Masters of industry
Science programs prioritizing business needs over basic research careers are bringing fairytale outcomes

Science career paths in the United States have a "Goldilocks" problem. Bachelor of Science degrees are "too small"—inadequate for employers' requirements. PhDs are "too big"—taking too long to complete and focusing disproportionately on academia-oriented research rather than real-world applications. Over the last decade, a "just right" degree—the Professional Science Master's—has been developed.

The Professional Science Master's (PSM) has grown from a handful of pilot programs sponsored by the Alfred P. Sloan Foundation (see "Unexpected origins") to more than 300 courses now affiliated by the PSM National Office.

The degrees are often referred to as "hybrid masters", because they combine the scientific focus of a traditional master's with the business skills of an MBA, a combined skill set companies say is lacking in trained scientists at all levels.

The programs, which usually take around two years to complete, appeal to recent Bachelor of Science graduates who want a career in science, but don't want to commit years to a PhD and postdoc, as well as those already in employment looking to boost their skills. PSM programs affiliated with the PSM National Office are subject to new standards which require a strict balance between scientific and soft skills. The bedrock of PSM programs remains scientific, with a mandatory minimum of 50 percent of credits in science. A further 20 percent of the PSM credits must come from courses that teach business skills like accounting or marketing and "soft skills" such as communication. Additionally, affiliated PSMs require some kind of experienced-based project, whether it is a group consulting project or an internship.

Unlike PhDs, PSM programs don't offer funding through teaching or research assistantships and students tend to pay for their own tuition, but many PSM alums regard that tuition as a good investment since their training helps to jump-start their careers.

Jeff Graybill, a senior project manager at California-based biotech firm Amgen, is an alum of one of the first PSM programs, at the Keck Graduate Institute (KGI) in Claremont, California. During the program, he interned with a KGI professor who was spinning out a company, Ionian Technologies, and stayed on after graduation. "I basically created a job for myself," Graybill says. His transition to Amgen was made easier because the company was represented on KGI's PSM advisory board.

Linked In
Perhaps the most beneficial aspect of the program is its connection, through host institutions, to industry, says Jim Sterling, director of the PSM National Office and VP for Academic Affairs at KGI. All affiliated PSM programs are developed with input from the business community. For instance, most programs have advisory boards, whose members help guide, evaluate and even hire the program's students—both as interns and as employees. The quantity and quality of such partners can make or break a program, because they provide a training and placement network.

"That network defines the strength of the program," Sterling says.

Before joining a program, Sterling recommends students ask program directors about the companies they work with: "Do the sponsors come back year after year? Do you actually see them on campus? Do the students have an opportunity to interact with them?" he says. Graybill's role, now senior manager in global operations planning at Amgen, is proof of the value of these business networks. "One of the people on the KGI advisory board was from Amgen. Some people I knew passed my name along," says Graybill. "That's why I am here."

It is also worth investigating which business partners participate in curriculum development and find out what roles they play. At Rice University, corporate affiliates provide feedback on the curriculum, and then faculty members develop it based on that input. For example, the energy company Chevron works closely with Rice University's engineering PSM program. Jerry Rovner, a consulting engineer in Chevron's Energy Technology Company, helps develop the curriculum, place interns and judge student projects. "My job is to see that the coursework is a good fit for companies like..."
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THE RIGHT FIT?

Since the PSM emerged 15 years ago for scientists to train for industry careers, flexibility has been a hallmark of the degree. All courses affiliated with the National Professional Science Master’s Association, in conjunction with the Council of Graduate Schools, require a solid science core, a number of ‘plus’ courses and some form of work experience. But other elements vary, including curriculum, class and program completion time. Here are a few factors to consider:

Full-time versus part-time
Location and discipline plays a role in the level of time required. For example, the PSM agri-business programs at the University of Illinois at Urbana-Champaign are a full-time commitment.

At Rutgers University, on the other hand, students are encouraged to get additional work experience while also taking classes – many of which are offered nights or weekends to accommodate working students.

Time to completion
Depending on work experience requirements and whether the program is taken full or part-time, completion can vary from a little over a year to around three years. Silver says most Rutgers PSM students need two or more years, whereas the engineering PSM at Northeastern University can be completed in a year, without an internship. But people who are in the program for professional development take one course at a time, evenings or weekends, and require a longer stint, says Sara Wadie-Fascetti, a Northeastern engineering professor involved with the university’s engineering PSM programs.

Virtual or real
Some programs offer geographic flexibility and a mix of real and virtual instruction, while others keep it local. The home of Northeastern University is in Boston, but it offers PSMs from regional campuses in Charlotte and Seattle and offers a hybrid of face-to-face and online instruction, says Wadie-Fascetti.

Others, like Buffalo State University’s data analysis and mathematical modeling PSM program, focus on face-to-face interaction, says Joaquin Carbonara, the program’s director, which allows for industry guest speakers, site visits and workshops.

Rigid or flexible
Carbonara keeps his program adaptable by structuring it as a series of one-credit evening courses. Those shorter courses were recommended by industries the university surveyed while developing the program and they make the curriculum easier to “plug and play”, says Carbonara. In other words, instructors can more easily tweak lesson parts, or scrap courses entirely, as the industry changes.

This means the course stays relevant, says Rutgers’ Silver. “If I were a student, I would want to be in a program that was affiliated and that was keeping up with what industry wants.”

For example, David W. King, director of the SUNY Professional Science Master’s Consortium, noticed that courses in regulatory affairs were among the most useful in biotech and drug discovery programs but not quite right for programs on medical devices, which have different regulations set by the FDA. So they quickly set up webinars on medical device regulation to meet the needs of students.

PSM students at Keck Graduate Institute make a presentation as part of their Team Master’s Projects (TMPs) in which teams of three to six students work with sponsoring companies to solve real problems.

“Chevron,” Rovner says.

And Chevron is just one company in a network of hundreds, primarily in the Houston area, connected to Rice’s PSM program. This network leads to jobs, says Dagmar Beck, director of Rice University’s Professional Master’s Programs in Science and Engineering: “All of our students have found employment.”

At Case Western Reserve University in Ohio, the PSM programs draw heavily upon CEO in Residence’ Bruce E. Terry, former president and CEO of manufacturing firm Mayfran International. The curriculum centers on entrepreneurship, so Terry’s experience as an angel investor and an intellectual property hunter feed directly into the program and he often brings guest speakers and lecturers from the investment and start-up community. Ed Caner, Case Western’s PSM director, says that prospective PSM students should examine a program’s advisory boards—but also ask about the board members’ level of involvement. “An advisory board is only useful if it is active,” he says.

Enrolling in a PSM will also give you a valuable network of peers who will be climbing career ladders alongside you. Kevin Sigitler, director of University of Illinois at Urbana-Champaign’s agribusiness-related PSMs says that the program’s graduates have created

“It is important to understand all the various people in a company that speak a slightly different language. If you can speak in a way that they are comfortable with it can really help your career.”

Jeff Graybill, senior project manager, Amgen
The National Professional Science Masters organizations are proud to announce the 300th Affiliated PSM program.

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UNEXPECTED ORIGINS

Sometimes unintended consequences are the best. When the Alfred P. Sloan Foundation helped pioneer Professional Science Master’s degrees fifteen years ago, there were concerns that the new degrees would cannibalize the pipeline to PhD programs. In fact, the opposite is true.

Many alums who wouldn’t have gone on to do graduate work have enrolled in PSM programs and some decide to pursue basic research rather than applied. The pipeline from academia to industry has improved. And some of the value-added education of PSMs—particularly training in communication, presentation and basic business management skills (see main story)—have migrated directly into some PhD programs or are being adapted into workshops by scientific professional societies.

When Sheila Tobias co-wrote Rethinking Science as a Career in 1995, academic jobs in science were so scarce that many PhDs were considering changing fields. The authors had no idea that the book would help launch a whole new degree.

PhD students interviewed for the book repeatedly expressed regret about lacking skills like business fundamentals, computer science and writing, Tobias says. She realized the gap represented a curriculum. “They were telling us what they needed to be more competitive outside academia,” she says.

She found career options after a B.S. were “limited” and that professors at graduate programs tended to steer their students toward research careers, despite a dearth of faculty positions. The business leaders she interviewed said that STEM graduates they wanted to hire didn’t have the interpersonal skills necessary for success in industry.

Tobias thought the M.S. could be tailored to offer more professional skills as well as science training. The M.S. was often considered a consolation prize for a failed PhD bid, she says.

The book led to what Tobias calls a “Sloan call” when the foundation offered funding for her to look into a small set of pilot programs. She contacted science deans from around the US to send questionnaires to people who either didn’t get into their PhD program or didn’t complete it.

The Sloan Foundation and several institutions she called upon as possible pilot projects were all receptive and thinking along the same lines, says Tobias.

The Sloan Foundation took on the PSM approach in part because the US science pipeline appeared to be leaky. “So many people major in science and math and so few go on,” says Michael Teitelbaum, a demographer and senior adviser with Sloan.

The PSM helps filter more US-trained scientists into the workforce, without, perhaps flooding the graduate school ranks. They offer a graduate level pathway to a science career,” says Teitelbaum. “It is not really a competitor to the PhD/postdoc path,” he adds, “it is a necessary addition.”

PSM students take part in an innovation workshop at the University of Illinois at Urbana-Champaign.

“I would definitely recommend a PSM for someone not looking forward to going into an academic environment. It’s a great way to link your undergraduate education to the needs of the corporate world.”

Diana Wolf, Finance Rotation Associate, Capital One Bank
management, marketing and presentation, says Bogdan Vernescu, head of mathematics at the Worcester Polytechnic Institute and president of the National Professional Science Master’s Association (NPSMA), which organizes best-practices workshops and guidance on launching PSM programs. A PSM should also cover the theoretical and applied side of the discipline. In the financial math PSM program supervised by Vernescu, students take courses in both the math and business departments. "The students need to understand both the mathematics and the business side of the investments or portfolio management," Vernescu says.

An emphasis on science is integral at Stony Brook University’s scientific instrumentation PSM, with courses in both classical and quantum physics. Harold Metcalf, the program’s director, says they make sure students are "physicists first". Having that background gives the students "a leg up", because acumen in accounting and statistics is gained more easily after the rigorous quantitative science courses.

To ensure that science was at the forefront of its PSM programs, Rutgers University in New Jersey, took a standard 30-credit science Master’s, added six business

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**CASE STUDIES**

After Diana Wolf earned her Bachelor of Science in mathematics from the University of Florida in 2009, she was unclear about her options. "The problem with pure math programs is they lead you to a PhD," says Wolf. "I didn’t want to be a professor or a researcher; I wanted to learn more about industry."

Wolf enrolled in a PSM program in financial mathematics at Worcester Polytechnic Institute and besides helping her learn how she could apply mathematics to real-world situations, the program gave Wolf the skills she uses every day in role as Finance Rotation Associate at Capital One bank — especially communication and cooperation skills. "In many classes I had to give presentations one-on-one to my professors and to the whole class," she says. "We also had to do a lot group work, which is how things are done in the real world."

Wolf says the internship she took during the program validated her decision to eschew academia for industry. "It definitely made me realize my skill sets and what I enjoy more," she adds. "I do enjoy the business side of things."

"I would definitely recommend a PSM for someone not looking forward to going into an academic environment," Wolf says. "It’s a great way to link your undergraduate education to the needs of the corporate world."

From the industry viewpoint, Jerry Rowner at Chevron sees what PSM recipients can bring to the company. He says that traditional B.S. degrees don’t prepare many students for today’s workforce. "People are educated, but we can’t find the skills we need."

The firm looks for people who can understand the language of science and business and can also handle project management. "There is a lot of business sense that goes into a project as well as the technical side," Rowner says.

The PSM offers Chevron what it needs for entry and mid-level employees, he says: "a firm technical background with business skills."

Rice’s PSM program is such a good fit for Chevron that the company placed a dozen interns and made offers to all of them.

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courses, and replaced a thesis with a team project, says Deborah Silver, executive director of its PSM program. Some standard Master's comprise a set of classes that don't necessarily fit together. She got involved with Rutgers' PSM program because she wanted to help create a degree with a set of classes that "tells a story."

**Plus points**

"Plus" courses help tell companies the story that PSM graduates will be a good fit, says Sterling. "Companies consistently ask us to provide training in more professional skills," he says. It's not just the content of these courses in subjects like ethics, communication, presentation, accounting, and product development, that are important, Sterling maintains, but how they are taught – often with guest lectures and workshops with industry leaders. Projects within those courses almost invariably require teamwork and culminate in a presentation that is often judged by industry experts from the school's advisory board.

Both the content and the method of learning at KGI appealed to Graybill. "The business classes were great," he says, because they taught him the languages of people he might interact with in a working environment, like the accounting terms used by a chief financial officer. "No one in our program was likely to become a chief financial officer," says Graybill. "It was more important to understand the CFO, and all the various people in a company that speak a slightly different language. If you can speak in a way that they are comfortable with it can really help your career."

**In at the deep end**

Perhaps the best industry interaction a PSM can provide is an internship that leads to a job. In some programs internships are mandatory, others just recommend them. Some will help place students, while in others the onus is on individuals to find a placement. Checking to see what help students can expect when it comes to landing an internship is one way of assessing the value of tuition investment.

Students completing a PSM with an affiliated institution must complete some form of work experience – but there is scope for taking on new roles with an existing employer, doing an internship, or taking part in a "capstone" project – which means working with a group of students as a consultancy for a company.

Besides being a conduit for a full-time job, Graybill's internship provided him with "pretty incredible" business experience because it meant creating a company out of one KGI professor's intellectual property. "I got to work on a business plan on the ground floor."

In Rice University's engineering PSMs, the program's advisory board members, like Chevron's Rovner, are very involved in the internship process – from placement to evaluation. "We go to the students' presentations and interact with them both before and after their internships." At these talks, Rovner says, he sees the benefits of taking communication courses. "I am rather envious of their presentation skills," he says.

Since Case Western's PSM emphasizes entrepreneurship, students get involved in early-stage companies. "Our students either work for start-ups or for an economic development group that supports start-ups," says Caner. "They do everything from technology feasibility analysis to market research or investigating whether there is a market sector that is missing."

Rutgers' PSM programs allow some flexibility, since many of its students work at least part-time. Some take on traditional internships, while other students do their internship at their existing place of employment, but in a different department, or performing a different role.

Students at Stony Brook's scientific instrumentation program are instructed quite simply for their work experience, says Metcalf. They are told, "Go into a laboratory and build something that works!" Students first approach a faculty member and ask what needs to be built to perform experiments that they don't already have. The professor then tells the students under what conditions the device needs to work and what data it should produce. "The faculty says, 'Here are the specs,'" says Metcalf. As part of their thesis, the students may often write a manual on how to use the device.

At KGI, which offered one of the first five PSM programs, students do both an internship and a Team Master's Project (TMP). The two are designed to be complementary, says Craig Adams, KGI's TMP director. The internship comes before the TMP and tends to focus on science and technology. The project emphasizes business skills.

Doing both an internship and a TMP puts students in touch with more potential employers – increasing the odds of a job when they finish the program. For Marc Doble, who did a biotech PSM at KGI, meeting many potential employers – through guest teachers, networking events, TMPs or internships – justified the time and expense of a PSM. "It gives you a defined runway when you start job hunting," he says. Doble, who roomed with Graybill when they both were in KGI's first biotech PSM cohort, took off from that runway, flew with the science and business skills he learned, and ultimately landed a job with Amgen. For Graybill and Doble, choosing a PSM turned out to be "just right."