First Report of the Advisory Group on Interdisciplinary Research

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Research Grants Division
Natural Sciences and Engineering Research Council

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Note: In this document, 'interdisciplinary' refers to both interdisciplinary and multidisciplinary research conducted by individuals as well as groups.

EXECUTIVE SUMMARY

Background

In November 1999, the Committee on Research Grants (CORG) asked staff to develop a proposal for a committee to study how interdisciplinary research could be better supported by NSERC. Shortly after, NSERC's Council discussed the framework for the third Reallocations Exercise, the process used to redistribute up to 10% of the Research Grants budget amongst the different disciplines it supports. Council members also supported the idea of creating a committee to look at the consideration of interdisciplinary research in the Reallocations Exercise. In May 2000, staff outlined a proposal to CORG for the mandate, membership and terms of reference for a committee that could meet both these objectives. CORG supported the proposal and in October 2000 the first meeting of the Advisory Group on Interdisciplinary Research (AGIR) was convened. AGIR met four times during the period October 2000-November 2001. AGIR's Membership, Mandate and Terms of Reference are found in Annexes 1 and 2.

Initially, the main objective of AGIR was to make recommendations and provide advice to the Reallocations Committee on the review and funding mechanisms for interdisciplinary initiatives in submissions, joint proposals and briefs (to be funded through the Research Grants budget). AGIR then looked at how interdisciplinary research was treated in NSERC programs. AGIR found that the majority of the grant programs and their peer review processes were in fact interdisciplinary. AGIR therefore focused on providing input and advice on improvements to the Research Grants Program, which is mainly discipline-based.

This report provides background information on the international context for interdisciplinary research, as well as a summary of AGIR's work to date on the Reallocations Exercise, NSERC's programs, and specifically the Research Grants Program. In the future, AGIR's role may be expanded to address cross-agency issues (see Section 6.0 – Next Steps).

Major Conclusions and Recommendations

International Context

AGIR reviewed program information on interdisciplinary research from nine foreign funding agencies and two Canadian provincial agencies, as well as special reports on interdisciplinary research. Following its analysis and discussion of this material, AGIR:

a) adopted a simple definition of interdisciplinary research from the OECD: "research that involves interaction among two or more different disciplines". [1]
b) noted that there is no magic solution for promoting, reviewing and supporting interdisciplinary research within programs like Research Grants.
c) emphasized that in order to have a true impact, interdisciplinary research must meet international standards of excellence, first and foremost, as must all research endeavours.
d) noted that interdisciplinary research is not something that always happens spontaneously or easily. Interdisciplinary research may sometimes require individuals and organizations within the research enterprise to develop and adapt new ways of operating and thinking.

Reallocations Exercise

AGIR recommended to the Reallocations Committee that:

a) Excellent interdisciplinary research should be encouraged in the Reallocations Exercise, but should not be mandatory.
b) Proposals should stand on their own and be evaluated in direct comparison with all other disciplinary proposals. Care should be taken in the selection of referees with expertise in interdisciplinary research. The Reallocations Committee should take a broad view when considering such proposals.
c) The Committee should put particular emphasis on interdisciplinary research by reviewing these proposals first, before the discipline-based ones.
d) There should be no special criteria or separate funding envelope for interdisciplinary proposals.

The Reallocations Committee did not agree with AGIR that particular emphasis should be placed on interdisciplinary proposals by reviewing them first, believing that all types of proposals should be treated the same way.

NSERC Programs

AGIR concluded that all NSERC programs combined offer many opportunities for interdisciplinary research.

Although NSERC's overall treatment of interdisciplinary research appears to be quite strong, AGIR was concerned that NSERC does not currently have a mechanism for responding quickly to changes in the research environment and emerging areas of research, particularly those that are high risk.

AGIR and staff are developing a proposal for an *Innovative Ideas Program* to support new, emerging and high-risk research (see Annex 7).

Research Grants - Conclusions

[1] OECD (1998) *Interdisciplinarity in Science and Technology*, page 4.

In comparison to NSERC's other grant programs, the Research Grants Program is based more directly on the natural science and engineering disciplines. However, many of the GSCs are flexible and they review and support proposals from a wide breadth of research areas, including interdisciplinary areas. It seems that most interdisciplinary proposals are in fact well accommodated within the discipline GSCs. While there is no immediate need to revise the current GSC structure, it should be monitored to ensure that it is responsive to changes within and across the disciplines.

Two broad areas were noted for improvement: a) enhancing the reputation and stature of GSC 21 and b) educating reviewers and peer review committees about the nature of interdisciplinary research and developing a culture and mind-set that is more open to such research.

Research Grants – Recommendations on enhancing the reputation and stature of the Interdisciplinary GSC (21)

An article on interdisciplinary research and GSC21 was published in NSERC's *Contact* in the fall of 2001 (see Annex 3).

Instructions to applicants will be revised to encourage those working in interdisciplinary research areas to flag their proposals for interdisciplinary review.

Ongoing analyses of applicants' research codes will help to identify the areas where new applicants are working and that need to be covered by GSC 21.

Research Grants – Recommendations on Educating Reviewers and GSCs

AGIR recommended that:

a) Its Policies and Guidelines on the Review of Applications in Interdisciplinary Research Areas (see Annex 4) be published in the Professor's Guide.
b) NSERC review its program literature and peer review manuals to ensure that appropriate coverage is given to interdisciplinary research and that consistent language and approaches are used. GSCs should be provided with more data and guidelines on interdisciplinary research.

Next Steps

The next major step for AGIR is to expand its role to address the important and complex area of cross-agency issues. AGIR would like to invite additional members and staff from the Canadian Institutes of Health Research, the Social Sciences and Humanities Research Council, the Canada Foundation for Innovation and the Canada Council for the Arts to participate in a meeting to be held in the fall/winter of 2002.

1.0 INTRODUCTION

NSERC supports and promotes high-quality research in the natural sciences and engineering, including research that falls between disciplines or that requires the skills of several disciplines, through a variety of grant programs. NSERC recognizes the importance of excellent interdisciplinary research; programs, policies and procedures are designed to breakdown barriers against it. Nonetheless, in recent years, there has been some concern about whether NSERC is providing sufficient opportunities and support for interdisciplinary research. This concern has been directed mostly at the Research Grants Program, which unlike other NSERC grant programs, uses mainly discipline-based Grant Selection Committees (GSCs) for peer review. This discipline-based structure may present hurdles for some interdisciplinary applications (for example, input from two or more GSCs, rather than just one, may be required for review purposes).

2.0 INTERNATIONAL CONTEXT

2.1 Introduction

A study was conducted for AGIR to obtain background information on the international context for promoting, reviewing and supporting interdisciplinary research. Nine foreign funding agencies in the natural sciences and engineering and two Canadian provincial agencies provided information on their key programs and issues having to do with interdisciplinary research (e.g., definition, peer review, training, etc) (see Annex 5 for list of participating agencies and web site addresses). The key findings are highlighted below, along with AGIR's response (see NSERC File Number N3052-A4 for a copy of the complete report).

2.2 Definition of interdisciplinary research

The international survey found that there is no standard definition of interdisciplinary research used by foreign funding agencies. Indeed, respondents commented on the difficulties of defining interdisciplinary research. What is considered interdisciplinary research by one person, agency or discipline might not be considered as such by others. Most councils use an administrative definition: research that crosses two or more divisions, programs or review panels. However, much of the literature on interdisciplinary research cites definitions used by the Organization for Economic and Cooperative Development (OECD).

AGIR wanted to establish a definition of interdisciplinary research in order to be able to a) know what to encourage and b) to track any changes that occur in the amount and type of interdisciplinary research being conducted. AGIR thought that having two definitions would be helpful: one for administrative purposes and tracking applications and another, more "intellectually satisfying" one, for policy discussions.

AGIR adopted a simple definition of interdisciplinary research from the OECD: "research that involves interaction among two or more different disciplines". This

may range from the sharing of ideas to full integration of concepts, methodology, procedures, theory, terminology, data and organization of research and training in a fairly large field. Multidisciplinary research involves drawing on knowledge from different disciplines but staying within the boundaries of those fields[2] (as noted earlier, in this report 'interdisciplinary' is used to refer to both types of research). **For administrative purposes, NSERC defines interdisciplinary grant applications as those that require the selection of referees from more than one discipline, the establishment of a review panel with members from more than one discipline, or the expertise of more than one selection committee or panel in the peer review process.** For example, within the Research Grants Program, NSERC has received applications in such areas as mathematical modelling, biochemistry, environmental engineering, chemistry, geophysics, biomedical engineering and engineering physics, and these have been reviewed using formal consultations between GSCs and, in some cases, review by the Interdisciplinary GSC.

2.3 Funding programs

AGIR was interested in how interdisciplinary research was supported by other funding agencies. Information from the different agencies was reviewed in order to identify new ways to improve NSERC's processes, guidelines and procedures.

The key findings are briefly summarized as follows:

a) There is no standard definition of interdisciplinary research used by the granting agencies.
b) Interdisciplinary research is usually categorized as collaborative, team oriented research focused on problems with social, economic, or environmental relevance, for example. This is not the approach taken within the Research Grants Program.
c) Funding programs that are organized around strategic interdisciplinary topics or themes are successful in promoting and supporting such research. It is common for agencies to have programs similar to NSERC's Strategic Projects Grants.
d) The peer review process for interdisciplinary applications requires careful selection of referees and often a greater number of referees. The key challenge is to find reviewers who can assess the integrated whole of the application and not just the component parts in isolation.
e) Some agencies have interdisciplinary training programs, or incorporate interdisciplinary research in planning exercises similar to NSERC's Reallocations Exercise.
f) Interdisciplinarity is a hot topic that has been addressed by high levels of government, reorganization of councils, discussions with policy committees, special reviews or workshops, and reports (see reference list in Annex 5).

AGIR noted that the 'grass is not greener' elsewhere and that there is no magic solution for promoting, reviewing and supporting interdisciplinary research within programs like NSERC Research Grants.

[2] OECD (1998) *Interdisciplinarity in Science and Technology*, page 4.

2.4 Importance of interdisciplinary research

The international study also revealed a clear consensus about why interdisciplinary research is important and what challenges it must face.

A variety of factors have contributed to the merging and overlapping of different fields and disciplines. Interdisciplinary research evolves to meet the demands of many societal, environmental, industrial, scientific and engineering problems that cannot be adequately addressed by single disciplines alone. Important discoveries often occur at the intersection between two or more disciplines.

In the pursuit of new knowledge, interdisciplinary research relies on the strength of established disciplines to provide sound theory and methodology. It pushes the traditional boundaries of disciplines, helps ensure their growth and vitality and may lead to the development of new disciplines. Other benefits are sharing resources and facilities, building teams and networks and removing duplication of effort in research.

In its discussions, AGIR emphasized that in order to have a true impact, interdisciplinary research must meet international standards of excellence, first and foremost, as must all research endeavours.

2.5 Challenges facing interdisciplinary research

Barriers that inhibit interdisciplinarity in the research enterprise and prevent the full realization of its benefits are also recognized internationally.

Foremost, university departments are generally discipline-based. Therefore, the promotion and budget allocation systems within institutions are concerned primarily with discipline requirements and it is difficult to establish interdisciplinary courses and training. Changes have begun to occur, however, and new interdisciplinary departments and graduate programs have been established.

Similarly, most scientific journals are discipline-based. These journals do publish interdisciplinary research, but often with a significant time lag (once an area has become more established). Certain types of research may be easier to publish in new journals dedicated to emerging or interdisciplinary research areas. However, these journals may not be well recognized by a wide audience and consequently the publications that appear in them may be undervalued.

Furthermore, because interdisciplinary communities are relatively small, it is more difficult to find appropriate, independent reviewers for some proposals. In general, there is a lack of critical mass in the community for effective dissemination of results, peer review and recognition of interdisciplinary research.

The international reports also noted that some important barriers are more personal in nature. Pressure to produce in one's own area does not allow researchers the time and opportunity to develop collaborations in different fields, to learn the 'languages', theories, concepts and methodologies of different disciplines, and to communicate and manage effectively in interdisciplinary teams. Within the peer review process, reviewers and committee members tend to think in 'ethnocentric' terms about their own areas of interest.

AGIR noted that despite its importance, interdisciplinary research is not something that always happens spontaneously or easily. Members agreed that barriers to interdisciplinary research could be barriers to innovation and creativity. Interdisciplinary research may sometimes require individuals and organizations within the research enterprise to develop and adopt new ways of operating and thinking.

While the background information discussed above provided important context for AGIR's discussions, the Group was not mandated to recommend solutions to problems outside of NSERC's purview. AGIR was concerned specifically with how interdisciplinary research was treated in NSERC programs.

3.0 REALLOCATIONS EXERCISE

3.1 Introduction

AGIR's first major task was to make recommendations and provide advice to the Reallocations Committee on the review and funding mechanisms for interdisciplinary initiatives in submissions, joint proposals and briefs.

The Reallocations Exercise allows NSERC to periodically examine the entire spectrum of research areas supported by the Research Grants Program, and make adjustments to the funding alloted to the various disciplines. Up to 10% of the Research Grants budget (about $25M) is redistributed to initiatives and needs identified, through broad community input and peer review, as the most important for Canada. Each discipline, or discipline grouping (based on the GSC structure), is represented by a Steering Committee that prepares a submission to NSERC on its vision, strategy and funding priorities.

The last Reallocations Committee had commented on the absence of proposals for interdisciplinary initiatives, and was concerned that some potentially important opportunities had not been pursued. Council reviewed the framework for the Exercise in January 2000 and asked that particular attention be given to this issue in the current exercise to ensure that the needs, challenges and opportunities of interdisciplinary research are considered. Therefore, in order to encourage the development of interdisciplinary proposals within the current Reallocations Exercise, two or more Steering Committees could collaborate on a joint proposal of up to four pages, in addition to their discipline-based submissions.

3.2 Conclusions and Recommendations

AGIR saw its role as facilitating the submission and consideration of interdisciplinary themes in the Reallocations Exercise. AGIR wanted to ensure that those ideas that impact small groups of researchers and sub-fields across a number of disciplines are brought forward and considered by Steering Committees. **At AGIR's request, Steering Committees were provided with a summary of the international context study on interdisciplinary research and a request to the community for ideas for interdisciplinary proposals to be considered by Steering Committees was posted on NSERC's web site and published in *Contact* (see Annex 6).**

AGIR anticipated that interdisciplinary proposals would be submitted to the Reallocations Exercise and expects that the most meritorious will be supported. AGIR recommended to the Reallocations Committee that:

a) Excellent interdisciplinary research should be encouraged in the Reallocations Exercise, but should not be mandatory. Proposals should stand on their own and be evaluated in direct comparison with all other disciplinary proposals.
b) Care should be taken in the selection of referees with expertise in interdisciplinary research.
c) The Reallocations Committee should take a broad view when considering such proposals.
d) The Reallocations Committee should put particular emphasis on interdisciplinary research by reviewing these proposals first, before the discipline-based ones.
e) There should be no special criteria or separate funding envelope for interdisciplinary proposals.

3.3 Outcomes

At its first meeting in April 2001, the Reallocations Committee reviewed AGIR's advice and recommendations, and was generally comfortable with them. **The Committee did not agree with AGIR that particular emphasis should be placed on interdisciplinary proposals by reviewing them first, believing that all types of proposals should be treated the same way.** The Committee noted that it would be difficult to distinguish between joint proposals involving two or more Steering Committees and interdisciplinary proposals included in discipline submissions.

Four interdisciplinary ideas for Steering Committees to consider were received in response to the article in *Contact* and the notice on the web:

a) Geography/geographic information systems/ecology and mathematics/statistics – to develop new theory and application of spatial structures for conservation issues, resource management decisions and planning, sustainability and habitat management.
b) Aquatic/terrestrial interactions.
c) Agro-forestry systems.
d) Mathematics/mechanical engineering/chemistry on PEM fuel cell research.

These ideas were forwarded to the relevant Steering Committees, and submissions and joint proposals were submitted in January 2002. Conservation issues, and the use of new GIS and data mining technology, were identified as priority areas in the submission from Evolution and Ecology. Also, Mechanical Engineering identified alternative energy systems as a key area. Otherwise, there were no specific interdisciplinary proposals on the above topics.

Five joint proposals were submitted, however, in the areas of complex data structures, materials, neuroscience, physiological genomics and software engineering. Although AGIR was initially disappointed with the relatively small number of joint proposals, it acknowledged that this was still an improvement over the last Exercise. Also, AGIR recognized that there are many difficulties in getting two or more separate Steering Committees to work together, given the structure of the exercise and the organization of the Committees themselves (based on GSCs, along discipline lines). All submissions include at least some discussion of interdisciplinary issues and some include interdisciplinary proposals within the discipline-based submissions (that involve only the GSC(s) represented by the submission).

AGIR is strongly supportive of the efforts made by Steering Committees to address interdisciplinary issues in their submissions and joint proposals. It asks that the Reallocations Committee take a broad view when considering such proposals, and that the most meritorious be supported. AGIR awaits with interest the final results of this Reallocations Exercise.

4.0 NSERC PROGRAMS

4.1 Introduction

AGIR's next task was to review NSERC programs to determine what opportunities were available to support interdisciplinary research. AGIR received information on Research Grants, Research Partnerships (e.g., Strategic Project Grants, Research Network Grants and Industrial Research Chairs), Scholarships and Fellowships, Collaborative Research Opportunities, International Opportunity Fund, Collaborative Health Research Projects, Genomics Projects and Networks of Centres of Excellence.

The majority of NSERC grant programs have selection panels and committees that are interdisciplinary, covering either a very wide breadth of research areas in the natural sciences and engineering, or specific interdisciplinary themes or research topics. (For example, the Panel for Collaborative Research Opportunities reviews all proposals submitted to that program, whereas the Value-Added Products and Processes Panel for Strategic Project Grants reviews proposals in this target area.) Committee and panel members come from diverse backgrounds and rely heavily on reviews from experts in many fields (e.g., external referees) to ensure that proposals are evaluated fairly. More emphasis is placed on the selection of referees, particularly when committee/panel expertise is thin in a given area.

4.2 Conclusions and recommendations

AGIR concluded that all NSERC programs combined offer many opportunities for interdisciplinary research. Indeed, the majority of grant programs (but not the majority of grants funding) specifically encourage, or require, interdisciplinary research, and use interdisciplinary peer review. AGIR therefore focused on providing input and advice on improvements to the Research Grants Program, which is mainly discipline-based, and may present more of a challenge to interdisciplinary research. AGIR's recommendations and conclusions for the Research Grants Program are covered separately in the next section, below.

Although NSERC's overall treatment of interdisciplinary research appears to be quite strong, AGIR was concerned that NSERC does not currently have a mechanism for responding quickly to changes in the research environment and emerging areas of research, particularly those that are high risk. Strategic Project Grants Program includes the *New Directions* targeted area to support outstanding research proposals on emerging topics where the research has a potential to lead to breakthrough discoveries. However, the project must involve non-academic partners or document and justify their absence and the lack of a 'receptor capacity'. AGIR was concerned that funding for this type of research falls under the Strategic Projects umbrella, which is not seen to be accessible to all researchers because of the usual requirements for partners and plans for exploitation of results. Also, the program operates on an annual competition cycle and cannot respond to special opportunities that may arise at different times throughout the year. AGIR noted that only a small number of applications are received and funded under the *New Directions* theme, and that reviewers and selection panel members find it difficult to apply Strategic Projects selection criteria to the *New Directions* area.

AGIR recommended that the *New Directions* area be expanded and moved out of the Strategic Projects umbrella. AGIR and staff are developing a proposal for an *Innovative Ideas Program* to support new, emerging and high-risk research, which is often at the intersection of two or more disciplines (see Annex 7 for draft). While recognizing the importance of program consolidation, AGIR felt that this mechanism could address a gap in the current suite of programs. The goal would be to provide a quick-turnaround of funding decisions, and for the peer review to focus on the quality of the proposal, and not on the track record of the applicant. **The Group asks that NSERC pursue the *Innovative Ideas* concept and seek input from the Strategic Planning Group of Council.**

5.0 RESEARCH GRANTS

5.1 Introduction

AGIR focused much of its time and effort on reviewing the Research Grants Program because of its unique discipline-based structure (see list of GSCs, Annex 8).

The Research Grants Program is NSERC's largest and is allocated the major share of funding; over $250M dollars in funding is provided annually to nearly 8,000 professors in Canadian universities. These grants support ongoing programs of research, rather than specific short-term projects. The program recognizes that creativity and innovation are at the heart of all research advances, whether made individually or by groups. Research Grant holders are not restricted to the specific activities described in the application, but may pursue new research interests provided they are within NSERC's mandate.

For the Research Grants Program, the GSCs are generally discipline-based. However, the purview of the GSC and the expertise available on it may be broad enough that some interdisciplinary proposals can be reviewed fairly by one committee. When applications cross the boundaries of two or more discipline-based committees, measures are taken to ensure fair evaluation (e.g., formal consultations with other discipline GSCs, broader selection of referees). A formal consultation (or cross-consultation) involves the Chair of one GSC asking the Chair of another GSC to identify a member who can prepare a written review on an application. Sometimes, the member from the second GSC may participate in the discussion of the application with the first GSC during competition week. The Interdisciplinary GSC (21) has the important role of reviewing a wide range of Research Grant applications that cannot be adequately reviewed through consultation between two GSCs. Like other interdisciplinary committees and panels, members come from diverse backgrounds and rely heavily on experts in many fields (i.e., external referees and members of other GSCs who prepare formal consultations) to ensure that proposals are evaluated fairly.

5.2 Key data

AGIR was interested in demographic data on researchers conducting interdisciplinary research, as well as competition statistics comparing success rates and average grants for interdisciplinary and disciplinary applications. NSERC staff conducted statistical analyses to respond to AGIR's questions and to be used in the Evaluation of the Research Grants Program. [Other qualitative studies conducted for this program evaluation (e.g., web-based survey of grantees, interviews with GSC members) were also useful to AGIR]. A summary of the findings is included in Annex 9, and is discussed below. (The complete report can be found on NSERC File Number N3052-A4)

Demographic profile

- An increasing number of assistant professors and new applicants are involved in interdisciplinary research, more than any other category of applicants.

- The proportion of male and female researchers in the interdisciplinary group (GSC 21 plus all cross-consultations) is very similar to the general population. There were no significant differences in the success rate and average grant for men and women in the interdisciplinary group. (Differences were found in general population, however, with men having higher success rates and average grants than women. Further analyses showed that success rate is directly linked to faculty position, and that men are more likely to be in higher faculty positions. Average grant is also linked to faculty position, but more analyses are required to clarify the exact relationship between these variables and gender.)

Interdisciplinary GSC (21)

- The number of applications in GSC 21 for 1997-2000 competitions has remained fairly constant and is relatively small (39 applications per year, on average).

- The Interdisciplinary GSC covers a wide range of areas. Applications from 19 different research subject areas (based on NSERC research subject codes) were reviewed in 2000, in engineering, mathematics, statistics, physics, chemistry, life sciences and information sciences, for example.

- The budget for GSC 21 takes into account changes in the pressure on this GSC (number and quality of applications) every year. NSERC tries to ensure its success rates and average grants are comparable to other GSCs, given similar quality of applications. When the cohort is stronger, the GSC can make a case for more funding.

- Despite this flexibility, the success rates and mean grant sizes for GSC 21 are consistently lower than other GSCs'. This can be partly explained by the fact that GSC 21 has received a higher proportion of proposals from new applicants in their cohorts than other GSCs.

- Interviews conducted in 2001 with university Vice-Presidents, Research and past and present GSC members (as a pre-cursor to the Evaluation of the Research Grants Program, currently underway) showed there is a perception in the community that the quality of proposals reviewed by GSC 21 is not high enough to succeed in the individual, discipline-based GSCs.[3] This perception may be based more on the 'poor cousin' image of the committee, rather than on direct experience or evidence.

Other GSCs

- Applications from a wide breadth of research areas are reviewed within different GSCs. For example, the Environmental Earth Sciences GSC reviewed applications from 14 different research subjects (as defined by NSERC's research subject codes) in 2000. The research subjects included engineering, physics and chemistry. Similar

[3] NSERC (2002) *Interdisciplinary Research within the Research Grants Program. Report for AGIR,* page 7.

examples would be the engineering and life sciences GSCs. In other GSCs there may be fewer areas included, but this could be due to problems with the structure and use of the research codes, and not with the actual breadth of the GSCs purview.

- A comparison of GSC discipline profiles for the 1997 and 2000 competitions showed no major changes in the discipline patterns over the four-year period.

- Preliminary findings from the survey of grantees (2002) showed that about 37% consider their research to be highly interdisciplinary (rated 6 or 7 on a seven-point scale). The majority of respondents also indicated that interdisciplinary research takes longer to complete and is more costly than discipline-based research.

Formal consultation process

- Only about 9% of proposals receive formal consultations (242 applications per year on average for 1996-2000). The number has increased over time in all GSCs, but the proportion in each competition is relatively stable and not increasing.

- The success rates for discipline-based applications were compared to the small number of applications receiving cross-consultations, by GSC, for the competitions 1997-2000 (combined). Success rates were lower for applications receiving consultations in most GSCs. However, the results were statistically significant in only seven committees. (When all the data is pooled, the effect is still significant, but very weak.) Four of these committees, in the life sciences, had the lowest success rates for discipline-based applications as well.

- A comparison of average grant by Committee was also provided. In most GSCs the amount of the average grant for applications receiving consultations was lower than that for the discipline-based proposals. In only a few GSCs, however, was the difference statistically significant. When all the data are pooled, the mean grant for applications in GSC 21 and all those that received formal consultations is slightly disadvantaged ($26,913 versus $27,761 for discipline-based research). Overall though the situation has improved over time (the difference is getting smaller).

5.3 Conclusions

AGIR noted that universities are not hiring replacements to 'backfill' areas of expertise. AGIR commented that the university structure seems to be evolving, or is at least flexible, with more young researchers working in interdisciplinary areas. GSC 21 is not part of the Reallocations Exercise and AGIR supports this on the understanding that the budget continues to be allocated on a flexible basis and that NSERC considers the different cohorts and type of applications in the competition each year.

The 'poor cousin' image of GSC 21 may influence some applicants to gear their proposals to a specific discipline GSC, and avoid interdisciplinary proposals. However, Research Grants provide flexibility to researchers to pursue new lines of inquiry not outlined in their proposal.

In comparison to NSERC's other grant programs, the Research Grants Program is more disciplinary based. However, many of the GSCs are flexible and they review and support proposals from a wide breadth of research areas, including interdisciplinary areas. It seems that most interdisciplinary proposals are in fact well accommodated within the discipline GSCs.

Nonetheless, AGIR was concerned that the discipline-oriented GSC structure does not always accurately reflect the interdisciplinary aspects of the research being done. Interdisciplinary proposals that cross the boundaries of two or more GSCs are accommodated through the use of formal consultations and sometimes reviewed by the

Interdisciplinary GSC. However, a small number of these may still be difficult to review in spite of the mechanisms in place.

AGIR was concerned that the lower success rates and average grants for interdisciplinary applications that receive formal consultations (in some GSCs in particular) may reflect either a problem with the quality of proposals and/or a bias in the system against this type of research. Interdisciplinary researchers may be disadvantaged if their research takes longer to complete, is more costly and/or more difficult to disseminate. Budget pressures may also cause GSCs to retrench and to focus funding on a more narrow range of discipline activities.

Two broad areas were noted for improvement: a) enhancing the reputation and stature of GSC 21 and b) educating reviewers and peer review committees about the nature of interdisciplinary research and developing a culture and mind-set that is more open to such research.

5.4 Recommendations

5.4.1 Enhancing the reputation and stature of the Interdisciplinary GSC (21)

An article on interdisciplinary research and GSC21 was published in NSERC's *Contact* in the fall of 2001 (see Annex 3).

Instructions to applicants will be revised to encourage those working in interdisciplinary research areas to flag their proposals for interdisciplinary review and possible consideration by GSC 21. AGIR believes that GSC 21 should not be seen just as a 'last resort' by applicants and GSCs. One of GSC 21's strengths is that it can accommodate certain research areas on a temporary basis, as the various disciplines evolve. While the GSC is a safety net for proposals that 'fall through the cracks', it is also home to truly interdisciplinary applications and an incubator for emerging areas (e.g., artificial intelligence). Interdisciplinary researchers should be encouraged to proactively request review by GSC 21 and not just wait and see if their applications do not fit in elsewhere. Applicants in GSC 21 should be able to expect similar success rates and average grants as those in other GSCs, by meeting the same standards of excellence.

While AGIR believes that the majority of interdisciplinary research should be handled by the GSCs or through collaboration among the GSCs, it would like to see more meritorious interdisciplinary proposals in GSC 21. A greater number of meritorious applications in GSC 21 would allow it to increase its success rate and build up a critical mass.

Ongoing analyses of applicants' research codes will help to identify the areas where new applicants are working and that need to be covered by GSC 21.

AGIR recommended that the GSC 21 members be given the report of the *Advisory Group on the Review of Guidelines for Engineering Applications* (see draft in Annex

10) as they have engineering applications to review. The document discusses the different training, types of contributions (e.g., no post-docs, more conference proceedings to get early feedback) and important interdisciplinary topics found in engineering applications. The GSC should review and discuss the report at the fall Orientation Session for GSC 21.

AGIR recognized that interdisciplinarity involves more than just GSC 21 and that such research cannot be promoted through one GSC alone.

5.4.2 Educating Reviewers and GSCs

AGIR recommended that:

Its *Policies and Guidelines on the Review Of Applications in Interdisciplinary Research Areas* (see draft in Annex 4) be published in the Professor's Guide. While this document was developed particularly with the Research Grants Program in mind, it is hoped that it will be of use to all NSERC programs. It is intended to be instructive for applicants, referees, selection panels and committees. The definition of interdisciplinary research is provided, along with information on the drivers and barriers for such research. Most of the document is devoted to a discussion of the peer review processes at NSERC for interdisciplinary applications and best practices.

The GSC structure and membership reflect new and emerging areas, and the fact that more new applicants are working in interdisciplinary areas. The breadth of expertise on GSCs should be broadened by selecting new members in emerging areas, and not just 'backfilling' to cover the research areas of retiring members. This is already covered in NSERC's membership guidelines (see Annex 11) but needs to be implemented more proactively. Some revisions to the GSC structure may be required to respond to changes in the disciplines and the evolution of interdisciplinary research in new and emerging areas.

The fall orientation session for new members normally include the topic of interdisciplinary research – general discussion of importance and barriers, where it fits in the GSC, importance of formal consultations, and best practices for peer review.

Data on success rates and average grants for interdisciplinary proposals (applications receiving consultation reports) be shared with individual GSCs. Members should examine the data for their committee and propose solutions for filling any gaps.

NSERC's database of external referees flag truly interdisciplinary researchers. The key challenge in the evaluation of interdisciplinary applications is to find sufficient numbers of appropriate reviewers who can assess the proposed research in its entirety and not just the different component parts in isolation.

The formal consultation process be improved by revising the letter requesting a review from the discipline-based GSC members. AGIR noted that GSCs do not always find input from formal consultations to be constructive. Reviewers tend to be too focused on the perspective of their own research area. The letter used by GSC 21 to request input (see attached, Annex 12) is a good model. Reviewers should be made aware of the importance of their input and of the need to interpret the significance of the proposal in the very broad context of interdisciplinary research and not just that of their particular discipline.

The research subject codes used by applicants be reviewed. The statistical analyses of interdisciplinary applications highlighted some problems with the research codes. There should be some way of differentiating between codes that are highly related versus those that represent more divergent subjects. Also, AGIR was unsure if the lack of interdisciplinarity reflected in some pie charts was due to the narrow purview of the GSCs, or because there just happened to be fewer specific codes available to describe the purview of those GSCs.

NSERC review its program literature and peer review manuals to ensure that appropriate coverage is given to interdisciplinary research and that consistent language and approaches are used.

6.0 NEXT STEPS

The next step for AGIR is a major one: to expand its role to address the important and complex area of cross-agency issues. AGIR would like to invite additional members and staff from other agencies to participate in a meeting to be held in the fall/winter of 2002. These would be the Canadian Institutes of Health Research, the Social Sciences and Humanities Research Council, the Canada Foundation for Innovation and the Canada Council for the Arts. AGIR would like to know about the joint programs and activities that exist between agencies and how each agency treats interdisciplinary research within its own programs. It would be helpful if other agencies were able to provide data comparable to those presented to AGIR on demographic profiles, success rates etc. for interdisciplinary applications in their own programs.

7.0 CONCLUSION

In the first year of its activities, AGIR reviewed and discussed a great deal of information on interdisciplinary research. The Group examined, in detail, the international context, NSERC's Reallocation Exercise and NSERC's grant programs, particularly the Research Grants Program. Overall, AGIR believes that NSERC's treatment of interdisciplinary research is very good; no major issues requiring attention were identified. Within the Research Grants Program, which is more discipline-based than other NSERC programs, AGIR noted two broad areas for improvement: a) enhancing the reputation and stature of GSC 21 and b) educating reviewers and peer review committees about the nature of interdisciplinary research and developing a culture and mind-set that is more open to such research. AGIR's specific recommendations and conclusions are summarized in the Executive Summary of this report, and some of these have already been acted upon. The two broad areas noted for improvement will require a cultural change for applicants, reviewers and committee members. It will be important for NSERC to work on the recommendations persistently over the long-term if real change is to occur.