute establishment to the Society.

Evaluation of Research Groups, Projects, and International Max Planck Research Schools. Beyond evaluating directors and institutes, the Society conducts ex-ante assessments of research groups and projects jointly established with universities or research institutions, as well as International Max Planck Research Schools. Support is granted only after recognizing the originality and scientific merit of the proposed research.

1.1.2 Evaluation Characteristics Adherence to the Harnack Principle with Director Selection at the Core. Given the disruptive, high-risk, and uncertain nature of basic research, prospectively evaluating long-term research directions poses significant challenges. Therefore, the Max Planck Society prioritizes scientific director selection in ex-ante evaluation. Compared to applied and experimental development research, basic research places greater emphasis on scientists' originality and expertise. Following the Harnack Principle, the Society believes that successfully recruiting top scientists as directors and building institutes around them and their teams ensures scientific excellence.

Emphasis on Scientific Excellence and Originality. During ex-ante evaluation, appointment committee experts thoroughly examine candidates' key publications to assess the originality and impact of their achievements, thereby evaluating their creative capacity and professionalism. Through expert deliberations, the committee assesses candidates' scientific caliber, international academic standing, and leadership qualities—not merely through bibliometric indicators like publication counts, citations, or impact factors. This approach aligns with the fundamental nature of basic research, where breakthroughs depend on high-level talent producing unique scientific achievements that require original theories and discoveries.

1.2 Ex-post Evaluation

The Max Planck Society consistently conducts ex-post evaluations of its institutes' scientific achievements approximately every two to three years, primarily through peer review by Scientific Advisory Boards. These boards comprise internationally renowned experts, mostly from universities and research institutions outside Germany, with maximum six-year terms. Experts are nominated by institutes and formally appointed by the Society's President in consultation with relevant Vice Presidents, though the President may also appoint additional experts. Board size typically ranges from five to fifteen members, depending on institute scale and research scope. As a world-leading basic research organization, the Society attracts nearly 1,000 committee experts from prestigious international institutions, including over 300 Nobel laureates.

1.2.1 Evaluation Content The ex-post evaluation process, conducted collaboratively by Scientific Advisory Boards, Max Planck Institutes, and Society management, comprises four stages: status report submission, on-site evaluation, written report formulation, and extended evaluation.

Stage 1: Status Report Submission. Institutes submit a comprehensive status report to their Scientific Advisory Board before on-site evaluations. This report details the institute's development, research progress, and plans, covering organizational structure, personnel, academic exchanges, and research outcomes, providing the foundation for board review (Table 1).

Stage 2: On-site Evaluation. Board members conduct two-to-three-day visits to institutes, evaluating them based on status reports. The Board chair and members allocate evaluation responsibilities beforehand. Activities include: presentations on research achievements and future plans; discussions with research group leaders; progress reports from junior researchers; meetings with doctoral and postdoctoral researchers; and facility tours. Throughout these activities, board members hold periodic deliberations and consult with the Society President, relevant Vice Presidents, and administrative liaison officers.

Stage 3: Written Report Formulation. Based on status reports and on-site evaluations, the Board convenes to provide specific recommendations and meets with the Society President, Vice Presidents, and institute directors. Through discussion, a detailed written report is finalized.

Stage 4: Extended Evaluation. Conducted approximately every six years, extended evaluation serves the Society's strategic planning needs by examining research field prospects across multiple institutes to identify potential synergies, common challenges, and avoid duplication. The evaluation focuses on three aspects: scientific achievements, resource allocation, and mid-term prospects. A Research Field Committee is established, comprising Board chairs, rapporteurs (top external scientists capable of evaluating entire research fields), the Society President or Vice Presidents, and relevant department directors.

The written report outlines evaluation results for the institute and its departments (Table 2), with the Society establishing a five-tier rating system (outstanding, excellent, very good, good, and satisfactory) to facilitate expert assessment.

1.2.2 Evaluation Characteristics Emphasis on Peer Review Importance and Professionalism. Scientific Advisory Boards play a pivotal role in ex-post evaluation, with their written reports serving as crucial evidence for assessing institute development and decision-making. The Society places great trust in these experts, carefully selecting board members to maintain objectivity and avoid conflicts of interest. While some connections are unavoidable in small scientific communities, the Society requires disclosure of any relationships before evaluation begins. This underscores the principle that only top scientists can properly evaluate excellent colleagues, minimizing the risk of "second- or third-rate scientists evaluating first-rate scientists."

Focus on Descriptive Analysis. Written reports provide extensive, detailed descriptions of institutes' scientific standards, personnel structure, resource allocation, and international collaboration. Although rating is permitted, experts must provide substantial justification. Descriptive analysis enables genuine expert judgment, identifies problems, and effectively guides future research. Institutes must respond in detail to written reports, with responses circulated to the Society President and board members, fostering iterative dialogue and shared understanding.

Diversified Evaluation Methods and Incentives. The Society employs both quantitative and qualitative methods. For strategic decisions, it does not rely solely on bibliometric analysis but conducts comprehensive on-site investigations. Bibliometrics provide objectivity but cannot produce meaningful results independently, serving only as a foundation for deeper assessment. Incentive mechanisms are highly flexible: institutes with poor evaluations face funding cuts and must improve; those with consistently poor results, completed objectives, or lacking director successors are closed, with resources reallocated. This flexibility enables the Society to continuously focus on promising basic research fields, maintaining its leadership position.

Linkage Between Evaluation Results and Long-term Stable Funding. Evaluation outcomes affect future funding allocation. Approximately 75% of the Society's annual budget comes from German federal and state governments, with only 25% from competitive projects or other sources. The government grants the Society substantial autonomy in fund allocation. Stable funding totals for each institute are determined during ex-post evaluation and adjusted during operation; poor evaluations result in funding reductions. Since basic research requires long-term stable support, this linkage motivates institutes to take evaluations seriously, engage in self-examination, and maintain focus on cutting-edge research.

Tolerance for Failure in Some Basic Research Activities. While emphasizing peer review, the Society acknowledges its tendency to favor consensus-driven research. Basic research, however, involves breakthrough and disruptive work with uncertain prospects that may not gain immediate expert approval. To support high-risk research, the Society does not require unanimous consensus; dissenting views can be detailed in written reports. Institutes may also hold reservations about certain recommendations, responding in subsequent evaluations. This demonstrates scientific trust and autonomy, tolerating failure and providing space for non-consensus research.

Attention to Young Scientists in Ex-post Evaluation. Young scientists are pillars of basic research. The Society emphasizes their cultivation and attraction, providing stable support and an appealing research environment. The ex-post evaluation process examines institutes' support for young scientists through: tracking career development of former junior scientists in status reports; personal discussions during site visits; and specific recommendations in written reports regarding support and training conditions.

2. Comparison of Key Evaluation Contents Across Different Periods

2.1 Comparison of 1995, 2015, and 2019

Current technological revolutions are shortening innovation cycles and intensifying competitive pressures, prompting the Max Planck Society to continuously review and revise its evaluation procedures and criteria to ensure sound decisions regarding staffing and research fields. This section compares key evaluation contents from these three periods to analyze system evolution (Table 3).

For comparative purposes, we divide the evaluation process into ex-ante and ex-post stages, though the Society's own divisions vary across periods. In 1995, ex-post evaluation comprised periodic Scientific Advisory Board assessments and post-evaluation institutional restructuring. In 2015 and 2019, it was divided into ex-post evaluation and extended evaluation. Overall, the three periods show substantial consistency, with 2015 and 2019 being particularly aligned. Ex-ante evaluation consistently follows the Harnack Principle, requiring top scientists as directors before establishing institutes. Ex-post evaluation consistently emphasizes peer review, values Scientific Advisory Board opinions, and focuses on scientific excellence and research field prospects.

Differences emerge in specific areas: 2015 and 2019 added content emphasizing young scientists' career development and training, while also paying greater attention to cross-institute research field prospects and synergies beyond individual institute development.

2.2 Long-term Stability of the Evaluation System

The comparison reveals that the Max Planck Society's evaluation system has remained stable for nearly two decades. This stability manifests in two dimensions: first, strategic objectives consistently focus on ensuring institutes maintain the highest basic research standards; second, specific evaluation stages maintain consistent core approaches across periods. Basic research is highly sensitive to evaluation culture and research environment, and the Society's stable system has fostered a mature evaluation culture that promotes a healthy research environment. Researchers have accepted this system and culture, valuing exchanges with international top scientists and viewing regular evaluations as opportunities for self-examination and improvement. The Scientific Advisory Boards, institutes, and Society management all demonstrate high acceptance of final evaluation results.

3. Summary and Implications

This study examines the evaluation system of the Max Planck Society, analyzing its evaluation stages and content, summarizing characteristics of ex-ante and ex-post evaluation, and comparing key contents across periods to identify developmental patterns. The analysis reveals that the Society focuses on institutes' significance and scientific level within their basic research fields, prioritizes attracting and gathering international top scientists, emphasizes assessment of originality and potential, stresses peer review importance and professionalism, respects basic research principles, tolerates failure in some research activities, employs diversified evaluation methods and incentives, and values young scientist cultivation. Based on these practices and China's current situation, we offer three recommendations for evaluating basic research institutions in China:

(1) Establish clear and stable evaluation systems to ensure long-term consistency in evaluation priorities. Unlike applied and experimental development research, basic research features strong originality, long cycles, and unclear pathways, requiring scientists to engage in sustained, in-depth exploration. Evaluation systems should remain stable, providing scientists with a predictable environment and avoiding frequent changes that disrupt continuous research. Basic research institutions should emphasize evaluation stability and continuity, establishing systems that pursue excellence while maintaining evaluation priorities aligned with basic research principles, enabling scientists to focus on long-term goals.

(2) Grant scientists greater scientific freedom and trust. When evaluating scientists' caliber and research field prospects, institutions should provide substantial scientific freedom and academic trust, allowing them to independently determine research directions and topics within broad basic research domains. Evaluation should reduce weight on metrics like goal alignment and topic relevance, minimizing requirements for specific research themes and encouraging free exploration to maximize creative potential. Evaluation results should not

be linked to scientists' salaries; performance-based pay proportions should be reduced to provide more stable research environments that tolerate failure and allow greater exploration space. Additionally, young scientist cultivation should be prioritized through differentiated talent evaluation mechanisms aligned with talent development patterns.

(3) Respect basic research principles and foster a healthy research environment. Basic research emphasizes autonomous exploration with characteristics of originality, breakthrough potential, unclear pathways, and uncertain outcomes. Therefore, evaluations must respect the inherent uncertainty of basic research, tolerate failure, employ diversified evaluation methods and incentives, and emphasize young scientist cultivation. Specifically: evaluation should prioritize quality over quantity, de-emphasize paper and patent counts, reduce bibliometric indicators like impact factors and citation rates, and adopt descriptive evaluation requirements focusing on academic contributions and innovative value of representative works or research progress. Long-cycle evaluation and support mechanisms should be established with reduced evaluation frequency to minimize disruptions. Small peer review groups should be promoted with international top scientists as evaluators, following the principle that outstanding scientists in the same field should assess excellent colleagues to enhance evaluation scientific rigor and professionalism.

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