I. Executive Summary

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In October 2003, an NSF-sponsored workshop on research policy as an agent of change was held in Tucson, Arizona, under the auspices of the University of Arizona. The workshop explored the role of research policies in a time of significant scientific, technological, and social change. Scholars from a wide range of relevant disciplines, as well as a number of NSF staff, met for two days to discuss what is, and what is not, known about how research policy contributes—in both intended and unintended ways—to major societal transformations.

This report is intended to capture the central themes of the workshop discussions. It begins with an executive summary that presents the participants' main conclusions. The body of the report describes major issues addressed in the discussions. These issues have been grouped under the headings infrastructure, benefits of research policy, unintended consequences, and critical research needs. The appendices present the workshop agenda, the short statements that participants wrote prior to arrival in Tucson, and brief descriptions of the small group discussions that took place on the second day of the workshop.

Participants reached three main conclusions:

1. A focused effort to study research policy as an agent of change (RPAC) is urgently needed.
2. Studies of RPAC will require the use of diverse research methods informed by a range of disciplinary, interdisciplinary, and multidisciplinary perspectives.
3. NSF should explore ways to encourage research in this area.

The next section elaborates on each of these themes in turn.

1. A focused effort to study RPAC is urgently needed.

Science and technology are integral to major social, political, economic, and environmental transformations, with significant implications at local, national, and global scales. For this reason, understanding the processes that shape developments in science and technology is a critical goal for the social sciences today. Because research policy influences these processes in myriad intended and unintended ways, the study of research policy and its role as an agent of change merits sustained attention.

The term *research policy* is subject to different interpretations. In its most general form, research policy can be thought of as "a strategy for achieving developments of new knowledge, new forms of expertise, and new infrastructure." [1]The term may refer exclusively to the formal policies of governmental science-funding agencies. Participants at the workshop agreed, however, that a more encompassing concept of research policy is needed to understand the forces at work

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[1] See paper by D. Johnson, Appendix C.

in contemporary research systems. These systems feature the activities of a diverse mix of public and private organizations that use a wide range of mechanisms to pursue goals related to resource allocation, implementation, and evaluation of scientific research and technological change. Accordingly, this report employs the term <u>research policy</u> to designate a multitude of strategies for developing knowledge, expertise, and infrastructures that constitute the frontier of scientific inquiry:

- Research policy encompasses a range of substantive areas pertaining to public and private investments in R&D. These include efforts to create research infrastructures; influence the exploitation and commercialization of research products; govern the conduct of research (e.g., as it relates to human subjects, environmental concerns, and accountability issues); and shape institutional dimensions of research systems, including the organization of scientific inquiry and its reward systems.

- Research policy includes not only governmental actions aimed directly at influencing R&D, but also encompasses the activities of such organizations as scientific advisory bodies, regulatory agencies, university administrations, standards setting and professional bodies, and courts—all of which also shape the production, use, and diffusion of knowledge.

- Research policy is shaped by a range of actors from all branches of government, industry, universities, foundations, venture capital firms, professional associations, non-governmental organizations (NGOs), and civil society. These operate and interact on national, state, local, transnational, and international levels.

- Research policy involves a range of mechanisms, including budget allocation, legislative authorization, industrial policy, non-state policies (such as university intellectual property rules), public-private partnerships, consortia, R&D tax credits, etc. Explicit, formal policies and informal policies, embedded in patterns of practice, are both important.

Research policy is frequently treated as a "black box" that is not systematically examined. But because research policy plays such a significant role in contemporary research systems, understanding its operation is of critical importance for informed decision making. Far too little is now known about precisely how research policies are implicated in social and scientific change. A multidisciplinary effort to address this gap in our knowledge would aid policy makers and inform the public debate on a host of issues.

A variety of important intellectual and practical concerns fall under the RPAC rubric. RPAC research can contribute to improving strategies for directing and regulating the production, use, and uptake of knowledge. To achieve this end, we need to better understand both the impact of research policy and the processes that shape it. Thus, RPAC should encompass studies that treat research policy as an independent variable and studies that treat it as a dependent variable. Studies are needed that move beyond linear models of policymaking (which typically progress from agenda setting, to decision making, to implementation, to evaluation) to capture the complex ways that governmental, industry, and university policies interact.

The study of research policy should not limit its focus to decisions and mechanisms that are actually put in place, but should also pay attention to roads not taken and counterfactual examples. There is a critical need for studies of agenda setting, of the implications of non-decisions, and of additional ways that institutional structures and organizational practices contribute to the neglect of potentially important research. Identifying how policies contribute not just to reducing but also to producing gaps in knowledge can have important practical implications, for it can suggest new ways of achieving social goals.

Beyond governmental and non-governmental policies, RPAC research should illuminate how institutions, culture, and politics shape the environment in which knowledge is created and put into use. Changes in the ecology of knowledge making have far-reaching effects, but their influence can be hard to discern because they can arise in many different organizations in geographically dispersed locations. Media coverage, accountability rules and structures, popular culture and mass media, legislative and legal decisions, and norms regarding commercialization all may influence this ecology. RPAC research should address how explicit and implicit policies, as well as historical contingencies, alter the environments and institutions where research takes place.

2. Studies of RPAC will require the use of diverse research methods and disciplinary perspectives.

Research in the RPAC domain is challenging. Studies using quantitative methods are often hindered by a lack of data. Workshop participants extensively discussed the need to improve the kinds of data that are available for research on research politics and their implications. Strategies to create improved databases, with broad coverage of government, corporate, and university R&D, would be an essential aspect of an RPAC program. In addition to databases, the research infrastructure should include archives of policy documents and other materials relevant to case studies and historical analysis of research policy. For both quantitative and qualitative studies, access to data that illuminates RPAC issues is often limited, owing to proprietary or political concerns. Beyond databases and archives, there is also a need for better measures of the effectiveness of research policy.

Ethnographic and qualitative studies are also needed to enrich and deepen understanding of RPAC complexity. For example, developing a detailed understanding of how policies interact with research practices requires *in situ* studies in specific local sites. Regulations, guidelines, and other policies are often adapted and transformed as they are implemented, and qualitative research is needed to examine such processes. In addition, qualitative research can shed light on the formation of research policy discourses, illuminating the ways that even subtle changes in categories, concepts, and analytic frameworks can have far-reaching impacts.

A recurring theme in the conference discussions was the importance of comparative research on RPAC topics. Variations in the ways that different nations approach policy making offer important opportunities for developing insights of both practical and intellectual importance. The need for historical studies was also highlighted repeatedly.

RPAC issues can only be addressed by an ongoing effort employing a variety of research methods and disciplinary perspectives. Research policymaking, not to mention the social processes that shape its development and affect its outcomes, cannot be fully understood when analyzed from the perspective of any single discipline. RPAC research should include a variety of quantitative and qualitative approaches, and should engage scholars trained in such fields as economics, sociology, science & technology studies, political science, history, law, and ethics. Often, RPAC research will benefit from collaborations between these scholars and natural scientists and engineers.

Building a diverse research agenda in RPAC will require finding ways to support graduate students, postdoctoral associates, and faculty who seek to work in this area. There is also a need to encourage cooperative efforts among researchers in social sciences, on the one hand, and natural sciences and engineering, on the other. Strengthening links among these communities should be a priority. Finally, there may be a need for specialized centers devoted to aspects of RPAC research.

3. NSF should explore ways to encourage research in this area.

Given the importance of the RPAC domain, workshop participants agreed that NSF should encourage research in this area. Doing so poses some challenges, because the community of researchers with relevant skills and interests remains somewhat fragmented. Even so, the workshop demonstrated the existence of a variety of interested scholars, and suggested that it would be possible to attract considerable talent to the area. At this juncture, NSF can play an influential role in building capacity among this community. Accordingly, the participants concluded that a significant effort should be made to inspire interest in the RPAC area. In the very near term, a series of workshops on carefully chosen topics should be held to build networks of researchers. Ultimately, steps should be taken to create a program to ensure that this important area is not neglected.

The participants agreed that follow-up workshops could help stimulate interest in this area. Three directions for future workshops were discussed:

- *Infrastructure*. Efforts to build infrastructure for RPAC research would provide resources for the community of scholars, circulate information that would allow the better utilization of NSF investments in data collection and facilitate research that addresses public policy issues related to privacy, conditions of access and the ownership of data and intellectual property. This workshop would assess the current infrastructure, compare U.S. efforts against those of other countries, and make recommendations and offer policy to augment the RPAC infrastructure and increase use and accessibility.

- *Universities and research policy*. This workshop would explore the influence of research policies on universities and the role of universities in formulating research policies. How do governmental research policies affect research universities? How do the institutional policies of universities (e.g., regarding university-industry relations, intellectual property, fundraising initiatives, composition of faculty, and graduate and postdoctoral programs) affect research agendas, practices, and outcomes? How do research policies affect the character of the university as an institution in intended and unintended ways?

- *Comparative studies of research policy*. The organization of scientific and engineering research differs considerably nationally and, within countries, among different agencies. In addition, transnational organizations, such as the World Health Organization, the International Panel on Climate Change, or the World Trade Organization, are increasingly influencing research agendas. This workshop would use comparative analysis of research policies to shed light on a number of questions: In what ways do research policies vary cross-nationally and with what effects? How do research policies fit into the broader politics of different societies and sites? And how do political cultures, institutional structures, and social movements influence the formulation and impact of research policies?

During the workshop, participants suggested a wide range of research topics that investigators interested in this area should be encouraged to explore. A brief sampling follows:

- Studies of how government and institutional policies affect the composition of the scientific and engineering laborforce, define career paths, and shape the opportunity structure for scientists and engineers.

- Studies of discourses of evaluation. What are those discourses, including but not limited to peer review, and how have they changed over time?

- A re-evaluation of the research university, one that is more reflexive and sensitive to institutional issues than evaluations done in the past. This could include examining specific institutional adaptations to RPAC issues, such as the creation of technology transfer offices, as well as considering broader questions of the effects of corporate funding or classified research on the culture or practices of the university.

- Studies of research policy and civil society. What role do influences from civil society play in shaping research policies? How has the "democraticization" of research, through greater input from citizen's groups and patient organizations, influenced research policy?

- Studies of research policy formation in different political cultures. Research that takes advantage of opportunities for comparison can gain analytic leverage on agenda setting and related topics.

- Research on the changing nature of knowledge production. Knowledge is being produced not only in laboratories and universities but also in sites such as law, health, and media. This complex process involves an ever-increasing number of social actors such as NGOs.

- Examinations of interdisciplinary research, e.g., focusing on the formation of new modes of inquiry through interdisciplinarity.

- Research on earmarked funding and its impact on competition for funding and the distribution of benefits.

- Studies of efforts to build research on social and ethical issues into scientific research programs (as in the cases of genomics and nanotechnology). What do such programs achieve, and how do they fit into various policy cultures?

Finally, workshop participants suggested a number of specific ways that NSF could encourage development of this area:

- NSF should alert investigators that studies of research policy will be eligible for consideration under the Agents of Change rubric within the initiative on Human and Social Dynamics. This is a natural place for RPAC research.

- NSF should encourage researchers to look at RPAC topics within the SDEST program.

- NSF should investigate whether there are ways to work with professional societies, other federal agencies, such as NIH, or journals to stimulate research in this area.