Introduction
Professional Science Master’s (PSM) programs provide core training in science, technology, engineering and mathematics (STEM) disciplines with research and internship experiences, as well as education in business management, communication, research ethics, and other professional skills. The majority of new jobs being created are in the non-academic sector, and graduates are well prepared for science-based careers in business, industry, nonprofit organizations, and government agencies. Basic criteria for recognition as a PSM include: evidence of workforce needs that overlap with faculty research interests as well as student interests; total minimum number of credits required; defined science and/or mathematics curriculum; professional or ‘plus’ course component; program approvals; employer advisory board; and plans to track graduate student enrollment and placement. PSM degrees should represent high quality educational programs approved by the Council of Graduate Schools (CGS) and reviewed and approved based on existing Oregon University System (OUS) degree approval processes. In some cases an abbreviated approval process may be allowed for conversion of existing graduate degrees to PSM degrees, whereby the OUS Provosts’ Council may approve a waiver of external review.

PSM Program Development
There are two ways to create new PSM programs: 1) develop new programs de novo; or 2) transform existing MS programs into PSM degree options. PSM program development should be based on regional workforce needs and engage representatives from appropriate industry, government and/or non-profit sectors in curricular needs assessments as well as internship and employment opportunities. Institutional PSM advisory boards guide development of new programs and keep existing PSMs responsive to changing workforce needs. Involving employer groups is a critical requirement of PSM program development. The CGS provides guidelines for development of PSM programs based on three stages (http://sciencemasters.com/Default.aspx?tabid=82) included in descriptions listed below:

Pre-Planning:
- Determine identifiable niche that will generate interest from faculty and students with strong support from business, government, and/or nonprofit sectors.
- Learn about jobs and labor markets for graduates to provide evidence of clear understanding of unique needs of industry, government or the non-profit sector and involve representatives from appropriate employment sectors in design of the PSM program and courses.
- Define a focus area, which could be interdisciplinary or be a non-traditional focus where there is existing faculty expertise and interest.
- Form advisory board of industry and other likely employers.
- Define scholarly rationale for the proposed degree program and its content and meet employer needs for relevant technical and professional skills.
- Specify faculty members and other participants with primary responsibility for core scientific and professional training, and highlight any distance learning components of the program.
- Win high-level institutional commitment to master's level education, including central coordination of all PSM programs at level of dean or above.
• Clarify the unifying aspects of the program – how STEM workforce-oriented educational, research and professional activities are tied together; describe what is new and innovative.
• Identify typical student pathways through the program and the expected time to degree.
• Prepare business plan projecting both expenses and revenues, and showing how and when each degree program can become self-sustaining based on tuition revenues, corporate support, and university support.
• Highlight broader impacts of the proposed activity including potential impact for other PSM programs in Oregon.

Curriculum Development:
• Design a curriculum with a majority of coursework in graduate level science and/or mathematics in one or more disciplines in which knowledge is commonly advanced by an active research community engaged in peer-reviewed exploratory research. An interdisciplinary curriculum is highly desirable.
• Include a professional skills component (often call the ‘plus’ component of a ‘science-plus degree’) that consists of a variety of relevant courses and activities developed in consultation with prospective employers in collaboration with appropriate academic units outside the sciences or taught by adjunct faculty from the targeted employment sector. Examples of plus-components include communication and teamwork, ethics, project management, legal and regulatory issues, finance and marketing.
• Include a total number of credits at least equivalent to a standard master’s degree (approximately 2 years, full-time equivalent, including projects and internships). Typically, PSM programs at OSU are a minimum of 54 credits compared to 45 for the traditional MS reflecting the true ‘plus’ component of professional training. This maintains rigorous standards of training in science, and students still finish their degrees in 2 years or less.
• Develop intense identity-building or "branding" experience for PSMs, including team project for entering students.
• Design exposure to cutting-edge research issues and equipment, for example, by lab rotations when appropriate.
• Describe specific metrics for assessing programs especially to ensure quality for professional components.
• Commit to conducting seminars/colloquia jointly for all PSM students.
• Incorporate or adapt a reasonable number of existing courses into the program for efficiency.
• Require a final project, usually a business/industry internship experience, which is summarized as a final report and presented as part of the oral examination similar to a thesis MS defense. List criteria used to evaluate the merit of internship and/or research experiences.
• Apply to the CGS for recognition as a PSM program.

Program Management:
• Appoint personnel or hire staff coordinator to handle liaison to business and industry; publicity; recruitment; student services; placement.
• Outline plans for recruitment, mentoring and retention of graduate students, including specific provisions aimed at members of groups underrepresented in STEM fields.
• Set up systems to keep track of graduate student enrollment and post-graduate placement.
• Assess quality metrics established during planning and curriculum development process.
The CGS guidelines state that PSM designation is intended to provide a mechanism for recognition of this new type of degree by offering assurance that the program conforms to nationally recognized standards. Ordinarily, MS degree programs with existing accrediting bodies or those that have been traditionally offered as training toward professional licensure or certification (such as public health, most genetic counseling, some engineering degrees) are not appropriate for PSM designation. Programs aimed at training educators are not eligible for PSM designation.

**PSM Program Approval**
For PSM programs developed in new interdisciplinary fields or in departments not currently offering similar non-thesis MS degree options, proposals should be drafted and submitted through the appropriate OUS approval process ([http://www.ous.edu/state_board/meeting/dockets/ddoc081107-Acad.pdf](http://www.ous.edu/state_board/meeting/dockets/ddoc081107-Acad.pdf)). For example, a PSM in Renewable Energy is currently being developed as an entirely new program and must be subject to the entire approval process. This level of review will allow for complete assessment of workforce needs, curriculum design, budgets and resources, as well as other factors involved in establishment of a new degree option. An abbreviated approval process will be considered for new PSM programs that:
- represent modifications of existing MS programs,
- are being developed in departments that currently offer non-thesis MS degrees, and
- conform to these guidelines.

An abbreviated approval process will allow institutions to become more responsive to emerging workforce needs and will encourage efficient use of resources (e.g., courses already in existence). In particular, the Provost's Council will consider providing a waiver of external review in these cases.

An example of a PSM program at Oregon State University (OSU) created through modification of an existing non-thesis MS program in Applied Physics ([http://psm.science.oregonstate.edu](http://psm.science.oregonstate.edu)):

<table>
<thead>
<tr>
<th><strong>MS in Applied Physics</strong></th>
<th><strong>PSM in Applied Physics</strong></th>
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<tbody>
<tr>
<td>Core courses (12 credits)</td>
<td>Core courses (12 credits)</td>
</tr>
<tr>
<td>General practical training (9 credits)</td>
<td>General practical training (18 credits)</td>
</tr>
<tr>
<td>Electives (15 credits)</td>
<td>Electives (3 credits)</td>
</tr>
<tr>
<td>Thesis or Project option (6-12 credits)</td>
<td>Internship (6-12 credits)</td>
</tr>
<tr>
<td></td>
<td>Professional courses (18 credits)</td>
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</tbody>
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Total: minimum 42 credits

minimum 57 credits

All PSM programs at OSU include a minimum of 54 credit hours comprised of 30 credits of science and 18 credits of professional or ‘plus’ coursework as well as a minimum of 6 internship credits equivalent to 3 months full-time work experience. Professional courses have been packaged as a Graduate Certificate Program in Management for Scientists available online fall 2010:
- Accounting & Finance for Scientists (PSM 565; 3 credits; fall term)
- Project Management & Marketing Scientific Technologies (PSM 566; 3 credits; winter term)
- Innovation Management (PSM 567; 3 credits; spring term)
- Communication & the Practice of Science (COMM 550; 3 credits; fall term)
- Research Ethics (PHL 547; 3 credits; winter term)
- Professional Skills (PSM 513; 3 credits; spring term)
Regardless of how PSM program development proceeds, it should be based on perceived regional workforce needs and engage representatives from appropriate industry, government and/or non-profit sectors in assessments of curricular needs as well as internship and employment opportunities. Program development guidelines described above should be addressed in proposals submitted for approval by the OUS and State Board of Higher Education, and, as “science plus” degrees, should exceed minimum credit requirements for traditional MS degrees. Professional coursework should follow CGS guidelines described above and include requirements for courses in communication, project management, basic business principles, ethics, and other educational content designed to meet employer needs.

In order to use the official PSM designation, a program must first be granted recognition by CGS as a PSM affiliate. Prospective Oregon programs should address the key criteria listed above and at [http://sciencemasters.com/PSMAffiliation/HowtoApplyforPSMAffiliation/tabid/116/Default.aspx](http://sciencemasters.com/PSMAffiliation/HowtoApplyforPSMAffiliation/tabid/116/Default.aspx) as part of the standard OUS Proposal for a New Academic Program materials. For example, PSM guidelines require an employer advisory board, so the proposal should include information about such a board in the Program Description section of the proposal; under the Accreditation section, the CGS/PSM approval process should be referenced (and if approval has been obtained, that information should of course be included); and the PSM required annual reporting can be included under the Outcomes and Quality Assessment section. Generally, the proposal should clarify how the program has been designed to meet all PSM standards.

For submission to CGS/PSM, a document that specifically addresses the seven bulleted criteria listed in “Guidelines for CGS Recognition as a Professional Science Master’s Program” (see attached) should be created; the OUS proposal does not have to be included, but may be, as supplementary information. Materials should be submitted to profmasters@cgs.nche.edu. If no questions arise, submissions are generally approved within four weeks; the web page above details the CGS/PSM review process if programs are not immediately approved. Submission can be made at any point in the OUS approval process; if CGS/PSM review necessitates changes to the planned program, those can then be incorporated before final board approval is sought. Similarly, if changes are made during the OUS approval process after CGS approval is granted, revised documents must be sent to CGS, and they will be quickly reviewed for compliance.