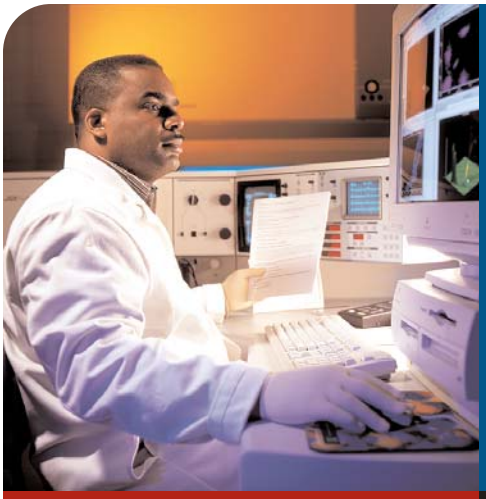

The Professional Science Master's Degree

Results of a Pilot Survey of Programs

PSM
PROFESSIONAL
SCIENCE MASTER'S

COUNCIL OF GRADUATE SCHOOLS
cgs

THE PROFESSIONAL SCIENCE MASTER'S DEGREE:
RESULTS OF A PILOT SURVEY OF PROGRAMS

Conducted and Analyzed by the Council of Graduate Schools
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INTRODUCTION

In January 2006, the Council of Graduate Schools (CGS) assumed primary responsibility from the Alfred P. Sloan Foundation for supporting and promoting the Professional Science Master's (PSM) Initiative, with the goal of making the PSM degree a regular feature of U.S. graduate education. The Sloan PSM initiative began in 1997 when a select number of research universities developed programs integrating science and mathematics studies with knowledge and training in management, law, or other professional arenas. In 2001, CGS began its promotion of the PSM by partnering with Sloan to extend this initiative to a number of master's focused institutions.

Because its member institutions award over 90% of the doctorates and 75% of the master's degrees in the U.S., CGS is well situated to facilitate the creation of new PSM programs, in addition to supporting existing programs. CGS provides information, guidance, and "best practices" on how to develop new programs, curricula, and internship opportunities and also articulates the need for, and value of, the PSM to its membership and the community at large.

In addition, through its Government Relations and External Affairs department, CGS shares information with policymakers and others about the PSM and its relationship to ensuring a highly qualified science, technology, engineering, and mathematics (STEM) workforce for the future. Last year, the President signed the America COMPETES Act which authorized support for PSM programs at the National Science Foundation. Expectations are that Congress will include appropriations for the PSM programs at NSF in legislation for Fiscal Year 2009.

MORE ABOUT THE PSM

The PSM is an exciting new degree option for bachelor's graduates in the sciences, mathematics, or engineering who choose not to pursue a doctorate, but need additional training and skills to compete in today's global marketplace. It is designed as a terminal degree preparing a student for entry directly into the workforce, not as a stepping stone to the doctorate. It involves not only advanced disciplinary study, but also an appropriate array of professional skill-development activities to produce graduates highly valued by employers and fully prepared to progress toward leadership roles.

The professional skills component (often called the "plus" component of a "science-plus degree") may consist of a variety of relevant courses and activities developed in consultation with prospective employers. Examples include business basics, legal and regulatory issues, finance and marketing, communication and teamwork, and are often developed in collaboration with appropriate academic units outside the sciences or taught by adjunct faculty from the targeted employment sector. In addition to courses and workshops, professional skills are usually enhanced by internships and problem-based projects sponsored by employers.

THE SURVEY

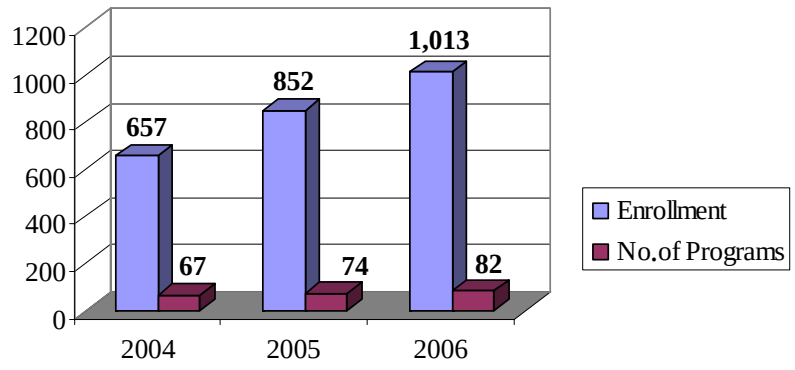
The ultimate test of PSM programs is employers' willingness to hire graduates, who are ideally suited for a variety of roles within business, government and the non-profit sectors that are key to keeping America competitive. To that end, CGS surveyed the Program Directors responsible for administering the PSM degree on their campus to ascertain the current status of PSM programs. We collected data on enrollments over the academic years 2004-2006, the number of graduates in 2006 and the employment status of the 2006 PSM graduates.

In order to assess the status of the current PSM programs, we also asked the Program Directors whether they were experiencing any problems in recruiting students for their programs or in securing sites for placing students in internships. Were graduates experiencing any difficulty in securing employment? Were PSM graduates being tracked? Were there any challenges in sustainability or institutionalization of the PSM on their campus? Were any additional PSM tracks being developed on their campus; if so, in what fields? Were they interdisciplinary? It is from this pilot survey conducted among the PSM Program Directors in 2006 that we are reporting the following data and information. We thank all of those who took the time to respond. These survey areas are addressed below, followed by some general conclusions.

Results

Enrollment. Figure 1 illustrates the rapid increase in enrollment in PSM programs from 2004 to 2006 of those institutions responding to the survey. In 2004, 657 PSM students were enrolled in 67 PSM programs (*Mean* = 9.8 students). By 2005, 852 students were enrolled in 74 PSM programs (*Mean* = 11.5 students), an enrollment increase approaching a third (29.7%). Enrollment increased again in 2006 by nearly 19%, as 1,013 students enrolled in 82 PSM programs (*Mean* = 12.4 students). Overall, from 2004 to 2006, total enrollment increased by 54.2%. With the number of PSM programs increasing, it is not surprising that enrollments and degrees are increasing as well.

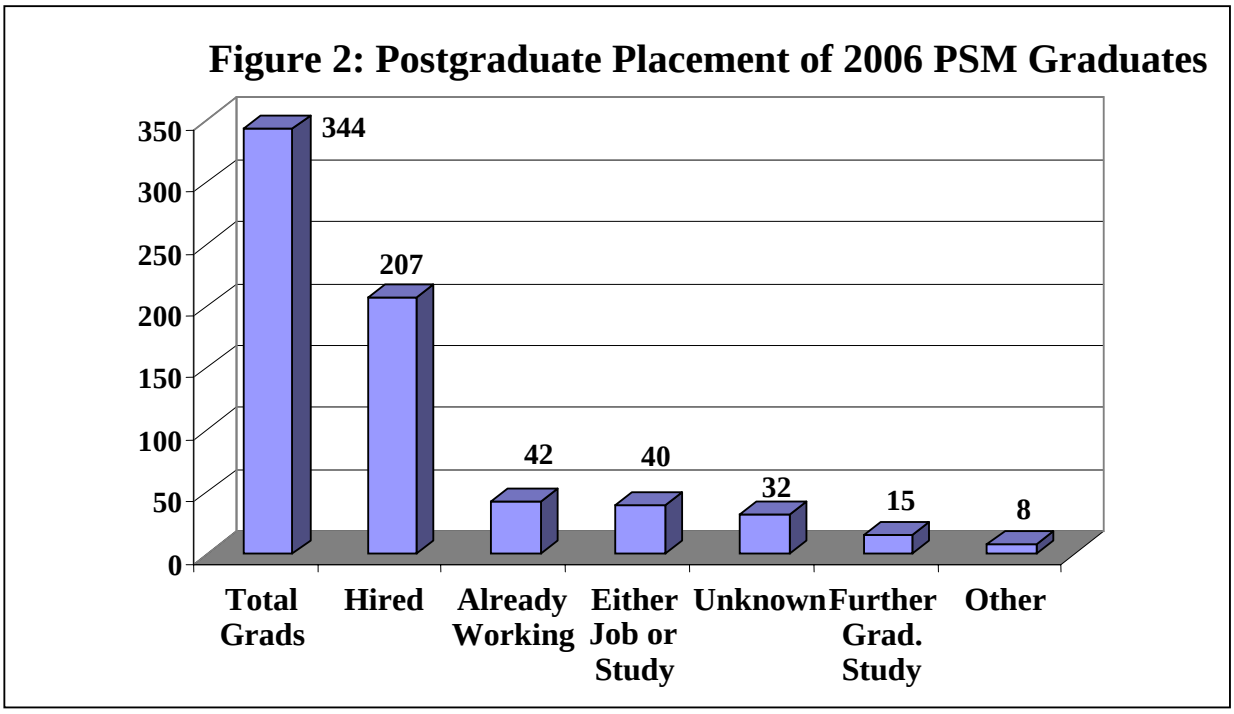
Figure 1: PSM Enrollment and Number of Programs, 2004-2006



Source: CGS, Survey of PSM Program Directors 2006

Post-graduation. Figure 2 illustrates that three out of five (60.2%) PSM graduates in 2006 entered the workforce immediately after completion of their PSM. This figure is actually higher, but we were not able to separate out the placement status for 40 graduates (11.6%). They were either employed

or pursuing further study. (We believe the bulk of these 40 graduates were employed based on conversations with some of the Program Directors). An additional 12.2% were already employed and completed the PSM to further their education and increase their opportunity for advancement. Thus, nearly three-quarters (73%) of PSM graduates in 2006 were employed in non-academic sectors, compared to about 4 percent of PSM students who opted for further graduate study – in most cases a PhD program. Again, this figure also should be higher as it would include some in the combined category of either job or study. Clearly, based on data from this pilot survey, the PSM model is fulfilling its mission of preparing graduate-level scientists to enter the Business/Government/Non-Profit (BGN) workforce and that PSM graduates are finding employment in the sector for which they were prepared.



Looking at enrollments and degrees by broad field reveals that PSM programs in the biosciences predominate, with well over a third of the enrollments and degrees in 2006 in this area. Following the biosciences in total number are PSM programs in the computational sciences. Table 1 presents 2006 enrollments and degrees by broad field.

Table 1: Enrollments and Degrees, 2006

Program	Fall 2006 Enrollments	2006 Graduates
Biosciences	363	122
Computation Science	164	53
Mathematics	123	36
Bioinformatics	107	50
Chemical Sciences	60	7
Physics	57	8
Environment/Geology	43	22
Medical-related	38	9
Other	58	37
Total	1,013	344

Source: Survey of PSM program directors, 2006-07.
39 institutions representing 82 programs responded.

Recruitment. Program Directors identified two challenges to student recruitment: (a) lack of student financial support, and (b) and some difficulty in interesting well qualified domestic students. First, PSM recruitment efforts seemed to be hindered by a lack of financial support, which is the case for most professional degrees. Debt-averse students may find the self-pay aspect of the PSM degree unappealing. Showing prospective students salary data comparing the PSM degree to the baccalaureate degree may help alleviate this problem. According to data published in 2006 from the National Science Foundation, the median annual salary for master's graduates in mathematics was $54,000, 50% more than the $36,000 earned by baccalaureate graduates in that field. Master's graduates in physical sciences earned 40% more - $49,000 compared to $35,000 and master's graduates in the biological sciences reported earning 38% more than their baccalaureate colleagues - $40,000 compared to $29,000. While comparable data for PSM graduates are not available, we do find that PSM graduates in 2005 reported salaries ranging from a low of $45,000 for those working in government or nonprofit organizations to a high of $64,000 for those working in private industry. Indeed, there is a definite salary premium for master's graduates in mathematics, physical sciences and biological sciences.

Second, a few Program Directors experienced difficulty in recruiting domestic students. A number indicated that when U.S. students find out that there is no funding, they lose interest. This is not surprising since capable individuals with undergraduate degrees in the natural sciences and mathematics are highly recruited into doctoral programs where funding is available. Additionally, interest among international students may be contributing to the influx of international students into STEM programs broadly.

Clearly, these Program Directors indicated that there is need for some form of student support if more domestic students are to be recruited into PSM programs.

Internships. Most PSM programs require an internship with an off-campus business, industry, government agency or research institute as part of the program. These internships are most valuable when they are directly related to the area of PSM study and many Program Directors help students find internships to fulfill this requirement. Internships allow students to engage in "real-world" work involving technical problems. Since internships also provide students an opportunity to work

in teams, as well as utilize their communications skills, they play an integral part in preparing students for non-academic employment.

Overall, Program Directors indicated that finding internships was not a problem. Most of them had very good relationships with their local/regional business community, which is an essential part of the PSM programs. However, one Program Director mentioned that some students are unwilling to relocate for an internship and "finding internship sites in our local area is challenging," and two Program Directors commented that corporate partners were lagging in supporting internships.

Job Placement. The overwhelming response to the question of whether PSM graduates were hard to place was "no." PSM graduates are not having a difficult time finding employment. For example, one Program Director wrote, "Over 80% of our graduates found employment within 3 months of graduation." Another Program Director noted that PSM graduates were receiving multiple job offers, while one said that one of his graduates had received 5 job offers and had chosen the employer where he had done his internship. The complete results of job placement are presented in Figure 2 (p. 4).

Exit surveys and track graduates. Most Program Directors indicate they have developed an in-house exit survey for PSM graduates of their own. However, a number of Program Directors mentioned some difficulty in getting graduates to complete the exit survey.

Additionally, most Program Directors either currently track their PSM graduates or plan to do so. However, the task of tracking graduates is regarded as challenging, particularly after the initial job placement. To streamline data collection, a few Program Directors are developing web-based surveys that graduates can complete online. The new National Professional Science Masters Association (NPSMA), which was funded by the Alfred P. Sloan Foundation in 2007, has plans to develop a web-based survey that all PSM programs can utilize to track PSM graduates.

Sustainability. Since most of the existing PSM programs were created with funding assistance from the Alfred P. Sloan Foundation, it is important to know if the programs can be sustained independently. In examining the information provided by the Program Directors, it appears that there may be differences in sustainability of PSM programs across disciplines. While a number of Program Directors indicated that they had no problems with sustainability - their administration was extremely supportive - others expressed some concern. One Program Director commented, "There are issues concerning sustainability in math and physics due to lack of faculty interest, low numbers of students, [and] not as much student support in those departments." However, another Program Director noted that although his regular applied master's program in mathematics had a very stable small enrollment for years, when he added the "plus" component to the program and made it a PSM program, enrollments soared. Another Program Director noted problems associated with administrator turnover on the campus. "The major problem we face is the 'revolving door' of administrators; this requires us to constantly educate and revisit agreements and policies. CGS can help with this by increasing awareness nationally of the PSM so that it is not foreign to administrators and other university officials."

CGS has been addressing this issue by sponsoring sessions about the PSM at its Annual Meeting and at its Summer Workshop for the past four years. Additionally, CGS staff has organized sessions on the PSM for the annual meetings of the four regional associations of graduate schools. All of these sessions have been well attended by the deans of the graduate schools who are members of CGS.

Most Program Directors indicated confidence in their institution's dedication to financially support their PSM programs, but there were a few who were concerned about the long-term financial commitment of their institutions. One Program Director noted, "Our challenges are in 1) developing a dedicated revenue stream for the program and 2) finding funding opportunities for new students." Similarly, a Program Director wrote, "[The] only problem is getting more graduate assistantships. [The] program could double if more assistantships were available."

New PSMs under development. Program Directors were evenly split on the development of additional PSM programs at their institutions. Fourteen Program Directors mentioned concrete plans to develop additional PSMs at their institutions, while a number mentioned informal plans to develop additional PSMs based on the interests of faculty and industry. Fifteen Program Directors indicated that no new PSM programs were under development at this time.

Requests for CGS support. When asked how CGS could support Program Directors in developing and maintaining their PSM programs, a number of suggestions were made, including:

- Tracking federal and state funding streams to support PSM students.
- Creating a national meeting for PSM students.
- Developing and maintaining a national database of employers that would provide internships and jobs to PSM students.
- Providing advice on how to recruit students.
- Creating a PSM brochure that individual programs can distribute with their own recruitment materials.
- Increasing national and international advertising for greater program visibility.

CGS has already acted on many of these suggestions. The organization provides regular updates to the Program Directors on federal and state legislation that might support PSM students. CGS hosted the Fifth Biennial Meeting of Program Directors which featured a number of PSM graduates. In presentations on the PSM, CGS personnel provided advice on ways to recruit students. They completely redesigned the PSM website (www.sciencemasters.com) resulting in soaring numbers of visitors to the site; they sponsored booths at national meetings such as at the Society for Advancement of Chicanos and Native Americans in Science Conference to present other career options for those who want to remain in science without getting a doctorate; and they provide links from the highly visited GradSchools.com website. They designed and circulated three PSM brochures designed for different audiences: students, employers and policymakers.

The newly formed National Professional Science Master's Association will act on some of these suggestions as well, including creating a national meeting for PSM students as well as tracking job placement.

General Comments. Program Directors addressed a variety of issues related to the development and sustainability of PSM programs. Some of their comments are noted below:

> "Getting NSF/NIH to provide training grants to assist PSM programs would help immensely and speaks directly to the problem that in the U.S. the upper level administrators realize the NEED for investment in technology, but this rarely

translates into incentives for the student to go into technological careers. A real disconnect..."

"Currently [we] track our graduates and ask them to potentially serve as mentors for new, incoming students via the Internet. [We also] try to list them on our alumni web pages."

"We always need scholarship money, so let me know if you have a source. Out-of-state students get nailed pretty good by [institution name] and the cost keeps them away in droves. In my field, our competition, [name of institution] is keeping costs down and has a "Mickey Mouse" online series of courses that further cut costs."

"During the exit interview, students are required to complete a survey about the PSM and have a face-to-face discussion with PSM staff to make sure they've completed all program requirements and discuss in person any concerns they might have."

CONCLUSIONS

PSM programs are growing across the country and enrollments are increasing (Figure 1). While this pilot study reports on data submitted by 67 PSM programs in 2004, 74 PSM programs in 2005 and 82 PSM programs in 2006, there are, as of February 2008, more than 120 PSM programs – over 50% more than in 2006 with more being developed each month. Data from post-graduate placement shows that the PSM mission is being fulfilled: more than seven out of ten PSM graduates are finding work in the business, government and nonprofit sectors.

As is the case with most professional degrees, the PSM degree is usually paid for by the student. Recruitment of students into PSM programs will benefit from salary data comparing the entry-level salary of PSM graduates versus other types of degrees. The majority of PSM students are finding internships and entry-level jobs without difficulty; many PSM graduates are faced with choosing among multiple job offers. There are several programs in which the demand for the graduates is so high that employers are providing full-tuition for the students.

Concerns over the sustainability of PSMs centered on securing dedicated funding streams. In 2007, a provision was included in the America COMPETES Act (Section 7034) that requires the National Science Foundation (NSF) to award grants to facilitate the creation or improvement of PSM programs at institutions of higher education. The legislation authorizes $12 million for the PSM program in Fiscal Year 2009. If funding were appropriated, this would enable up to an additional 200 institutions of higher education to institute or improve PSM programs.

Another sustainability issue involved the continuous education of "revolving-door" administrators who were unfamiliar with the PSM model, although half of the Program Directors indicated concrete plans for the development of new PSM programs at their institutions.

A survey by the National PSM Association to obtain more detailed information for 2006 onward is currently in the field. Data will be broken out by demographics, job placement data, and provide more complete answers to some of the questions that were examined by CGS on sustainability, recruitment, internships, etc.

The Professional Science Master's degree has definitely moved from the concept stage to reality. In just over a decade, the value of PSM programs is already widely recognized by employers in the public and private sectors. Currently, there are more than 1,300 PSM graduates nation-wide and many of them are advancing and making important contributions in their respective fields. As the second decade begins, CGS believes this growth will continue even more rapidly than was seen in the first decade of the PSM.

INSTITUTIONS AND PROGRAMS PARTICIPATING IN THE SURVEY FOR 2006

American University
- Applied Computing
- Biotechnology
- Environmental Science & Assessment

Arizona State University
- Computational Molecular Biology/Bioinformatics

California State University, Fresno
- Biotechnology
- Forensic Science

Case Western Reserve University
- Chemistry for Entrepreneurship
- Entrepreneurial Biotechnology
- Mathematics for Entrepreneurship
- Physics for Entrepreneurship
- Statistics for Entrepreneurship

College of Saint Rose
- Computer Information Systems

Eastern Michigan University
- Bioinformatics

Georgia Institute of Technology
- Bioinformatics
- Human Computer Interaction
- Prosthetics & Orthotics
- Quantitative and Computational Finance

Grand Valley State University
- Biostatistics
- Cell & Molecular Biology, Biotechnology Emphasis
- Medical & Bioinformatics

Illinois Institute of Technology
- Analytical Chemistry
- Biology
- Health Physics
- Materials & Chemical Synthesis

Indiana University/Purdue University at Indianapolis
- Laboratory Informatics

Keck Graduate School
- Computational Molecular Biology/Bioinformatics

Michigan State University
- Biomedical Lab Operations
- Computational Chemistry
- Food Safety
- Integrated Pest Management
- Industrial Microbiology
- Industrial Mathematics
- Zoo and Aquarium Management

Middle Tennessee State University
- Biostatistics
- Biotechnology
- Health Care Informatics

North Carolina State University
- Financial Mathematics
- Microbial Biotechnology

Northeastern University
- Bioinformatics and Computational Biology
- Biotechnology

Oregon State University
- Applied Biotechnology
- Applied Physics
- Applied Systematics in Botany
- Environmental Sciences

Pennsylvania State University
- Applied Statistics
- Biotechnology
- Forensic Science

Rice University
- Environmental Analysis & Decision Making
- Nanoscale Physics
- Subsurface Geoscience

San Jose State University
- Biotechnology

Southern Illinois University, Edwardsville
- Environmental Sciences Management

Stanford University
- Biomedical Informatics

State University of New York at Buffalo
- Computational Chemistry
- Environmental Geographical Information Systems
- Molecular Chemical Biology

Temple University
- Drug Analysis
- Forensics

University of Arizona
- Applied Biosciences
- Applied and Industrial Physics
- Mathematical Sciences

University of British Columbia
- Bioinformatics

University of California, Santa Cruz
- Bioinformatics

University of Connecticut
- Applied Financial Mathematics
- Applied Genomics

University of Dayton
Financial Mathematics
University of Houston, Clear Lake
Physics, Technical Management
University of North Carolina at Wilmington
Computer Science & Information Systems
University of Northern Iowa
Applied Physics
University of Pittsburgh
Financial Mathematics
University of South Carolina
Bioinformatics
Biotechnology
University of Southern California
Computational Linguistics
University of Texas, San Antonio
Applied Mathematics
University of Texas, El Paso
Bioinformatics
University of Utah
Biotechnology
Computational Science
Environmental Science
Science Instrumentation
Virginia Commonwealth University
Bioinformatics
Worcester Polytechnic Institute
Financial Mathematics
Industrial Mathematics

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