

Masters of Industry

Professional science master's programs take root

[Celia Henry Arnaud](#)

For more than a decade, proponents of the professional science master's degree (PSM) have sought to change the perception of master's degrees as nothing more than a consolation prize or a stepping stone on the way to a doctorate. This new type of degree has spread, and there are now more than 120 programs at more than 60 institutions.



Brett Stanley/CSU San Bernardino

On Route 66 Ken Pham (from left), Shannon Johnson, Jennifer Bell, David Bertolacci, and Tanya Zeferjahn, students in the environmental science PSM program at California State University, San Bernardino, take a break during a soil-sampling trip.

The PSM has found its way onto government radar screens. It was featured by name in the America Competes Act as a way to expand the scientific workforce. The Department of Education is getting into the game, providing grants to improve existing PSM programs and help to start new ones.

The PSM prepares students for professional careers in scientific industries and the nonprofit sector. Many jobs in these sectors, especially those outside the lab, require more than a bachelor's degree but not a Ph.D. PSM curricula at schools across the country incorporate scientific content and business-related "plus" components. The plus components vary with the program but typically include topics such as communications, business fundamentals, project management, and intellectual property. Instead of doing research for a thesis, PSM students complete an industrial internship.

The [Alfred P. Sloan Foundation](#) has bankrolled most PSM program development. Over time, Sloan has shifted its focus. At first, the foundation supported programs at Ph.D.-granting institutions, but it soon became obvious that the focus needed to be where the majority of master's level students are found: at comprehensive master's-granting institutions, many of which are publicly funded. The second round of funding primarily established programs at such universities. The latest round of funding looks beyond programs at individual schools to the systemwide level. Sloan is funding initiatives at the [State University of New York](#) (SUNY), [California State University](#) (CSU), and the [University of North Carolina](#) systems.

Sloan has enlisted the [Council of Graduate Schools](#) (CGS), an organization of colleges and universities engaged in graduate education, to oversee the ongoing PSM initiative and the system-level implementation. Carol Lynch, head of the PSM initiative at CGS, is convinced that this is the most important reform at the master's level. "CGS is committed to promoting the PSM."

To help with that promotion, CGS has partnered with the National Governors Association. Earlier this month, NGA convened government and education representatives from five states—Arizona, New Mexico, Oregon, Pennsylvania, and Virginia—for a two-day PSM Academy of intensive sessions with facilitators to craft individual action plans for implementing PSM programs at their states' universities, says Christopher Hayter, program director for economic development at NGA and organizer of the PSM Academy.

The CSU system is already far along the path of systemwide PSM implementation. Currently, 14 PSM programs are offered at 12 of the system's 23 campuses. Another 16 programs are in the planning stages. "We project that three to four years out, we'll have 30 programs involving 17 of our campuses," says Joan S. Bissell, PSM coordinator in the CSU Chancellor's Office. Of the current and planned programs, more than a dozen focus on the life sciences, including biotechnology, agricultural biotechnology, biostatistics, and genetic counseling.

The system office helps individual programs navigate the approval process for new degree programs, says Keith Boyum, associate vice chancellor for academic affairs at CSU. In addition, the central office helps programs share what works.

PSMs are a perfect fit for the mission of the CSU system, Boyum says. The program is "a brilliant bull's-eye for our sense of mission and our sense of self." The CSU system has long focused on educating the state's technical and scientific workforce at the master's level.

Just as each individual PSM program has an advisory board of local industry representatives, the CSU system has a statewide advisory board, which held its inaugural meeting at the end of February. One direct outcome of that meeting is the launching of a systemwide internship clearinghouse that can be shared by programs across the state.

On most CSU campuses, PSM programs are already established or under consideration. Moving from interest to an actual program "takes a faculty believer," Boyum says. "It takes somebody to roll up sleeves and say 'I'm going to devote a significant portion of my professional attention and time to this program.' "

But PSMs in the CSU system are not completely replacing research-based M.S. degrees. Many faculty involved with basic research still want regular M.S. programs to continue, Boyum says. However, the focus on degrees that directly prepare students for professional, nonresearch careers has been welcome, he notes.

Kavita Pandit, senior vice provost in the SUNY system office, says SUNY is in the initial stages of systemwide implementation. The SUNY system, which has 64 campuses, received almost half a million dollars from Sloan to spur implementation. "It's not big in proportion to how many campuses we have," Pandit says, "but it was enough to jump-start us."

SUNY's interest in PSMs stems from a desire to educate workers for new industries, especially as New York's industrial base matures. "New York works hard to create environments, create new industries, and bring new people in," Pandit says. "SUNY's role in New York's economic development is always on our radar. The PSM seems tailor-made to facilitate this."

SUNY intends to use its advantage as a large system to develop ways in which its campuses can share courses required for the plus components of the PSM. "Not all campuses have business or law or public policy programs," Pandit says. "We're devising ways that some campuses can share their relevant courses with surrounding campuses." Systemwide implementation is about "leveraging each other's strengths," she says.

So far at SUNY campuses, PSMs are being offered as traditional master's degrees rather than as degrees of a new type. New degree programs need to go through a rigorous approval process with the New York State Education Department. "Part of the work the system has to do is in laying the groundwork for that approval," Pandit says.



Don Peters/BD Bioscience

Send-Off The systems engineering group at BD Bioscience, led by senior manager Don Peters (back row, far left), gathers to bid farewell to intern Jarred Lyons (back row, second from left), a PSM student in the biotechnology PSM program at San Jose State University, part of the California State University system.

The America Competes Act threw the [National Science Foundation](#) into the PSM fray. The legislation authorized (but did not appropriate) funds for NSF to establish a database of best practices for PSM programs and to support the development of new and existing PSM programs.

Myles G. Boylan, a program officer in the NSF Education & Human Resources Directorate, questions whether NSF is the appropriate home for the database because the [National Professional Science Master's Association](#) (NPSMA) has launched its own repository of best practices.

NPSMA, incorporated in spring 2007, is an outgrowth of biennial meetings of PSM program directors. Once again, Sloan stepped in with financial support, both with an initial planning grant and with a larger grant to fund the association through its first couple of years.

The association hopes to work with programs at all stages of their development, from those just being planned to those that are well established. It seeks to "create a sense of community in PSM programs and also to engage business, industry, and nonprofit partners in meaningful dialogue," says Bogdan M. Vernescu, NPSMA's first president and a math professor at Worcester Polytechnic Institute. "All of these programs have connections to local industry. At the national level, our goal is to connect the programs with large corporations" that need employees from a range of scientific disciplines.

Although many PSM programs nationwide have chemistry connections, such as biotechnology, few programs are explicitly in chemistry. By far the largest number of programs is in the life sciences. Sheila Tobias, an education consultant who helped Sloan launch the PSMs and who has championed the programs from the beginning, suspects that the difference in the number of programs may be a direct result of the difference in the annual number of bachelor's recipients in biology and chemistry—approximately 68,000 versus 12,000, respectively.

T. Gregory Dewey, vice president for academic affairs at the [Keck Graduate Institute](#), speculates that chemistry PSMs may not have caught on as much as those in the life sciences because chemistry is such a versatile degree to begin with. "There's a lot going on for chemists. You don't have to create as many new avenues," he says. "A lot of these professional science master's [programs] are trying to create new options." KGI was founded as an institution that focuses on a model similar to the PSM ([C&EN, May 29, 2000, page 65](#), and [Dec. 10, 2007, page 39](#)).

Currently, seven programs in chemistry and three in forensics have met with varying degrees of success nationwide.

The programs at [Illinois Institute of Technology](#) predate the PSM label, having been launched in 1996. Of IIT's four PSM programs, two are in chemistry—one in analytical chemistry and one in materials and chemical synthesis.

IIT's programs were started by now-retired Walter C. Eisenberg, who had previously worked in industry. "He saw this great need for a master's education for working professionals," says Elizabeth Friedman, PSM coordinator at IIT. "They weren't necessarily on the research track, so they didn't need to go for the Ph.D." From the beginning, IIT incorporated business courses into its curriculum, just like other PSM programs.

IIT's program started as a distance-learning program in which the classes were broadcast via satellite television. Students would go to classes at centers throughout the Chicago area. Because the students continued to work full time, many found commuting to the remote sites difficult.

In 1998, the university began offering the classes over the Internet. Such a format requires that the students be very disciplined and motivated, Friedman says. Except for its new biology PSM, IIT's programs are part time, designed to be completed in two-and-a-half years while students continue working full time.

One of the challenges of developing the PSM program at IIT was seeing what courses could be used for both PSM and traditional master's students, who have differing needs. "Surprisingly, we found that the traditional M.S. degree graduate students were interested in taking courses designed for PSM students," Friedman says. The courses are presented live on campus, at which time they are recorded for the Internet.

Most of the students in IIT's program get their tuition reimbursed by their employers and the program, in turn, invites employer input into the curriculum. "For example, the members of the analytical chemistry advisory board inform us of current industry demands and future trends, which we balance with the pedagogical needs of the discipline," Friedman says.

So far, 198 students have graduated from IIT's PSM programs. Enrollment, which was about 200 students in the spring 2008 semester, has tripled since 1996.

Job placement through IIT's programs has been helped by the fact that the vast majority of students already work full time. "We haven't had a student graduate and not find a job," Friedman says.

At the [University of Northern Iowa](#), the first chemistry PSM student, Ryan Jones, has finished the program, even though it just started this year. Jones attended UNI as an undergraduate as well. "Ryan recruited himself before our program officially started," says Shoshanna R. Coon, a chemistry professor at UNI.

UNI also offers a traditional M.S. degree in chemistry. Initially, faculty were concerned about how the PSM program would affect the existing program. Traditionally, there's been about a 50-50 split between master's graduates at UNI going to work in industry and those continuing for a Ph.D. at another institution. "Some of those graduates would have been better served by a PSM if we'd had it at the time," Coon says.

Jones decided to do the PSM rather than the traditional M.S. degree to get some of the business training. "I decided that I did not want to pursue a Ph.D., but I did not want to be trapped with just a bachelor's degree," he says. "I saw a PSM as a vehicle for advancing my professional career, a vehicle to get into management more quickly than if I had just graduated with a bachelor's degree." Jones will soon get a chance to see how well his PSM has prepared him. This month he starts a job as a research scientist in analytical method development at Albany Molecular Research, a global pharmaceutical contract services and R&D company headquartered in Albany, N.Y.

At UNI, PSM and M.S. students take the same scientific courses. The only difference is that PSM students are required to take a new course called Corporate Chemistry. "We're able and proud to say that the PSM students take the same courses that a regular M.S. student would take," Coon says.

The UNI chemistry PSM program started with three students this year and expects to have six in the fall. "We're comfortable with our slow growth at this point," Coon says, "because we're not sure what we would do if we suddenly had 10 students."

One program that has not been successful is the computational chemistry PSM program at Michigan State University. The program, which was one of the original PSMs funded by Sloan, has never enrolled a single student, says James F. Harrison, chemistry professor and program coordinator. The rigorous program was designed to give students a thorough grounding in the theoretical chemistry, mathematics, and computer science needed to work in industrial computational chemistry. "We put together the program that I would want to take," Harrison says.

Although they have received many inquiries about the program, not a single application has ever materialized. Harrison suspects that the mathematics prerequisites—four semesters of calculus—for the computer science courses have scared off many potential students. The program remains in the MSU catalog, and Harrison, who expects to retire in a couple of years, hopes that one of his younger colleagues will revamp the program in a way that attracts students.

The cost of PSM programs has made them a tough sell with some students. From the outset, Sloan has forbidden schools to use any of the start-up money for student stipends and scholarships, although programs are welcome to subsidize students with funds from other sources. "Sloan was eager to send a message to applicants," Tobias says. "This is a professional program and a very good investment. Just as you would pay for law school or medical school, you're going to have to pay for this." Programs have taken hold in public universities far more than in private universities because of the typical difference in tuition rates.

PSM proponents are happy with the design and goals of PSM programs. They continue to promote the concept, seeking even more acceptance from both students and employers. CGS's Lynch hopes that PSMs will encourage more students to stick with scientific careers. "We know that fewer and fewer of our domestic students are pursuing a Ph.D., but they're still doing science majors as undergraduates," she says. "We're trying to capture those students who obviously like science but for whatever reason choose not to go on to a Ph.D."

Tobias is proud that the PSMs have come so far in their first decade. "Programs start and stop in higher education, but it isn't very often that an entirely new degree is launched," she says.

Despite her pride at the programs' success, she sees plenty of work yet to be done. Tobias hopes eventually to see systemwide PSM programs in every state's public university system.

Her greatest disappointment is that the programs seem not to have reached the radar of the nation's top business leaders. She was especially disheartened that PSMs were not mentioned at

the Department of Commerce's competitiveness summit held last month in Chicago. "Our graduates are poised to contribute to America's next great push," Tobias says. "How is it possible for men and women at that level talking about American competitiveness not to mention the PSM?"

KGI's Dewey argues that basic research is as successful as it has ever been but that product development is what is needed. "Innovation doesn't necessarily follow from success in basic research," he says. "What you ultimately need are people who understand the product development pipeline. It's not really about making scientists who understand how to work on applied problems. It's about people who understand commercialization. That's what these PSM programs try to do."