

*Impact of Proposal and Award  
Management Mechanisms*

*Final Report*

**August 1, 2007**



National Science Foundation

Cover photo: **Sensation: Interior View (2006)** is an abstract sculpture by Jersey City artist Nancy Cohen that was inspired by discussions with Princeton University President Shirley Tilghman. Tilghman, a leader in the field of molecular biology, collaborated with Cohen and Princeton University Electrical Engineering Professor James Sturm on the artwork, which is an abstraction about the sense of smell and how odors are recognized and remembered. Multi-colored cast resin discs are affixed to a steel armature forming a wall that connects to bulb-shaped structures by vibrant wires. The different colors of discs represent the sensor neurons in the nose that detect different odorant molecules; the wires represent the axonal connections that pass through the skull to the olfactory bulb in the brain, with the neurons from each type of sensor going to their own specific region in the olfactory bulb.

**Credit:** Edward Greenblat, Photographer, Princeton, NJ; Nancy M Cohen, Sculptor, Jersey City, NJ, and Professors Shirley Tilghman and James Sturm, Princeton University

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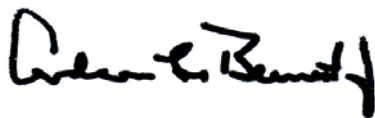
## PREFACE

The National Science Foundation (NSF), created over 50 years ago, is the premier Federal agency supporting basic research at the frontiers of discovery across all fields of science and engineering as well as science, technology, engineering, and mathematics education at all levels. As envisioned in our Strategic Plan, NSF strives to sustain excellence in the science and engineering research and education enterprise and to support research with the transformative potential to produce new discoveries, fuel innovation, stimulate the economy, and improve our quality of life. To do this, we must nurture and engage the innovative scientists, engineers and students who are achieving these goals and stimulate broader, continuing participation in this enterprise throughout the nation.

A substantial decline in NSF's proposal funding rate between FY 2000 and FY 2004 raised concerns about the potential impacts on the nation's science and engineering capacity. The potential effects on early career researchers and on the nature of the research that is proposed and funded were of particular concern. To enable the development of evidence-based policy to address these concerns, NSF charged the Impact of Proposal and Award Management Mechanisms (IPAMM) working group to perform a detailed study of the trends, impacts, and causal factors associated with the recent declines in proposal funding rates and the simultaneous growth in proposal submission rates.

The IPAMM results reflect a careful and thoughtful analysis of a wide variety of interrelated issues and concerns. Although the data show that the system is under stress, they also reveal that the NSF program staff and our proposer and reviewer communities are dedicated to maintaining excellence in the nation's scientific and engineering enterprise. Additionally, NSF program officers have demonstrated their commitment to broadening participation, ensuring that beginning investigators, underrepresented groups, and smaller institutions are not disproportionately affected by the reduction of NSF's funding rate.

The data and recommendations contained in this report will be invaluable as the Foundation seeks optimal management mechanisms to maintain the excellence of our merit review process and ensure a vibrant science and engineering enterprise, both now and into the future. NSF will carefully consider these findings and options as we revise existing and develop new funding opportunities.



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IPAMM gratefully acknowledges the contributions of Beth Ann Velo and Emily Fort (both of the Budget Division, Office of Budget, Finance, and Award Management), who provided indispensable support in generating, analyzing, and graphically representing all of the NSF statistical data reported here. Beth Ann Velo and Emily Fort are also acknowledged for their vital contributions in support of the NSF Proposer Survey, as are Jeri Mulrow (Division of Science Resources Statistics in the Directorate for Social, Behavioral and Economic Sciences) and Robert Groves (Director of the Survey Research Center, University of Michigan). IPAMM expresses their appreciation to Brent Miller (AAAS Science and Technology Policy Fellow, Directorate for Biological Sciences) and Louie Rivers (Directorate for Social, Behavioral and Economic Sciences) for their contributions to the Causal Factor data analyses, Kelli Savia (Budget Division, Office of Budget, Finance, and Award Management) for her assistance in formatting the graphs and tables, and Kathi Plaskon and Adrian Apodaca (Office of Legislative and Public Affairs) for the cover design and preparing the document for publication. IPAMM also thanks the Booz Allen Hamilton survey team (Chris Johnson, Luke Monck, Pat Corrigan, Mary Kay Gibbons, George Angerbauer, Michael Carrieri, and Keisha Kelly) for their work in developing, implementing and analyzing the 2007 NSF Proposer Survey.

# TABLE OF CONTENTS

<b>PREFACE</b> .....	<b>i</b>
<b>MEMBERSHIP AND ACKNOWLEDGEMENTS</b> .....	<b>ii</b>
<b>TABLE OF CONTENTS</b> .....	<b>iii</b>
<b>EXECUTIVE SUMMARY</b> .....	<b>v</b>
<b>I. INTRODUCTION</b> .....	<b>1</b>
BACKGROUND.....	1
CHARGE TO IPAMM.....	1
SCOPE AND DEFINITIONS .....	2
ORGANIZATION OF REPORT .....	3
<b>II. THE ISSUES IN CONTEXT</b> .....	<b>4</b>
THE NSF BUDGET.....	4
AWARD SIZE AND DURATION .....	5
RESEARCH PROPOSAL SUBMISSION RATES .....	6
PI SUBMISSION RATES .....	6
MULTIPLE PROPOSAL SUBMISSIONS .....	8
PI SUCCESS RATES.....	9
GROWTH IN INTERDISCIPLINARY RESEARCH.....	10
DIRECTORATE-LEVEL TRENDS .....	10
SUMMARY .....	12
<b>III. IMPACTS ON NSF AND THE COMMUNITY</b> .....	<b>13</b>
IMPACT ON HIGH QUALITY AND TRANSFORMATIVE RESEARCH .....	13
IMPACT ON THE REVIEW PROCESS .....	14
IMPACT ON BEGINNING AND NEW INVESTIGATORS.....	15
IMPACT ON UNDERREPRESENTED GROUPS AND INSTITUTIONS .....	18
<i>Women and Minorities</i> .....	18
<i>Institution Type</i> .....	21
IMPACT ON DIFFERENT S&E COMMUNITIES .....	23
CONCLUSIONS .....	24
<b>IV. CAUSAL FACTORS</b> .....	<b>25</b>
FINANCIAL FACTORS AFFECTING NUMBERS OF AWARDS MADE .....	25
<i>Award Size</i> .....	25
<i>Proposal Submissions</i> .....	26
<i>Funding Rate</i> .....	26
FACTORS AFFECTING NUMBERS OF RESEARCH PROPOSALS RECEIVED .....	27
<i>Investigators' Expectations</i> .....	27
<i>Institutional Pressures</i> .....	27
INCREASES IN THE APPLICANT POOL.....	28
<i>NSF Outreach</i> .....	28

Underrepresented Groups .....	29
Proposals from Research Intensive and Other Institutions .....	29
SPECIAL PROPOSAL COMPETITIONS .....	30
CHANGES IN FUNDING FROM NON-NSF SOURCES .....	33
OTHER NSF INTERNAL ACTIVITIES.....	34
CONCLUSIONS .....	35
<b>V. ASSESSMENT OF NSF EFFORTS TO MANAGE PROPOSAL SUBMISSIONS AND FUNDING RATES .....</b>	<b>36</b>
LIMITING PROPOSAL SUBMISSIONS .....	36
INCREASING THE AVAILABLE POOL OF FUNDS FOR SPECIFIC ACTIVITIES .....	40
CASE STUDIES.....	41
1. <i>Human and Social Dynamics Priority Area (HSD)</i> .....	41
2. <i>Integrative Graduate Education and Research Traineeship Program (IGERT)</i> .....	42
3. <i>CISE/Division for Information and Intelligent Systems (IIS)</i> .....	44
4. <i>Directorate for Engineering (ENG)</i> .....	45
5. <i>The Mathematical Sciences Priority Area (MSPA)</i> .....	46
6. <i>GEO Division of Earth Sciences (EAR)</i> .....	46
DISSEMINATION OF INFORMATION .....	47
CONCLUSIONS .....	48
<b>VI. FINDINGS AND RECOMMENDATIONS.....</b>	<b>49</b>
MAJOR FINDINGS .....	49
RECOMMENDATIONS .....	51
<b>APPENDICES.....</b>	<b>54</b>
APPENDIX A. CHARGE TO IPAMM.....	54
APPENDIX B. TERMS AND ACRONYMS .....	56
APPENDIX C. REGRESSION TABLES: PREDICTING CHANGES IN SUBMISSIONS .....	57

## EXECUTIVE SUMMARY

The competition for National Science Foundation (NSF) funds has always been intense, but it has grown more so in recent years. From Fiscal Year (FY) 2000 to FY 2006, NSF's overall funding rate for research proposals decreased from 30% to 21%. During this period, research proposal actions (awards and declinations) increased by 47%, from 21,442 to 31,518. Members of the research and education community have expressed concern that the funding rate and proposal action trends may be negatively impacting the academic research infrastructure, resulting in increased workload and diminished science and engineering capacity. Responding to these concerns, in March 2006 NSF established the Impact of Proposal and Award Management Mechanisms Working Group (IPAMM) to: *“recommend policies and preferred practices to improve NSF’s program announcement and solicitation processes in ways that achieve appropriate balances between proposal funding rates, award sizes and award durations....”*

In conducting its study, IPAMM analyzed quantitative data from internal NSF databases and attitudinal data collected through a survey of all NSF principal investigators (PIs) who submitted research proposals during the last three fiscal years. The survey focused on PI perceptions about the proposal review process, factors that influence decisions to submit proposals, reviewer workload, and funding rates with NSF and other organizations.

IPAMM found that many factors influence proposal submissions and proposal funding rates. Casual consideration of the trend may give the impression that the funding rate problem is the direct and simple result of budget issues, but careful analysis of the data failed to identify any single factor as being the primary contributor. When IPAMM examined all of the data, including results from the survey and case studies, trends and patterns emerged that helped formulate its findings.

### **Findings:**

- NSF proposal funding rates declined due to a surge in proposal submissions at the same time NSF was making a concerted effort to increase the average award size. Increases in the overall NSF budget were absorbed by the growth in the average award size, such that the annual number of awards made stayed relatively constant. As a result, funding rates dropped significantly between FY 2000 and FY 2004, leveling off in FY 2005 and FY 2006.
- The increase in proposal submissions can be attributed both to an increased applicant pool and to an increased number of proposals per applicant. The expansion of the applicant pool is due in part to an increased size and capacity of the research community, loss of funding from other sources, and the increased use by NSF of targeted solicitations in new areas. The growth in the intellectual capital of the country is a positive outcome of Federal investments in building the nation's capacity, which will need to be incorporated into planning by all funding agencies, including NSF. External institutional pressures, combined with the decreased funding rate, contributed to the growth in the number of proposals submitted per proposer.

- There is evidence that NSF's peer review system is overstressed. Reviewer workloads have increased, and feedback received through the NSF Proposer Survey indicated that the reviews submitted by overworked reviewers may be diminishing in quality.
- The overall decrease in funding rate has affected the entire NSF proposer community, but does not appear to have had a disproportionate effect on women, minorities, beginning PIs, or PIs at particular types of institutions.
- A major impact of the reduced funding rates and increased proposal submission rates has been the increased work for all involved – the PI community, the reviewer community, and the NSF staff. More time is being spent on efforts associated with obtaining funds, which detracts from the nation's scientific and engineering enterprise. Although the increased workload has not yet reduced NSF's timeliness in processing proposals, various units across NSF employed one or more strategies to alleviate the pressure on the PI and reviewer communities, either by limiting proposal submissions or by increasing the available pool of resources for particular competitions.
- NSF and the community it serves appear to be coping, despite the increasing workload. The quality of proposals submitted and awarded has not declined due to increased competition or lowered funding rates, though there is evidence that more high quality proposals are being declined. Although it was not possible to quantify, NSF is taking steps to ensure that decreased funding rates do not discourage PIs from submitting proposals with risky, potentially breakthrough ideas.

### **Recommendations:**

The results of this study do not support a single best or preferred approach to managing proposal submissions and funding rates, or in establishing an appropriate balance between funding rate and award size. Rather, there are a variety of options, all of which balance trade-offs between keeping the proposal workload to a manageable and productive level (for both NSF and the community) and encouraging the free flow of ideas to NSF. The challenge facing NSF and the community is to find the right level of competition, i.e., one that hones the quality of the proposals and results in funding excellent research with the minimum amount of time spent in the propose-review-decline-resubmit cycle.

IPAMM believes that this can best be accomplished by giving the directorates and research offices the responsibility and flexibility to meet this challenge, and by focusing on maintaining both enabling award sizes and funding rates that respond to the priorities and needs of the different communities that each unit serves. Further, NSF management should view the proposal and award management process as a total system. Manipulating any one component of this system is very likely to affect other parts of the system in ways that may not be obvious, thus care should be taken to consider possible unintended consequences when making changes. Because of the complex nature of the interactions between internal and external factors, the following recommendations focus on the development of strategies that are appropriate within the context of the directorate/office, and that balance long-term planning with the ability to respond to changing needs.



1. NSF should require that each of the directorates and research offices develop an overarching framework that accounts for and balances all of their research-related activities to help guide strategic planning when determining the appropriate balance between funding rates and award size for particular solicitations or more broadly across the unit. The framework should incorporate flexible management approaches that enable the directorates/offices to track and respond to developments that are most relevant to their communities, including the growth of collaborative interdisciplinary research activities.
2. Research investments build communities and infrastructure (including both physical infrastructure and human resources) that have real needs that persist after the funding opportunity ends. Long-term planning for accommodating this growth must go beyond expecting the newly developed community to be absorbed later by the core programs. Program solicitations that are intended to develop targeted research areas should be focused as much as possible to help the community develop relevant proposals and avoid the unproductive preparation of proposals that have a low likelihood of funding.
3. The practice of limiting the number of proposals that a PI or institution can submit is appropriate in some situations. Because this practice is perceived to have negative impacts on the community, its use should be carefully considered in the context of the trade-offs, impacts, and any special circumstances.
4. Careful consideration should be given to the short-term use of various management practices to increase the number of awards (including changing the balance of standard and continuing awards, or using funding from multiple years) to ensure that the decline in funding rates does not trap PIs and reviewers in an unproductive spiral of revising, resubmitting, and re-reviewing proposals that were highly rated but could not be funded due to limited resources.
5. NSF management should inform the appropriate internal and external communities when implementing new proposal management practices and should monitor their concerns during implementation. Changes to these practices should incorporate annual evaluations of proposal data and feedback from the research community.
6. To ensure that the community has access to specific and accurate statistical data on funding rates, NSF should evaluate the Budget Internet Information System (BIIS, NSF's public portal to award information) to determine if it is readily available to the community and responsive to their needs, and make appropriate changes if necessary to accomplish those goals.
7. The changing nature of the science and engineering enterprise and the increasing burden on the review system warrant continued attention. It is recommended that the trends analyses reported here be updated annually for internal NSF review, and included in the annual Report on the NSF Merit Review Process to the National Science Board. It is further recommended that NSF senior management periodically reassess the impact of the practices and policies employed by the directorates and research offices, to ensure that NSF maintains its capacity to fulfill its vision of sustaining excellence in the science and engineering research enterprise.