HOUSE OF COMMONS
CANADA

CANADA'S INNOVATION STRATEGY: PEER REVIEW AND THE ALLOCATION OF FEDERAL RESEARCH FUNDS

Report of the Standing Committee on Industry, Science and Technology

Walt Lastewka, M.P.
Chair

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TENTH REPORT

Pursuant to Standing Order 108(2), the Standing Committee on Industry, Science and Technology proceeded to a study on the three federal granting agencies, peer review funding, and the Canada Research Chairs Program. After hearing evidence, the Committee agreed to report to the House as follows:

CHAIR'S FOREWORD

Prosperity in the new knowledge-based economy depends, in large part, on innovation. One of the major priorities of the federal government is to improve Canada's innovation performance since Canada lags behind other advanced economies in this regard. The federal government's *Innovation Strategy*, released in February 2002, is intended to serve as a blueprint for increasing innovation and productivity in Canada. The *Innovation Strategy* outlines broad goals, targets and federal government priorities to help meet the objective of improving Canada's innovation performance and standard of living over the next decade.

Two of the areas listed in the Strategy that influence innovation capacity are "skills" and "knowledge performance." The Strategy indicates that the federal government's role in improving capacity in these areas will be achieved, in part, via an increase in the federal government's current investments in research and development (R&D), and in the training of highly qualified personnel. Part of those investments are in the three federal granting agencies, the Natural Sciences and Engineering Research Council of Canada, the Social Sciences and Humanities Research Council of Canada and the Canadian Institutes of Health Research.

The Committee believes that these three agencies all have vital roles to play in improving Canada's innovation capacity through their support of research, training, and knowledge and technology transfer. However, earlier work conducted by the Committee suggested that improvements in how the agencies allocate federal research funds may be necessary. In the Committee's June 2001 report *A Canadian Innovation Agenda for the Twenty-first Century*, the Committee committed to examining the mandates, processes and decision-making criteria of the agencies to ensure that funds are being managed in the best possible way before additional investments are made. Part of the Committee's concerns about the allocation of federal research funds centred on the low research capacity of certain small and regional universities, and the relatively low success rates of these universities' applicants in the granting agencies' competitions. The Committee believes that small research institutions have an important role to play in ensuring that all regions of Canada participate in and benefit from the knowledge-based society that we are building; access to federal granting agency funds for researchers at these institutions is critical in this regard.

The Committee undertook an examination of these issues by organizing a series of roundtables in which representatives of the granting agencies, advisory bodies, policy groups, university and college associations, and the research community expressed their opinions on peer review and other issues related to the allocation of federal research funds. A wide range of views on this topic was heard; the Committee believes that this report captures the essence of those views and that its recommendations will help the granting agencies in their work of supporting R&D and innovation.

I would like to thank the individuals and organizations that took part in this series of hearings, and express my appreciation to them for helping the Committee in its ongoing work to improve Canada's innovation performance. The Committee, in the context of its planned future work on innovation and productivity, will continue to study the allocation and management of federal R&D funds. With the help of Canada's research community, the Committee will continue to promote the importance of science, technology and innovation for improving Canada's economic performance and the quality of life of its citizens.

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RECOMMENDATIONS

RECOMMENDATION 1

That the Government of Canada, in consultation with the provinces and territories, instate a permanent program for the support of the indirect costs of federally funded research in its next budget, and that the formula used to calculate the grant to each institution take into account the differential costs between large and small institutions.

RECOMMENDATION 2

That the Government of Canada, in consultation with the provinces and territories, set up targeted programs through the granting agencies to assist "underdeveloped" small and regional institutions strengthen their research capacity in key areas, and that appropriations be made to the agencies to fund these programs.

RECOMMENDATION 3

That the Government of Canada increase the level of funding to SSHRC, especially given the impact of this funding on researchers at small institutions.

RECOMMENDATION 4

That the Government of Canada immediately increase funding to all three granting agencies so that success rates and/or grant levels for excellent research can be increased.

RECOMMENDATION 5

That the Government of Canada encourage the granting agencies to collaborate further with each other and with non-academic stakeholders, including the provinces and territories, when deciding on target areas within strategic programs. The agencies should also ensure that formalized review mechanisms and adequate levels of funding are available to support high-calibre interdisciplinary research or research in emerging areas, especially that which crosses the boundaries of the agencies' mandates. The agencies should consider establishing a formal mechanism to facilitate collaboration on all

levels so that their operations are more uniform, allowing for "seamless" access by the research community to federal research funds.

RECOMMENDATION 6

That the Government of Canada establish a more formalized mechanism, in consultation with the provinces and territories, for setting or modifying S&T policy, deciding on funding priorities, and ensuring that they are implemented. Such a framework could include a science advisory body and/or Chief Scientific Adviser that would report directly to Parliament.

RECOMMENDATION 7

That the Government of Canada, given the increases in overall funding levels that should be made to the agencies, encourage the three granting agencies to increase success rates and stipend levels for existing graduate scholarship and postdoctoral fellowship programs. The granting agencies should also create or enhance scholarship programs that introduce undergraduate students to research.

RECOMMENDATION 8

That the Government of Canada create separate research funding programs administered either by the granting agencies and/or other government bodies to support college researchers and students. The programs' selection criteria should reflect the situation at colleges and be based on excellence. Appropriations should be made to the relevant agencies to deliver these programs.

RECOMMENDATION 9

That the Government of Canada ensure that the granting agencies release all information on file relevant to a funding recommendation to applicants in addition to the notification of decision. Additionally, a formal appeal process, limited to perceived errors in procedure or fact, should be in place for applicants to all peer-reviewed programs, and a third-party, not the original selection committee, should review appeals of decision.

RECOMMENDATION 10

That the Government of Canada encourage the granting agencies to engage in more regular internal reviews of their own programs and practices (including peer review), and to periodically examine decision-making processes at other Canadian and foreign agencies to ensure that best practices for the allocation of research funds are in place. The results of these internal evaluations should be easily accessible to the research community and general public.

RECOMMENDATION 11

That the Government of Canada ensure that the federal granting agencies take steps to better measure and report on the outcomes and, where possible, impacts of their research programs for the benefit of the general public.

INTRODUCTION

In its report, *A Canadian Innovation Agenda for the Twenty-first Century*[1] released in June 2001, the Committee expressed some broad concerns about how research funds are allocated by the three federal research granting agencies (the Natural Sciences and Engineering Research Council of Canada or NSERC, the Social Sciences and Humanities Research Council of Canada or SSHRC, and the Canadian Institutes of Health Research or CIHR). Although generally supportive of the agencies' work and accomplishments, it was concerned about how the agencies carry out their mandates and about the decision-making processes employed for funding research projects and programs. The Committee indicated that given the government's commitment to double Canada's annual investment in research and development (R&D) by 2010, a review of decision-making processes and selection criteria used by the granting agencies is important, before additional investments are made, to ensure that funds are being managed in the best possible way.

The Committee detailed some specific concerns in its report about the allocation of federal research funds by the granting agencies. In particular, the Committee was troubled to learn of the relatively weak research capacity of small universities and the corresponding low success rates of researchers from small universities in obtaining research grants from the federal granting agencies. The Committee was concerned about the concentration of federal research funds in a few large institutions. The Committee also voiced its concerns about the method used to calculate the allocation of Research Chairs to universities under the *Canada Research Chairs Program* announced in the federal government's 2000 budget; specifically, it was worried that the allocation of the Chairs based on the past performance of universities in obtaining federal research grant funds would reinforce the existing disparity in research capacity across the country. The Committee was also concerned that the Program would lead to the "poaching" by large universities of the best faculty from smaller universities thus augmenting even further the disparity in research capacity. On the subject of research capacity, the Committee believes that the government is not doing enough to develop this capacity in certain regions of the country and in smaller institutions.

Chapter One provides an overview of the budgets, missions and grant selection processes at the three granting agencies and in the *Canada Research Chairs Program*. All three of the granting agencies use a similar peer-review process in which experts assess the quality of research proposals and make funding recommendations to the agencies.

In Chapter Two, the Committee addresses the concerns of small and regional institutions with respect to the allocation of federal research funds. The Committee details

[1] The report can be accessed electronically at: http://www.parl.gc.ca/InfoComDoc/37/1/INST/Studies/Reports/indu04-e.htm

concerns about the weak research capacity of small universities, and discusses suggestions made by witnesses as to how research capacity can be improved at these institutions. Potential mechanisms to improve research capacity include establishing a permanent program for the payment of the indirect costs of research by the federal government, providing programs through the granting agencies that are targeted to building research capacity in small or regional universities, ensuring that small and regional universities find their research "niches," increasing funding levels for research in the social sciences and humanities, and increasing funding levels to all three granting agencies. Each of these issues is examined in this chapter, and the Committee also addresses the matter of whether there are any inherent biases against researchers from small institutions in the decision-making processes of the federal granting agencies.

The issue of funding priorities for Canada and their relationship to agency programs and selection criteria is discussed in Chapter Three. For the large majority of granting agency programs, the excellence of the proposed research and the researchers is the most important criterion for selecting which research proposals are to be funded. For other programs, the socio-economic relevance of the proposed research in target areas of national importance is also an important selection criterion; in a few cases, it is as important as the excellence of the proposed research. The issue of granting agency selection criteria and what proportion of federal government research funds should be directed towards supporting research in target areas is addressed in this chapter. Additionally, the Committee addresses the matter of support for interdisciplinary research and research in emerging areas, and suggests that the agencies can make improvements in these areas. The chapter also discusses federal policy in the context of funding research in strategically important areas and indicates that stronger direction in this area is required.

Chapter Four addresses the important contributions that highly qualified personnel and college researchers make to R&D in Canada's knowledge-based economy. The Committee believes that, for different reasons, both groups are undervalued in the present system for allocating federal research funds. Mechanisms to improve the situation for both groups are presented in this chapter.

The Committee believes that although the present system for allocating limited federal research funds is the most appropriate and effective mechanism available, there is certainly room for improvement on several levels. In Chapter Five, the Committee recommends that improvements can be made to: the monitoring and evaluation of peer review practices by the agencies; the types of feedback and appeal mechanisms provided to applicants; and the measurement and communication of the outputs, outcomes and impacts of federally-funded research. In addition, the Committee discusses alternatives to peer review, and the feasibility of such proposals.

CHAPTER ONE: AN OVERVIEW OF THE FEDERAL GRANTING AGENCIES AND THE CANADA RESEARCH CHAIRS PROGRAM

Research and development (R&D) may lead to innovation.[2] Even if R&D fails to deliver innovation in the short term, it adds to the general body of knowledge and can point to other, often more promising, lines of enquiry that may lead to innovation in the longer term. Innovation is acknowledged to be a basic building block of economic growth. In fact, according to the Organisation for Economic Co-operation and Development, innovation and technological change have become the principal drivers of growth in advanced economies.[3] The results of R&D may also lead to other (e.g., social, environmental or medical) advances that may not lead directly to wealth creation but improve the quality of life of the world's citizens.

Governments around the world provide support for R&D. A large body of economic literature[4] exists to explain the rationale behind the investment by government in R&D. According to contemporary economic theory, the benefits of R&D extend beyond the performers of the R&D themselves (or "spill over") to other sectors of the economy. Econometric analyses suggest that the social rates of return to R&D investments can be up to five times higher than private rates of return, and that social rates of return on basic R&D are higher than those on applied R&D. The value of the benefits from investments in R&D is not completely appropriable by the R&D performers, and in a market economy, "inappropriability" of value leads to underproduction (i.e., the market fails to allocate an efficient quantity of resources to R&D). Governments support R&D to compensate for the market's socially sub-optimal investment in R&D, and to rectify shortcomings in the government's ability to provide rights to the R&D performer for appropriations resulting from those investments. Government support for R&D can take several forms including the provision of grants, prizes, tax incentives and an intellectual property rights regime.

The Government of Canada spent $6.85 billion (or 4.4% of the federal government's total budget) on science[5] and technology (S&T) activities for fiscal year 2000-2001. Of this amount, $4.21 billion was spent on the intramural performance and

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2 Innovation is defined as "a process through which economic value is extracted from knowledge through the generation, development and implementation of ideas to produce new or improved products, processes and services." Conference Board of Canada, *Investing in Innovation: Third Annual Innovation Report (2001)*.

3 OECD, *OECD Science, Technology and Industry Outlook 2000*.

4 See references in G. Lenjosek and M. Mansour, "Why and How Governments Support R&D," *Canadian Tax Journal*, Vol. 47, 1999, p. 242-272.

5 The Committee uses the term "science" to represent the whole ranges of sciences, including social sciences, natural sciences, engineering and health sciences.

extramural funding of R&D.[6] For fiscal year 2001-2002, estimates indicate that the government spent $7.39 billion on S&T activities (4.5% of its total budget), of which $4.65 billion was on R&D funding. Canada's Gross Domestic Expenditures on R&D (GERD)[7] in 2001 ($20.871 billion[8]) were estimated to be about 1.9% of its GDP. In 2001, the percentage of the GERD financed by the federal government was estimated to be approximately 18%[9] or about 0.35% of the GDP. In 1999, the last year for which comparative international figures are available, Canada's GERD as a percentage of its GDP (1.77%) lagged behind that of all other G-7 countries with the exception of Italy.[10] The three granting agencies, the Natural Sciences and Engineering Research Council (NSERC), the Social Sciences and Humanities Research Council (SSHRC), and the Canadian Institutes of Health Research (CIHR),[11] as well as the Canada Foundation for Innovation, are the major federal government funders of R&D performed in Canadian universities.[12]

The Federal Granting Agencies

Budgets and Agency Objectives

In fiscal year 2000-01, slightly more than $1 billion flowed through the three federal granting agencies — NSERC, SSHRC and CIHR — to fund university-based research, to train highly qualified personnel and to foster research partnerships among academia, government institutions and the private sector. By 2002-03, projected base budgets for the three agencies are expected to total $1.28 billion. Over the last 10 years, funding to the three agencies has increased substantially, with the largest percentage increase going to CIHR, which has seen its budget more than double over that period (see Table 1).

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6 According to international convention, Statistics Canada splits S&T activities into R&D and related scientific activities. The latter includes such activities as data collection, information services (e.g., libraries and museums), and special services and studies (e.g., testing and standardization, and feasibility studies).

7 GERD = total intramural expenditures on R&D performed on the national territory during a given period. It includes R&D performed within a country and funded from abroad but excludes payments made abroad for R&D (OECD definition). The Federal Government values that are part of GERD are its R&D activities performed intramurally.

8 Statistics Canada, *Federal Scientific Activities 2001-2002e*, April 2002.

9 *Ibid.*

10 Statistics Canada, *Service Bulletin Science Statistics*, Vol. 25, No. 8, November 2001 (see figure in Appendix 1).

11 The two granting councils, NSERC and SSHRC, report to the Minister of Industry, and CIHR reports to the Minister of Health.

12 Statistics Canada, *Federal Scientific Activities 2001-2002e*, April 2002.

Table 1. Base Budgets for the Three Federal Granting Agencies (NSERC, SSHRC and CIHR) [13]

	Fiscal Year				
Agency	**1990-91**	**1995-96**	**2000-01**	**2001-02**	**2002-03**
NSERC	$424 million	$443 million	$521 million	$528 million	$559 million
SSHRC	$90 million	$100 million	$128 million	$134 million	$157 million
CIHR[14]	$243 million	$252 million	$360 million	$487 million	$562 million

The *Natural Sciences and Engineering Research Council of Canada* is the national instrument for making strategic investments in Canada's capabilities in S&T. Its mission is to invest in people, discovery and innovation to build a strong Canadian economy and to improve the quality of life for all Canadians. The agency achieves its mission by awarding scholarships and research grants through peer-reviewed competition and by building partnerships among universities, colleges, governments and the private sector. NSERC supports nearly 16,000 students and fellows in their advanced studies and funds more than 9,700 researchers. In addition, over 500 companies participate in some of NSERC's programs.

The *Social Sciences and Humanities Research Council of Canada* is Canada's federal funding agency for university-based research and graduate training in the social sciences and humanities. SSHRC's goal is to help build the human knowledge and skills Canada needs to improve the quality of its social, economic and cultural life. The agency offers grants for basic and applied research by Canadian university-based researchers and scholars. It also offers fellowships for research training at the doctoral and postdoctoral levels, and grants to support the publication and dissemination of research findings. Additionally, it is involved in a range of efforts to help integrate social sciences and humanities research expertise into the process of social and economic policy-making.

The *Canadian Institutes of Health Research* is Canada's federal agency for health research. Its objective is to excel, according to internationally accepted standards of scientific excellence, in the creation of new knowledge and its translation into improved health for Canadians, more effective health services and products and a strengthened health care system. The CIHR concept involves a multi-disciplinary approach, organized through a framework of 13 "virtual" institutes, each one dedicated to a specific area of

[13] Base budget (to the nearest $1 million) = grants and scholarships (or awards), and operating expenses. Figures reported here (and elsewhere in the report, unless stated otherwise) do not include so-called "flow through funds" allocated to each agency for the *Canada Research Chairs Program* and the *Networks of Centres of Excellence Program*. Operating expenses average 6.3%, 9.2%, and 6.4% of base budgets for NSERC, SSHRC and CIHR, respectively for fiscal years 2000-01 through 2002-03 (includes NCE operating expenses). Figures supplied by the agencies.

[14] Data from 1990-91 and 1995-96 are for the Medical Research Council.

focus, linking and supporting researchers pursuing common goals. An Act of Parliament created CIHR in 2000, replacing the former Medical Research Council.

Peer Review

With some modifications, all three granting agencies use a similar peer-review process for making funding recommendations and allocating limited research funds. In peer review, experts from a particular field of study assess the quality of (depending on the context) research proposals, scholarly manuscripts, or other bodies of work in that field or in related fields. "Non-peers" (e.g., administrative staff or potential end-users of the research results) may also be members of peer review committees. The results of the evaluation may be used to determine, among other things, whether a researcher is granted funding, a manuscript is published in a scholarly journal, or a professor receives tenure. The first recorded use of peer review as a mechanism to assess the quality of scientific contributions is associated with the founding of the *Philosophical Transactions* of the Royal Society in 1665.[15] The formal use of peer review as a mechanism for the allocation of central government research funds has its origins in the middle of the 20th century when structured government programs for the support of R&D were established in many countries.[16]

Peer review has been used by the Canadian federal granting agencies to determine the allocation of research funds since the agencies' creation (NSERC in 1978, CIHR in 2000 (replacing the Medical Research Council, created in 1965), and SSHRC in 1977). The quality of each proposal is judged according to selection criteria that are established by the agencies (usually after consultation with members of the community). The selection criteria generally include some combination of the quality of the proposal and the investigator(s), and the past achievements of the applicant(s). In some cases, the short-term socio-economic relevance of the proposed work, often in particular "target" or "strategic" areas, is also evaluated. Depending on the program in question, peer review may be conducted by a panel of experts set up by the agency, by external reviewers, or by some combination of both methods.

The experts who sit on the selection panels or committees are chosen according to guidelines set up by the granting agencies. These guidelines are intended to ensure that the committees are proportionally balanced in terms of gender, regional, institutional and "sectoral" (university, government or industry) representation, and in language abilities. At CIHR, for its strategic or "thematic" funding areas, members who are not researchers are also included on committees:

> *… [O]ther experience and expertise can add important additional dimensions and perspectives to the review of applications. For example, we include community*

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15 D. E. Chubin and E.J. Hackett, *Peerless Science: Peer Review and U.S. Science Policy*, State University of New York Press, Albany, New York, 1990. p. 19.

16 F.Q. Wood, *The Peer Review Process*. Report commissioned for the National Board of Education, Employment and Training (Australia), Australian Government Publishing Service, Canberra, 1997.

> *members on committees that review proposals in the area of Aboriginal people's health.* [Mark Bisby, CIHR, 39:15:35]

Success rates vary among agencies and among programs at each agency, but the demand for funding outstrips the amount of funds available at each agency:

> *While about 70% of the 5,000 proposals that are reviewed each year are considered worthy of funding, the budget that is available allows only about 30% to be funded. The CIHR's rating scale, which goes from 0 to 5, currently requires about a 4, or an excellent rating, on the rating scale for a proposal to be sure of being funded.* [Mark Bisby, CIHR, 39:15:30]

For their major funding programs, each agency has a different philosophy in how limited funds are allocated. At NSERC, a large proportion (about 80%) of applicants to its *Discovery Grants Program* (approximately $255 million, or 49% of NSERC's grants and scholarships budget in fiscal year 2000-01) is funded, but the size of the grant is relatively small, averaging about $37,000 per year over a four-year period for the 2001 competition. At SSHRC a relatively small proportion, approximately 40%, of applicants to the *Standard Research Grants Program* (approximately $39.3 million or 30% of SSHRC's grants and scholarships budget in 2000-01) is funded and the average research grant is just under $25,000 per year over three years. At CIHR, the success rate is relatively small, about 30%, in its *Operating Grants Program* (approximately $207.5 million or 58% of CIHR's grants and awards budget in 2000-01), but the grant size is relatively large, averaging $100,000 per year for a three- to five-year period.

The agencies argue that peer review is the most efficient way of allocating research funds in light of the limited monies available for research funding:

> *Like many agencies around the world, we believe peer review is the best way of selecting the highest quality applications from thousands of competing proposals.* [Elizabeth Boston, NSERC, 39:15:40]

> *First of all, in Canada, peer review is already more than 40 years old and it is a process that is recognized all over the world. Given meagre resources, it remains the best system to distribute public funds. However, it is a system that first and foremost ensures a high degree of excellence in subsidized research. It is the most independent, the most transparent and the most objective granting process.* [Ned Ellis, SSHRC, 39:15:40]

The *Canada Research Chairs Program*

Budget and Program Goals

In its 2000 budget, the Government of Canada provided $900 million to support the establishment of 2000 Canada Research Chairs in universities across the country by

2005. About 400 new Chairs, recruited from both inside and outside Canada, will be named in each year.

The main goals of the *Canada Research Chairs Program* (CRCP) are to enable Canadian universities, together with their affiliated research institutes and hospitals, to achieve the highest levels of research excellence and to become world-class research centres in the global, knowledge-based economy. The Program's goals are to be achieved through the creation of Chairs in the natural sciences, engineering, health sciences, social sciences and humanities. The Program's emphasis is on investment in basic and applied research at Canada's universities.

Under the Program, there are two types of Chair: (1) seven-year renewable "Tier I" Chairs targeted at experienced researchers who are acknowledged by their peers as world leaders in their own fields (each Chair is worth $200,000 annually); and (2) five-year "Tier II" Chairs, renewable once, targeted at researchers who are acknowledged by their peers as having the potential to lead in their fields (each worth $100,000 annually).

The CRCP is governed by a Steering Committee comprising the presidents of NSERC, CIHR, SSHRC and the Canada Foundation for Innovation, as well as the Deputy Minister of Industry Canada.

Allocation of Chairs

Each eligible[17] university receives a predetermined allocation of Chairs per year. The allocation is proportional to the amount of eligible grant funding a university has received from the three federal granting agencies, including funds received by any affiliated research institutes and hospitals, over a three-year period. A three-year "moving average" is used to calculate the allocation, so that the number of Chairs allocated is adjusted annually to reflect changes in granting agency funding received by each university.

A "special allocation" (6% of the 2000 Chairs) has been reserved for smaller universities, i.e., those universities that have received one per cent or less of the total of federal research granting agency funds over the three-year period. Depending on the amount of research funding they have received from the granting agencies, these smaller institutions may: 1) qualify for both a regular allocation (as above) and a special allocation; 2) qualify only for a special allocation; or 3) not be eligible in the first three years of the Program (if they received less than an average of $100,000, in total, per year from the federal granting agencies). Over the first three years of the Program, the special allocation will be distributed as follows: a) universities that have received, on average, between $100,000 and $200,000 per year from the three federal granting agencies

[17] Only Canadian degree-granting universities are eligible to participate in the Program. During the first three years of the Program, these institutions are eligible only if they have received, annually, an average of $100,000 or more from the three federal granting agencies.

combined will receive a special allocation of one Tier I Chair or equivalent ($200,000). This allocation was made available in the first year; or b) universities that have received, on average, at least $200,000 per year, but less than one per cent of the funding from the three granting agencies combined, will receive a special allocation of $400,000 for Tier I or Tier II Chairs. In the fourth and fifth years of the Program, there are plans to hold a competition for the Chairs remaining in the reserve. Universities eligible to compete will be those that have been awarded one percent or less of the total funding from the three research granting agencies combined.

The 1880 Chairs allocated to the larger universities are divided among discipline groups as follows: 1) for the natural sciences and engineering, 45 percent or 846 Chairs, over five years; 2) for health, 35 percent or 658 Chairs, over five years; and 3) for the social sciences and humanities, 20 percent or 376 Chairs, over five years. The percentage of Chairs allocated to a university in each of these three discipline groups is the same as the percentage of relevant research agency eligible funds that the university received over the three-year period. In terms of the distribution of Chairs by tier, for universities receiving a total allocation of one Chair, an amount of $200,000 will be set aside. For universities receiving an allocation of more than one Chair, half of the allocation will be based on Tier 1 ($200,000) and half on Tier 2 ($100,000). Small institutions that have received Chairs through a “special allocation” have some flexibility in how they allocate their Chairs (by tier and by granting agency).

Chair Selection Process

The Program requires that each participating institution submit a “Strategic Research Plan” describing how the Chairs will be deployed. Chairs are assigned to priority areas identified by universities in their plans, and are filled by individuals who meet the Program’s criteria of excellence. Appointment of the Chairs is based on nominations from Canadian universities. Appointments follow a peer-review process conducted by members of the Program’s College of Reviewers and, where necessary, the Interdisciplinary Adjudication Committee. Both the College and the Adjudication Committee are composed of some of the world’s leading experts in disciplines being funded through the Chairs Program who are nominated by the partnering federal granting agencies.

Nominations are reviewed by peers against two criteria related to the objectives of the Program: a) quality of the nominee and the proposed research program, and b) integration with the university’s Strategic Research Plan. Three experts from the College of Reviewers review each nomination. If the reviewers concur in their assessments, a recommendation to fund or not to fund is made to the Program Steering Committee. If consensus cannot be reached among the reviewers, the nomination is sent to the Interdisciplinary Adjudication Committee for further review. This Committee in turn makes its recommendation to the Program’s Steering Committee.

In terms of feedback following a decision, the CRC Secretariat provides each university with copies of the Reviewer Report Forms that are completed during the review of each nomination. In those cases where nominations are referred to the Interdisciplinary Adjudication Committee, the university also receives a summary of the committee's recommendation. There is no appeal mechanism:

> *… [I]f the nomination is rejected, both the university and the nominee can review the assessments that were made and may decide to submit the application again, at which point we will send the file to three new experts in order to have a fresh look on this second review.* [René Durocher, *Canada Research Chairs Program*, 39:16:00]

Evaluation of the Program

The first nominations for Canada Research Chairs were received in September 2000 and the first recipients of Chairs were announced in December 2000. By February 2002, of 618 nominations received, 554 nominations were approved (90% success rate). Of those Chairs approved, 532 had been accepted, with most of them (471) going to researchers already in Canadian universities.[18]

In terms of an evaluation of the Program, a scheduled review of the operation and structure of the Program is underway; the objective of this review is to identify any improvements that could be made to the Program. Any changes to the Program resulting from this review will be implemented in September 2002. A comprehensive evaluation will be performed in the fifth year of operation.

[18] Statistics supplied by the Canada Research Chairs Secretariat.

CHAPTER TWO: SMALL AND REGIONAL UNIVERSITIES AND THE ALLOCATION OF FEDERAL RESEARCH FUNDS

In its June 2001 report, the Committee expressed some concerns about the nationwide distribution of federal research grant funds. It was particularly troubled by the relatively weak research capacity of small universities and the subsequent concentration of federal research funds in a few large institutions. Many researchers from small universities claim that they have more difficultly in obtaining research grants from the federal granting agencies than do researchers at larger universities. Additionally, certain regions of the country (e.g., Atlantic Canada and some parts of western Canada), in part because of the higher proportion of small institutions there than in other parts of the country, receive relatively low levels of federal research grant funding. The Committee recognized that the apparent lower success rates and/or funding levels of researchers from small universities were not because these researchers are of inferior quality to researchers at larger universities. Instead, barriers such as high teaching loads, small graduate programs, inadequate infrastructure, and in many cases, low levels of regional, value-added industrial activity probably have a greater impact on the research capacity of small institutions.

The Committee wished to explore further the reasons why researchers from small institutions are not faring as well as their large university counterparts under the present system of allocating research funds, and whether there are any inherent biases against researchers from small institutions in the decision-making processes of the federal granting agencies.

Funding of Researchers at Small Universities

During the course of its hearings, the Committee heard from several witnesses who suggested that researchers from small and regional universities face special difficulties in securing funds from the federal granting agencies to conduct their research. The granting agencies did not present any data on success rates or funding levels of researchers at small (or regional) institutions as compared to their large university counterparts, although suggestions were made that the agencies are beginning to examine the issue:

> *[W]e are aware that small and some medium-sized universities in some regions of Canada aren't succeeding as well as they would like. NSERC senior management takes this very seriously, and last year we visited 16 universities in the Atlantic and prairie provinces to investigate the issue a bit further. We found that there are indeed barriers in some universities to research productivity, which can in turn significantly affect their ability to compete in an excellence-based peer review system.* [Elizabeth Boston, NSERC, 39:15:35]

The Committee compiled data provided by the granting agencies (for their major research grants programs[19]) and the Association of Universities and College of Canada (numbers of faculty at each institution) to construct its own figures on the allocation of funds by size of institution (Fig. 1) and by region (Fig. 2) for the three agencies. These figures provide an overview only of funding patterns since they represent a single competition year (2001) for all three agencies combined, and institution size was estimated by counting the number of full-time faculty (not all of whom are active researchers) at each university.[20] Nevertheless, the data do provide a representative snapshot of recent funding patterns at the three agencies. Since there are differences among agencies in funding levels and patterns, it is important to also examine the breakdown of funding patterns by agency (see Appendix 2). The data support the anecdotal evidence that researchers at small universities tend to have less success in granting agency competitions (Fig. 1a and Appendix 2), and receive smaller grants, on average (Fig. 1b and Appendix 2), than their large university counterparts. Consequently, funds are concentrated in a few, large institutions (Fig. 1c). Differences in success rates among the institutions classified by size are most prominent for SSHRC and CIHR (Appendix 2), and are not as noticeable when data for all three agencies are pooled (Fig. 1a).

In terms of the regional distribution of funds, researchers from Atlantic Canada tend to have slightly lower success rates and smaller grant sizes, on average, than researchers from other regions, which is correlated with the relatively high proportion of small institutions in Atlantic Canada (see Appendix 2d). Furthermore, of the 16 Faculties of Medicine in Canada, only two are located at institutions (Dalhousie University and Memorial University) in Atlantic Canada; a correspondingly small proportion of CIHR research grants goes to fund medical researchers at these two facilities (see Appendix 2c). The regional distribution of federal research funds also mirrors the pattern of investment by the provinces and/or the private sector in R&D; Ontario and Quebec have the largest provincial GERD,[21] and receive the largest proportion of research funds from the federal granting agencies.

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[19] *Research Grants (*now *Discovery Grants) Program* at NSERC, *Standard Research Grants Program* at SSHRC, and *Operating Grants Program* at CIHR.

[20] Size of institution: Small = 0-499 faculty members; medium = 500-999 faculty members; and large = greater than 1000 faculty members; data on faculty numbers are from 1999 (most recent figures available) and were provided by the Association of Universities and Colleges of Canada. See Appendix 2d for list of universities grouped by size.

[21] Statistics Canada, *Service Bulletin Science Statistics*, Vol. 25, No. 8, November 2001.

Fig. 1. Success Rates and Average Annual Grant Size for NSERC, SSHRC and CIHR Applicants Combined (Competition Year 2001[22])

Fig. 1a. Success Rate by Size of Institution

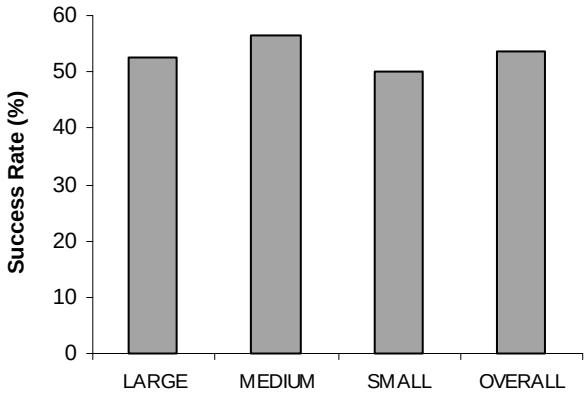


Fig. 2a. Success Rate by Region

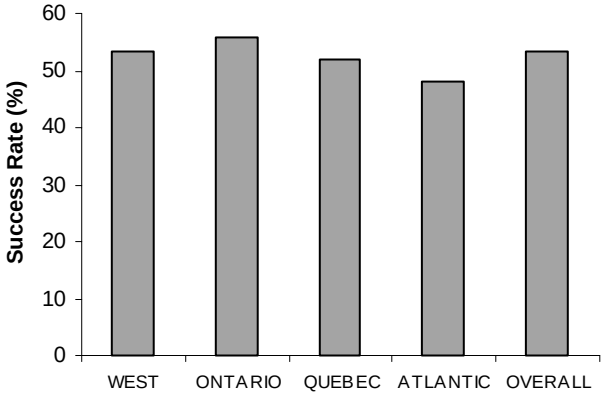


Fig. 1b. Average Grant Size by Size of Institution

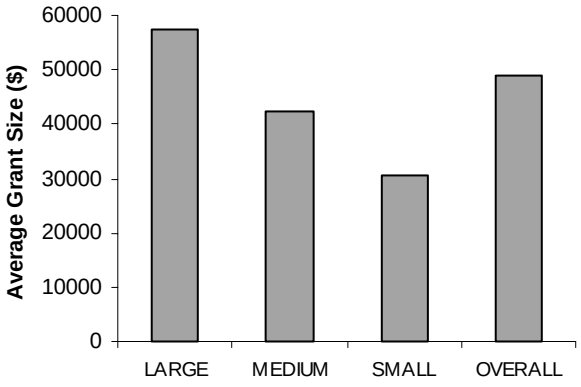


Fig. 2b. Average Grant Size by Region

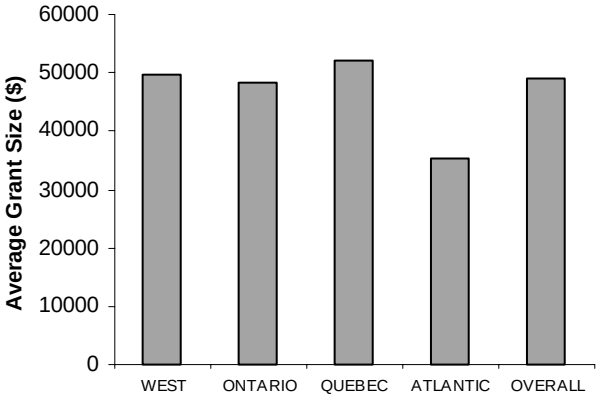


Fig. 1c. Amount Awarded by Size of Institution

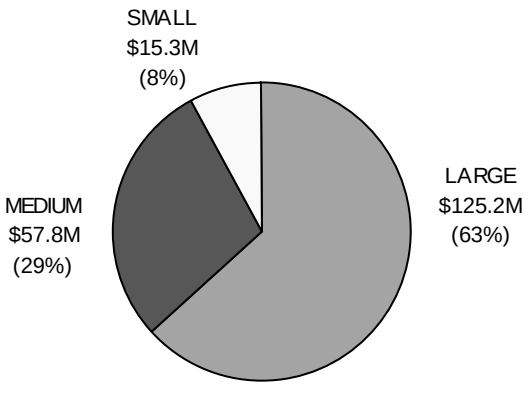
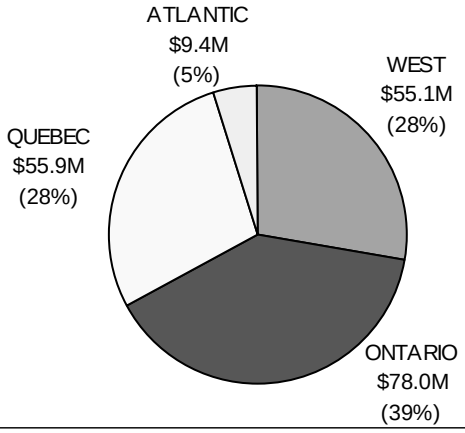


Fig. 2c. Amount Awarded by Region



[22] Raw data supplied by the agencies for their major granting programs.

The concentration of government research funds in a few large or research-intensive institutions is a phenomenon witnessed in other countries (e.g., the United States, the United Kingdom and Australia), and is not unique to the Canadian context. In the United Kingdom, some smaller universities are attempting to attract more research funding by examining the possibility of merging or forming "strategic alliances" (to share equipment and laboratory space) with larger universities.[23] The Committee notes this trend, but points out that in a geographically large country like Canada, mergers and the sharing of infrastructure would, in most cases, be difficult to implement.

In terms of the success of researchers from small and regional institutions in Canada in obtaining research funds, a representative from SSHRC made the following observation:

> *We have three categories of recommendations that are made by committees. One is "recommended and funded." The second is, "recommended, but unfortunately SSHRC does not have the money." The third category is, "not recommended at all." That second group, recommended but not funded, is where you find a lot of the small universities and a lot of the universities over which there are regional concerns*. [Ned Ellis, SSHRC, 39:15:50]

The granting agencies contend that low success rates and/or small grants reflect the low overall levels of funding provided to the granting agencies by the federal government.

Roots of the Funding Problem for Researchers at Small Institutions

Most witnesses reinforced the suggestion made during the Committee's last study on innovation that weak research capacity and lack of resources are the major barriers preventing researchers from small institutions in competing effectively for research funds with researchers from large universities. When these institutions are located in regions of the country with low levels of value-added industrial activity and/or low levels of provincial investment in R&D, the problems are exacerbated:

> *One of the fundamental problems we face as smaller institutions [in obtaining grant funds] … is that when we meet the test of excellence and when we submit proposals, whether it's to granting councils or within other types of programs, the level of resources available to support those excellent proposals is often the problem, as opposed to built-in biases [in the selection process].* [Bonnie Patterson, President, Trent University, 51:09:50]

> *… As smaller institutions, they have less well-developed, if any, research and development offices, commercialization facilities, and partnerships with national or international institutions or organizations. Their capacity to develop any of these aspects of research and innovation may be further limited by the financial resources*

[23] D. Adam, "Manchester merger to spawn research giant," *Nature*, Vol. 416, March 2002, p.114.

> *of the province in which they are located.* [Jacquelyn Thayer Scott, Advisory Council on Science and Technology and President and Vice-Chancellor, University College of Cape Breton, 55:09:45]

Most witnesses argued that research capacity at small institutions has to be improved in order that researchers from small universities can compete on a "level playing field" with their large university counterparts:

> *It's not a matter here of a bias in the system, which is fundamentally founded on quality and excellence. I think those are values that we absolutely have to preserve. The issue is, how do we make sure that different institutions with different capacities are able to compete with one another effectively?* [Tom Traves, President, Dalhousie University, 51:09:50]

Increasing Research Capacity at Small Institutions

The Committee heard several suggestions as to how research capacity can be increased, which would (according to the witnesses) correspondingly increase the success rates of researchers in securing research funds at small and regional universities. These suggestions included paying the indirect costs of federally funded research providing programs through the federal granting agencies (or other bodies) that are targeted to building research capacity in small or regional universities, ensuring that small and regional universities find their research "niches," increasing funding levels to SSHRC, and increasing overall federal funding levels to the federal granting agencies.

Payment of Indirect Costs

University representatives argued that the most important first step in "levelling the playing field" between small and large institutions would be to establish a permanent program to support the payment to universities of the "indirect costs" of federally funded research. Indirect costs are those involved with providing the services and physical environment necessary for the conduct of research but that are not associated directly with a specific project (e.g., expenses associated with providing lighting, central computing services, library and research archiving, research administration, and technology transfer and commercialization offices). Direct costs include salaries of research associates, equipment and supplies, travel and subsistence, and communication of research results. The salaries of principal investigators are considered to be included in the operating grants provided to the universities by the provinces.

Universities suggest that the indirect costs of research are increasing as more university-based research and researchers are funded. In Canada, the indirect costs associated with federally funded research are paid from university operating budgets; the federal government pays only for the direct costs of research. In the United States, universities claim a large portion of a researcher's grant (negotiable with the U.S. granting

councils on a university-by-university basis) to cover indirect costs. Canadian universities and university associations have been pressing the federal government to establish a permanent program to support the payment of indirect costs:

> *As someone from a medium-sized university with a very active research environment, I experience first-hand the dilemma that universities face in trying to deal with increased enrolment on the one hand, and the increasing complexity of research support programs, accountability, or regulatory requirements for research with human subjects, animals, and biohazards on the other. A major step forward would be for the federal government to reimburse universities for the indirect costs they incur in conducting research funded by the granting agencies.* [Wayne Marsh, President, Canadian Association of University Research Administrators, 43:09:10]

The *Advisory Council on Science and Technology* (ACST) has proposed that funding for indirect costs should be provided to the universities by the federal government. It suggested that each university eventually receive 45 percent of the level of funding provided to the university by the three federal granting agencies (based on a rolling three-year average of funds received). Under the proposal, smaller institutions that receive lower amounts of funding from the granting agencies would receive a larger percentage (up to 95%) of these amounts to account for an inability to achieve inherent economies of scale in research activities. This increased percentage for small universities should directly reduce the implicit cross-subsidy obtained from teaching activities and indirectly increase their research capacity which should, in turn, help to leverage more funds from the granting agencies for the direct costs of research. At the time the ACST released its report (September 2000), it estimated that the final cost of delivering the program would be in the range of $450 million annually.

This Committee, in its June 2001 report, recommended that the government, in discussion with the provinces, address the issue of payment of the indirect costs of federally supported research. In its December 2001 budget, the federal government announced a one-time $200 million payment, with a promise of ongoing support, to help support indirect costs at universities and research hospitals:

> *Looking ahead, the Government will work with the university community on ways to provide ongoing support for indirect research costs that is predictable, affordable and incremental to existing support.* [The Budget Plan 2001, Department of Finance, December 2001]

The federal government made its first announcements about the distribution of the one-time payment at the end of February 2002. The Canada Research Chairs Secretariat is administering the monies. The formula used to calculate the size of the indirect costs grants resembles a "reverse income tax" model, where the first $100,000 of research funding from the three federal granting agencies is supported at a level of 80% for all universities.[24] The next $900,000 is supported at a rate of 50%, the following $6 million at 40%, and the remainder at slightly less than 20%. The government's *Innovation Strategy*[25] released in February 2002 indicates that supporting the indirect costs of federally supported research is one of its priorities for improving the university research environment and Canada's knowledge performance.[26] The Committee deems that the permanent support of the indirect costs of research by the federal government as being very important. It believes that the formula used to calculate the one-time payments is appropriate since the differential costs between small and large universities are recognized, but encourages the government to look at other models (e.g., that of ACST) when designing any permanent program. The Committee thus recommends:

RECOMMENDATION 1

That the Government of Canada, in consultation with the provinces and territories, instate a permanent program for the support of the indirect costs of federally funded research in its next budget, and that the formula used to calculate the grant to each institution take into account the differential costs between large and small institutions.

Programs Directed to Small and Regional Institutions

Some witnesses appearing before the Committee suggested that more programs to build research capacity that are targeted to small and regional universities are necessary. Building research capacity should lead to an increase in the success rates and funding levels of researchers from small universities in national, open competitions for research funds:

> *More must … be done to foster and strengthen innovation capacity in smaller Canadian universities so that they can continue to strategically harness the innovation potential of the communities in which they are located. In advancing a new federal capacity building initiative, we acknowledge the need to recognize and*

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[24] Any degree-granting Canadian university that has received research grants from at least one of the three granting agencies may receive a grant for indirect costs, subject to some restrictions that are listed on the Indirect Costs section of the Canada Research Chairs Secretariat's Web site: http://www.chairs.gc.ca/english/indirectcosts/qa.html

[25] The two papers forming *Canada's Innovation Strategy* can be accessed electronically on the Innovation Strategy web site at http://www.innovationstrategy.gc.ca/cmb/innovation.nsf/pages/index

[26] *Achieving Excellence: Investing in People, Knowledge and Opportunity,* http://www.innovationstrategy.gc.ca/cmb/innovation.nsf/vRTF/PDF/$file/achieving.pdf, p. 52.

> *build on the demonstrated flexibility of existing federal programs. The research capacity building initiative we propose also recognizes excellence as the fundamental criterion of funding allocation.* [Robert Giroux, President and Chief Executive Officer, Association of Universities and Colleges of Canada, 51:09:10]

There are already some programs in place at CIHR and SSHRC that are specifically intended to assist small universities and/or certain regions of the country build research capacity. A description of these programs follows.

CIHR

> *CIHR has an obligation not only to support excellent health research, but also to ensure that there is robust health research capacity in all regions of Canada. The peer review system does not generally consider regional distribution as one of its criteria for evaluation, and we have developed other processes to try to ensure that there is good regional distribution of CIHR funds …* [Mark Bisby, CIHR, 39:15:35]

In 1996, the former Medical Research Council of Canada began a program in response to a decline in funding to health researchers in Saskatchewan, Nova Scotia, Newfoundland and Manitoba. The *Regional Partnerships Program* (RPP) was expanded in June 1999 to include Prince Edward Island and New Brunswick. The Canadian Institutes of Health Research continues to offer this Program. In addition to funding health research, the RPP supports a local strategic planning process to establish research priorities and partnerships, emphasizing the recruitment and retention of promising and/or excellent researchers, building on local strengths and priority interests of the institutions.

Under the Program, research funding and personnel support applications that are judged to be of high scientific merit through peer review, but are below the funding capacity of CIHR's base budget in regular competition, are eligible to receive funding if there is a partner to co-fund the proposal. The annual maximum CIHR co-funding is $1 million for each of the original four provinces (Manitoba, Newfoundland, Nova Scotia and Saskatchewan) on a 1:1 partner-funding ratio. For the Program's newest provinces (Prince Edward Island and New Brunswick), funding has been set at a level of $200,000 per annum at a 1:1 partner funding ratio. CIHR's current commitment to the Program is $4.4 million per annum. The Program has had positive effects in increasing the research capacity of institutions in the participating provinces in the area of health sciences:

> *[T]he Medical Research Council a number of years ago instituted a program, which … set aside a designated amount of what was essentially seed money — small grants — for a designated number of smaller institutions that allowed us to invest in our good ideas. So when we eventually did go forward to compete with scholars at much bigger and better funded universities, we had the same pre-investment in our project and had made the same progress as they had. So we were able to compete on a level playing field. Significantly our research grant results went up substantially as a result of that kind of support.* [Tom Traves, President, Dalhousie University, 51:09:50]

CIHR also established the *Institutional Establishment and Development Grants Program*, which is intended to increase capacity in health research at Canadian institutions. The Development Grants portion of the Program is intended to permit certain "underdeveloped" institutions[27] to undertake activities that will increase their competitiveness in applications for CIHR funding. The Program provides a one-time grant of up to $100,000 per institution (expiring on March 31, 2002). At present, this Program is a "one-time" funding opportunity for institutions, pending submission of final reports by the institutions and an evaluation of the Program's outcomes in 2003. The rationale behind establishing Development Grants stems from the fact that most institutions have identified health research as a priority for development in their *Canada Research Chairs Program* (CRCP) strategic plans, yet investigators at many institutions currently receive very little funding from CIHR. Since CRCP allocations are based on past funding received from the three federal granting agencies, such institutions receive few or no CIHR-CRCP allotments. The purpose of development grants is to assist underdeveloped institutions to build and mobilize their health research capacity, which should, in turn, lead to CRCP allocations in health research and increased research growth.

SSHRC

The *Aid to Small Universities Program* offered by SSHRC is intended to help small universities develop and strengthen focused research capacity in the social sciences and humanities. Small institutional grants are awarded on a competitive basis for a three-year period and support such activities as start-up costs/partial funding of research centres; stipends to doctoral students; organization of colloquia or symposia; and seed funding for collaborative research or the development of partnerships. The maximum value of a grant is $30,000 per year for three years.

The *SSHRC Institutional Grants Program,* which is open to *all* eligible Canadian postsecondary institutions and helps to fund small-scale research activities by faculty in the social sciences and humanities, also assists universities in strengthening research capacity. Under the Program, SSHRC provides block grants (minimum of $5,000) for three-year periods to each eligible institution. The institutions use these funds to award, through their own competitive process, small individual grants to support research activities such as short-term research projects, research-related conference travel and organizing small seminars.

Other SSHRC policies indirectly ensure that funds in certain programs are shared among institutions across the country:

[27] Those institutions that have received less than 1% of the CIHR grants and awards budget in fiscal year 2000-01, and are eligible to receive Canada Research Chairs.

> *In certain programs sometimes we will introduce particular clauses, in the* Community-University Research Alliance Program,[28] *for instance, which was, of course, community-based and had a huge demand. What was nice about that program was that we specified that institutions could only get one Community-University Research Alliance, which meant that it was much more widely spread across the country.* [Ned Ellis, SSHRC, 39:15:45]

NSERC

Although NSERC has had programs directed to small universities in the past, no such programs exist today because of budget constraints. The agency is in favour of targeting resources to build the research capacity of small and regional universities that would allow these institutions to be more successful in national competitions:

> *[The universities] need targeted resources to bring their research facilities and capacity to a high level, to allow them to compete on a level playing field, and a relatively modest program to provide flexible infrastructure support could go a long way to achieving this goal. This advice has been made available to Industry Canada and the federal regional economic development agencies.* [Elizabeth Boston, NSERC, 39:15:35]

Focusing on Research Strengths

The importance of small institutions identifying their areas of research strength and focusing their efforts in those areas was emphasized by several witnesses. Strategically focusing research efforts in an area of speciality allows a small university to build research capacity and productivity and to excel, both nationally and internationally, in that area:

> *In terms of capacity building for research, many of us find it is critically important to our success to be very niche-focused. We need to develop critical mass in particular areas. Some of the programs the federal government has put in place in fact are now allowing us to establish excellence at a critical mass level.* [Bonnie Patterson, President, Trent University, Association of Universities and Colleges of Canada, 51:09:30]

Another witness argued, however, that some small institutions because of their mandates and/or types of industry in the region might have difficulty expanding into other areas of research:

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[28] The *Community-University Research Alliance Program* was a pilot program begun in 1999 that funded research, training and knowledge-sharing partnerships between universities and communities. The pilot program was heavily subscribed, but SSHRC suspended the program for the 2001-02 competition because of lack of funds. SSHRC's Council decided in March 2002 to launch a new competition (letters of intent stage only, pending an examination of the availability of funds for a full scale program) for 2002-03.

> *[R]esearch activities in smaller institutions with subregional development mandates are generally less well developed … Typically, they begin with involvement in some form of sectoral economic activity within their subregion that may support a very limited number of mid-sized or larger employers … It may be difficult for such institutions to move into other niche areas that will focus on assisting SMEs or helping to diversify the base for their local economy.* [Jacquelyn Thayer Scott, Advisory Council on Science and Technology and President and Vice-Chancellor, University College of Cape Breton, 55:09:45]

Despite this caution, the Committee supports the idea that small institutions should strategically focus their research efforts in one area rather than trying to engage in "across the board" research activities. A suggestion was made that as part of any program intended to build research capacity at small or regional universities, the universities should be required to identify their areas of research strength, and to request funds to help promote research capacity in that area:

> *This is why we suggested a program that would target smaller universities. [The universities] would submit a plan to strengthen their capacity in one area and would outline their needs. This program could be available to finance the capacity-building side of university research.* [Robert Giroux, AUCC, 51:09:40]

Within these programs, some witnesses made the point that excellence should still remain the primary selection criterion for the allocation of funds.

The Committee was encouraged to learn that some programs to help certain small and regional institutions are already in place at the granting agencies. These types of programs are essential in assisting these institutions build research capacity in areas of strength, and ultimately in helping their researchers to obtain a larger proportion of research funds, through open competition, from the granting agencies. The Committee therefore recommends:

RECOMMENDATION 2

That the Government of Canada, in consultation with the provinces and territories, set up targeted programs through the granting agencies to assist "underdeveloped" small and regional institutions strengthen their research capacity in key areas, and that appropriations be made to the agencies to fund these programs.

Increased Funding for Research in the Social Sciences

The Social Sciences and Humanities Research Council of Canada currently receives the lowest level of funding of the three granting agencies (projected base budget of $157 million for fiscal year 2002-03 as compared to $559 million for NSERC and $562 million for CIHR). The agency argues that it is under-funded since it represents 55% of all university researchers, but receives only about 13% of the federal investment

in university-based research. The Committee notes this difference, but suggests that part of this funding gap may be explained by the lower costs, on average, of research in the social sciences as compared to much of the research in the natural sciences, engineering and health sciences. Differences in amounts of federal funding among different areas of research may also reflect differences in the socio-economic impact of the research. The Committee encourages SSHRC to place more effort into promoting to the public the impacts of SSHRC supported research on Canadian society.

A few witnesses appearing before the Committee suggested that since many smaller institutions have their research foci in the social sciences and humanities, providing adequate levels of funding in these areas is critical for ensuring that researchers in small institutions receive appropriate levels of federal funding for their work:

> *The second factor for many of us [at small universities] is that we are largely focused on the social sciences and humanities. At Trent, for example, our focus is approximately 60% in that area. Therefore, access to resources through such granting councils as SSHRC becomes fundamental to the ability of our universities to compete, not just regionally and nationally but internationally.* [Bonnie Patterson, President, Trent University, 51:09:30]

> *… [W]e feel the time has come to address the historic underfunding of the SSHRC … Again, that Council plays a particularly important role at many smaller institutions in the country …* [Wayne Marsh, President, Canadian Association of University Research Administrators, 43:09:10]

The Committee is concerned about the level of funding to SSHRC and especially its impact on researchers at smaller and regional universities. It notes that relatively low levels of funding at SSHRC have resulted in the suspension of some programs, and an inability for SSHRC to participate in certain initiatives. For example, SSHRC has been unable to provide any monies to follow up on recommendations made to NSERC and SSHRC by the *Task Force on Northern Research* to rebuild Canadian northern research capacity, whereas NSERC has been able to channel some of its funds to at least partially implement the recommendations.[29] To address the issue of differences in funding levels among agencies, the Committee recommends:

RECOMMENDATION 3

That the Government of Canada increase the level of funding to SSHRC, especially given the impact of this funding on researchers at small institutions.

[29] The Task Force's recommendations can be accessed electronically in its report *From Crisis to Opportunity: Rebuilding Canada's Role in Northern Research*, ftp://ftp.nserc.ca/pub/nserc_pdf/nor/crisis.pdf

The Committee believes that officials at Industry Canada, who are familiar with the agency's mission and the outcomes and impacts of its programs, are in the best position to decide on the size of the increase to SSHRC's budget.

Increased Funding to All Three Federal Granting Agencies

Some witnesses appearing before the Committee argued that low success rates and funding levels to researchers at small institutions reflect inadequate levels of funding to the three federal granting agencies, not flaws in the peer review system itself:

> *I think the real problem is not redistributing the dollars and not putting the finger on the problems of process as being the cause of the other problems. I think the problem is that we don't spend enough on R&D in the country as a whole.* [Michael Piva, Canadian Association of University Teachers, 43:10:00]

> *[T]he fundamental, underlying issue is the overall lack of funding in the granting councils in particular. You will therefore get situations in which people are writing good proposals time after time, but they're not being funded. That's because in the judgment of the people doing the reviews, is not that it's not meritorious research, it just comes a little too far down on the scale and the funding doesn't come down far enough to meet it.* [Wayne Marsh, President, Canadian Association of University Research Administrators, 43:10:10]

The Committee appreciates that higher levels of funding are required for university-based research in Canada, and notes that this need is also recognized in the government's *Innovation Strategy*.[30] The Committee believes that larger annual increases to the granting agencies (i.e., larger than the 7% increases awarded to SSHRC and NSERC in the December 2001 budget) are necessary to help meet the federal government's target of doubling its annual investment in R&D by 2010. The Committee recommends:

RECOMMENDATION 4

That the Government of Canada immediately increase funding to all three granting agencies so that success rates and/or grant levels for excellent research can be increased.

The Committee encourages the government to consider a doubling of agency funding levels by 2010, and ensure that annual increases to the agencies reflect this long-term goal.

The Committee recognizes that the recommendations made in this section of the report will lead to results only if the institutions and regions involved also work towards the

[30] *Achieving Excellence: Investing in People, Knowledge and Opportunity,* http://www.innovationstrategy.gc.ca/cmb/innovation.nsf/vRTF/PDF/$file/achieving.pdf, p. 52.

goals of improving regional and institutional research capacity. Issues such as the levels of provincial support for research (for both direct and indirect costs) and for universities, as well as institutional support for researchers, have an important impact on research capacity and productivity, independent of federal efforts in this area. Furthermore, the Committee notes that stronger collaboration between the provinces, territories and the federal government on such research funding problems would make it easier to find solutions. Similarly, increased collaboration on other issues related to research, development and innovation would improve the innovation performance of Canada, the provinces and the territories relative to their international competitors.

Potential Bias Against Small Institutions in Decision-making Processes

An argument was made that the present peer review system is biased towards supporting researchers at established, large institutions since the selection criteria focus on such factors as the quality of an applicant's publication record and the numbers of highly qualified personnel trained, which are usually stronger for researchers at large universities. One witness argued that other evaluation standards need to be applied to researchers at small institutions, which are often newer and located in rural or remote regions of the country. The witness indicated that there are different and equal standards of excellence that are more appropriate to different contexts, and that separate funding programs, targeted to researchers at small institutions, are needed at the granting agencies:

> *That really is what the ACST has been saying in at least two of its reports, that we've been doing very good things related to strengthening the good things that already exist in Canada's well-developed universities in metropolitan regions, but now we need to have separate programs that are equally excellent, but with different standards for the excellence appropriate to other communities that are at a different developmental stage.* [Jacquelyn Thayer Scott, Advisory Council on Science and Technology and President and Vice-Chancellor, University College of Cape Breton, 55:09:45]

However, other witnesses argued that although many researchers from small universities do face problems in securing funds from the granting agencies, they did not want the selection criteria and peer-review processes altered. These witnesses suggested that the present excellence-based, competitive decision-making process is fundamental to the efficient allocation of research funds. Instead, they recommended that the issue of weak research capacity be addressed in order that researchers from small universities can compete in open competition with their large university counterparts:

> *… Peer review isn't perfect, but it's by far the best imaginable system. I stress that it's the only one that can make us internationally competitive ... To make that reversal of our relative decline [in productivity] and to be economically competitive, you have to allow for a competitive system in the allocation of the grants. Yes, do the capacity building. Yes, do the special programs we've all been talking about, but my goodness, peer review is the heart of what translates the dollars into excellence.*

> *Give up on peer review and you give up on the excellence.* [Paul Davenport, President, University of Western Ontario, 51:10:40]

The Committee recognizes the importance of maintaining a competitive system for the allocation of funds, but it encourages the granting agencies to ensure that the special situations of small and regional universities is taken into account in all aspects of the review process.

At this stage, the Committee believes that it is important to address the issues of the payment of indirect costs, disparities in research capacity between small and large institutions, and low overall funding levels to the granting agencies. The Committee will monitor the success rates and funding levels of researchers at small and regional institutions to see whether improvements in the aforementioned areas are correlated to improved results for these researchers in granting agency competitions. If major improvements are not witnessed, other factors (including, possibly, the peer-review process itself) are likely responsible for the relatively poor performance of researchers at these institutions. The Committee encourages the federal granting agencies to review their funding mechanisms to ensure that researchers from small and regional institutions participate actively in decision-making processes, and that, as far as possible, the review process take into account the difficulties faced by researchers at these institutions. The Committee will continue to monitor the situation and determine whether further investigation and changes are required.

The *Canada Research Chairs Program* and Small Universities

The Committee's concerns about the allocation of Chairs under the *Canada Research Chairs Program* were two-fold: (1) the formula used to calculate the allocation of Chairs to universities is based on the past performance of universities in obtaining federal research grant funds which might reinforce the existing disparity in research capacity across the country; and (2) the Program might lead to the "poaching" by large universities of the best faculty from smaller universities thus augmenting even further the disparity in research capacity across the country. Some universities and university associations had the same concerns when the Program was launched in 2000.

In general, witnesses appearing before the Committee stated that their initial concerns about the Program have largely been erased. With respect to the allocation formula, witnesses suggested that the Program provides some flexibility in how the Chairs can be used by smaller institutions:

> *First of all, one of our experiences with the Program is that where there can be flexibility with the Chairs, the happier and easier it is in some particular disciplines to address issues. As we see some of our highest-end researchers approaching retirement, the ability, for example, to use a senior-awarded Chair in two particular areas as junior Chairs has been very helpful in our case. I would speak to the*

> *structure of the Program being fine as we're moving forward.* [Bonnie Patterson, President, Trent University, 51:10:00]

As for the issue of raiding, the Chair of the Association of Atlantic Universities made the following comments:

> *My region was certainly one that was very anxious about this. As I indicated, we have many small institutions. There was a great anxiety at the start of the Program that we would essentially be raided — that the best people at our institutions would disappear into the better-funded, larger institutions across the country. That has not happened. At my university we've lost one person. But at the same time we've attracted people from other institutions. If you just see this in the context of the normal movement by people in terms of their careers, it fundamentally has not proven to be the kind of anxiety we worried about.* [Tom Traves, President, Dalhousie University, 51:09:55]

The Committee is still concerned about the allocation of Chairs to small universities and encourages the Canada Research Chairs Secretariat to pay special attention to this issue in present and future reviews of the Program.

CHAPTER THREE: EXCELLENCE, RELEVANCE, AND STRATEGIC RESEARCH

The issue of funding priorities for Canada, and their relationship to granting agency programs and selection criteria, came up on a number of occasions during the Committee's hearings. Most of the witnesses appearing before the Committee stressed that excellence should be the fundamental selection criterion for any peer-review process for the allocation of federal research funds. However, for certain types of research programs, the short-term socio-economic relevance of the proposed research, sometimes in specified target areas, is also very important. The question of what proportion of granting agency funds should be dedicated to supporting research in particular target areas is a contentious issue. Some critics argue that certain research areas of socio-economic importance to Canada are not receiving adequate funding and that more funds should be channelled to those areas. Other commentators argue that there is already an adequate proportion of granting agency funds directed towards supporting research in target areas, and more funds should not be directed there at the expense of funding for other types of research. The issue of how much funding should be directed to different research areas is clouded, according to come critics, by a lack of structured government policy in this area. These questions are explored in this chapter.

Relevance and "Strategic" Granting Programs

In addition to the excellence of the research proposal and investigators, and the need for funds, other factors are considered for certain programs when deciding on the allocation of research funds. For example, some programs at the federal agencies examine the industrial relevance of the proposed research and whether the project is likely to generate economic spin-offs for the Canadian economy within a reasonable period of time. Other programs focus on the socio-economic relevance of the proposed research in particular target areas of national importance. The objective of these "strategic" programs is to promote research and training in target areas with the ultimate goal of transferring knowledge or technology expertise to Canadian-based organizations that have a capacity to use the results; all three granting agencies offer some form of dedicated, strategic research programs. The research is usually conducted in conjunction with government or industry-based partners.

In fiscal year 2000-01, these strategic programs accounted for approximately 7% of expenditures at NSERC (spending on other non-targeted research with societal or industrial relevance conducted in partnership with industry and government agencies accounted for a further 9% of NSERC expenditures), 15% at SSHRC, and 20% at CIHR (Networks of Centres of Excellence not included in the calculations for the three agencies). Expenditures on strategic research at CIHR is expected to grow to between 30% and 40% of the total budget as the agency's institutes, which began operating in

February 2001, expand. Other research in target areas of national importance to Canada is funded through non-targeted research programs, so the actual expenditures on such research by each agency are higher than the amounts reported here. The proportion of research in target areas funded by the granting agencies has increased over the past few years:

> *Look at the agencies' budgets … There has been an evolution over the course of the last 20 years … They have all, without exception, followed this trend. Today, between 20 and 30% of the agencies' budgets, agencies which up until very recently only funded non-directed, non-strategic fundamental research, [are] already devoted to such programs.* [Benoît Godin, Observatoire des sciences et des technologies, 66:09:55]

The percentage of expenditures at SSHRC on targeted research programs will be higher for 2002-03 because of the funds ($100 million over five years) that the government has invested in the *Initiative on the New Economy* (INE), which are managed by SSHRC. The main goal of this initiative is to help Canada and Canadians adapt to and benefit from the "New Economy." The INE will focus on four major areas of research (that were selected by the federal government in consultation with a variety of stakeholders): general new economy issues, management and entrepreneurship, education and lifelong learning. A major departure in the evaluation process compared to other SSHRC programs is that before INE applications proceed to the adjudication stage, an interdisciplinary committee of academics and non-academics, with experience in the areas relevant to the four INE themes, screens the applications for relevance to INE objectives. Only applications that pass this "relevancy test" are sent on for traditional peer review.

For strategic research programs, the granting agencies all have mechanisms in place to choose and modify target areas. The methods used and the time periods between reviews of the areas vary among the agencies. At NSERC, the *Strategic Projects Program* supports research in target and emerging areas of national importance. The Program operates on a five-year cycle; the Program's most recent evaluation of target areas was in 2000. The target area evaluation begins with a study of the existing national and international material on priority research areas identified by the private and public sectors. The results of this study are then validated with leaders in the academic, industrial and government sectors. In 2000, the strategic areas selected were: biosciences, environment and sustainable development, information and communications technologies, value-added products and processes, and "new directions." At NSERC, the allocation of funds to various disciplines is also examined and modified every four years in its main *Discovery Grants Program*, which funds basic and applied research. Funds are shifted among disciplines during the "Reallocations Exercise" to ensure that science and engineering that is important for Canada receives appropriate levels of funding under the system.

At SSHRC, different methods have been used over the past 10 years to select strategic research areas. The selection is usually made following broad consultation with

academics, university administrators, government representatives, members of non-governmental organizations and other stakeholders. An "environmental scan" highlighting knowledge gaps in the social sciences and humanities is produced following the consultation process and is presented to SSHRC's Governing Council. A short list of theme areas is drawn up, discussed with the community, and then the Council makes final decisions on theme areas to be selected. Reviews of the theme areas are made every three to five years to ensure that the areas selected are still relevant. The most recent set of strategic themes, selected in March 2002, are: culture, citizenship and identity (including issues involving peace and security); environment and sustainable development; texts, visuals and technology; and Aboriginal peoples.

At CIHR, the individual Institutes decide on thematic initiatives based on a rolling three- to five-year strategic "outlook." The outlooks are developed by the Scientific Director of each Institute, working in partnership with each Institute's multi-stakeholder Advisory Board. The CIHR Governing Council approves these broad outlooks, and from them the Institutes develop specific plans for research investments in the upcoming fiscal year. These plans are presented to the Research Planning and Priorities Committee (RPPC), which is made up of CIHR's President, Vice-President (research portfolio) and the 13 Institute Directors, for appraisal and modification prior to launch. Following the publication of CIHR's first overall strategic outlook,[31] the RPPC is now considering a number of proposals for major cross-cutting research priorities which would involve a number of Institutes working together, in addition to the priority areas defined by each Institute individually. Examples include such themes as rural and northern health, gene-environment interactions and disease, and tobacco control.

Other research in target areas is also supported through the granting agencies. The *Networks of Centres of Excellence* (NCE) *Program* is a tri-council and Industry Canada initiative that was established in 1989 and made a permanent Program in 1997. The Program promotes partnerships among universities, industry, government and non-governmental organizations. There are currently 22 networks in four areas: health, human development and biotechnology, information and communication technology, natural resources, and engineering and manufacturing. Its present budget stands at $77.4 million per year.

The identification of research priorities within the NCE Program has been achieved in two ways: (1) through a bottom-up approach in which applicants propose a NCE in a given area and the applications are judged in open competition; and (2) through a top-down approach in which specific research areas of national importance are identified in advance and proposals invited to address those areas. The first of these targeted competitions was conducted in 1995, the second one in 1999. Target areas are identified through consultations with the research community, with industry and with government. Prior to each competition, the NCE Steering Committee (composed of the presidents of the three federal granting agencies and the Deputy Minister of Industry Canada) decides

[31] http://www.cihr.ca/news/publications/publications/revolution.pdf

on the need to target areas for new networks and, if the decision is to target, recommends targeted areas to the Ministers of Industry and Health. The federal government (Cabinet) makes the final decision.

Research in Interdisciplinary and Emerging Areas

Much of today's research is interdisciplinary, crossing discipline boundaries within agencies and, in an increasing number of cases, crossing the boundaries of granting agency mandates. Other research is in emerging or small areas that does not fit well into the traditional, discipline-based structure of the major "open" granting programs at the agencies. Some researchers contend that research in interdisciplinary, emerging or small fields is disadvantaged under the present system. The Committee heard of such an example from a researcher who works in the area of animal health research:

> *NSERC has neither a mechanism nor the expertise to review or fund this [population] real-world [animal health] research. NSERC's perspective on the issue is that there is no problem, since it doesn't receive proposals for funding of this type of research. The reason they receive no proposals is that investigators will not submit proposals until there is an appropriate grant selection committee in place.* [Ian Dohoo, Professor, University of PEI, 58:09:40]

The witness believed that areas not covered by the present committee structure are disadvantaged in the competition for funds. He argued that because of limited funds, committee members are reluctant to recommend funding for research in new areas at the expense of funding for the majority of proposals that are in more traditional areas. For animal health research, the witness suggested that NSERC should follow the example of CIHR in its approach to funding research:

> *So what's the solution? Well, in the recent transformation of the Medical Research Council into the Canadian Institutes for Health Research, the need to fund the full spectrum of health research from basic laboratory research to real-world or population- and clinical-based research was clearly recognized, and that's been built into the four pillars each institute is built upon. Ideally we need the same sort of transformation — the same approach to animal health research — at NSERC.* [Ian Dohoo, Professor, University of PEI, 58:09:40]

NSERC contends that it funds both laboratory-based and population studies in animal health, and that a variety of NSERC programs are available to support animal health research. Despite this assurance, the Committee encourages NSERC to review its mechanisms for funding animal health research (in collaboration with other federal departments that work in this area, if necessary) to ensure that this area of research is

receiving proper consideration. Additionally, the Committee notes that Canada's four veterinary colleges are facing other problems related to outdated or inadequate infrastructure that, if not remedied, could result in the colleges losing their international accreditation.[32] Given the importance to Canadians of the research conducted by the veterinary colleges in such areas as food safety and animal disease, the Committee encourages the federal government, granting agencies, veterinary colleges and provinces to work together to quickly resolve these problems.

For interdisciplinary research and research in emerging areas, the Committee heard that the small pool of reviewers available is a problem in terms of evaluating proposals in these areas:

> *We have an excellent system for judging incoming proposals. If it has flaws, it's because the pool of academic reviewers is too small with the result that there is reviewer fatigue. This is particularly true for interdisciplinary panels. The problem is often compounded since the individual who may be familiar with your work often has to withdraw simply because they are in some way part of your small community with the result that the proposal does not receive the detailed review that it should.* [J. Adam Holbrook, Associate Director, Centre for Policy Research on Science and Technology, Simon Fraser University, 66:09:10]

An example of the "small reviewer pool" problem was provided to the Committee for the area of polar research. The witness suggested that polar research is disadvantaged by the system, because of the small research community and consequently a lack of researchers who can provide unbiased reviews of polar research proposals:

> *The small and shrinking community of polar scientists, in many disciplines, results in the fact that we know each other very well; we've usually co-operated on research projects; we've frequently co-authored papers with each other; and established partnerships in terms of funding with the granting councils, with government agencies and other people. And, as a consequence, establishing a peer review panel for major research proposals or even proposals within the current granting council system is really quite difficult.* [Peter Johnson, Chair, Canadian Polar Commission, 75:09:15]

In the long term, the witness argued that the solution to improving the situation for the evaluation of polar research proposals is to build up the polar research community (for example, by implementing the recommendations of the Task Force on Northern Research[33]). In the short term, the witness suggested that agencies should rely more on international reviewers to evaluate proposals in polar research (the agencies already do solicit the help of international reviewers in their review processes).

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[32] Karen Birchard, "Veterinary schools could lose accreditation," *University Affairs*, January 2002, p. 30.

[33] The Task Force's recommendations can be accessed electronically in its report *From Crisis to Opportunity: Rebuilding Canada's Role in Northern Research*, ftp://ftp.nserc.ca/pub/nserc_pdf/nor/crisis.pdf

At CIHR, efforts are being made to ensure that the review process reflects its new, broader, interdisciplinary mandate:

> *The peer review system at CIHR is undergoing a period of evolution. We've introduced a dozen new committees in the past year to deal with increased application pressure and to accommodate CIHR's broadened mandate, and we're creating about 15 ad hoc committees to review the strategic or thematic initiative … . To try to find the best fit between a specific proposal and the team of reviewers that evaluates it, we'll be forming clusters of similar peer review committees, which will meet at the same time, allowing for a flexible committee membership, better tailored to the review of a wide range of proposals. This cluster organization should also stimulate a more rapid evolution of committee mandates to anticipate, rather than react to, changes in the directions of health research.* [Mark Bisby, CIHR, 39:15:30]

For their major research grants programs, both the NSERC and SSHRC have interdisciplinary committees that evaluate research proposals at the boundary between disciplines or involving several disciplines that cannot easily be reviewed by the traditional discipline-based committees. The committee members represent a variety of disciplines. At the NSERC, the interdisciplinary committee often requests reports on proposals from members of other grant selection committees, in addition to reports requested from external experts, in helping it reach a funding recommendation.

High-risk Research

Given that, on average, industry tends to shy away from conducting research with a high level of risk, governments have an important role to play in helping to fund this type of high-risk, high-payoff research. One witness contended that peer review works well for most types of research, including interdisciplinary research, as long as selection committees are appropriately structured. However, the witnessed questioned whether high-risk research receives proper consideration under peer review. According to the witness, the inherently high risk of failure associated with this type of research, the scarcity of funds, and the tendency for committees to reach consensus by making conservative funding recommendations lead to a bias against this type of research:

> *[P]robably the most serious problem with peer review is how it treats high-risk research. Despite the many federal agency pronouncements on the importance of supporting high-risk, high-payoff research, in reality there are few incentives and motivations for promoting truly high-risk research and there are many disincentives. … Use of committees for performing peer review, especially large committees, which is characteristic of many of the funding agencies, intrinsically leads to conservative judgments.* [Ronald N. Kostoff, 88:10:10]

The witness suggested that "top-down" agency mechanisms may be the only way to ensure that this type of research receives appropriate levels of funding:

> *I don't really have an answer to [the problem] other than hiring [agency staff] who basically are willing to take these risks and are willing to accept the failures. It becomes a very personal issue. I don't see how one can in a sense legislate that organizations should be taking risks.* [Ronald N. Kostoff, 88:10:35]

In some foreign funding agencies (e.g., the National Science Foundation in the United States), program officers or directors have the authority, in some cases, to allocate a small proportion of the budget envelopes that they manage to fund high-risk research or research in emerging areas. Furthermore, staff can override the funding recommendation of a selection panel if the panel's decision is considered to be overly conservative. At the Canadian federal granting agencies, staff overseeing the operations of peer review committees does not have the authority to make independent funding decisions, alter budget envelopes, or unilaterally override the funding recommendations of the committees.

The Committee realizes that the major "open" granting programs at the Canadian agencies allow researchers to pursue other, often riskier, lines of research than those detailed in their grant applications. The agencies, as part of program evaluations, are examining the support of high-risk and interdisciplinary research. Some effort (e.g., at CIHR) is being made to provide funds specifically for high-risk research projects. The Committee encourages the agencies to continue to monitor and improve the mechanisms for the support of high-risk research.

Increased Collaboration Among the Granting Agencies

The Committee was generally pleased with the mechanisms in place within each of the granting agencies, especially at the CIHR, to assess and modify the distribution of research funds within strategic programs. It questions, however, whether research in target areas of national importance is receiving adequate support from the overall funds available at NSERC and SSHRC, although it realizes that such research is also being funded through non-targeted programs at those agencies. Additionally, the Committee is concerned about whether support for research in emerging fields and high-risk or interdisciplinary research is receiving adequate consideration under the present system. The Committee is worried that interdisciplinary research, often in strategically important areas, that crosses the boundaries of the three granting agencies' mandates (other than that supported through the NCE Program) is not receiving adequate consideration and appropriate levels of funding.

The Committee notes that the seven research councils in the United Kingdom have established "The Cross Council Research Forum," an informal group of individuals whose goal is to improve cross-council operations. One of the topics it has tackled is the review of proposals that are at the "interface" of the six grant-awarding research councils. The Committee encourages the Canadian granting agencies to review the general

operating principles[34] established by the U.K. councils for reviewing such proposals to see whether there are any novel principles that might be appropriate in the Canadian context. In May 2002, the U.K. government launched *Research Councils UK* which, working with the Office of Science and Technology, will develop new areas of collaboration in key scientific fields. It will build on areas where research councils are already working together, including the provision of interdisciplinary programs in such areas as genomics, e-science, basic technologies, stem cell research and climate change. *Research Councils UK* will also strive to harmonize procedures and provide a more efficient service for the councils' applicants, by, for example, developing a single application route for all research councils.[35]

The Committee believes that the Canadian federal granting agencies could co-operate further to support strategic and interdisciplinary research that falls under the purview of all three agencies. It also believes that cross-council operations in general could be improved. The Committee recommends:

RECOMMENDATION 5

That the Government of Canada encourage the granting agencies to collaborate further with each other and with non-academic stakeholders, including the provinces and territories, when deciding on target areas within strategic programs. The agencies should also ensure that formalized review mechanisms and adequate levels of funding are available to support high-calibre interdisciplinary research or research in emerging areas, especially that which crosses the boundaries of the agencies' mandates. The agencies should consider establishing a formal mechanism to facilitate collaboration on all levels so that their operations are more uniform, allowing for "seamless" access by the research community to federal research funds.

Basic and "Curiosity-driven" Research

Research that is deemed to be of immediate socio-economic importance to Canada is usually easier to justify to the government and public in terms of it being "value for money" than is basic research. The former, however, often depends heavily on advances in areas of basic research that may not have obvious or immediate value in a non-scientific arena:

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34 http://www.research-councils.ac.uk/researchforum/peerreview.htm

35 The formation of *Research Councils UK* results from the implementation of a recommendation made in the government's *Quinquennial Review of the Grant-Awarding Research Councils* (2001).

> *The advances in biology and human health tomorrow will come from fundamental understandings in physics, in social sciences, in philosophy, etc.* [Matthew Spence, President and Chief Executive Officer, Alberta Heritage Foundation for Medical Research, 66:09:30]

In many cases, the socio-economic value of a particular research program is not realized until years down the road when a discovery emanating from that research is applied to a specific problem. The majority of federal granting agency funding in Canada goes to fund research in areas chosen by the investigators themselves ("curiosity-driven" research, which may or may not have immediate industrial or societal relevance), and is not channelled into funding research in target areas selected by the granting agencies or government. According to some witnesses, most scientists support such a system and suggest that it may lead to much more useful research in the longer term than directly supporting research that has immediate and obvious socio-economic value and/or is in a particular target area:

> *The great thing about our Canadian system is that we have enough autonomy among our faculty and universities that we can have this interest-driven research that often is far more valuable in the long run than research that has an immediate commercial application.* [Paul Davenport, President, University of Western Ontario, 51:10:15]

The question of what proportion of federal granting agency funding should be directed towards funding basic, applied and strategic research is a contentious issue that is often raised by scientists, funding agencies and governments around the world:

> *We ask this question for 50 years now, since government started investing in science and technology: What is the balance between fundamental research and applied research? There's no magic formula to answer this … if you [look at] the funding council[s], a third of their funding is actually devoted to a kind of strategic research … Is that too much? Scientists say so. Government thinks no ... I think we should not go too far in that direction.* [Benoît Godin, Director, Observatoire des sciences et des technologies, 66:10:25]

The Committee recognizes that there is no consensus on this issue.

Federal Research Priorities

Along with the issue of what proportion of federal funds should be directed towards supporting research in target areas deemed to be of national importance is the question of who should be deciding on which areas are to be funded. Target areas in strategic programs at the federal granting agencies are generally proposed by multi-stakeholder committees and decided upon by the agencies' governing councils, or in the case of the NCEs, by Cabinet. Some critics point to the lack of clear research priorities at the federal level to explain the recurring debate that relates to the subject of the allocation of research funds:

> *I would suggest that one of the causes of this problem is simply that we do not have a clear set of priorities for our country. As a consequence, we try to fund all fields of research and thus cut a small pie into even smaller pieces. To be fair, the government has tried to remedy this situation by setting up special funds, programs and even institutions to focus scarce research funds in specific areas, but at the end of the day we still do not have these priorities. Rather, we have all-encompassing generalities such as economic development or social capital.* [J. Adam Holbrook, Associate Director, Centre for Policy Research on Science and Technology, Simon Fraser University, 66:09:10]

Some national governments do channel relatively large (according to some members of the research community) proportions of funds for university-based research to target areas of national importance. For example, in January 2002, the Australian government directed the Australian Research Council (Australia's main funding agency for basic research) to allocate 33% (about $130 million) of its total funds for the 2003 funding round to research projects in four priority research areas: nano-materials and biomaterials, genomics and gene expression, complex/intelligent systems, and photonics. The directive met with some criticism from the research community, but others feel that for small countries, such national priority setting is necessary:

> *It's certainly an issue which is very contentious, but the argument in favour of it in relation to Australia is that we have a very small population. We have a large landmass, but in terms of the population, the spread of our expertise, we can't possibly afford to cover everything and priority setting at some stage is inevitable.* [Fiona Wood, University of New England, Australia, 79:19:55]

In terms of decisions on the allocation of federal research funds in Canada, the Committee shares the concerns expressed by some of the witnesses about the lack of a clear set of federal priorities in this area. The Committee believes that a stronger federal S&T advisory framework is necessary to ensure that the government is receiving appropriate and adequate counsel for setting federal research priorities and policy. Such advice would ensure that the government is providing sufficient funding for research in strategically important areas while at the same time maintaining a strong support base for other research. The Committee was encouraged to see that the issue of decision making and priority setting is mentioned in the federal government's *Innovation Strategy*, and that the government will consider establishing a national, arm's length science organization (the *Canadian Academies of Science*) to provide independent assessments on science-based issues of national importance.[36] The Committee notes that other industrialized countries have S&T advisory frameworks that include a Chief Scientific Adviser to the executive branch of government who is usually head of a government office of science and technology policy (e.g., in the United Kingdom and the United States). Some countries also have priority-setting programs that identify future S&T directions and needs (e.g., the United Kingdom's *Foresight* program). In terms of Canada's S&T advisory framework, the Committee recommends:

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[36] See http://www.innovationstrategy.gc.ca/cmb/innovation.nsf/vRTF/PDF/$file/achieving.pdf, p. 70.

RECOMMENDATION 6

That the Government of Canada establish a more formalized mechanism, in consultation with the provinces and territories, for setting or modifying S&T policy, deciding on funding priorities, and ensuring that they are implemented. Such a framework could include a science advisory body and/or Chief Scientific Adviser that would report directly to Parliament.

CHAPTER FOUR: OTHER PLAYERS IN CANADA'S INNOVATION FRAMEWORK

During the hearings, concerns were expressed that important contributors to Canada's "innovation framework" are not receiving adequate consideration under the present system for allocating federal research funds. Two categories of stakeholders in particular were discussed: highly qualified personnel and college researchers. In this chapter, the Committee addresses how the federal government, via the granting agencies, can help to realize the potential that these two groups have in building Canada's R&D capacity.

Highly Qualified Personnel

Many witnesses described the importance of investing in the training of highly qualified personnel to ensure that Canada has the supply of skilled researchers necessary to remain competitive and move ahead on global innovation scales:

> *… [M]aybe the more important outcome of NSERC funding is the highly trained people we produce. These are the people who go on to work in universities, in industry, and in government. And they're the people who will have ideas of the future. They will be the people who create new companies and other real innovations. I think it's been identified that in order for Canada to move ahead of other countries in this area, it's the people and their skills that we really need.* [Elizabeth Boston, NSERC, 39:17:10]

Some witnesses expressed concern that Canada will not have enough skilled researchers to advance or even maintain the knowledge-based economy in future years, especially in emerging areas of research. These witnesses pointed to the problems that many universities have in attracting top-quality students into graduate studies:

> *I'm more concerned about the fact that we are not attracting the best people into our PhD programs. PhD stipends, or salaries if you like, are so uncompetitive in my field [design engineering] compared to industrial salaries that it's absolutely economically a disaster to do graduate studies.* [Peter Frise, Professor, University of Windsor, 58:10:50]

The training of highly qualified personnel to provide the next generation of skilled researchers is part of the missions of all three federal granting agencies. Competitive scholarship and fellowship programs exist at all three agencies; they generally consist of a review of proposals by the applicants' universities, and, for most programs, review by a selection committee of researchers (appointed by the granting agencies) of all applications received from the universities by the agencies. For fiscal year 2000-01,

expenditures on the training of highly qualified personnel totalled $96.9 million at NSERC (about 19% of its budget), $33.5 million at the SSHRC (approximately 26% of its budget) and $33 million at the CIHR (about 9% of its budget).

In March 2002, NSERC announced that part ($6.5 million) of the 7% (or $36.5 million) increase to its annual budget beginning in fiscal year 2002-03, which was announced in the federal budget of 2001, would be channelled into its training programs for highly qualified personnel. The CIHR's training budget will increase in 2002 with the introduction of the *Strategic Training Initiative in Health Research*. The initiative, which began on a small scale in fiscal year 2001-02 with contributions from CIHR of approximately $1.7 million, will be in full operation in fiscal year 2002-03 with a CIHR allocation of $14.3 million. The initiative will provide training grants (up to $300,000 per year) to institutions to pay for stipends and travel for trainees (undergraduate through postdoctoral level) conducting research in all areas of health research. Preference will be given to innovative, interdisciplinary programs, and applications are especially sought in areas where the applicants can demonstrate the need to develop research capacity.

At NSERC, scholarships for undergraduate and graduate (Master's and PhD level) students are available, as well as fellowships for postdoctoral fellows. At all levels, scholarships and fellowships are available at NSERC that allow students to conduct some or all of their research in an industrial setting. At SSHRC, a doctoral and postdoctoral fellowships program is offered. Doctoral research awards, combined MD/PhD studentships, and a variety of fellowship programs for postdoctoral researchers and health professionals are offered by CIHR.

Success rates and stipend levels vary among programs and agencies. At the graduate level, the annual stipend ranges from approximately $17,000 to $19,000 and the success rate (data from competition year 2001) ranges from a low of about 38% at SSHRC to a high of approximately 65% at the NSERC. The success rate for obtaining an NSERC Industrial Postgraduate Scholarship, where scholars spend a minimum of 20% of their time at a sponsoring company on activities related to their thesis project, is considerably higher (in the range of 90 to 95%).[37] Stipends for postdoctoral fellowships range from $35,000 per annum for two years at SSHRC and NSERC, to $38,500 (for PhD holders) or $48,500 (for health professionals) at CIHR. The success rate for obtaining postdoctoral fellowships ranges from a low of 25% at SSHRC to a high of 37% at NSERC (data for competition year 2001). The success rate for receiving an NSERC Industrial Research Fellowship, which provides financial contributions to support recent doctoral graduates engaged in industrial research, is much higher — in the range of 80%.[38] Since an initial "triage" of applications occurs at the universities for most of these awards, the actual success rates are generally lower than the figures reported here. Students and postdoctoral fellows are also supported through the research grants of

[37] NSERC contributes $13,800 a year (for two years) for each Industrial Postgraduate Scholarship and the sponsoring company contributes a minimum of $5,500 a year.

[38] NSERC contributes $30,000 a year (for two years) for each Industrial Research Fellowship and the sponsoring company contributes a minimum of $10,000 a year.

individual researchers, but the annual stipends are usually smaller than those listed above. Representatives of SSHRC point to the relatively low success rate of its doctoral fellowship program and the lack of a Master's level scholarship program as further evidence that it is under-funded in comparison to the other granting agencies.

The Committee appreciates the importance to Canada's future in R&D and to its economy of attracting more students to graduate level study. In addition, the Committee believes that more efforts should be made by the federal government at earlier stages in the training "pipeline" to attract students to scientific research. It notes that NSERC already has a program for undergraduate students, the *Undergraduate Student Research Awards Program*, which provides stipends for students to conduct research for four-month periods in universities or in industry. The Committee is also in favour of the federal government increasing its role in the promotion of science and the impact of R&D to youth and to the public at large. It is aware of programs that are already in place at the agencies to promote science or to communicate the results of federally sponsored research to the media and general public. For example, the *PromoScience Program* at NSERC supports programs that promote science to school-aged (elementary, high school and cégep level youth). It funds practical, interactive training programs (e.g., science camps, university science outreach programs, science clubs, and programs that involve students in research). The Committee encourages the government to explore additional avenues (either via the granting agencies or other bodies) for expanding its role in this type of science promotion.

The federal government's *Innovation Strategy* also recognizes that developing, attracting and maintaining highly qualified personnel is crucial for Canada's innovation performance.[39] Among other initiatives, the strategy calls for increased financial incentives to attract students to graduate level study. As part of the strategy, the federal government announced a $125 million endowment in February 2002 for the *Advanced Research in the Humanities and the Human Sciences Fund* to fund up to 100 doctoral fellowships and mid-career awards to exceptional researchers in certain areas of the humanities (e.g., human rights and social justice) that reflect the interests of former Prime Minister Pierre Trudeau. Some members of the Committee appreciate the additional investment in training that the government has made via the Pierre Elliott Trudeau Foundation, although the Commitee notes that the monies will support relatively few individuals in a limited number of research areas only.

Some members of the Committee expressed reservations about the appropriateness of the federal government's injection of $125 million into the Pierre Elliott Trudeau Foundation for doctoral and post doctoral fellowships in the humanities and human sciences. The reservations expressed by these members arise primarily from the fact that the federal government funds released for this initiative should have gone directly to SSHRC, a public body, and not to a private foundation, which is not held accountable to the public for the funds it receives. Given the chronic under-funding of SSHRC, such

[39] *Achieving Excellence: Investing in People, Knowledge and Opportunity,* http://www.innovationstrategy.gc.ca/cmb/innovation.nsf/vRTF/PDF/$file/achieving.pdf, p. 60.

an injection of public funds into its coffers would have been particularly welcome. The Committee believes that applications for these fellowships should be peer-reviewed based on the excellence of the applicant's record and quality of the proposal.

One witness made the following observation with respect to the training of highly qualified personnel and their importance to the success of any innovation strategy:

> *Research is the practice of turning wealth into ideas. Innovation is the practice of turning ideas into wealth. And education is the practice of turning people into citizens who can be innovative and generate more wealth. In my view, all three of these issues: research, innovation and education, are inextricably linked and to treat one without the other is not going to generate success for Canada's future.* [Peter Frise, Professor, University of Windsor, 58:09:30]

The Committee shares these sentiments and believes that Canada will not make progress in its goal to become one of the most innovative countries in the world without increased investment in the training of highly qualified personnel. The current level of investment allows the agencies to offer scholarship and fellowship programs that have, in most cases, relatively low success rates and uncompetitive stipends. The Committee suggests that additional investments in research training should be directed through established training programs at the granting agencies that are accessible to a broad cross-section of the student and postdoctoral fellow population. As such the Committee recommends:

RECOMMENDATION 7

That the Government of Canada, given the increases in overall funding levels that should be made to the agencies, encourage the three granting agencies to increase success rates and stipend levels for existing graduate scholarship and postdoctoral fellowship programs. The granting agencies should also create or enhance scholarship programs that introduce undergraduate students to research.

The Committee suggests that the granting agencies direct a portion of any additional funds earmarked for training to the enhancement or promotion of scholarship and fellowship programs in which students or postdoctoral fellows can collaborate on research projects with other stakeholders not based in universities (e.g., industry researchers). The Committee believes that such partnerships are essential to improving and diversifying the skills of highly qualified personnel.

Colleges

In terms of contributions to R&D and innovation, Canada's community colleges[40] play an important role in applied research, technology transfer and product development. Much of the technology transfer work occurs at the community level with local businesses and colleges working together. Colleges also play an important role in education and research in areas of the country where there are no universities. For example, in Canada's North, the three territorial northern research institutes[41] are a major focus for northern research activities. A representative from the Association of Canadian Community Colleges (ACCC) testified that the potential of colleges to contribute to Canada's R&D base goes largely unrecognized by the government:

> *… [The government] continues to marginalize the important contribution of colleges to innovation, research, and the technology transfer needs of business, industry, and community organizations … We continue to wonder why the recognition and funding are disproportionate to the breadth, depth, and economic impact of the applied research emanating from the college system.* [Gerald Brown, President and Chief Executive Officer, Association of Canadian Community Colleges, 43:09:15]

Additionally, colleges feel excluded from many of the programs offered by the federal granting agencies. Historically, college researchers have not been a major focus of granting agency programs. For most programs at SSHRC, applications are accepted from any researcher affiliated with a post-secondary institution. For its two institutional grant programs, an institution must be a member of the Association of Universities and Colleges of Canada (AUCC) to be eligible to apply for support (AUCC members are universities and university colleges whose primary mission is to provide university degree programs). Until recently, college researchers were not eligible to apply for any of NSERC's programs. In 1999, NSERC expanded its eligibility criteria so that college researchers from eligible institutions can now apply, as co-applicants with university researchers, for certain types of project research funding. As of June 2002, four community colleges had been declared eligible to participate in NSERC programs: the British Columbia Institute of Technology, the New Brunswick Community College at Bathurst, the Nova Scotia Community College — Annapolis Campus, and Old's College in Calgary. NSERC has yet to receive applications for funding involving the participation of researchers from other colleges. At CIHR, only researchers at Canadian universities or affiliated institutions can apply as principal applicants for CIHR grants. The agency is considering a significant broadening of eligibility to include any health researcher working in the not-for-profit sector (with the exception of the federal government).

Even when college researchers are eligible to apply for the granting agencies' programs, ACCC believes that researchers from colleges cannot compete with their

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[40] The term "community college" includes institutes, and cégep (in Québec).

[41] The Northern Research Institute of Yukon College, the Aurora Research Institute of Aurora College (NWT), and the Nunavut Research Institute of Nunavut Arctic College.

university counterparts because of the programs' selection criteria that reflect the university, not college, environment:

> *Within the peer-review process, the colleges and institutes are overshadowed by the university-focused process. This process is based solely on university criteria … At the practical level, involving college faculty in applied research has been and continues to be a huge challenge, due to the … high teaching loads of college and institute faculty.* [Gerald Brown, President and Chief Executive Officer, Association of Canadian Community Colleges, 43:09:15]

A representative from AUCC suggested that to make the granting agency programs more accessible to college researchers and to reflect the kind of research conducted at community colleges, the structure of programs and selection criteria would have to be altered:

> *[I]t may be that the kind of research [that the colleges and institutes] are doing would not fit within the criteria or the guidelines of the granting councils, and if there's a decision to proceed to support colleges, these would have to be adapted to meet the needs of the colleges.* [Robert Giroux, President and Chief Executive Officer, Association of Universities and Colleges of Canada, 51:10:35]

As an alternative to altering current eligibility and selection criteria at the granting agencies, ACCC proposes that a separate funding pool, what it calls the *Canadian College Innovation and Technical Assistance Program*, be established to help support the applied research, technology transfer and commercialization work that is carried out by Canada's community colleges. The components of the proposed program include Chairs for college researchers, fellowships and internships for students, networks of centres of excellence with college and industry participants, and a fund to promote and assist the development of commercial products and processes. The ACCC suggests that the program have an initial duration of five years and that it would require about $600 million of funding over that period.

The Committee believes that altering program eligibility criteria at the granting agencies to allow more access to college researchers would be a symbolic change only; college and university researchers work in quite different environments, and college researchers likely would have difficulty competing with their university counterparts in competitions based on present selection criteria. Similarly, the Committee is of the opinion that it would be difficult for the granting agencies to adapt the selection criteria for most granting programs so that the criteria reflect the situation for both university and college researchers. Instead, the Committee supports ACCC's idea of establishing discrete funding programs for college researchers and students, and thus recommends:

RECOMMENDATION 8

That the Government of Canada create separate research funding programs administered either by the granting agencies and/or other government bodies to support college researchers and students. The programs' selection criteria should reflect the situation at colleges and be based on excellence. Appropriations should be made to the relevant agencies to deliver these programs.

The Committee is of the opinion that it would be premature to suggest a funding level and structure for such programs at this time; the federal government and the ACCC should work together to plan and develop any initiative. Although the Committee believes that separate funding programs at some level are necessary for college researchers, it also feels that the granting agencies should continue to work to include college researchers in existing programs that support applied research. The Committee strongly believes that the inclusion of college researchers in these programs will increase collaboration between university and college researchers, and ultimately boost Canada's innovation performance.

CHAPTER FIVE: IMPROVEMENTS TO THE SYSTEM FOR ALLOCATING FEDERAL RESEARCH FUNDS

The Committee supports the practice of employing peer review as a mechanism for determining the allocation of federal research funds, but it believes that a number of improvements can be made to the system. This chapter addresses this issue and builds on testimony heard during the hearings on “best practices” for peer review, and for the allocation of federal research funds in general.

Perceived Weaknesses in the System

In addition to the broad areas of concern expressed earlier in the report, the Committee is worried about other shortcomings in the present system for the allocation of federal research funds. These areas of concern include unsatisfactory feedback to, or appeal mechanisms for, applicants; a lack of data on the efficacy of peer review in general; insufficient internal reviews of agency programs; peer reviewer overload; and inadequate efforts by the granting agencies to measure and communicate the impacts of federally funded research on Canadian society.

Inadequate or Inconsistent Feedback to Applicants

The Committee believes that the granting agencies could place more effort into improving and harmonizing the types of feedback that applicants receive following a funding decision, and ensuring that a formal, transparent appeal mechanism is available at each agency to deal with complaints about the decision-making process.

The Committee notes that all three agencies provide some type of feedback to applicants following a funding recommendation, but that the feedback provided varies within and among programs, and according to the agency involved. The Committee heard that the feedback obtained from the granting agencies is not always very useful:

> *[The feedback] is inconsistent. In some cases, yes, there is [adequate feedback], and people are able to improve their applications and are successful in a subsequent submission. In some instances, it isn’t as helpful as it might be. In part, I’m sure this reflects the staff pressures the granting agencies are under in trying to get comments out. But it can be difficult when you have one or two external reviews that are very positive, yet the decision is negative. One is left in a quandary about how one is going to improve [the application].* [Wayne Marsh, President, Canadian Association of University Research Administrators, 43:10:15]

By law, applicants have access to their application files (however, under the *Privacy Act*, the written opinion of a reviewer about an application is available to the applicant, but the name of the reviewer cannot be divulged). For its major *Discovery Grants Program*, NSERC sends a notification of funding decision to applicants, followed shortly thereafter by the selection committee's comments on the application, if available. Applicants receiving comments also receive any external referees' reports on the application. When selection committee comments are not available, an applicant may submit a written request to NSERC to obtain any external referees' reports received on the application. For SSHRC's *Standard Research Grants Program*, applicants receive copies of all information used to make a decision, including external written assessments and the committee's deliberations relating to their application. For its major research funding programs, CIHR provides copies of external referees' reports (if available), copies of the internal reviewers' assessments (one from each of the two principal readers assigned to the application), and a summary of the committee discussion (when available) with the notification of a funding decision.

At NSERC and SSHRC, a formal appeal process is in place for applicants who feel that their applications have been unfairly treated by the peer-review process. At NSERC, appeals of decision must be based on compelling evidence of error or discrimination in the review process; the onus is on the applicant to demonstrate the error. The process may vary according to the program, but for the *Discovery Grants Program* external consultants, who are senior members of the research community and have some experience with NSERC peer review, examine appeals:

> *Sometimes errors can occur in the peer review process … and if an applicant feels their application wasn't assessed appropriately, they can use our appeal process to request a review of the decision. NSERC then requests an independent review by a senior researcher, who was not involved in the original decision, and staff makes a final decision based on this adviser's report.* [Elizabeth Boston, NSERC, 39:15:40]

At SSHRC, appeals of decisions must be based on procedural or factual error in the process. If SSHRC determines that there are sufficient grounds for appeal, the application and any new information provided are examined by the adjudication committee that made the original decision. The two agencies receive a relatively small number of appeals each year (see Table 2).

Table 2
Data on Applications Appealed at NSERC and SSHRC
for the Agencies' Major Research Grants Programs
Competition Years 2000 and 2001

Agency	Competition Year	No. of Appeals	No. of Applications	% of Applications Appealed	No. of Successful Appeals
NSERC[42]	2000	132	2963	4.45	18
	2001	96	3089	3.11	15
SSHRC[43]	2000	10	1571	0.64	1
	2001	11	1821	0.60	1

The CIHR does not have a formal appeal process. However, for CIHR's major research funding programs, applicants who are unsuccessful in one competition may resubmit the same (or a similar) application in a subsequent competition, and may include a two-page rebuttal with the resubmission to address concerns raised by reviewers or to counter criticisms that the applicants believe are unfounded. The *Operating Grants Program* at CIHR has two competitions per year (unlike the major grants programs at NSERC and SSHRC that are held once a year), thus the time between receiving a notification of decision and resubmission is a matter of a few months. The Committee appreciates the process at CIHR whereby applicants can submit rebuttals to reviewers' comments with a subsequent application, but it is concerned that CIHR does not have a formal appeal process for its programs.

The Committee notes that some foreign granting agencies (e.g., the Australian Research Council) allow applicants to reply to external referees' comments *before* a funding recommendation is made. It also notes that the Cross Council Research Forum of the U.K. research councils suggests that allowing applicants the "right to reply" to referees' comments should be part of joint, cross-council programs that review interdisciplinary proposals. The Committee encourages the Canadian granting agencies to consider the feasibility of incorporating such a "rejoinder mechanism" in its major granting programs.

The Committee is aware that providing feedback and offering a formal appeal process necessitates substantial effort on the part of the agencies and selection committees, and that there is a financial cost involved in providing such feedback. Nevertheless, the Committee feels that the agencies should make every effort to provide

[42] Data for NSERC's *Research Grants Program* (now called the *Discovery Grants Program*).

[43] Data for SSHRC's *Standard Research Grants Program*.

applicants with as much feedback as possible following a funding recommendation. Since all three agencies are conducting more of their business electronically, the administrative burden and cost of providing feedback may decrease in the future as "e-business" practices become more established and new technologies become available (the Committee recognizes that privacy issues may limit some of the efficiencies that could potentially be realized by providing feedback electronically). The Committee therefore recommends:

RECOMMENDATION 9

That the Government of Canada ensure that the granting agencies release all information on file relevant to a funding recommendation to applicants in addition to the notification of decision. Additionally, a formal appeal process, limited to perceived errors in procedure or fact, should be in place for applicants to all peer-reviewed programs, and a third-party, not the original selection committee, should review appeals of decision.

Peer Review Is Untested

Peer review is often described as being "rigorous" or "a cornerstone of excellence." According to one witness, however, the value of peer review for deciding on the allocation of research funds is taken as an "article of faith," and the system is largely untested:

> *… [W]e see that there is little scientific evidence for the efficacy of peer review in general … Good science means, at the very least, conducting reliable, repeatable scientific research on both consistency of past reviews and the impacts of decisions taken.* [Bryan Poulin, Professor, Lakehead University, 58:09:30]

The witness argued that agency databases should be opened to interested researchers so that these individuals can study whether the system is working, and went on to suggest that:

> *… [Funds] should be more widely distributed until we find out if the peer review system is fatally flawed. If it's fatally flawed, it needs an overhaul.* [Bryan Poulin, Professor, Lakehead University, 58:09:30]

The Committee shares the concerns about the paucity of data on the efficacy and impact of peer review in the Canadian system. It notes, however, that comprehensive studies or reviews of peer review practices have been conducted in such countries as the United States[44] and Australia.[45] One witness suggested that there is a large literature on peer review:

> *In terms of the literature on peer review, it's vast and disaggregated. There's a long history since the funding councils have been around of [studies] regarding the strengths and weaknesses of peer review. Some being based on anecdotal comments, some have been based on studies done at different times and under different circumstances. There are few systematic studies linking grant decision outcome with funding policies. The majority of studies that are actually represented in the literature are not by those who've been involved in the funding councils themselves. They tend to be produced by those who are, like myself, independent researchers.* [Fiona Wood, University of New England, Australia, 79:19:55]

Internal Evaluation of Agency Programs and Practices May Be Insufficient

The Committee believes that the agencies themselves should be doing more to evaluate their programs and practices, including peer review, to ensure that they are efficient, transparent and responsive to the needs of the research community. The Committee notes that internal program evaluation studies are conducted by the agencies, but that the period of time between evaluations is often long (in some cases more than 10 years[46]), even for major funding programs. At present, both the *Discovery Grants Program* at NSERC and the *Operating Grants Program* at CIHR[47] (the two agencies' major research grants programs) are under evaluation.

The Committee points to the evaluation plan proposed by the CIHR as being a good model for internal program evaluation. The agency plans to evaluate all programs on a periodic basis: the aim is to evaluate continuing programs every five years, limited-term strategic programs at the end of their term (normally five years), and partnered programs, which also normally have a term of five years, at the termination of their memorandums of understanding. In addition, the entire organization will be subject to international review every five years, and the performance of individual institutes will be evaluated at the time of the appointment (or renewal) of their scientific directors (every four years).

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[44] D. E. Chubin and E. J. Hackett, *Peerless Science: Peer Review and U.S. Science Policy*, State University of New York Press, Albany, New York, 1990.

[45] F. Q. Wood, *The Peer Review Process*, report commissioned for the National Board of Education, Employment and Training (Australia). Australian Government Publishing Service, Canberra, 1997.

[46] See Appendix 2 for a list of recent major evaluation studies at the three agencies.

[47] The Auditor General recommended that CIHR evaluate its *Operating Grants Program* since it has never been subject to an intensive evaluation.

The Committee suggests that internal examinations of peer review by the agencies can be conducted in isolation and do not have to form part of more intensive program evaluations. For example, the Committee notes that the Director of the National Science Foundation (NSF) in the United States must submit an annual report on the NSF proposal review system. The report provides summary information about levels of proposal and award activity and the process by which proposals are reviewed and awarded. The report is posted on the agency's Web site each year.[48] In other countries, funding agencies (e.g., the Economic and Social Research Council in the United Kingdom) conduct periodic, independent reviews of their peer review processes. The Committee notes that evaluations of peer review practices have occasionally been conducted by the Canadian federal granting agencies (see Appendix 2). As such, the Committee recommends:

RECOMMENDATION 10

That the Government of Canada encourage the granting agencies to engage in more regular internal reviews of their own programs and practices (including peer review), and to periodically examine decision-making processes at other Canadian and foreign agencies to ensure that best practices for the allocation of research funds are in place. The results of these internal evaluations should be easily accessible to the research community and general public.

Peer Reviewer Overload

As mentioned earlier in the report (Chapter Tree), it is often difficult to find qualified, arm's length external referees or selection committee members to evaluate proposals in emerging and interdisciplinary areas because of the small number of researchers working in those areas. Members of these small communities tend to know and work with each other; the Canadian federal agencies all have guidelines intended to prevent a researcher that has a conflict of interest with an applicant from acting as a referee of that applicant's proposals. Because of the relatively small research community in Canada, finding impartial reviewers for more "mainstream" research proposals may be problematic as well. Additionally, the introduction of new, peer-reviewed programs at the federal agencies, government departments and other organizations (e.g., the Canada Foundation for Innovation) has led to an increased demand for peer reviewers, and to a phenomenon termed "peer reviewer fatigue" by some commentators.

The federal granting agencies have tried to reduce the problems associated with a small reviewer pool by calling on international reviewers to participate in the review process:

[48] *Report to the National Science Board on the National Science Foundation's Merit Review System Fiscal Year 2000*, http://www.nsf.gov/nsb/documents/2001/nsb0136/nsb0136.pdf

> *The potential for peer fatigue is quite critical. It's particularly true in a country like Canada, compared to the States, where there are a limited number of qualified experts who can serve on review panels. Countries such as Sweden, Australia, and New Zealand make substantial use of international experts to ensure the independence of their review processes and to counteract peer fatigue. Certainly, I'm aware of international experts participating in Canadian reviews, and I think that's an increasing trend.* [Alan Winter, President and CEO, New Media Innovation Centre and Council of Science and Technology Advisors, 55:09:35]

The agencies also limit the number of times any one individual can be called on by an agency program to act as an external referee. However, since granting agencies around the world are experiencing the same problems, other solutions to reduce overload on reviewers are probably required. One option being employed by some agencies is offering some form of incentive to reward reviewers or their universities:

> *Peer reviewers in the past have tended not to be paid, so it's interesting to note that a number of funding councils are moving much more towards the idea of paying for the reviews that they receive. The EPSRC [Engineering and Physical Sciences Research Council] in the U.K. is a good example of this. The concern is basically driven by the perception of overload on reviewers so the idea is in fact, given their competing demands on the time of the best reviewers that an incentive needs to be provided to ensure that there is a value placed on the reviews that are received.* [Fiona Wood, University of New England, Australia, 79:19:55]

In EPSRC's "Referees' Incentive Scheme," which began as a three-year pilot project in 2001, university departments earn points for "useful" referee reports returned on time to EPSRC by researchers. In December of each year, beginning in 2002, points accumulated by departments over the preceding academic year will be translated into a share of the scheme fund, which stands at £750,000 (approximately $1.7 million) for the first year. These funds will be paid centrally to institutions on behalf of departments, and heads of department can use the monies for any purpose that EPSRC would normally consider to be legitimate expenditure on a grant. Other granting agencies also use some form of payment to recognize and reward the work of reviewers. In Canada, for example, the Alberta Heritage Foundation for Medical Research offers payment to external referees for reviews:

> *I should point out that because we work outside the province, in other words we're pulling in our reviewers from around the world, there's really no reason for them to help Alberta, other than altruism, and altruism only goes so far. So we actually pay for this, which adds to the cost of our peer review system, but I think it increases the quality, because we are pulling in an international opinion.* [Matthew Spence, President and Chief Executive Officer, Alberta Heritage Foundation for Medical Research, 66:10:50]

The three federal granting agencies generally offer no compensation to peer reviewers. Members of selection committees receive payment only for expenses incurred to attend committee meetings.

An informal survey on the topic of "peer reviewer fatigue" by NSERC in 2000 suggests that, at present, it may not be a major problem.[49] The Committee appreciates the difficulties associated with finding individuals to act as referees for grant applications. It notes, however, that the federal agencies are augmenting the amount of business that they conduct electronically, and that one of the stated goals of "e-business" is to reduce the workload for peer reviewers. Given the considerable expense involved in offering some form of payment for referee reports, and that peer reviewer workload does not seem to be unmanageable at present, the Committee is reluctant at this time to make a recommendation that focuses on payment of referees. Instead, the Committee encourages the agencies to continue with their efforts to find other ways to reduce the workload associated with peer review that would not involve large increases to their administrative budgets. Other options, including payment of referees, may have to be considered if these efforts do not have the desired result or if the workload linked to peer review continues to increase.

Outcomes and Impact of Research Are Not Adequately Measured and Reported

The Committee is concerned that the Canadian federal granting agencies do not put enough effort into measuring and communicating the outputs, outcomes and impacts[50] of federally funded research programs. Funding agencies around the world are being asked to better measure and report on the outputs, outcomes and impacts of funding. The under-reporting of output measures by granting agencies may be related to several "disincentives" for reporting on performance:

> *For high-risk research but even for less risky research, there will be many instances where the original research objectives were not met. Some oversight organizations could view this as failure. In addition, bibliometric studies have shown that … seminal research is produced by relatively few performers. That is independent of whether the metric is the number of papers you produce, the number of patents, the number of citations, or whatever, especially for outputs. They are the quantification of the near-term products. Why would organizations be motivated to show the concentration of productivity in a relatively small number of performers?* [Ronald N. Kostoff, 88:11:10]

A form of "performance monitoring" is undertaken by the Canadian granting agencies through the annual Departmental Performance Reports tabled in Parliament. Since 2001, these reports are supposed to place more emphasis on linking resources to outcomes (i.e., benefits to Canadians), rather than reporting largely on departmental activities. Performance monitoring is also undertaken internally by the agencies through irregular evaluations of individual programs. In addition, independent performance audits

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[49] *NSERC Contact*, Fall 2000, Vol. 25, No. 3, http://www.nserc.ca/pubs/contact/v25_n3_e.pdf

[50] Output = the direct result of program activities; outcome = accomplishment of program objectives attributable to program outputs; and impact = broad (often long-range) social, economic or environmental results of a research program. Definitions adapted from categories discussed in the U. S. *Government Performance and Results Act of 1993*.

(as well as financial and compliance audits) are conducted for Parliament by the Office of the Auditor General, which periodically assesses the "value for money" of some of the agencies' programs.

At the level of the individual applicant, peer review evaluates the outputs and outcomes (but rarely the impact) of past research funding provided by the agency. At the level of the agency, other measures and types of performance evaluation are necessary. There are different sorts of measures, whose utility varies according to the type of research and discipline involved, that can be used as indicators of agency performance. Bibliometrics, the study of the quantitative data of the publication patterns of individual articles, journals, and books in order to analyze trends and make comparisons within a body of literature,[51] is used by some researchers and a few agencies to measure the outputs, outcomes and impacts of research programs. In bibliometrics, counts of numbers of publications are taken as a measure of research output, and citation data (the number of times a paper is cited in the literature) are used to measure impact. Bibliometrics can be used to monitor or evaluate a group's (e.g., an institution, agency or country) research productivity and impact. The Director of a Canadian organization that conducts bibliometric studies as part of its activities, informed the Committee that, in terms of program evaluation:

> *CIHR has asked us in the last year to evaluate their granting programs … everything [from] the scientific production [to] the quality of the papers published by the researchers who have received grants. This is the first time that CIHR asked us, and the other Councils do so, I would say, quite sporadically.* [Benoît Godin, Observatoire des sciences et des technologies, 66:09:25]

The Committee recognizes that for program evaluation purposes, the data produced from bibliometric studies should not be taken at face value nor used in isolation, since there are problems associated with such data.[52] For research with commercial potential or purpose, other measures (e.g., the number of patents and licences issued, the production of spin-off companies etc.) related to the economic impact of the research can be examined instead of, or in addition to, traditional bibliometric indicators to assess the impact of research. Some critics argue that measuring the impact of research in the humanities and social sciences is difficult, if not impossible, to do, and that performance indicators are suited more to measuring the impact of research in the applied sciences and technology. The design and utility of performance indicators for the social sciences is currently a major subject of debate in that community. Despite the difficulties in measuring the impact of research in the social sciences, one witness suggested that efforts in designing and using performance indicators should be stepped up:

> *Twenty years ago, there was an interest in impact measurement. But it seems as though what is being said is that it is too difficult to measure. The task requires*

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[51] ISI (formerly the Institute for Scientific Information) definition, http://www.isinet.com/isi/search/glossary/index.html#B.

[52] R. Barré, "Sense and nonsense of S&T productivity indicators," *Science and Public Policy*, Vol. 28, August 2001, p. 259-66.

> *instruments that do not exist and there certainly are major methodological challenges. It is certainly not easy to measure the social or cultural impact of scientific activities, but it is our belief that a community effort, probably supported by government programs, should be made with regard to this important issue of the measurement of non-scientific impacts of … science and technology.* [Benoît Godin, Observatoire des sciences et des technologies, 66:09:50]

The Committee notes that NSERC did provide some quantification (via bibliometrics, and numbers of patents, licences and spin-off companies produced from NSERC sponsored research) of the outcomes and impact of agency funded research in its *2000-01 Departmental Performance Report*;[53] many of the figures provided refer to the nation's performance, thus the exact contributions of NSERC funded research to these figures and the impact of particular programs is difficult to ascertain. The Departmental Performance Reports produced by SSHRC and CIHR for the same year provide fewer quantitative data, and, in the case of SSHRC, less concrete qualitative information on the link between funding provided and the outcomes and impacts of that funding. The Committee notes that SSHRC plans to introduce a "Final Research Report" form that grantees will be required to complete at the end of each granting period. The form will capture data on such measures as research productivity, knowledge dissemination and transfer, training, international collaboration, and leveraging of financial resources. The information collected from these reports will allow SSHRC to better track the outputs of its research programs. The report will be tested as a pilot project in the late spring of 2002, and SSHRC plans to officially launch the report in late June 2002. Such final report forms are used by certain foreign agencies (e.g., the Economic and Social Research Council in the United Kingdom).

The agencies suggest that measuring the outcomes or impact of some types of research is difficult since there are often long gaps between funding a research project or program and witnessing the socio-economic impact of that research. The Committee appreciates this issue, but it notes that in that case, the agencies should place more effort into long-term evaluations of the impact of their overall research programs through "retrospective analysis," in addition to more short-term monitoring efforts. One witness argued that in addition to the time lag problem associated with measuring outcomes, there is also a problem associated with tracking the outputs and outcomes over time:

> *For science and technology, tracking this output data over long periods of time is difficult. … Research gets conducted in a given organization. It evolves into technology development. That may be conducted in another organization, [and] … may be sponsored by another sponsor. … It keeps going like that to eventual application … The point is, it is very difficult to track research that was sponsored and performed by organizations initially and track them into eventual applications.* [Ronald N. Kostoff, 88:11:10]

[53] The report is accessible electronically from the Treasury Board of Canada Secretariat web site: http://www.tbs-sct.gc.ca/rma/dpr/00-01/NSERC00dpre.pdf

The Committee recognizes the difficulties associated with assessing the outcomes and impacts of agency funded research, especially in areas such as the social sciences and humanities. However, it believes that the granting agencies should do as much as possible to link budget with performance, and to better explain the economic, societal or environmental impact of research that they fund. Reporting on the qualitative and quantitative outputs, outcomes and impacts of agency-supported research should form part of Departmental Performance Reports, internal program evaluations, and material for public relations. The agencies have a responsibility to provide evidence to the government and taxpayer that there is "value for money" in the relatively large investments made by the government in the agencies. Such reports could also serve a role in helping the agencies to decide the research areas where funds should be allocated in the future. The Committee commends efforts made by the agencies to improve performance monitoring, but believes that they can do more in this regard. To that end, the Committee recommends:

RECOMMENDATION 11

That the Government of Canada ensure that the federal granting agencies take steps to better measure and report on the outcomes and, where possible, impacts of their research programs for the benefit of the general public.

Alternatives to Peer Review

The Committee heard evidence that peer review is the most efficient system available for determining the allocation of federal research funds. Some witnesses indicated that without peer review, science of inferior quality might be supported by the granting agencies:

> *An absence of peer review or ever watered down peer review may result in mediocre science, waste of resources, and in the long term, poor policy decisions. And some of my international colleagues have in fact reflected on this absence of peer review in certain areas of science and the problems it's created.* [Peter Johnson, Chair, Canadian Polar Commission, 75:09:15]

However, the Committee also heard the opinion that the peer-review process needs to be improved, or even overhauled. A variety of alternatives to peer review have been proposed in recent years, including such mechanisms as productivity-based formula funding, bibliometrics, cash prizes, lottery, block grants to universities (where decision-making is transferred from research funding agencies to universities), discretionary (or "pork barrel") funding, and bicameral review. Three of the leading alternatives, which were discussed during the Committee's hearings, are considered in more detail here.

Bibliometrics

Some researchers suggest that bibliometrics, either through the analysis of citation data or "journal impact factors" (a measure of the average number of citations earned by the papers that each journal contains), could be used as a supplement to the peer-review process:

> *The other way bibliometrics can be useful is to aid peers in their decision to fund research. I would add that it does not replace peers' judgment, but it can be used as a tool to help researchers, because bibliometrics can aid researchers in telling them what is the quality of the journals they evaluate in which researchers publish.* [Benoît Godin, Observatoire des sciences et des technologies, 66:09:25]

Using journal impact factors as an information tool to assess and compare the quality of an individual's publishing record is a controversial issue since the impact factors were not designed to evaluate the work of individuals.[54] Additionally, extra cost and time is introduced when bibliometrics becomes a part of the evaluation process:

> *Also, once we start using bibliometrics information as an explicit part of the process, then you actually have to start commitment funding to obtaining that information, ensuring its accurate and reliable, ensuring that the way it's actually used by, for example, your review panel, it's consistent across panels, documenting where there are problems, how you approach those problems and resolve them. So it's an order of complexity that's probably beyond a number of funding agencies at this time.* [Fiona Wood, University of New England, Australia, 79:20:20]

In 1999, the Medical Research Council (MRC) in the United Kingdom launched a pilot study to examine the feasibility of incorporating bibliometrics into its peer review process. The pilot study found that there was a good correlation between the results of bibliometric assessment and conventional peer review of past progress. However, the correlation of bibliometric assessments with the final award decision was quite low. The MRC concluded that bibliometrics should not be used routinely as part of the Council's evaluation procedures since the costs and extra review time needed to use the data properly would not be justified by the benefits offered.[55] The inclusion of bibliometric data as part of the peer-review process has been adopted by the Wellcome Trust, the world's largest medical research charity. The Trust's neuroscience panel (annual budget of approximately £20 million or about $45 million) uses modified journal impact factors, citation analysis and paper counts, to help panel members judge the scientific record of applicants. These data are not used in isolation, and in fact, applicants judged to have excellent track records have been turned down for funding for other reasons (e.g., a poor research proposal).[56] The Committee encourages the Canadian granting agencies to

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[54] D. Adam, The Counting House, *Nature*, Vol. 415, February 2002, p. 726-29.

[55] See *MRC Bibliometric Analyses Pilot Study, 1999*, http://www.mrc.ac.uk/index/funding/funding-specific_schemes/funding-evaluation_of_schemes/funding-bibliometric_analyses_pilot_study.htm

[56] G. Lewison, R. Cottrell and D. Dixon, "Bibliometric indicators to assist the peer review process in grant decisions," *Research Evaluation*, Vol. 8, April 1999, p. 47-52.

explore the value and practicality of incorporating bibliometric measures into its peer-review processes.

Bicameral Review

One witness told the Committee that the present system for allocating research funds is completely flawed, and presented some anecdotal evidence to support his claim. The witness presented a proposal for an alternative peer review system, called "bicameral review":

> *It might be thought that current peer review procedures, despite their flaws, are better than simply allocating funds by tossing a coin. But coin tossing at least gives excellence a fighting change. In fact, the current system is worse than coin tossing since it actively selects against excellence … Under bicameral review the first decision is made by the committee of peers, who only review the applicant's track record, not the applicant's proposed project. The second decision is made in-house by specialists in the funding agency, who with respect to budget justification only review the applicant's proposed project, not the applicant's track record.* [Donald Forsdyke, Professor, Queen's University, 58:09:50]

Under the system proposed by the witness, track record is assessed as a ratio of achievement to funds received by the peer review committee. The agency takes the applicant ratings provided by the peer-review committees and then decides what funds the applicant needs. Funds are allocated on a sliding scale: applicants at the top of the scale get 100% of what they are deemed to need, and applicants just below the top receive a lower proportion of funds. This allocation method progresses to the bottom of the scale, where the applicant may receive only 10% of what he or she needs.

Productivity-based Formula Funding

This alternative to peer review is based on the assumption that past success is the best predictor of future performance. Productivity-based formula funding proposes that researchers be funded based on their track records. Under such a system, funds would be allocated according to an algorithm (i.e., dollars awarded would be proportional to some weighted sum of numbers of publications, numbers of advanced degrees awarded, etc.).

One witness pointed out that there are strong similarities between bicameral review and productivity-based formula funding:

> *These two alternatives place heavy emphasis on awards to established researchers with strong track records, although they differ in how the track records would be determined. Both minimize the use of true technical experts in the evaluation of the prospective portion of the proposed research.* [Ronald Kostoff, 88:10:10]

The witness went on to suggest that since traditional peer review also places heavy emphasis on the track record of the performer(s) in reaching a funding recommendation, the two proposed alternatives are, in practice, fairly similar to standard peer review methods. The major difference is the absence of technical experts to evaluate the proposed research described in grant applications.

The Committee welcomes concrete suggestions for changes to the system for the allocation of federal research funds. It has some concerns, however, about the bicameral review and productivity-based formula funding proposals. First, the lack of evaluation of the quality and feasibility of the proposed research itself by an expert panel is worrisome, especially in the context of project- (vs. program) based proposals. Second, the idea of giving money to every applicant under the bicameral review system is a concern given that funds are scarce, and funds would be channelled from applicants ranked highly by the initial review panel to lower-ranked applicants. The Committee does not believe that this method is an efficient or wise way to allocate taxpayers' money. Nevertheless, the Committee encourages the agencies to review these and other proposed alternatives (or enhancements) to peer review when conducting internal evaluations of peer review (see recommendation 10).

Although many alternatives to peer review have been proposed, most members of the research community do not consider that these alternatives could entirely replace peer review since many of them lack an arm's length, "quality assurance" component. Rather, the general consensus is that peer review can be fine-tuned but not replaced:

> *There really aren't alternatives to what funding agencies are using by way of obtaining scientific expertise for their decision-making. It's really things like whether or not bibliometrics has a role to play in funding agencies in helping with the process.* [Fiona Wood, University of New England, Australia, 79:20:20]

> *My bottom line is that while peer review has its imperfections and limitations, there is little evidence that the best researchers and ideas are going without funding and far less evidence that the alternatives described above would improve the situation.* [Ronald Kostoff, 88:10:10]

The Committee concurs and believes that peer review is the most efficient method for determining the allocation of federal research funds. However the system can and should be improved. Regular reviews and refinements of peer review practices by the agencies themselves are critical to ensuring that the system for the allocation of federal research funds is efficient, transparent and responsive to the changing needs of the research community and other stakeholders.

CONCLUSION

After hearing from a number of witnesses representing various interests in the research community, the Committee believes that the mechanisms used to allocate research funds by the three federal granting agencies are, for the most part, efficient. Evidence the Committee heard, and data it collected on the nationwide distribution of granting agency funds, indicated that there are regional differences in the success rates of researchers in obtaining research funds and in the average size of grants received. Such differences were also noted in relation to the size of institutions, with researchers from larger institutions generally having a higher success rate in obtaining federal research funds and receiving larger grants, on average, than researchers from small institutions. The Committee believes that regional differences in success rates and funding levels likely reflect the relatively large number of small universities and low levels of value-added industrial activity and/or provincial investment in R&D in certain regions of the country. Researchers at small universities face barriers such as high teaching loads and small graduate programs that reduce their capacity to conduct research relative to their large university counterparts.

Based on the evidence heard, the Committee is of the opinion that the best way to address some of the regional differences in success rates and grant levels in granting agency competitions is to first address differences in research capacity at institutions across the country, not to change the decision-making processes for the allocation of funds at the granting agencies. The Committee's recommendations for the government to establish a permanent program for the support of the indirect costs of federally supported research, and to provide programs targeted to building research capacity at small or regional universities aim to "level the playing field" for researchers competing in open competitions at the granting agencies. Furthermore, the Committee encourages the granting agencies to review their funding mechanisms to ensure that researchers from these institutions participate actively in decision-making processes, and that, as far as possible, the peer-review process takes into account the difficulties faced by researchers at these institutions. The Committee also believes that low overall funding levels to the federal granting agencies have contributed to the generally low success rates and/or grant sizes for researchers from small and regional institutions. The Committee recommends that the government act quickly on the *Innovation Strategy*'s commitment to increase funding levels to the granting agencies, especially to SSHRC.

Although the Committee is convinced that the excellence of the investigator(s) and the proposed research should remain the primary criterion in peer review for selecting research proposals for funding, it believes that other selection criteria, such as the relevance of the research to target areas of national importance, are also very important in many cases. The agencies should carefully examine whether research in areas of national importance is receiving the attention it deserves. The Committee recommends that the agencies work together better to ensure that strategic, emerging and interdisciplinary research that crosses the boundaries of granting agency mandates is

properly supported. Furthermore, the Committee recommends that the agencies establish a formal mechanism to facilitate collaboration on all levels so that the research community can have seamless access to federal research funds in Canada. The Committee also recommends that the federal government examine the ways it sets S&T policy and decides on funding priorities. It believes that a stronger, more co-ordinated S&T governance framework, that could include a Chief Scientific Adviser and/or a science advisory body that reports to Parliament, would ensure that research in target areas of national importance, as well as other types of research, receives appropriate levels of funding.

The Committee is of the opinion that other players in Canada's innovation framework may not be receiving the attention that they deserve from the federal granting agencies. Although all three agencies have core programs to support the training of highly qualified personnel, low overall funding levels to the agencies translate into relatively low success rates and stipend levels for most training programs. The Committee recommends that the government increase funding levels to the granting agencies so that they can correct these deficiencies. Another group of researchers that the Committee feels is undervalued by the granting agencies is college researchers. This group is beginning to contribute more and more to the development and technology transfer end of the innovation continuum. In recognition of this contribution, the Committee recommends that the government establish separate funding programs, through the granting agencies and/or other government bodies, to support the work of college researchers. The Committee believes that the granting agencies should continue to encourage college researchers to participate in their programs, but it feels that this group of researchers also requires separate funding programs whose excellence-based selection criteria reflect the special situation faced by researchers in the college environment.

The Committee supports the practice of peer review as a mechanism for determining the allocation of federal research funds, but it believes that a number of improvements can be made to the system. The Committee's recommendations include making improvements to feedback or appeal mechanisms for applicants, and requiring the agencies to engage in more regular reviews and refinements of their peer-review processes and practices in general. Finally, the Committee believes that although it is important to examine the mechanisms employed by the agencies for the allocation of federal research funds, more effort should be placed into examining the outcomes and impacts of federally funded research. The Committee makes a recommendation to the government that it ensure that the granting agencies take steps to better measure these outcomes. This information would help the agencies decide on research areas that should receive special consideration for funding, and would present the government and public with a clear idea of the "value for money" of these granting programs.

APPENDIX 1

Gross Domestic Expenditures on R&D (GERD) as a Percentage of Gross Domestic Product for Selected OECD Countries[1]

Country	1991	1992	1993	1994	1995	1996	1997	1998	1999
Canada	1.58	1.63	1.68	1.74	1.71	1.67	1.67	1.67	1.77
France	2.41	2.42	2.40	2.34	2.31	2.30	2.22	2.18	2.17
Germany	2.61	2.48	2.37	2.26	2.26	2.26	2.29	2.31	2.44
Italy	1.24	1.20	1.13	1.05	1.00	1.01	0.99	1.02	1.04
Japan[2]	3.00	2.95	2.88	2.84	2.98	2.83	2.90	3.04	3.04
Sweden	2.89		3.27		3.46		3.67		3.80
U.K.[3]	2.11	2.13	2.12	2.07	1.98	1.91	1.84	1.83	1.87
U.S.A[4]	2.81	2.74	2.62	2.42	2.50	2.54	2.57	2.60	2.64

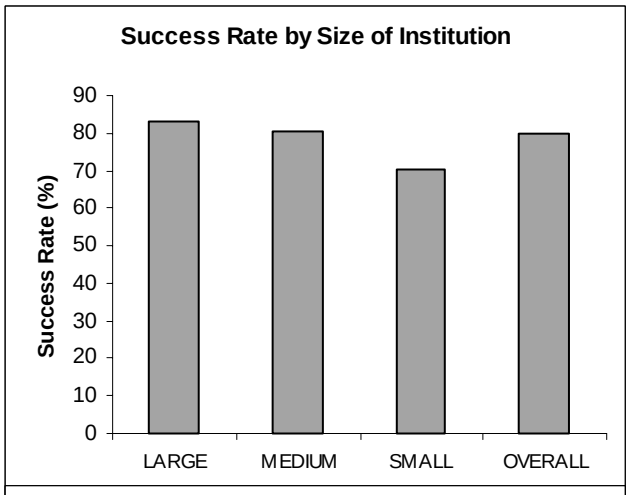
1 Statistics Canada, *Service Bulletin Science Statistics*, Vol. 25, No. 8, November 2001 (*Source: Main Science and Techhnology indicators*, No. 1, DSTI, OECD, 2001).

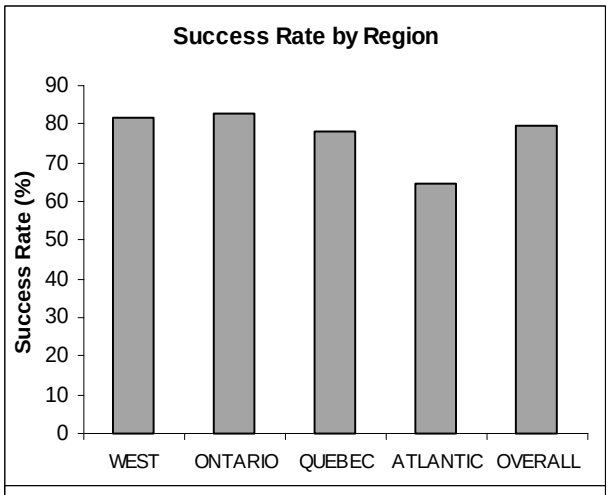
2 Overestimated or based on overestimated data

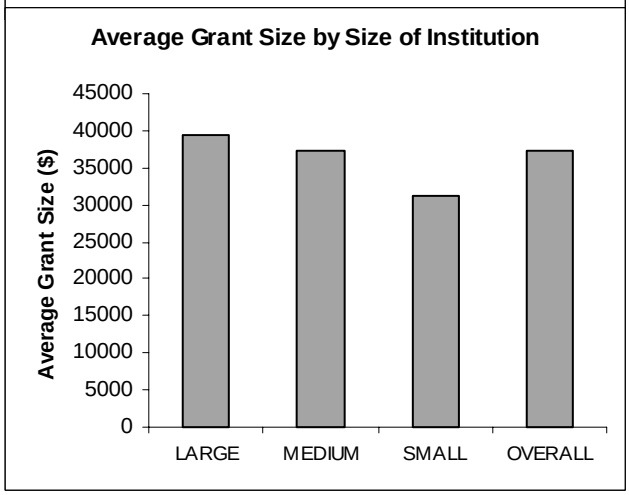
3 Underestimated or based on underestimed data

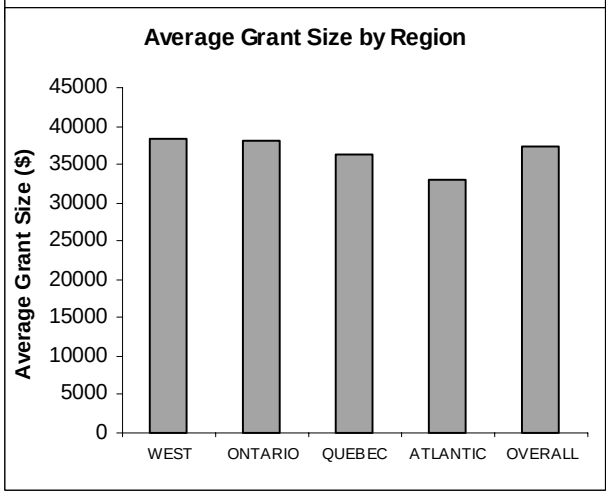
4 Excludes most or all capital expenditure

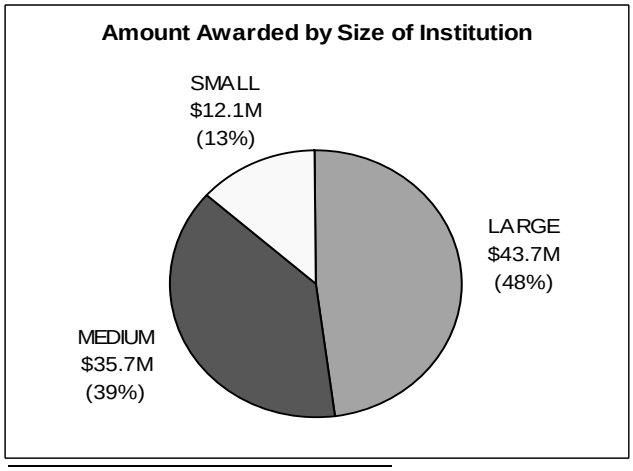
APPENDIX 2A — Success Rates and Average Annual Grant Size for NSERC Applicants (Competition Year 2001[1])

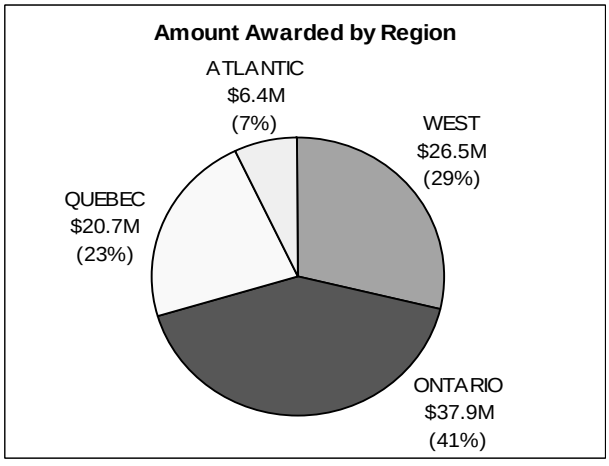






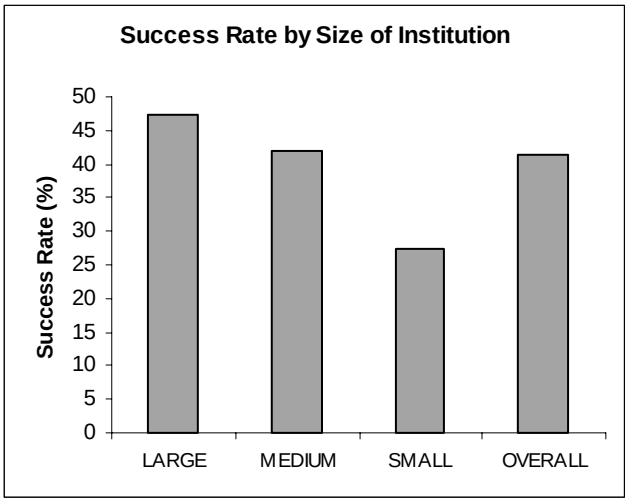


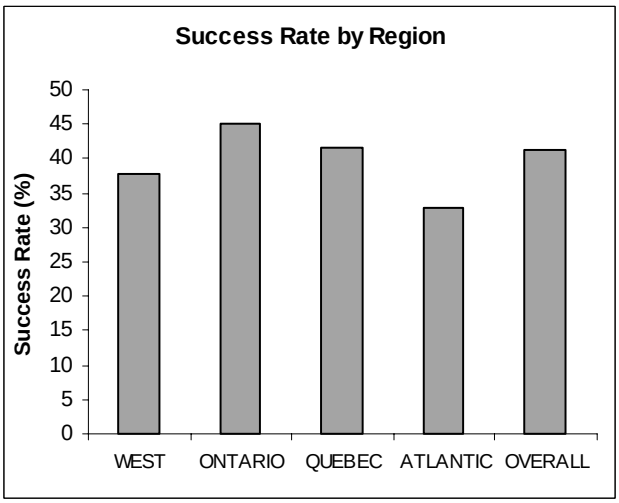


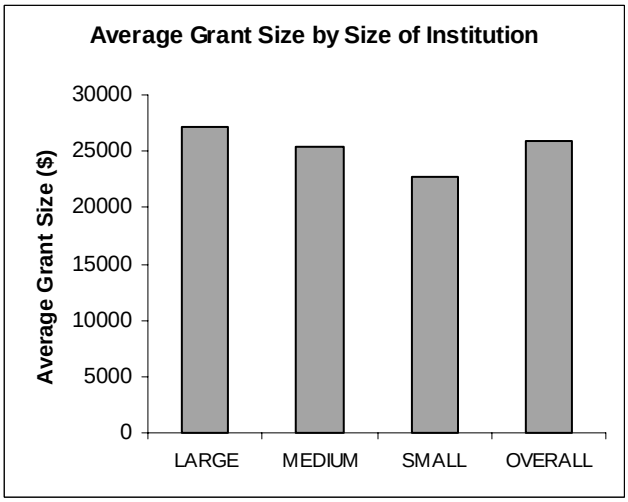


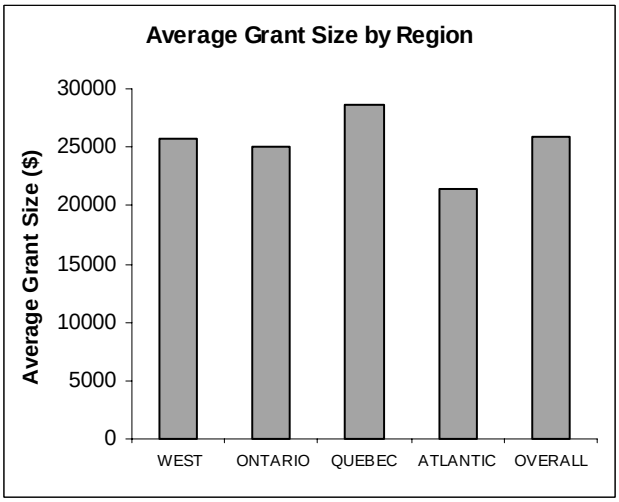
[1] Raw data supplied by NSERC for its *Research Grants Program.*

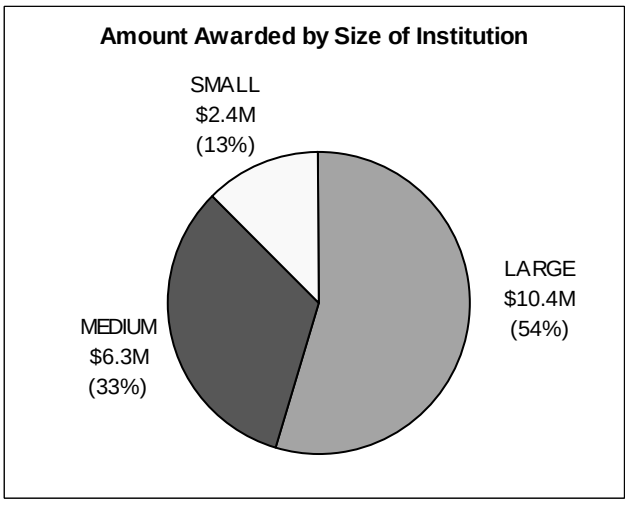
APPENDIX 2B — Success Rates and Average Annual Grant Size for SSHRC Applicants (Competition Year 2001[2])

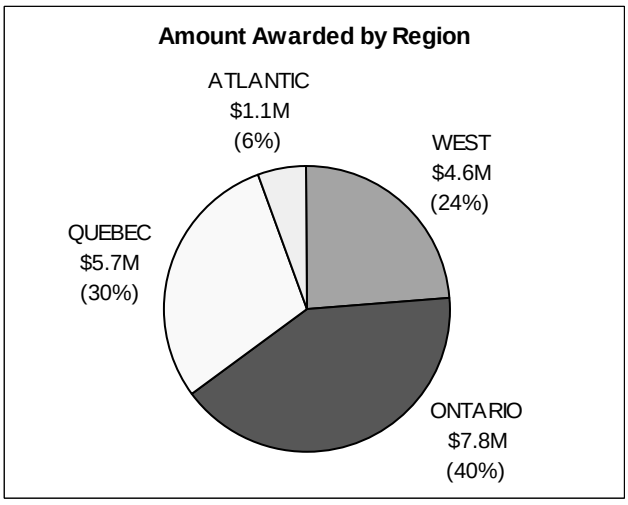






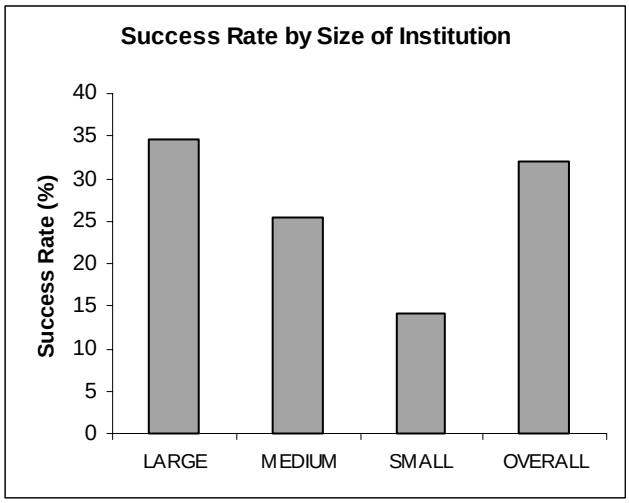


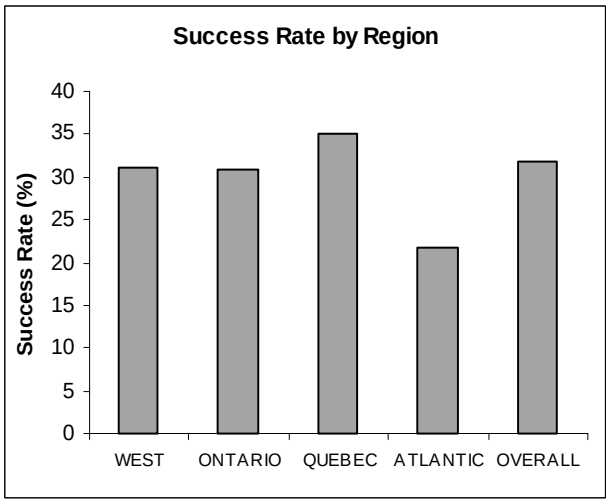


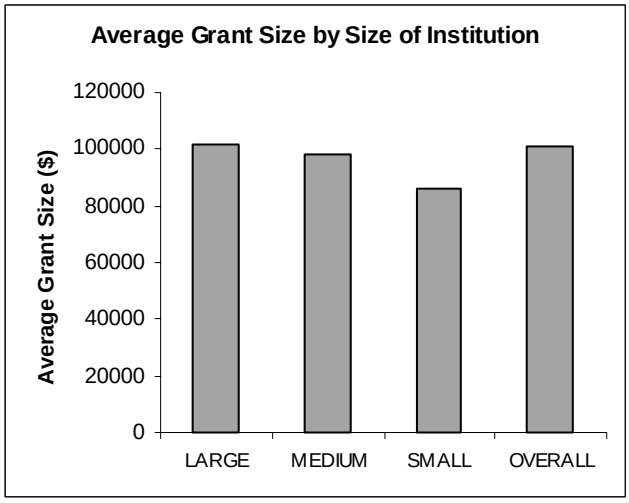


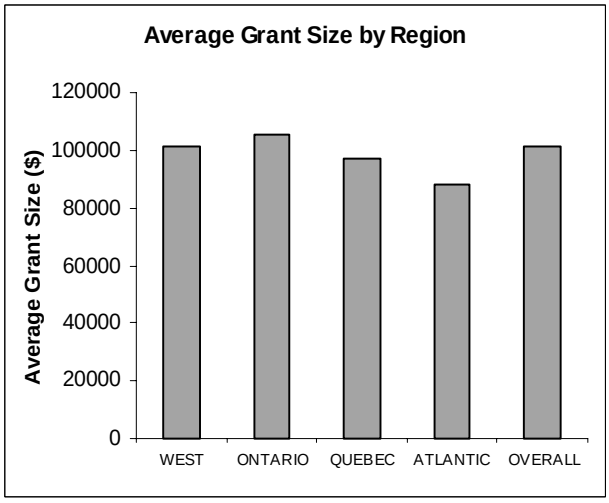
[2] Raw data supplied by SSHRC for its *Standard Research Grants Program.*

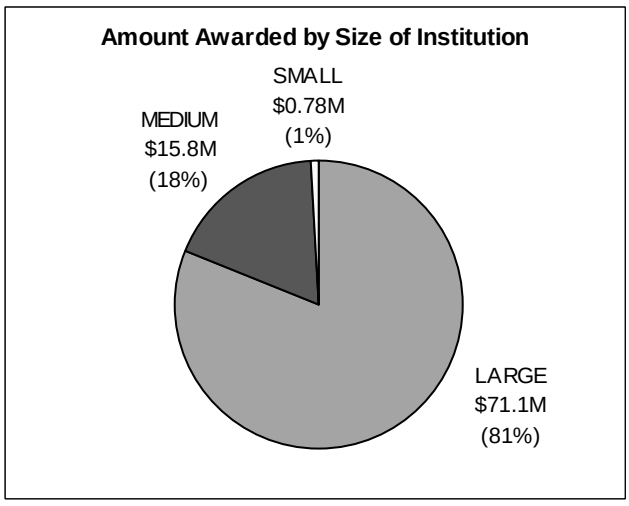
APPENDIX 2C — Success Rates and Average Annual Grant Size for CIHR Applicants (Competition Year 2001[3])

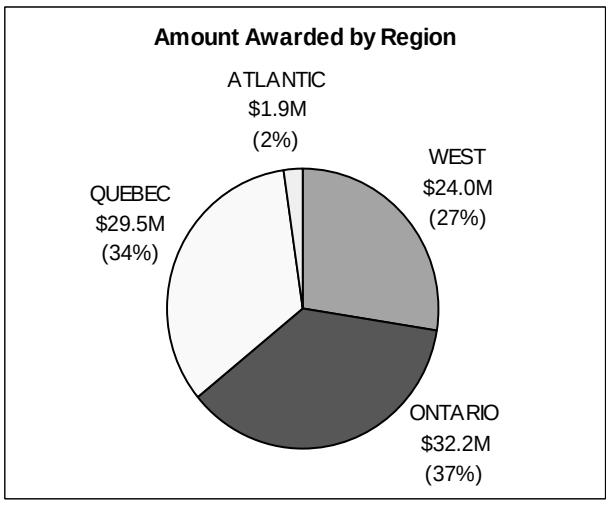












[3] Raw data supplied by CIHR for its *Operating Grants Program.*

Appendix 2D – List of Universities by Region and by Size[4] of Institution

	Region			
Size	**West**	**Ontario**	**Quebec**	**Atlantic**
Large	UBC Alberta Calgary Manitoba	Toronto Western York	Laval McGill Montreal	
Medium	Saskatchewan Simon Fraser Victoria	McMaster Ottawa Waterloo Queen's Guelph Carleton Ryerson	UQAM Sherbrooke Concordia	Dalhousie Memorial New Brunswick
Small	Regina Lethbridge Winnipeg Brandon Northern BC Trinity Western Augustana Univ.Coll. Canadian Bible Coll. Athabasca Univ. Coll. Cariboo Coll. U. St. Boniface Univ. Coll. Fraser Valley Luther College Malaspina Univ. Coll. Okanagan Univ. Coll. Regent College Royal Roads Tech. U. of B.C.	Windsor Brock Wilfrid Laurier Laurentian Lakehead Trent RMC Nipissing King's College Huron College Redeemer College St. Jerome's Coll. Dominican Brescia College Sudbury St. Michael's Coll. Victoria (U. of T.) Wycliffe Coll. Saint Paul	UQTR UQAC École Polytechnique UQAR EHEC UQAH INRS Bishop's École tech. sup. UQAT TELUQ ENAP	Moncton Saint Mary's St. Francis Xavier Acadia PEI Mount St. Vincent Mount Allison Univ. Coll. Cape Breton St. Thomas NS Ag. College Univ. of King's Coll. (NS)

[4] Size of institution: Small = 0-499 faculty members; medium = 500-999 faculty members; and large = greater than 1000 faculty members; data on faculty numbers are from 1999 (most recent figures available) and were provided by the Association of Universities and Colleges of Canada.

APPENDIX 3

APPENDIX 3A — Recent Evaluation Studies and Reviews at NSERC[1]

Program Evaluation Studies	Year of Report
Discovery Grants Program (formerly Research Grants) — Phase II (Evaluation)	On-going 2001/2002
Discovery Grants Program (formerly Research Grants) — Phase I (Design)	2000
Strategic Projects Program (formerly Strategic Projects Grants)	1999
Technology Partnerships Program	1998
Women's Faculty Awards Program	1997
University-Government Program	1994
Scholarships and Fellowships Programs (PGS, PDF, USRA)	1993
Follow-up to Research Partnerships	1992
Special Microelectronics Fund	1991
Research Partnerships Programs (IRC, CRP, CRD)	1991
Research Tools and Instrument Grants (formerly Equipment Grants)	1990
Strategic Projects Grants	1988
Canadian Microelectronics Corporation	1988
Discovery Grants Program (formerly Operating Grants) and Steacie Fellowships Program	1986
Scholarships and Fellowships Programs (PGS, PDF, USRA)	1985
Pre-evaluation/Framework Study	
Discovery Grants Program (formerly Research Grants)	1999
Technology Partnerships Program (framework)	1995
Scholarships and Fellowships Programs (PGS, PDF, USRA)	1991
Research Partnerships Programs (IRC, CRP, CRD)	1990
Research Tools and Instrument Grants	1989
Strategic Projects Grants	1987
Discovery Grants Program (formerly Operating Grants)	1985
Joint Evaluation Studies (Tri-Council/Departmental)	
Chairs in the Management of Technological Change	On-going 2001/2002
Networks of Centres of Excellence Program	On-going 2001/2002
Canada Research Chairs	On-going 2002
Networks of Centres of Excellence Program — Phase II	1997
Eco-research Program	1995
Canadian Genome Analysis and Technology Program	1995
Networks of Centres of Excellence Program (Interim Evaluation)	1993
Networks of Centres of Excellence Program - Phase I (Evaluation Assessment)	1992
Matching Funds	1989
Other Studies	
Results-based Accountability Framework for Research Partnerships Programs	On-going 2002
Grants Adjudication Analysis (peer review)	1994

[1] Data supplied by NSERC.

APPENDIX 3B — Recent Evaluation Studies and Review Activities at SSHRC[2]

Program Evaluation Studies	Year of Report
Immigration and the Metropolis Joint Initiative	2001
Women and Change Strategic Theme Program	2000
Review of SIGs and Aid to Small Universities programs	2000
Health Promotion Joint Initiative	1998
Strategic Grants Program	1996
General Research Grants Program	1995
Postdoctoral Fellowships Program	1994
Dissemination Programs Cluster	1994
Support to Specialized Research Collections and Fleeting Opportunities	1994
Strategic Theme: Education and Work in a Changing Society	1993
International Summer Institutes Pilot Program	1993
Joint Initiative: Aboriginal Affairs	1992
Strategic Theme: Women and Work	1992
Doctoral Fellowships Program	1991
Major Grants Program	1991
Aid to Scholarly Publications Program	1991
Canadian Studies Research Tools Program	1991
Aid to Small Universities Program	1989
Research in Priority Areas (Thematic Research)	1989
Joint Evaluation Studies (Tri-Council/Departmental)	
Networks of Centres of Excellence	On-going 2001/2002
Canada Research Chairs	On-going 2002
Chairs in the Management of Technological Change	2002
Networks of Centres of Excellence Program — Phase 2	1997
Networks of Centres of Excellence Program — Interim Evaluation	1993
Other Studies	
Review of SSHRC's Research Time Stipend Policy	2002
Peer review — Research Grants Program (Gaskell Report)	1999
Peer review — Research Grants Program	1995
Peer review — Strategic Grants Program	1994
Peer review — Doctoral Fellowships Program	1993
Peer review — Research Grants Program	1992
Peer review — Research Grants Program	1991
Needs & Priorities Study for Reorientation of the Evaluation Function	1991

[2] Data supplied by SSHRC.

APPENDIX 3C — Recent Evaluation Studies and Activities at MRC and CIHR[3]

Program Evaluation Studies	Year of Report
CIHR Operating Grants Program	On-going 2002
MRC-PMAC Health Program	1999
International Review of the MRC	1996
NHRDP-MRC Joint Program for the Development of Research in Nursing	1993
Pre-evaluation/Framework Study	
Rx&D-CIHR Research Program	2002
CIHR Operating Grants Program	2002
CIHR Performance Measurement Framework	2001
MRC Performance Indicators Framework	1997
Joint Evaluation Studies (Tri-Council/Departmental)	
Networks of Centres of Excellence Program	On-going 2001/2002
Canada Research Chairs Program	On-going 2002
Networks of Centres of Excellence Program - Phase 2	1997
Canadian Genome Analysis and Technology Program	1996
Canadian Breast Cancer Research Initiative	1996
Eco-research Program	1996
Networks of Centres of Excellence Program (Interim Evaluation)	1993
Other Studies	
Stakeholder Satisfaction Surveys - Service Improvement Initiative	2002
CIHR Performance Measurement Strategy	2002
CIHR Planning Reporting and Accountability Structure	2001
System for selecting MRC Doctoral Research Awards recipients	1996
Review of a Study of Journal Impact Scores for Selected Groups of MRC Grant Applicants	1997
Performance Indicators for the Technology Partnerships Program	1995
Maintaining the Momentum, Health Research as a Growth Sector in the Canadian Economy. Input to Program Review	1994

[3] Data supplied by CIHR.

APPENDIX 4 — WITNESSES

Organizations	Appeared	Meeting No.
Advisory Council on Science and Technology	22/11/2001	55
Jacquelyn Thayer Scott, President and Vice-Chancellor, University College of Cape Breton		
Alberta Heritage Foundation for Medical Research	07/02/2002	66
Matthew Spence, President and Chief Executive Officer		
Association of Canadian Community Colleges	25/10/2001	43
Gerald Brown, President and Chief Executive Officer		
Association of Universities and Colleges of Canada	08/11/2001	51
Robert J. Giroux, President and Chief Executive Officer		
David Barnard, President, University of Regina		
Paul Davenport, President, University of Western Ontario		
Bonnie Patterson, President, Trent University		
Tom Traves, President, Dalhousie University		
Canada Research Chairs Program	16/10/2001	39
René Durocher, Executive Director		
Canadian Association of University Research Administrators	25/10/2001	43
Wayne Marsh, President		
Canadian Association of University Teachers	25/10/2001	43
Michael Piva, Member of the Executive Committee		
Canadian Institutes of Health Research	16/10/2001	39
Mark Bisby, Director, Research Portfolio		
Canadian Polar Commission	11/04/2002	75
Peter Johnson, Chair		
Steven Bigras, Executive Director		
Centre for Policy Research on Science and Technology (CPROST), Simon Fraser University	07/02/2002	66
Adam Holbrook, Associate Director and Adjunct Professor		
Council of Science and Technology Advisors	22/11/2001	55
Alan Winter, President and Chief Executive Officer		

Organizations	Appeared	Meeting No.
Individuals		
Ian Dohoo, Professor, Epidemology, Associate Dean, University of P.E.I.	29/11/2001	58
Donald Forsdyke, Professor, Department of Biochemistry, Queen's University	29/11/2001	58
Peter Frise, Professor, Mechanical/Design Engineering, University of Windsor	29/11/2001	58
Ronald N. Kostoff, Expert in Research Evaluation	04/06/2002	88
Bryan Poulin, Professor, Faculty of Business Administration, Lakehead University	29/11/2001	58
Fiona Wood, Senior Research Fellow and Lecturer, Centre for Higher Education and Management Policy, School of Professional Development and Leadership, University of New England, Australia	23/04/2002	79
Natural Sciences and Engineering Research Council of Canada	16/10/2001	39
Elizabeth Boston, Director, Research Grants		
“Observatoire des sciences et des technologies”	07/02/2002	66
Benoît Godin, Professor, INRS		
Social Sciences and Humanities Research Council of Canada	16/10/2001	39
Ned Ellis, Vice-President, Programs		

REQUEST FOR GOVERNMENT RESPONSE

Pursuant to Standing Order 109, the Committee requests that the government table a comprehensive response to this report within one hundred and fifty (150) days.

A copy of the relevant Minutes of Proceedings of the Standing Committee on Industry, Science and Technology (*Meetings Nos. 39, 43, 51, 55, 58, 66, 67, 68, 75, 74, 84, 85, 86, 88, 89 and 90 which includes this report*) is tabled.

Respectfully submitted,

Walt Lastewka, M.P.
St. Catharines

Chair

Canadian Alliance Dissenting Report

The Canadian Alliance does support prudent investments in innovation, technology and research. It has called for increasing funding for Canada's research granting councils: the National Research Council (NRC), Natural Sciences and Engineering Research Council (NSERC), Social Sciences and Humanities Research Council (SSHRC), and the Canadian Institutes of Health Research (CIHR). The Canadian Alliance also supports a competitive peer review process to determine who shall receive grants through these respective councils.

The Canadian Alliance members of this committee would like to emphasize certain recommendations of this report, as well as express some concerns or reservations about other recommendations.

Firstly, the Canadian Alliance strongly supports recommendation 6: "That the Government of Canada establish a more formalized mechanism, in consultation with the provinces and territories, for setting or modifying S&T policy, deciding on funding priorities, and ensuring that they are implemented. Such a framework could include a science advisory body and/or Chief Scientific Adviser that would report directly to Parliament.

We have consistently called for a funding framework for Science & Technology in the 37th Parliament; unfortunately, numerous Secretaries of State for Science and Technology and Ministers of Industry have ignored this advice and failed to establish a framework. We hope that the government will finally act on this recommendation.

We also hope that the government will appoint a Chief Scientist of Canada, who would coordinate science activities in all government departments, help scientists communicate their findings, and help bridge the gap between scientists, bureaucrats and elected officials.

Secondly, the Canadian Alliance is very concerned that over half of the recommendations in this report call for increased funding in one way or another, and do so in a very general way with no specific figures or guidelines attached. From our perspective, to constantly request more funding for every area, group, or agency without attaching specific numbers — or even prioritizing — is fiscally irresponsible for a Parliamentary Committee and not the way in which to build a modern Research & Development infrastructure in Canada.

Thirdly, the Canadian Alliance believes that we should not single out SSHRC for special attention, as is done in recommendation number 3. There was much debate about the perceived inequity in funding for SSHRC vis-à-vis the other granting agencies; however, this perception must be based on some evidence other than statements by the granting agencies themselves. This could certainly be an issue for further study by this committee.

Furthermore, tying increased funding to SSHRC to small universities is a mistake. If small universities are facing extraordinary funding problems, then the government should address this issue separately from the funding of research and development. It should address it through stable long-term funding via the Canada Health & Social Transfer (CHST), rather than setting up separate national programs – such as the recent Trudeau fellowship — which deplete the government's ability to ensure stable long-term funding.

Fourthly, the Canadian Alliance is concerned that the committee is recommending moving away from merit as the guiding principle to direct research funding. As mentioned with respect to SSHRC, Committee members appear intent on using funding to granting agencies to address fiscal problems facing small universities and colleges. In order to be internationally competitive in science, medical and humanities research, Canada must be guided by merit and excellence in its public funding of Research & Development; and should address the problem of funding for small universities and colleges separately.

The Canadian Alliance members of this Committee are concerned about the implications of funnelling research dollars into every post-secondary institution in Canada. Some committee members seem intent on transforming ever post-secondary institution in Canada into a research-based institution; and in doing so, seem unaware of the dangers this would pose to a true liberal arts education. One of the major crises facing post-secondary education in the humanities is pressure on professors to focus on research at the expense of teaching and developing the next generation of critical thinking citizens, citizens which are essential to ensuring the long term health of a democratic society.

James Rajotte, Industry Critic

Brian Fitzpatrick

Cheryl Gallant

MINUTES OF PROCEEDINGS

Thursday, June 6, 2002
(*Meeting No. 89*)

The Standing Committee on Industry, Science and Technology met *in camera* at 9:02 a.m. this day, in Room 705, La Promenade Building, the Chair, Walt Lastewka, presiding.

Members of the Committee present: Stéphane Bergeron, Brian Fitzpatrick, Walt Lastewka, Serge Marcil, Joe McGuire, Dan McTeague, James Rajotte, Andy Savoy, Brent St. Denis and Joseph Volpe.

In attendance: *From the Library of Parliament*: Lalita Acharya and James McQueen, Research Officers.

Pursuant to Standing Order 108(2), the Committee resumed consideration of its study on the Three Federal Granting Agencies, Peer Review Funding, and the Canada Research Chairs Program *(See Minutes of Proceedings, Tuesday, October 16, 2001, Meeting No. 39)*.

It was agreed, — That the Committee authorize the printing of dissenting or supplementary opinions as an appendix to this report, immediately following the signature of the Chair.

It was agreed, — That the opinions be limited to not more than five (5) pages.

It was agreed, — That the opinions be received by the Clerk in both official languages no later than Monday, June 10, 2002 at 3:00 p.m.

At 10:38 a.m., the Committee adjourned to the call of the Chair.

Tuesday, June 11, 2002
(*Meeting No. 90*)

The Standing Committee on Industry, Science and Technology met at 9:10 a.m. this day, in Room 269, West Block, the Chair, Walt Lastewka, presiding.

Members of the Committee present: Larry Bagnell, Stéphane Bergeron, Brian Fitzpatrick, Cheryl Gallant, Walt Lastewka, Serge Marcil, Joe McGuire, Dan McTeague, Andy Savoy and Brent St. Denis.

Acting Members present: Pierre Brien for Stéphane Bergeron.

In attendance: *From the Library of Parliament*: Dan Shaw, Lalita Acharya and James McQueen, Research Officers.

Witnesses: *From the Department of Industry*: Renée St-Jacques, Chief Economist and Director General, Micro-Economic Policy Analysis Branch; Someshwar Rao, Director, Micro-Economic Analysis Directorate. *From Statistics Canada*: John R. Baldwin, Director, Micro Economic Studies and Analysis; Tarek Harchaoui, Chief, Multifaction Productivity Measures, Micro-Economic Studies and Analysis.

Pursuant to Standing Order 108(2), the Committee commenced its consideration of the subject of Innovation, Productivity and Growth.

Renée St-Jacques and John Baldwin each made an opening statement and, with the other witnesses, answered questions.

At 10:40 a.m., the Committee proceeded to sit *in camera*.

Pursuant to Standing Order 108(2), the Committee resumed its consideration of its study on the Three Federal Granting Agencies, Peer Review Funding, and the Canada Research Chairs Program (*See Minutes of Proceedings, Tuesday, October 16, 2001, Meeting No. 39*).

It was agreed, — That the draft report (as amended) be concurred in.

Ordered, — That the Chair present the Tenth Report (as amended) to the House at the earliest possible opportunity.

It was agreed, — That pursuant to Standing Order 109, the Committee request that the Government table a comprehensive response to this report within one hundred fifty (150) days.

It was agreed, — That the Chair be authorized to make such typographical and editorial

changes as may be necessary without changing the substance of the draft report to the House.

It was agreed, — That 550 copies of the Report be printed in a tumble format.

At 11:00 a.m., the Committee adjourned to the call of the Chair.

Normand Radford
Clerk of the Committee