GradEdge
Insights and Research on Graduate Education
COUNCIL OF GRADUATE SCHOOLS
WWW.CGSNET.ORG | VOLUME 1, NUMBER 4 | MAY 2012

Advancing STEM Graduate Education: The "I's" Have It

Four "Imperatives" Facing Graduate Education

A host of recent studies and recommendations (Commission on the Future of Graduate Education in the United States, 2010; Denecke, 2009), including many associated with the Council of Graduate Schools (CGS), have reinforced the importance of four "Imperatives" crucial to the transformation of graduate education. Indeed, these "I's Have It" as new strategies and effective practices unfold that help define the path forward:

- *Inclusiveness*—Broadening participation and access to graduate education (Council of Graduate Schools, 2009),
- *Interdisciplinary Programs*—Advancing integrative research and education to address the complex challenges facing society while maintaining strength in the core disciplines (Council of Graduate Schools, 2010),
- *Into Careers*—Fostering professional development and enhanced career opportunities for graduate students (Commission on Pathways through Graduate School and Into Careers, 2012),
- *Intellectual Capital and Innovation*—Fueling the U.S. competitive advantage in the global economy through world-class graduate education (Council of Graduate Schools, 2008).

This article is informed by these broad objectives as it focuses specifically on graduate education in Science, Technology, Engineering and Mathematics (STEM) disciplines and the associated federal investments from lead agencies such as the National Science Foundation (NSF). Most importantly, the article endeavors to spark a new round of dialogue with the academic community and associated graduate school leadership concerning future actions involving agencies such as NSF to maintain U.S. leadership in STEM fields.

"An Interface": The NSF/CGS Dean in Residence (DIR) Position

It was my privilege to accept the DIR position as of March 1, following eleven years as the Vice President for Research and Dean of the Graduate School at the University of Oregon. It is an exceptional opportunity to engage and link national and university leadership supporting STEM graduate education. Funding for the position is provided by a grant from NSF to CGS, with the expectation of robust connections between the DIR and NSF's seven directorates.

The NSF is the leading federal funder of basic research in science and engineering, and for U.S. STEM education programs more generally. (NSTC Committee on Science, Technology, Engineering, and Math Education, 2010) It supports approximately 40,000 graduate students annually through direct funding (research fellowships) or indirect funding (grants to institutions that provide graduate research assistantships or traineeships). The NSF's commitment to the Dean in Residence position is a reflection of its continuing interest in catalyzing transformational change in research and education to sustain U.S. excellence in science and technology fields.

The DIR position is affiliated with the Division of Graduate Education (DGE) within NSF's Directorate for Education and Human Resources (EHR). The DGE oversees the Graduate Research Fellowship Program (GRF) and the Integrative Graduate Education and Research Traineeship Program (IGERT). The DIR provides perspectives to DGE and CGS about programs and prospective strategies supporting STEM graduate education. The DIR also facilitates communication and networking between NSF and CGS, as well as with the broader institutions and stakeholders involved in STEM graduate education.

NSF's "Portfolio" for STEM Graduate Education—Addressing "I's" beyond Its Core Mission of Basic Research

Dr. Subra Suresh, the current NSF Director, has aligned the agency around a primary goal, "…Educational excellence in all NSF activities and research excellence in all NSF activities…" (Morrissey, 2012) Exploiting the

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synergies in coupling leading- edge research and education is paramount, as is cross-agency collaboration that enhances efficiency and promotes leveraging of resources. In short, the objective is "OneNSF," an optimal integration of programs for research, education, innovation, and training while retaining basic research as the core NSF mission (Morrissey, 2012).

Within the estimated 40,000 graduate students supported annually by NSF, the large majority are supported on research assistantships, with the remainder funded through graduate research fellowships (10-15%), or traineeships (6-8%) (Lightbourne, 2012).

The Graduate Research Fellowship program was created at the inception of NSF, and celebrates its 60th year in 2012. The occasion will provide an extraordinary opportunity to highlight the impact of this sustained NSF commitment to the development of many thousands of graduate students, thereby providing the foundation for their countless contributions to sustaining the nation's science and engineering research and education enterprise. The agency-wide fellowship program has supported many of the most promising young minds through nurturing early research endeavors, and has provided a cohesive focus to enable NSF support across all STEM disciplines. Innovations to enhance partnerships with the directorates have occurred recently, notably a co-sponsorship of industry internships involving the Directorate for Engineering. There are increasing efforts to expand global opportunities and international research experiences for fellows, such as the Nordic Research Opportunity supplements to GRF awards. The NSF continues to assess the GRF program, including program administration and outcomes such as impact on broadening participation in the STEM workforce.

In more recent times, the NSF launched its formal traineeship programs, such as IGERT.

Since 1997, there have been 278 IGERT awards with more than 5,200 students supported. IGERT has compiled an increasingly compelling collection of data on outcomes indicating that:

- Traineeships have accelerated graduate student training addressing the scientific and technical challenges of our time.
- Traineeships have cultivated Ph.D. scientists and engineers with enhanced technical and professional skills, as well as broader interdisciplinary perspectives.
- Traineeships have facilitated diversity in student participation and preparation.
- Traineeships have promoted engagement in settings where students consider how their discoveries may contribute to society and the "innovation ecosystem."
- Traineeships have provided a wealth of educational experiences bridging research and outreach, such as opportunities for university-industry research partnerships.

Yet, there is intense budget pressure across NSF, and the potential is very real for a major decrease in FY13 IGERT funds relative to levels of just two years ago. It appears to me that a continuing need is for NSF to catalyze institutional transformations that sustain and enhance the professional training of graduate students, in aspects such as research ethics, leadership, entrepreneurship, management, and analytical and communication skills. The question will be how to best accomplish that across the agency and how to appropriately align it with the needs of academic institutions and employers more generally.

Initiatives are underway to extend the IGERT model to NSF's emerging interdisciplinary research priorities, notably a new partnership announced with the Cyberinfrastructure Framework for 21st Century Science and Engineering Program (CIF21). It will be of interest to see how such an experiment might extend to NSF's other interdisciplinary initiatives.

More broadly, it appears timely to consider how NSF's current investments in center and traineeship programs may be leveraged more effectively to enhance training opportunities for graduate students funded through other NSF mechanisms such as GRFs or RAs. Inter-agency discussions are developing to better coordinate and validate the federal portfolio of STEM education investments. All of this, of course, is directly relevant to the enormous challenges facing our universities in institutionalizing educational opportunities and approaches. At the core is the objective of expanding access to effective practices in STEM graduate education, irrespective of the funding mechanisms involved.

Beyond the central programs administered through NSF's Division of Graduate Education, it is important to recognize that NSF has a very diverse array of initiatives and research programs that help respond to the four "Imperatives" facing all of graduate education. For example, major center grants such as Science and Technology Centers (STCs) and Engineering Research Centers (ERCs), have elevated graduate student research and training opportunities.

Indeed, NSF provides a broader set of "I's" that appropriately align with the emerging goals for transformational change in STEM graduate education. Table 1 provides a listing with associated hyperlinks to representative NSF activities and programs. Within the limited space available for this article, I can highlight only a few recent NSF developments that enhance research or training opportunities impacting graduate education.

Illustrations of new cross-agency efforts having strong support from the NSF Director's office include interdisciplinary initiatives related to CREATIV (Creative Research Awards for Transformative Interdisciplinary Ventures), international partnerships involved with SAVI (Science Across Virtual Institutes), and translational research partnerships through I-Corps (Innovation Corps). Graduate students stand to benefit from all of these opportunities, as do university research teams more generally.

The NSF has long recognized the value of interdisciplinary research, including solicited and unsolicited interdisciplinary proposals, programs focused on areas of national need and importance, various center competitions, and grants advancing the integration of research, education and training activities. Approximately one-third of recent NSF proposal solicitations included the word "interdisciplinary."

The CREATIV program is a new initiative that endeavors to support "unrestrained" interdisciplinary research proposals that are both "creative and risky." Leverage will be achieved in that half of the funds will come from the NSF Director's Office matched by a combination of resources from the relevant directorates. The program may provide as much as $120 million per year when it is fully implemented. In comparison, the current IGERT budget is on the order of $60 million annually.

International partnerships are also an increasing focus of the NSF portfolio, including numerous programs that seek to catalyze international collaborations in both research and education. A recent initiative involves SAVI, an innovative concept to foster and accelerate scientific advances through interactions among scientists, engineers and

Table 1

The NSF's "I's": Examples of NSF programs, offices and initiatives that support the four "Imperatives" in the context of STEM research and graduate education.

Integration of Research, Education and Outreach

- Integrative Graduate Education and Research Traineeship Program (IGERT)
- NSF Office of Integrative Activities (OIA)

Interdisciplinary Programs

- Portfolio of NSF Funding Mechanisms for Interdisciplinary Research
- Creative Research Awards for Transformative Interdisciplinary Ventures (CREATIV)
- Joint Initiative to Support Research at the Interface of the Biological and Mathematical Sciences (DMS/NIGMS)

International Cooperation

- Office of International Science and Engineering (OISE)
- Science Across Virtual Institutes (SAVI)

Industry Partnerships and Innovation

- Innovation Corps (I-Corps)
- Partnerships for Innovation (PFI)
- Industrial Innovation and Partnerships (IIP)

Inclusiveness- Broadening Participation

- Centers of Research Excellence in Science and Technology (CREST)
- Alliances for Graduate Education and the Professoriate (AGEP)
- Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers (ADVANCE)

Impact- Assessment

- STAR Metrics
- Research on Evaluation of Education in Science and Engineering (REESE)
- Evaluation and Data-Driven Decision Making

educators around the globe. SAVI specifically funds the exchange of students, postdocs and faculty between the U.S. and other countries. In the words of Dr. Suresh, "Good science anywhere is good for science everywhere, provided that a free and open flow of information, through a transparent process with measures to promote scientific ethics and integrity, flourishes everywhere" (Morrissey, 2012).

Although NSF retains an unwavering commitment to the value of fundamental research, it has begun to devote some resources to help bridge "the Valley of Death" from basic discoveries to societal and commercial applications. I-Corps is a new opportunity to assess the readiness of emerging technology concepts for transitioning into valuable products through public-private partnerships. It will facilitate the convergence of scientific, technical and business expertise to help bring discoveries out of the university lab to the benefit of economic development and the public good. The initial NSF goal is to make a modest annual allocation of about $5 million to develop a virtual network of mentors and to seed translational research that provides opportunities to university researchers, from undergraduates to faculty members, to probe the societal applications of their discoveries.

Input—Catalyzing Change and Next Steps

The above sections have highlighted the variety of NSF programs and initiatives that directly or indirectly impact the direction of STEM graduate education. However, there are myriad unresolved questions, many extraordinarily complex in light of the wide variability of university programs, disciplinary "cultures," and institutional resources. This article endeavors to spark new dialogue on the value of federal research and education partnerships in catalyzing transformational changes in graduate programs that will advance U.S. competitiveness.

From a university, perspective, what are the key issues regarding NSF's portfolio and its alignment with the needs of graduate education? Possible focal points for future discussions of NSF priorities and activities include aspects such as:

- Providing the optimal mix of funding mechanisms and models for graduate student success.

- Assuring the appropriate blend of disciplinary and interdisciplinary graduate research and training.
- Elevating professional workforce competencies and skills, through educational and professional development experiences funded by NSF, for both master's and doctoral students.
- Addressing fragmented support of STEM graduate education such as exists within NSF, between NSF and other federal agencies, or between NSF and academic institutions.
- Broadening participation in the STEM professional workforce through expanded access to integrative research, training and educational opportunities as supported by NSF.
- Assessing the importance of graduate education to U.S. competitiveness through federal investments such as those made by NSF.
- Catalyzing government-university-industry partnerships relevant to graduate education.
- Linking NSF support to grand societal challenges in areas such as sustainability, STEM education, and cyberinfrastructure.
- Sustaining graduate programs in light of recurring federal budget uncertainties, escalating competition for competitively awarded grants, changing program priorities, and NSF's expectations for institutionalization of successful programs.
- Advancing partnerships between NSF and U.S. graduate school's to elevate STEM education, including the integration of research and graduate training opportunities.
- Prioritizing graduate education among competing federal priorities for STEM education. (A new report from the National Science and Technology Committee on STEM Education (coSTEM) indicates that NSF is responsible for 41% of the $2.95 billion federal investment in STEM education (President's FY13 request). While it acknowledges the importance of federal support of graduate students, it does not target graduate education as among its top four priorities in an emergent five-year federal strategic plan on STEM education.)

In my role as NSF/CGS Dean in Residence, I strongly encourage feedback from CGS institutions on these and other issues and concerns. I welcome ideas for NSF/CGS forums and workshops, as well as suggestions about institutional or individual participants in such activities. As a next step, I am organizing an NSF panel discussion at the 2012 CGS Summer Workshop in Boston to explore future NSF priorities and effective strategies advancing STEM graduate education.

As always, the active engagement and counsel from CGS institutions will be an essential element in "moving the needle" to the benefit of U.S. innovation and competitiveness. We need your collective "I's" to have it!

By Richard W. Linton, NSF/CGS Dean in Residence

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CGS/ProQuest Distinguished Dissertation Award Nominations Sought

Nominations are now being accepted for the 2012 CGS/ProQuest Distinguished Dissertation Award. Two awards will be presented at the CGS Annual Meeting in December: one in the field of Mathematics, Physical Sciences and Engineering; the other in the Social Sciences. Each CGS member institution can submit a nomination for one individual in each of the two fields. The dissertation has to have been completed between July 1, 2010 and June 30, 2012. Winners receive an award of $2000 plus travel and expenses to attend the Annual Meeting in Washington DC. The award will be presented at the awards luncheon where the winners will speak about their research. Nominations are due no later than July 31, 2012. More details and the nomination form may be found at http://www.cgsnet.org/cgsproquest-distinguished-dissertation-award. Questions should be addressed to Cheryl Flagg at cflagg@cgs.nche.edu.

Data Sources: Results from the 2012 CGS Pressing Issues Survey

Graduate deans report that their top pressing issues in 2012 are about recruitment, admissions, and enrollment management, according to the Council of Graduate Schools' (CGS) annual *Pressing Issues Survey*. Each year, CGS asks graduate deans at member institutions to identify the three most important or "pressing" issues or challenges they currently face. The findings from this *Pressing Issues Survey* inform CGS about the concerns of graduate deans and help to shape sessions at Summer Workshops, Annual Meetings, and other forums, as well as future best practices projects. The survey has been conducted annually as part of the *CGS International Graduate Admissions Survey, Phase I: Applications* since 2004 and through the CGS membership survey and other surveys in prior years.

The 2012 Phase I survey was sent to the 500 U.S. colleges and universities that were members of CGS as of January 2012. A total of 242 institutions responded to the survey, for a response rate of 48% (Bell, 2012). About 91% (221) of the Phase I survey respondents wrote in one or more pressing issues in response to this open-ended question, and the analyses below are limited to these 221 respondents. They included 147 doctoral institutions, 58 master's-focused institutions, and 16 institutions classified as baccalaureate or specialized in the 2010 basic Carnegie Classifications. Sixty-nine private, not-for-profit institutions responded to the *Pressing Issues Survey*, along with 152 public institutions. By geographic region, 60 of the responding institutions were in the Midwest, 49 were in the Northeast, 33 in the West, and 79 in the South. Responses to the *Pressing Issues Survey* were coded into broad categories. Since respondents were able to write in up to three pressing issues, the percentages sum to more than 100%.

Pressing Issues in 2012

The top pressing issue identified by graduate deans was recruitment, admissions, and enrollment management, mentioned by more than half (58%) of all respondents (see Table 1). Within this category, respondents mentioned managing declining or growing enrollments, competition for prospective graduate students, challenges in attracting a diverse applicant pool, challenges in recruiting international students, and recruiting quality graduate students, among other concerns. Respondents from master's and specialized institutions were more likely to mention recruitment, admissions, and enrollment management than graduate deans from doctoral institutions (68% vs. 54%), and respondents from private, not-for-profit institutions were more likely to indicate that this was a pressing issue than those at public institutions (65% vs. 55%).

Graduate student financial support was the second most commonly mentioned pressing issue, with half (50%) of all respondents saying this was a concern. This category includes health insurance for graduate students, as well as direct support through assistantships, fellowships, etc. Graduate deans from doctoral institutions were more likely than those from master's and specialized institutions to indicate that graduate student financial support was a concern (53% vs. 45%). Respondents from public institutions were more likely to note graduate student financial support as a pressing issue than respondents at private, not-for-profit institutions (53% vs. 45%).

Graduate program financing, dealing with budget cuts, and issues related to state economies and the national economy ranked third (36%). Respondents from doctoral institutions and master's and specialized institutions were nearly equally likely to mention this issue, as were respondents from public institutions and private, not-for-profit institutions.

General management and administration issues ranked as the fourth most pressing issue this year (28%). Within this category, respondents mentioned implementing new technology systems, changes to policies and procedures, and changes to the structure of the graduate school, among other concerns. Respondents from doctoral institutions were more likely to mention general management and administration issues than graduate deans from master's and specialized institutions (30% vs. 24%), and respondents from private, not-for-profit institutions were more likely to indicate that this was a pressing issue than those at public institutions (32% vs. 26%).

The percentages of respondents who mentioned the remaining pressing issues are shown in Table 1. Student support and services (24%) includes advising and mentoring, professional development for graduate students, mental health counseling, career advice, and job placement assistance, among other concerns. All issues related to program quality; the evaluation, assessment, or review of graduate programs; accreditation; and student learning outcomes were grouped together as program quality, evaluation, assessment, and review (16%). The category of faculty and staff issues (11%) mainly includes responses about the challenges of dealing with faculty and staff shortages, primarily due to budget cuts. Issues surrounding retention, completion, attrition, and time-to-degree (11%) are also grouped together, as are responses related to developing or eliminating programs (9%). The category of leadership and advocacy (7%) includes responses related to promoting graduate education and communicating the value of graduate education to internal and external stakeholders, among other related issues. Finally, all responses related to program delivery, including the delivery of online, distance, interdisciplinary, and joint and dual programs are grouped as program delivery (7%).

Pressing Issues by Carnegie Classification and Institutional Control

The rank order of the top three pressing issues was the same for respondents from doctoral institutions as it was for respondents from master's and specialized institutions (see Table 1). In both cases recruitment, admissions, and enrollment management was the top issue (54% and 68%, respectively), graduate student financial support was ranked second (53% and 45%, respectively), and graduate program financing, dealing with budget cuts, and issues related to the economy ranked third (37% and 35%, respectively). Respondents from doctoral institutions were more likely than respondents from master's and specialized institutions to mention student support and services (31% vs. 12%), but they were less likely to mention faculty and staff issues (7% vs. 18%).

The findings for respondents from public institutions and private, not-for-profit institutions also mirrored the overall findings, with recruitment, admissions, and

enrollment management; graduate student financial support; and graduate program financing, dealing with budget cuts, and issues related to the economy as the first, second, and third most pressing issues, respectively (see Table 1). However, respondents at private, not-for-profit institutions were more likely than those at public institutions to indicate that recruitment, admissions, and enrollment management was a pressing issue (65% vs. 55%) and that student support and services was a concern (32% vs. 21%). In contrast, respondents at public institutions were more likely than those at private, not-for-profit institutions to cite graduate student financial support as a pressing issue (53% vs. 45%).

Pressing Issues by Geographic Region

Recruitment, admissions, and enrollment management was the top pressing issue identified by graduate deans at institutions located in all four regions of the United States (see Table 2). The percentage of respondents indicating this area as a pressing issue ranged from a low of 53% of respondents in the South to a high of 67% of respondents in the West. Graduate student financial support was the second most pressing issue across all four regions, with about half of all respondents in each geographic area indicating that this was a concern. Graduate program financing/budget/economy was the third most pressing issue for respondents from the Midwest, West, and South, while general management and administration issues ranked third for respondents from the Northeast. Respondents from the Northeast were also most likely to mention issues related to student support and services.

Historical Comparison of Pressing Issues

Articles in previous years about the Pressing Issues Survey have provided an examination of the changes in pressing issues over time. Over the past several years, however, there have been variations in coding among researchers, as well as variations in the broad categories used to group issues, meaning that such an examination of changes over time is inexact. Rather than presenting rankings of pressing issues categories over time, it is better to simply touch on the issues that remain among the top concerns of graduate deans each year.

Two broad topics in particular have been mentioned frequently by graduate deans over the past several years: graduate student financial support and recruitment, admissions, and enrollment management. In most recent years, these have been among the two most pressing issues faced by graduate deans. Issues related to graduate program financing, dealing with budget cuts, and the economy have also been mentioned frequently by graduate deans, particularly in the last four years. General management and administration issues have also been cited as concerns in recent years, but given the wide variety of issues that are typically grouped within this category, the specific challenges have varied from year to year.

Conclusion

The results of this year's *Pressing Issues Survey* reveal that the majority of graduate deans view recruitment, admissions, and enrollment management as their top concern, as they face issues related to managing declining or growing enrollments, competition for prospective graduate students, and challenges in attracting a diverse applicant pool, among other concerns. They also remain concerned about graduate student financial support and about graduate program financing, dealing with budget cuts, and issues related to the economy. The latter is often reflected in other broad categories as well, with respondents mentioning concerns about the effect of budget cuts on other aspects of graduate education, including recruiting budgets, personnel, and program delivery. Overall, the results of the *Pressing Issues Survey* reveal the continued focus of graduate deans on recruiting, enrolling, and financially supporting high quality graduate students; on offering high quality graduate programs that produce graduates ready to meet the demands of the 21st century global economy; and on providing students with the necessary support to ensure their successful completion.

By Nathan E. Bell, Director, Research and Policy Analysis, Council of Graduate Schools

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Table 1

Results from the 2012 CGS Pressing Issues Survey

	Percentage of Respondents				
Pressing Issue	Total	Doctoral	Master's & Specialized	Public	Private, not-for-profit
Recruitment/Admissions/Enrollment Mgmt.	58%	54%	68%	55%	65%
Graduate Student Financial Support	50%	53%	45%	53%	45%
Graduate Program Financing/Budget/Economy	36%	37%	35%	37%	35%
General Management and Administration	28%	30%	24%	26%	32%
Student Support and Services	24%	31%	12%	21%	32%
Program Quality/Evaluation/Assessment/Review	16%	17%	14%	16%	15%
Faculty and Staff Issues	11%	7%	18%	13%	7%
Retention/Completion/Attrition/Time-to-Degree	11%	14%	5%	11%	10%
Program Development/Elimination	9%	5%	15%	8%	10%
Leadership and Advocacy	7%	8%	4%	7%	6%
Program Delivery	7%	4%	14%	9%	4%

Source: *2012 CGS Pressing Issues Survey*

Table 2

Pressing Issues by Geographic Region, 2012

	Percentage of Respondents				
Pressing Issue	Total	Midwest	Northeast	West	South
Recruitment/Admissions/Enrollment Mgmt.	58%	60%	61%	67%	53%
Graduate Student Financial Support	50%	52%	47%	52%	51%
Graduate Program Financing/Budget/Economy	36%	35%	24%	33%	38%
General Management and Administration	28%	33%	41%	15%	22%
Student Support and Services	24%	23%	35%	21%	20%
Program Quality/Evaluation/Assessment/Review	16%	15%	8%	18%	20%
Faculty and Staff Issues	11%	5%	16%	15%	10%
Retention/Completion/Attrition/Time-to-Degree	11%	10%	6%	12%	14%
Program Development/Elimination	9%	7%	6%	3%	14%
Leadership and Advocacy	7%	5%	2%	3%	13%
Program Delivery	7%	8%	2%	3%	11%

Source: *2012 CGS Pressing Issues Survey*

PSM Transition

Introduction and Background

The Professional Science Master's degree (PSM) is an innovative graduate program designed to allow students to pursue advanced training in natural science, technology, engineering, mathematics, or computational sciences while simultaneously developing professional workplace skills highly valued by employers. Over the past decade, the PSM has been embraced enthusiastically by the graduate education community in an effort to produce the kinds of science and engineering professionals needed to keep the U.S. globally competitive. The PSM has rapidly expanded from about 80 programs in 2006 to about 250 programs at 115 institutions today. By fall 2011, PSM programs enrolled approximately 5,500 students, including 1,700 first-time students. In 2010-11, 1,573 PSM degrees were awarded.

Since 2006, the Council of Graduate Schools (CGS) and the Alfred P. Sloan Foundation have successfully worked together to institutionalize and promote the growth and development of the PSM and to establish a process for recognizing programs. CGS was tasked with establishing the PSM brand as a recognizable degree and regular feature of graduate education; a key strategy has been the implementation of an affiliation process. This involves formal review, by CGS staff assisted by an external review committee, of proposals for PSM affiliation that are submitted by institutions seeking to launch a new PSM program. The review is based on a set of PSM standards that are referred to as the *Guidelines for Recognition as a Professional Science Master's Program*.

CGS issued a Request For Proposals (RFP) to identify an organization that would assume the responsibility for sustaining the PSM affiliation process. The Keck Graduate Institute (KGI) was selected from among those who responded to the RFP. KGI is a member of the Claremont College consortium in California and is "dedicated to education and research aimed at translating into practice, for the benefit of society, the power and potential of the life sciences." KGI offers the PSM as its flagship degree and has established an outstanding network of corporate advisors, employers, and trustees that embodies the PSM model. Established in 1997, KGI is graduating its 11th class of PSM graduates this May.

CGS will continue to manage and staff the existing PSM Affiliation process until responsibility has been transferred to KGI. To complete a full transition from CGS to KGI by July 1, much activity has been underway since early this year. The CGS research team will continue to field test the PSM enrollment and degrees and career placement surveys until these instruments are fully established in December 2013 when KGI will assume this data collection function.

The purpose of this article is to summarize the transition process including KGI's leadership vision and to present details on implementation plans.

PSM Leadership Vision

KGI is very pleased to have been awarded the honor of taking responsibility for managing the PSM affiliation process, curation of the sciencemasters.com website, and managing use of the registered PSM logo. The early entrepreneurial efforts of Henry Riggs, Sheila Tobias, many PSM program leaders, and the Alfred P. Sloan Foundation were largely responsible for the launch of the PSM initiative or movement that has grown dramatically over the past fifteen years. The success of the movement may also be attributed to the leadership and support of the National Professional Science Master's Association (NPSMA), the National Association of System Heads (NASH), the Systemwide, Statewide and Regional (SSR) PSM group and federal support from the NSF for establishment of new science masters degrees. The formation of these overlapping but independent PSM constituencies can be viewed as a natural progression in the evolution of a professional educational program. CGS became the natural home for the care, nurturing and promotion of this innovative and impactful graduate degree and has enjoyed serving as a kind of "national headquarters" for the PSM movement for nearly a decade. As in the evolution of educational programs in other professions, for the PSM it was essential to direct specific attention to issues of quality control aspects of the programs.

We anticipate that the PSM Office at KGI will be advised through an Executive Advisory Commission to the PSM Office that will meet regularly to ensure stakeholder issues are addressed. We have been in active discussions regarding the creation of this group with the hope and expectation that there will be broad stakeholder representation. We welcome input from the community regarding the establishment of this Executive Advisory Commission to the PSM Office at KGI.

PSM Affiliation: New Programs

The PSM is a professional degree but there is no single clearly-identified profession that graduates enter, and there is no single profession whose interests warrant licensure of PSM graduates or accreditation of this degree. Therefore, in contrast to many professions, there is no need for an independent accreditation organization. Similarly, there is no single type of risk that is presented to the customers of the employers of PSM graduates that could lead to a specific form of malpractice, the need for licensing, or to the need for specific continuing education requirements for PSM graduates. As a result, there seems to be consensus among stakeholders that accreditation is not warranted for PSM programs. However, there is a perceived need to ensure that a new program meets the *Guidelines* and that some form of re-affiliation review system be in place to ensure that a program continues to meet the *Guidelines* as the program evolves.

The PSM Office is committed to utilizing the *Guidelines* that were developed through the PSM stakeholders meetings for new PSM program affiliation, and will continue to utilize the same application and review process that has been in use at CGS, which confirms that each of the guidelines is addressed in the application for affiliation of a new PSM program. Iteration with the applicant is quite common and changes can be made and multiple re-submissions are acceptable. Most applications are well prepared, and demonstrate that the guidelines will be met. If there is concern about a particular aspect of a program, an external volunteer affiliation committee opinion is provided to make the final decision on affiliation. The PSM Office at KGI will assume the responsibility for managing the PSM affiliation process on July 1, 2012, and we aim for a smooth transition from the CGS PSM management team.

PSM Affiliation Review of Existing PSM Programs

The approval of PSM affiliation for a new program is based on the promise that a

program plans to meet the guidelines and shows evidence that the curricular and co-curricular features of a PSM are established. There is no guarantee, however, that a program will implement all the PSM features and the nature of these innovative programs is that they often evolve very quickly. Programs are likely to be reviewed as part of an institution's internal program review cycle and PSM programs will be a part of regional accreditation review. These are the primary mechanisms to ensure quality control of PSMs but there are some pressures that could influence changes that would be adverse to the PSM movement. In many institutions of higher education, financial challenges are leading to cutbacks in student services and the ability of academic staff to provide program support.

One of the criteria of PSM programs defined in the *Guidelines* is that the employment history of graduates should be tracked to help assess program outcomes. We are just beginning to gather empirical data on career outcomes for PSM graduates since PSM programs had only rudimentary systems in place to track graduates. There is a perception that program directors are stretched to serve multiple management roles and that they may not have the resources or capacity to implement robust tracking systems.

We see that both the financial pressures and bandwidth limitations of program directors can be viewed as factors that could weaken the quality and rigor of PSM programs. External factors may therefore adversely affect the ability of PSM programs to meet the *Guidelines* through cutbacks of certain course content, professional development activities, or overall scope of a program. It is our view that these conditions warrant the implementation of a PSM Affiliation Review process by the PSM Office. We look forward to working with PSM stakeholders in 2012-13 to launch PSM Affiliation Review for existing programs.

Financial Aspects of the Transition

The Sloan Foundation has provided grant support to CGS to cover costs of managing new PSM program affiliation and the PSM logo through the start-up phase. There is a need going forward to cover the cost of managing the affiliation application process. With the momentum of the PSM movement, it is now clear that there is value in PSM affiliation and use of the PSM logo in marketing programs to both prospective students and employers. Based on this value in affiliation, PSM programs should begin to financially support the administrative costs through affiliation fees.

There has been email communication to the PSM community that the PSM Office will begin charging a $1500/affiliation fee to partially offset the staffing costs of managing the affiliation process for new PSM programs, and the administration of the website and use of the PSM logo. We would like to emphasize that there is ongoing communication with the NPSMA leadership, members of the SSR group, and others regarding the impact that such fees could have on the PSM movement. The PSM Office is sensitive to the budgetary impact this fee could have and will work with programs, departments, schools, and systems to implement payment plans (e.g. $300/year x 5 years) or deferrals. We also advocate the NPSMA as the best membership organization for PSM program support and will work to ensure that PSM stakeholders support this group through membership dues, participation in best-practices workshops and by sending representatives to NPSMA meetings. We encourage PSM stakeholders to communicate with the PSM Office with ideas and concerns about the fee structure for the PSM program affiliation process.

Enhancing the PSM Brand

In addition to taking on the responsibility of the PSM affiliation process, the CGS handoff also assigns the PSM Office at KGI responsibility for the curation of the sciencemasters.com website and the licensing and use of the PSM acronym and logo that have been registered as a certification mark by the Sloan Foundation. One of the main objectives of the PSM Office is to increase national awareness of the PSM movement through marketing of programs on the website. The website will remain the primary repository of the list of affiliated PSM programs with links to the program web sites and a ticker showing the number of affiliated programs. We anticipate enhancements and partnerships with other websites to expand outreach to PSM corporate partners to develop awareness of PSM benefits.

Affiliated PSM programs will continue to have the right, and obligation, to utilize the PSM logos on their own websites and promotional materials. This logo is gaining recognition and remains an important mechanism to prevent inappropriate use of the PSM moniker for programs that fail to meet the *Guidelines*. With continued growth and success, emulation of PSMs in other forms are likely to result in competing brands that could threaten the reputation of quality and rigor that has been earned over the past 15 years.

The CGS Role Going Forward

CGS is strongly invested in the success of the PSM initiative and will continue to highlight the PSM in its Best Practices. As part of its Benchmarking and Consultation services, CGS is able to provide expertise from deans who are experienced PSM leaders to assist institutions interested in developing and/or expanding PSM programs. Most importantly, as the leading national advocate for graduate education, CGS will continue to urge support of the PSM as part of its government relations advocacy and public outreach agenda.

Summary

A full transition from CGS to KGI of the affiliation review process, management of the sciencemasters website, and the use of the PSM logo is expected to be completed by July 2012. We anticipate that the Alfred P. Sloan foundation will transfer the license to approve use of the PSM logo from CGS to KGI at that time. The transfer of the survey instruments will be completed by December 2013. Over the coming months, CGS and KGI will continue working together to achieve a smooth transition. CGS has had the privilege of providing leadership for the development of the PSM concept which is contributing in fundamental ways to the graduate education enterprise and to the U.S. innovation agenda. The broad PSM community can look forward to active engagement with the PSM Office at KGI in advancing the PSM into the future.

We encourage communications regarding this article and the transition of the PSM affiliation process to be made through a new email address:
psmoffice@sciencemasters.com

By James Sterling, Vice President for Academic Affairs, Keck Graduate Institute, Carol B. Lynch, Senior Scholar in Residence and Co-Director, Professional Master's Programs, Council of Graduate Schools, and Sally K. Francis, Senior Scholar in Residence and Co-Director, Professional Master's Programs, Council of Graduate Schools

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