Professional Science Master’s

Meeting Employers’ Needs in North Carolina

10 YEAR LEGACY

Proudly serving the University of North Carolina, a multi-campus university system
Appalachian State University • East Carolina University • Elizabeth City State University • Fayetteville State University
NC A&T State University • NC Central University • NC State University • UNC Asheville • UNC Chapel Hill • UNC Charlotte
UNC Greensboro • UNC Pembroke • UNC Wilmington • UNC School of the Arts • Western Carolina University
Winston-Salem State University • NC School of Science and Mathematics
GREETINGS FROM THE UNC PSM DIRECTOR

It is with gratitude and excitement that I look back on the last decade to reflect on how far we have come and what we have become. North Carolina State University (NC State) started its first two PSM programs in 2003, Financial Mathematics and Microbial Biotechnology. Both programs are thriving and are now accompanied by multiple other PSM programs at NC State and other University of North Carolina (UNC) campuses. The goal to provide a model suite of programs to meet the need for job-ready graduates has been achieved!

New trails have been blazed in external employer alliance-making, experiential and workforce-relevant education, interdisciplinary program planning, intra- and inter-university collaboration, and sharing best practices with national and international audiences. The most prominent outcomes include:

- 22 active PSM programs/concentrations have been developed at 7 UNC campuses
- 26 new PSM programs/concentrations are planned at 12 UNC campuses
- Professionals from more than 456 companies, government agencies, and nonprofit organizations have contributed to the PSM Program’s success
- More than 700 degrees have been conferred (2013 statistics)
- ~74% of graduates remain in North Carolina after graduation (2012 statistics, NC Commerce data analysis)
- ~90% of graduates are employed (~10% status unknown) (2012 statistics, LinkedIn analysis)
- Multiple PSM-related books and papers have been published and companion workshops have been offered
- A mentorship program between students and industry professionals has been started
- Four electronic management tools have been developed
- Two central websites for NC State’s PSM Program and the UNC PSM Program have been launched
- Two PSM councils have been established: the NC State PSM Council and the UNC PSM Council
- The UNC PSM Director is a co-founder of the National PSM Association (NPSMA) and instrumental in starting the Systems, State-wide and Regional PSM Group (SSR PSM)

This report provides an overview of results and resources. It serves as a guide to future PSM work as seen from both industry and university perspectives. Thank you to all contributing funding agencies, external employers, professors, program directors, program coordinators, deans, and other executive administrators for your support.

It is my hope that the PSMs will continue to inspire translational alliance-building with external employers and inclusion of workforce-relevant components at all educational levels.

It has been a pleasure serving you.

Lisbeth Borbye, Ph.D.
Assistant Dean for Professional Education,
North Carolina State University
UNC PSM Director,
UNC General Administration

May 2014
CONTENTS

ACKNOWLEDGMENTS ........................................................................................................................................................................4

MISSION AND DEFINITION OF THE PROFESSIONAL SCIENCE MASTER’S ..............................................................................................................................6

PSM AFFILIATION .........................................................................................................................................................................................6

STAKEHOLDER BENEFITS ...........................................................................................................................................................................7

PSM PROGRAM PROGRESSION .........................................................................................................................................................................8

Campus Programs ........................................................................................................................................................................................................9

Alfred P. Sloan Award, Sub-awards and Other Funding .................................................................................................................................10

Inclusion of PSMs in the UNC system’s Strategic Directions ...........................................................................................................................12

ORGANIZATION ..................................................................................................................................................................................................14

NC State PSM Council .........................................................................................................................................................................................14

UNC PSM Council ..............................................................................................................................................................................................14

National PSM Association ..................................................................................................................................................................................15

Council of Graduate Schools ...........................................................................................................................................................................15

National PSM Office ..........................................................................................................................................................................................15

Systems, Statewide and Regional PSM Group .......................................................................................................................................................15

ESSENTIAL PSM SERVICES AND NC STATE PSM COUNCIL EXPERTISE INVENTORY .................................................................................................16

OUTCOMES .....................................................................................................................................................................................................18

Degrees Conferred .................................................................................................................................................................................................18

Graduate Residency, Employment and Wages ................................................................................................................................................19

Websites ..............................................................................................................................................................................................................21

Books and Booklets ..........................................................................................................................................................................................22

Publications ...........................................................................................................................................................................................................24

Workshops ........................................................................................................................................................................................................25

Electronic Management Tools ........................................................................................................................................................................26

Academic Planning Tool ..................................................................................................................................................................................26

Data Management ............................................................................................................................................................................................27

Professional Skills Assessment .......................................................................................................................................................................28

Mentoring Program ..........................................................................................................................................................................................29

Web-based Documentation ................................................................................................................................................................................30

Sustainability Plan ................................................................................................................................................................................................30

Internship Pilot Programs ................................................................................................................................................................................31

Professional Skills Certificate ..........................................................................................................................................................................31

PLUS Course Inventory ....................................................................................................................................................................................32

TIMELINE HIGHLIGHTS ......................................................................................................................................................................................35

CLOSING BY THE UNC PSM DIRECTOR .........................................................................................................................................................36

APPENDICES ...................................................................................................................................................................................................38

Appendix 1. Quick Guide to Developing a Professional Master’s Program (updated) ..................................................................................38

Appendix 2. Poster ................................................................................................................................................................................................50
THANK YOU

to the professionals affiliated with more than 456 companies, government agencies, and nonprofit organizations who have contributed to the success of the UNC PSM Program (instruction, projects, practica, internships, jobs, mentoring, advisory board members, equipment, and other resources)

THANK YOU

MISSION AND DEFINITION OF THE PROFESSIONAL SCIENCE MASTER’S

Professional Science Master’s (PSM) are relatively new degree programs that seek to meet employers’ and society’s need for employment-ready graduates and a means of re-tooling the existing workforce. PSM education offers students up-to-date technical and managerial knowledge, hands-on practica, and transferable professional skills, in addition to in-depth interdisciplinary academic acumen. The programs, which focus on today’s challenges and emerging fields, are designed and continuously adjusted in collaboration with external employers.

What is a PSM?
- **PSM = Professional Science Master’s**
- Master degree program
- Multi- or interdisciplinary STEM core
- Inclusion of field-specific management and transferable professional skills (the so-called PLUS courses)
- Program is designed in collaboration with employers
- Focus is on today’s challenges/emerging fields
- Internship and/or projects with employers

PSM mission
- The UNC PSM Program seeks to
  - Meet North Carolina employers’ needs for a job-ready, highly adaptive, and professional (master-level) graduate workforce

PSM AFFILIATION

PSM affiliation is a quality control measure that helps to ensure that PSM programs comply with set national standards. The mission is to “keep academic depth, add breadth, management skills and employer input and interaction.” Specifically, the following guidelines found at [www.sciencemasters.com](http://www.sciencemasters.com) apply:
- >50% of curriculum is multi- and/or inter-disciplinary STEM (science, technology, engineering, mathematics) courses
- At least 20% of curriculum is management (field and trade-specific management, people management, change management)
- Active employer advisory board
- Employer-provided projects and/or internships
- Tracking of PSM graduate employment for 5 years
- Program assessment and re-affiliation every 5 years
- Use of PSM logo

PSM affiliation was originally overseen by the Alfred P. Sloan Foundation, New York. Later, the Council of Graduate Schools, Washington D.C. formalized and managed the affiliation process. Recently, the National PSM Office (NPSMO) was established at the Keck Graduate Institute in California; this entity currently manages all affiliation and re-affiliation requests on a fee-for-service basis. PSM affiliation cost is $1500 per program and/or concentration and is valid for five years. The NPSMO is considering cost-saving measures for programs with several PSM concentrations.
STAKEHOLDER BENEFITS

The UNC PSM Program offers economic and educational benefits to the following groups and areas:

Benefits for Students:
- Employment-relevant, competitive education
- Essential professional skills & newest technology
- Focused career prospects
- Contributing to the resolution of complex industry issues
- Employer network
- Familiarity with the workplace environment
- Good potential for employment and anecdotal evidence of rapid promotion

Benefits for Universities:
- Access to employer networks, newest technology, and resources
- Increase in external engagement
- New interdisciplinary research and innovation potential
- Provision of employment-relevant, competitive education for graduate careers outside the university
- Low research cost
- High ROI: majority of students pay own way, high graduation and employment rates
- PSM components can be transposed to undergraduate and doctorate levels
- Enrollment “pipelines” can be established in and out of PSM programs

Benefits for Employers:
- Co-creation of education can be tailored to meet own needs
- Access to out-of-the-box student thinking and faculty research
- Interaction with potential future employees
- Prospects of hiring the best graduates
- Recruitment cost savings
- New employee adjustment savings
- Potential for new research and fundraising collaboration
- Prospects of increasing level of innovation
- Giving back to society

Benefits for Society:
- Economic benefits of an employment-ready, competitive work-force
- Universities that are able and wish to collaborate with industry, governments, and non-profit agencies
This academic year (2013/2014) marks the celebration of the ten-year anniversary for PSM programs in North Carolina. The first two PSM programs in North Carolina were launched at NC State University in 2003. In the six years that followed, a total of five programs at four UNC campuses were active. In 2010 NC State received a grant from the Alfred P. Sloan Foundation with the goal to expand the PSM program portfolio in North Carolina. This support (and support from NC State, UNC General Administration, the National Science Foundation, the North Carolina Biotechnology Center, and others) has led to strong growth centered on development and management of both NC State’s university-wide PSM Program and the entire UNC system PSM Program.

Currently, seven UNC campuses are offering 22 PSM programs/concentrations (12 are at NC State). The UNC PSM Program is poised for considerable expansion within several years; an additional 26 programs are being planned at 12 UNC campuses (including three Historically Black Colleges/Universities and two Research Universities).
<table>
<thead>
<tr>
<th>University</th>
<th>PSM Program</th>
<th>Status*</th>
<th>Affiliation Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appalachian State University</td>
<td>Engineering Physics: Instrumentation and Automation Concentration</td>
<td>Both Concentrations are Active</td>
<td>2007</td>
</tr>
<tr>
<td></td>
<td>Engineering Physics: Nanoscience for Advanced Materials Concentration</td>
<td></td>
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<tr>
<td></td>
<td>Environmental Monitoring &amp; Assessment</td>
<td>Planning Phase</td>
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<tr>
<td></td>
<td>Entrepreneurial Information Technology</td>
<td>Feasibility Stage</td>
<td></td>
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<tr>
<td>Elizabeth City State University</td>
<td>Computer Information and Cyber Security</td>
<td>Planning Phase</td>
<td></td>
</tr>
<tr>
<td>University of North Carolina at Greensboro</td>
<td>Nanoscience (Joint School of Nanoscience and Nanoengineering)</td>
<td>Active</td>
<td>2011</td>
</tr>
<tr>
<td></td>
<td>Biology &amp; Nutrition</td>
<td>Planning Phase</td>
<td></td>
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<tr>
<td></td>
<td>Mathematics (applied statistics)</td>
<td>Planning Phase</td>
<td></td>
</tr>
<tr>
<td>North Carolina A&amp;T</td>
<td>Construction Science and Management</td>
<td>Planning Phase</td>
<td></td>
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<tr>
<td></td>
<td>Physiology &amp; Genomics</td>
<td>Planning Phase</td>
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<td></td>
<td>Developmental and Applied Chemistry</td>
<td>Planning Phase</td>
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<td></td>
<td>Building Engineering</td>
<td>Planning Phase</td>
<td></td>
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<tr>
<td>North Carolina Central University</td>
<td>Applied and Industrial Chemistry</td>
<td>Planning Phase</td>
<td></td>
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<tr>
<td></td>
<td>Pharmaceutical Sciences and Business Administration</td>
<td>Planning Phase</td>
<td></td>
</tr>
<tr>
<td>North Carolina State University</td>
<td>Financial Mathematics</td>
<td>Active</td>
<td>2002</td>
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<tr>
<td></td>
<td>Microbial Biotechnology</td>
<td>Active</td>
<td>2002</td>
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<td></td>
<td>Geospatial Information Science and Technology</td>
<td>Active</td>
<td>2009</td>
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<td></td>
<td>Analytics</td>
<td>Active</td>
<td>2010</td>
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<td></td>
<td>Biomanufacturing</td>
<td>Active</td>
<td>2010</td>
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<td></td>
<td>Nutrition: Human Nutrition Concentration</td>
<td>Both Concentrations are Active</td>
<td>2010</td>
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<td></td>
<td>Nutrition: Feed Science Concentration</td>
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<td></td>
<td>Electric Power Systems Engineering</td>
<td>Active</td>
<td>2010</td>
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<td></td>
<td>Environmental Assessment</td>
<td>Active</td>
<td>2010</td>
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<tr>
<td></td>
<td>Computer Networking: PSM Concentration</td>
<td>Active</td>
<td>2012</td>
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<tr>
<td></td>
<td>Crop Science: Crop Management and Improvement Concentration</td>
<td>Active</td>
<td>2012</td>
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<td></td>
<td>Climate Change and Society</td>
<td>Active</td>
<td>2010</td>
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<td></td>
<td>Electronic Product Development</td>
<td>Feasibility Stage</td>
<td></td>
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<tr>
<td></td>
<td>Computer Gaming (Collaboration with UNC School of the Arts)</td>
<td>Planning Phase</td>
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<td></td>
<td>Advanced Medical Technologies</td>
<td>Planning Phase</td>
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<td></td>
<td>Forensic Science and Engineering</td>
<td>Planning Phase</td>
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<td></td>
<td>Poultry Science: PSM Concentration</td>
<td>Planning Phase</td>
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<td></td>
<td>Performance and Protection Science</td>
<td>Planning Phase</td>
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<td></td>
<td>Digital Game User Experience</td>
<td>Planning Phase</td>
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<tr>
<td>University of North Carolina at Chapel Hill</td>
<td>Ecology and Environmental Biology</td>
<td>Feasibility Stage</td>
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<tr>
<td></td>
<td>Geology and the Environment</td>
<td>Feasibility Stage</td>
<td></td>
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<tr>
<td></td>
<td>Applied Mathematics</td>
<td>Feasibility Stage</td>
<td></td>
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<tr>
<td></td>
<td>Biomedical and Health Informatics***</td>
<td>Active</td>
<td>Pending</td>
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<tr>
<td></td>
<td>Geology and Petroleum</td>
<td>Feasibility Stage</td>
<td></td>
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<tr>
<td></td>
<td>Plant Biology</td>
<td>Feasibility Stage</td>
<td></td>
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<tr>
<td></td>
<td>Systems Biology</td>
<td>Planning Phase</td>
<td></td>
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<tr>
<td></td>
<td>Toxicology***</td>
<td>Active</td>
<td>Pending</td>
</tr>
<tr>
<td>University of North Carolina at Charlotte</td>
<td>Mathematical Finance**</td>
<td>Active</td>
<td>2007</td>
</tr>
<tr>
<td></td>
<td>Bioinformatics</td>
<td>Active</td>
<td>2011</td>
</tr>
<tr>
<td></td>
<td>Health Informatics</td>
<td></td>
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<tr>
<td></td>
<td>Biotechnology</td>
<td>Planning Phase</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data Science and Business Analytics***</td>
<td>Active</td>
<td>Pending</td>
</tr>
<tr>
<td>University of North Carolina at Wilmington</td>
<td>Computer Science and Information Systems</td>
<td>Active</td>
<td>2005</td>
</tr>
<tr>
<td></td>
<td>Clinical Research &amp; Product Development**</td>
<td>Active</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interdisciplinary Data Sciences</td>
<td>Planning Phase</td>
<td></td>
</tr>
<tr>
<td>Western Carolina University</td>
<td>Chemical Characterization: PSM Concentration***</td>
<td>Active</td>
<td>Pending</td>
</tr>
</tbody>
</table>

**"Active" describes programs that have been fully approved and to which students may enroll. "Planning Phase" describes programs that have not yet entered the final approval stage. "Feasibility Stage" describes programs that have not yet been approved for the planning stage.**

**Formal PSM affiliation not obtained. Data from these programs not included in this report.**

***PSM affiliation underway.**
**ALFRED P. SLOAN AWARD, SUB-AWARDS AND OTHER FUNDING**

**Alfred P. Sloan Foundation**  The UNC PSM Program received a second system grant from the Alfred P. Sloan Foundation in December 2010 in response to a proposal entitled “Expansion of the University of North Carolina Systemwide Professional Science Master’s (PSM) Initiative.” Funds were provided to begin multiple PSM programs, distribute PSM training materials to all campuses, and hold three annual meetings for the UNC PSM Council Group together with key industry leaders. The Alfred P. Sloan Foundation has been instrumental in supporting the UNC PSM effort since 2002. (See table key for a list of A.P. Sloan grants and grant phases.)

**North Carolina Biotechnology Center**  The North Carolina Biotechnology Center has supported the production of PSM educational materials and numerous meetings. In 2009 the Center funded a highly successful workshop for deans and PSM program directors entitled “Creating Alliances and Educational Projects With Industry Partners.”

**UNC General Administration**  The Director of the UNC PSM Program received support from the UNC General Administration for the development of a suite of online tools for management, advertising, student promotion, strategic planning and economic impact assessment of PSM programs, all of which are described in this report.

**Funding for Individual PSMs**
The Alfred P. Sloan Foundation has provided support for development of several of the original individual UNC PSM programs. Several other entities have provided additional funding for PSM program development at NC State University. Examples include:

- Electric Power Systems Engineering (Department of Energy: $3.5 million*)
- Biomanufacturing (National Science Foundation: $700,000)
- Microbial Biotechnology (North Carolina Biotechnology Center: $55,200)
- Advanced Analytics (SAS Institute: $2 million)
- Financial Mathematics (SAS Institute: $141,744, Progress Energy: $229,859, Wachovia: $50,000 (estimate**), National Science Foundation: $50,000 (estimate***)

* Proportion of funds earmarked for PSM Program.  ** Part of endowed fellowship.  *** Part of grant funding.

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**LIST OF GRANTS AND PROJECTS SPONSORED BY THE ALFRED P. SLOAN FOUNDATION AND OTHER GRANTS**

<table>
<thead>
<tr>
<th>Institution</th>
<th>Description</th>
<th>† Sloan grant phase</th>
<th>Other grants</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Appalachian State University</td>
<td>PSM in Engineering Physics: Instrumentation and Automation</td>
<td>1</td>
<td>PSM completed</td>
<td></td>
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<tr>
<td>2 Appalachian State University</td>
<td>PSM in Environmental Monitoring &amp; Assessment</td>
<td>5</td>
<td>PSM in progress</td>
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<tr>
<td>3 Appalachian State University</td>
<td>PSM in Engineering Physics: Nanoscience for Advanced Materials</td>
<td>3</td>
<td>PSM completed</td>
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<tr>
<td>4 Appalachian State University</td>
<td>Planning of Multiple PSM Programs (Nutrition and Food Systems, Environmental Science and Hazard Mitigation)</td>
<td>3</td>
<td>Project completed</td>
<td></td>
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<tr>
<td>5 Appalachian State University</td>
<td>PSM in Wine Science</td>
<td>2</td>
<td>Not completed</td>
<td></td>
</tr>
<tr>
<td>6 Appalachian State University</td>
<td>PSM in Financial Mathematics</td>
<td>2</td>
<td>Not completed</td>
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<tr>
<td>7 Appalachian State University</td>
<td>PSM in Entrepreneurial Information Technology</td>
<td>4</td>
<td>PSM in progress</td>
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<tr>
<td>8 East Carolina University</td>
<td>PSMs in Health Physics &amp; Medical Physics</td>
<td>3</td>
<td>Not completed</td>
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<td>9 Elizabeth City State University</td>
<td>PSM in Applied Mathematics</td>
<td>3</td>
<td>MS completed</td>
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<td>10 Elizabeth City State University</td>
<td>PSM in Computer Information and Cyber Security</td>
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<tr>
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<td>14 North Carolina A&amp;T State University</td>
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<td>PSM in progress</td>
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<td>15 North Carolina A&amp;T State University</td>
<td>PSM in Building Engineering</td>
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<td>16 North Carolina Central University</td>
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<tr>
<td>17 North Carolina Central University</td>
<td>PSM in Pharmaceutical and Chemical Sciences</td>
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<td>18 North Carolina Central University</td>
<td>PSM in Applied and Industrial Chemistry</td>
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<td>19 North Carolina Central University</td>
<td>PSM in Pharmaceutical Sciences and Business Administration</td>
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<tr>
<td>Institution</td>
<td>Description</td>
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<td>Other grants</td>
<td>Status</td>
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<tr>
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<td>PSM in Microbial Biotechnology</td>
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<td>x</td>
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<td>22 North Carolina State University</td>
<td>Lead and Manage UNC PSM Initiative</td>
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<td>23 North Carolina State University</td>
<td>Colloquium on Professional Graduate Education</td>
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<td>Project completed</td>
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<tr>
<td>24 North Carolina State University</td>
<td>PSM in Geospatial Information Science and Technology</td>
<td>3</td>
<td>x</td>
<td>PSM completed</td>
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<tr>
<td>25 North Carolina State University</td>
<td>Feasibility of Sustainable Development Practice</td>
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<td>Project completed</td>
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<tr>
<td>26 North Carolina State University</td>
<td>PSM in Nutrition: Human Nutrition</td>
<td>3</td>
<td>x</td>
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<tr>
<td>27 North Carolina State University</td>
<td>PSM in Nutrition: Feed Science</td>
<td>3</td>
<td></td>
<td>PSM completed</td>
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<tr>
<td>28 North Carolina State University</td>
<td>PSM in Environmental Assessment</td>
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<td>Project completed</td>
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<td>29 North Carolina State University</td>
<td>PSM in Analytics</td>
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<td>30 North Carolina State University</td>
<td>PSM in Biomanufacturing</td>
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<td>31 North Carolina State University</td>
<td>PSM in Electric Power Systems Engineering</td>
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<tr>
<td>32 North Carolina State University</td>
<td>PSM in Climate Change and Society</td>
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<td>PSM completed</td>
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3. UNC Grant 1 Phase 2 (UNC-GA): 2009. NC State takes leadership of UNC PSM development. The remainder of the A. P. Sloan grant is managed by NC State through the end of the granting period. Mini grants during 2009.


MS–Master of Science
INCLUSION OF PSMS IN THE UNC SYSTEM’S STRATEGIC DIRECTIONS

In 2013 UNC’s new strategic plan entitled “Our Time, Our Future” was developed. The PSMS were included in two sections (Goal 1 and Goal 3). PSMS sub plan – Four strategies were envisioned and these are listed in the slides below (excerpt from Graduate Council meeting in 2013):

**Our Time, Our Future: UNC strategic directions 2013–2018**
- Goal 1: Setting degree attainment goals responsive to state needs
- Goal 2: Strengthening academic quality
- Goal 3: Serving the people of North Carolina
- Goal 4: Maximizing efficiencies
- Goal 5: Ensuring an accessible and financially stable university

**UNC strategic directions 2013–2018**
**PSMs are of utmost importance**
- Chapter 1F: Improve graduate student education
  …Thus, to meet the enrollment growth target modeled here, aggressive new investments in…industry-responsive masters programs such as the Professional Science Masters (PSM) will be of utmost importance.
- Chapter 3: Serving the People of North Carolina** PSM Action Steps**
  Support existing and develop new Professional Science Master’s programs…Expand professional science master’s degree programs…should move more rapidly to coordinate future growth in this key area

**UNC strategic directions 2013 – 2018**
**PSM sub plan – Four strategies**
1. Engage UNC Industry Advisory Board in planning and development
2. Provide leadership at state and national levels
3. Incentivize and prepare faculty to develop, provide and manage PSM programs
4. Assess student outcomes, economic impact and stakeholder satisfaction
The details of the four strategies are described below. Many of the activities are described in this report.

1. Engage UNC Industry Advisory Board in planning and development
   - Provide UNC Industry Advisory Board (to be formed) with information to understand, communicate, and enhance PSM program effectiveness and impacts.
     - Annual report, inventories (PSM programs, employer alliances, PLUS course usage)
   - Engage UNC Industry Advisory Board in implementation of state-wide internship portal.
   - Develop models for sustainability of
     - the UNC PSM Program
     - individual campus PSM programs

2. Provide leadership at state and national levels
   - Coordinate campus PSM program planning and development efforts.
     - NC State PSM Council and other individual campus PSM councils
     - UNC PSM Council
     - NPSMA
     - SSR PSM
   - Convene PSM stakeholders in North Carolina.
     - Ten year anniversary celebration
   - Disseminate knowledge about best practices locally, regionally and nationally. Books, journal articles, campus visits and invited presentations

3. Incentivize/prepare faculty to develop/provide/manage PSMs
   - Explore separate degree designation for the PSM.
   - Offer centralized program materials, program development grants (pending resources), student advertisement, and electronic program management tools. Website, video, poster, program report, four electronic management tools (program planning, data management, advertising, assessment, mentoring)
   - Develop and host regular faculty workshops and consultation opportunities on program development, alliance-building with employers, professional transferable skills, PSM affiliation, and other needed topics.

4. Assess student outcomes, economic impact & stakeholder satisfaction
   - Establish centralized mechanisms for data collection and reporting.
     - Enrollment, graduation, time to degree
     - Residency, employment and wages
   - Survey employers and program alumni to understand overall economic impact of the PSM program for North Carolina.
     - Success stories, quotes
     - Financial value of student work
ORGANIZATION

NC STATE PSM COUNCIL

The NC State PSM Council consists of approximately 20 professors, directors, and coordinators from NC State University and was established by the UNC PSM Director and the Dean of the Graduate School. The Council is the formal PSM advisory council to the Dean of the Graduate School and to the Provost's Office at NC State University. Members of the Council meet in person once per month and the Council is chaired by the UNC PSM Director. The mission is to develop and maintain a cross-discipline dialogue between PSM programs from different colleges with the purpose of addressing needs and future direction of the university-wide PSM Program. The UNC PSM Director reports to the Council any essential PSM news from national fora and from the UNC PSM Council (see below). Together with the Council, the UNC PSM Director sets the agenda for the meetings. Because NC State is the UNC campus furthest along in terms of PSM development and number of active programs, many innovative activities have taken place at the council level. If the result was deemed valuable for the other UNC campuses, a “roll-out” of these activities was usually planned.

Examples of topics, products and resolve include:
- Cross-disciplinary, university-wide planning and operation
- University-wide advocacy
- Inter-college assistance to start and manage PSM programs
- Incentives for faculty
- Budgets and sustainability plans
- Grants
- New central management tools and databases
- Inter-college course sharing
- Professional skills certificate
- Premium tuition
- Central website, please see http://www.ncsu.edu/grad/psm-ncsu
- Advertising
- Internship collaboration
- Enrollment pipelines in and out of PSMs
- NC State meetings
- NC State ten year celebrations
- Assistance network – “PSM expertise inventory” (See pages 16–17). This inventory provides an overview of essential PSM tasks and services at individual program, university and system levels.

UNC PSM COUNCIL

The UNC PSM Council consists of approximately 50 deans, professors, directors and coordinators from multiple UNC campuses involved with PSM program development and management. The Council is a shared, informal PSM advisory council to all UNC campuses, and most recently, to UNC General Administration. Members of the Council meet by phone conference once per month and the Council is chaired by the UNC PSM Director. The goal is to provide inter-campus support of PSM program development and address arising needs of the UNC PSM Program. As with the NC State PSM Council, the UNC PSM Director reports to the UNC PSM Council any essential PSM news from national fora. Individual campuses report on their progress and seek assistance through this body. Together with the Council, the UNC PSM Director sets the agenda for the meetings. The areas of work have included:
- Planning and assistance for new PSM programs
- Inter-campus collaboration
- Inter- and intra-campus course sharing
- Campus-wide data collection
- Campus-wide databases
- Sub-grant solicitation and distribution
- Central website, please see http://www.ncsu.edu/grad/psm or http://psm.northcarolina.edu
- Central advocacy and advertising
- UNC multi-campus meetings with employers
NATIONAL PSM ASSOCIATION

The National PSM Association (NPSMA) conducts field-specific workshops with the aim of supporting individual PSM program development nation-wide. The NPSMA is a member-based organization with outreach to both faculty and alumni. For more information, please visit www.npsma.org. The UNC PSM Director is a co-founder of the NPSMA.

COUNCIL OF GRADUATE SCHOOLS

The Council of Graduate Schools (CGS) has been instrumental for several years in overseeing the quality of new PSM program curricula by approving PSM affiliation, maintaining the most commonly visited PSM site, and performing national surveys. These tasks are now performed by the national PSM Office (see below).

NATIONAL PSM OFFICE

The National PSM Office (NPSMO), located at the Keck Graduate Institute, is the new entity responsible for approving both PSM affiliation for new programs and PSM re-affiliation for five-year old or older programs. The NPSMO will be conducting national surveys of PSM enrollment, graduation, and employment data and also of alumni satisfaction. The NPSMO is maintaining and updating www.sciencemasters.com, which lists all individual programs, the forms for PSM affiliation, and much more.

SYSTEMS, STATEWIDE AND REGIONAL (SSR) PSM GROUP

Each month a national phone conference is conducted with PSM leaders involved in systemwide, statewide, and regional (SSR) planning of PSM programs. The UNC PSM Director co-initiated this informal group. Among the states and organizations currently represented are: Arizona, California, Middle Atlantic Historically Black Colleges and Universities, New York, Connecticut, Maryland, Massachusetts, North Carolina, Washington, Illinois, Pennsylvania, Florida, Oregon, Texas, Minnesota, New Jersey, Ohio, Hawaii, Washington, Colorado, Missouri, the Council of Graduate Schools, and the Alfred P. Sloan Foundation. This group and many of its member programs can be found at www.nash-psm.org, which is the website for the National Association of System Heads (NASH) joint project for PSM degree programs. A wide range of topics related to the operation of SSR PSM programs are discussed. Examples include:

- System-wide and statewide planning and operation
- Assistance to start and manage PSM programs
- Sustainability and funding
- PSM degree registration
- Workshops
- Central advocacy
- Marketing and outreach to employers
- Mentoring
- Alumni tracking
- Interaction with economic development entities
- National collaboration
## ESSENTIAL PSM SERVICES AND NC STATE PSM COUNCIL EXPERTISE INVENTORY

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### Abbreviation Key

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<tr>
<td>JA</td>
<td>Jonathan Allen</td>
<td>Coordinator, Nutrition Program, Director of Graduate Program, Food Science</td>
<td><a href="mailto:jon_allen@ncsu.edu">jon_allen@ncsu.edu</a></td>
</tr>
<tr>
<td>MB</td>
<td>Mesut Baran</td>
<td>Professor, Electrical &amp; Computer Engineering</td>
<td><a href="mailto:baran@ncsu.edu">baran@ncsu.edu</a></td>
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<tr>
<td>RB</td>
<td>Roger Barker</td>
<td>Burlington Chair in Textile Technology, Director of the Textile Protection and Comfort Center</td>
<td><a href="mailto:roger_barker@ncsu.edu">roger_barker@ncsu.edu</a></td>
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<tr>
<td>LB</td>
<td>LisaBeth Borbye</td>
<td>Assistant Dean for Professional Education, UNC PSM Director</td>
<td><a href="mailto:lborbye@ncsu.edu">lborbye@ncsu.edu</a></td>
</tr>
<tr>
<td>PC</td>
<td>Pam Carpenter</td>
<td>Program Manager, Clean Energy Education and Workforce, N.C. Solar Center</td>
<td><a href="mailto:pam_carpenter@ncsu.edu">pam_carpenter@ncsu.edu</a></td>
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<tr>
<td>HD</td>
<td>Hugh Devine</td>
<td>Professor of Parks, Recreation and Tourism Management</td>
<td><a href="mailto:hugh_devine@ncsu.edu">hugh_devine@ncsu.edu</a></td>
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<tr>
<td>AD</td>
<td>Andrew DiMeo</td>
<td>Assistant Professor of the Practice of Industry Relations</td>
<td><a href="mailto:ajdimeo@ncsu.edu">ajdimeo@ncsu.edu</a></td>
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<tr>
<td>BD</td>
<td>Beth Dittman</td>
<td>Program Coordinator, RISE program</td>
<td><a href="mailto:realscience@ncsu.edu">realscience@ncsu.edu</a></td>
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<tr>
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<td>Professor, Extension Nutritionist</td>
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<td>Fundraising (grants, fellowships, employer resources)</td>
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<td>Inter-campus program planning and collaboration</td>
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<th>National and International level</th>
<th>JA</th>
<th>MB</th>
<th>RB</th>
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<th>PC</th>
<th>HD</th>
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<th>PF</th>
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<th>JS</th>
<th>FS</th>
<th>CS</th>
<th>LT/BD</th>
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<td>National and international advocacy</td>
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<td>Sharing and publication of best practices</td>
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<td>Publication of new methods in professional education</td>
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<td>Invited seminars and workshops</td>
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<td>Metrics reporting to NPSMA, NPSMO</td>
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OUTCOMES

DEGREES CONFERRED
Statewide, the UNC PSM program has graduated approximately 700 students (2013 statistics), with more than 500 coming from NC State University’s longstanding commitment to these degrees. The figures below show the growth and cumulative growth per year, respectively of graduates from the five campuses graduating PSM students in 2004–2013.

GROWTH PER YEAR: NUMBER OF DEGREES CONFERRED

CUMULATIVE GROWTH: CUMULATIVE NUMBER OF DEGREES CONFERRED
EMPLEYMENT AND WAGES

Post Graduate Residency, Wages and Type of Work

UNC General Administration and the NPSMA have performed analyses of post graduate residency, wages, and type of work. The table below shows the details for 514 graduates (graduation before 8/1/2012). The majority (73.7%) of these PSM graduates stayed and worked in North Carolina.*

<table>
<thead>
<tr>
<th>Location</th>
<th>Percent</th>
<th>Number of Graduates</th>
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</thead>
<tbody>
<tr>
<td>NC</td>
<td>67.10%</td>
<td>345</td>
</tr>
<tr>
<td>NC-In School</td>
<td>6.60%</td>
<td>34</td>
</tr>
<tr>
<td>Unknown</td>
<td>4.90%</td>
<td>25</td>
</tr>
<tr>
<td>DC</td>
<td>2.70%</td>
<td>14</td>
</tr>
<tr>
<td>PA</td>
<td>2.10%</td>
<td>11</td>
</tr>
<tr>
<td>GA</td>
<td>1.90%</td>
<td>10</td>
</tr>
<tr>
<td>NY</td>
<td>1.80%</td>
<td>9</td>
</tr>
<tr>
<td>CA</td>
<td>1.40%</td>
<td>7</td>
</tr>
<tr>
<td>IL</td>
<td>1.40%</td>
<td>7</td>
</tr>
<tr>
<td>In School-Other</td>
<td>1.20%</td>
<td>6</td>
</tr>
<tr>
<td>India</td>
<td>1.00%</td>
<td>5</td>
</tr>
<tr>
<td>TX</td>
<td>1.00%</td>
<td>5</td>
</tr>
<tr>
<td>VA</td>
<td>0.80%</td>
<td>4</td>
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<tr>
<td>China</td>
<td>0.60%</td>
<td>3</td>
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<tr>
<td>FL</td>
<td>0.60%</td>
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<tr>
<td>WA</td>
<td>0.60%</td>
<td>3</td>
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<tr>
<td>MA</td>
<td>0.40%</td>
<td>2</td>
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<td>MD</td>
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<td>OH</td>
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<td>Russia</td>
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<td>TN</td>
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<td>CT</td>
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<td>Canada</td>
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<td>OH</td>
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<td>Hong Kong</td>
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<td>KY</td>
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<td>MI</td>
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<td>SC</td>
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<td>Taiwan</td>
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<td>UT</td>
<td>0.20%</td>
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*Through a partnership with the Department of Commerce’s Labor and Economic Analysis Division (LEAD), UNC tracks the employment outcomes of university students who stay and work in North Carolina.
According to preliminary employment and wage analyses (performed by UNC General Administration), more than two-thirds of PSM graduates were employed in North Carolina in 2012. Employed PSM graduates received wages in the top 25% of all NC wage earners*.

Linked-in analysis of the first 493 graduates supplements this information by employer type. Please note that the education category in this figure includes both working educators (corporate and academic) and students back in school (Ph.D, MBA, other). As expected, most graduates find jobs in businesses.

*Through a partnership with the Department of Commerce’s Labor and Economic Analysis Division (LEAD), UNC tracks the employment outcomes of university students who stay and work in North Carolina.
WEBSITES

**UNC PSM Portal and NC State PSM Website**

A website has been developed for the UNC PSM Program: [www.ncsu.edu/grad/psm](http://www.ncsu.edu/grad/psm). The website includes a brief description of the UNC PSM Program and links to all the PSM programs, news, publications and resources, workshops and more. NC State's PSM Program website can be found at [www.ncsu.edu/grad/psm-ncsu](http://www.ncsu.edu/grad/psm-ncsu).

Several innovative tools have been developed that can be accessed by UNC System administrators, faculty, and students through the PSM Portal:

- **PSM Program Data Management**
  Program data entry, management, and report creation (see description p. 27)

- **Professional Skills Assessment**
  Teamwork-based performance measurement (see description p. 28)

- **Geographic Information Academic Planning Tool**
  PSM program demand and resource localization in North Carolina (see description p. 26)

- **Electronic Mentoring**
  PSM student engagement with working professionals (see description p. 29)
Guidance for Starting and Managing a PSM Program


The Quick Guide to Starting a Professional Master’s Program is available at the UNC System PSM website and answers the following questions:

• Why are professional master’s programs important?
• How do we determine whether we want to start a professional master’s program?
• What is the logical process for creating a professional master’s program?
• How do we best advertise the program to students?
• Which types of support does the Graduate School at NC State University provide?
• How do we contact others involved in professional master’s programs?

Please see Appendix 1 for an updated version (April 2014).

Creating Employer Alliances and Projects


Overview and audience: How to contact industry partners and how to build educational projects with them. Also contains reusable case studies in science and business. The method to contact industry is for all audiences; the specific case studies are for PSM audiences mostly in science and business.

Many students and university faculty are unfamiliar with industry workplace environments. Case studies developed in collaboration with working professionals can help students and professors bridge the gap between universities and industry. This book provides guidance on how to approach industry professionals and create educational alliances. The strategy of establishing contact with industry employers and the process of developing and teaching case studies are described. Eight reusable case studies are presented. Among the case studies are examples of how to identify biomarkers and new drugs simultaneously, prioritize and develop products in compliance with rules and regulations, commercialize products and protect and manage the intellectual property, optimize processes and technologies for manufacturing and minimize human errors in production.

Essential Professional Skills


Overview and audience: Description of the essential professional skills needed in the workplace for all PSMs, all fields, all new employees. This book is written with input from multiple professionals in the Research Triangle Park, North Carolina, and reflects what is needed to function well in the work environment.

Students are often surprised by the differences between the university and industry work environments when adjusting to their first jobs in industry. Such adjustment often takes nine to 12 months and is costly for the employer in terms of lost effectiveness. Students can improve their employment readiness and competitiveness by learning about the new workplace environment prior to entry. Topics include business goals and bottom line, leadership and teamwork, communication skills, marketing, discipline, flexibility, creativity and out of-the-box thinking, ambiguity management, intellectual property, specialty technology and knowledge, quality, ethics, globalization, expectation management and career management.
Teaching, Learning and Assessing Essential Professional Skills

ISBN 9781608451753 (paperback).

Overview and audience: How to teach professional skills and how to simulate the work environment outside the university. Also contains a professional skills assessment tool to evaluate student skills levels. For all PSM audiences and all others who teach professional skills.

This book describes a simple, common-sense method of how to include professional skills training in any curriculum without compromising academic rigor. It relies on introduction of unanticipated, yet manageable, crises simulating scenarios commonly experienced in the workplace. Examples include how to respond to a demand for innovation and teamwork, a layoff, a reorganization or switching jobs and projects. Preparing and practicing a mindful and healthy response is beneficial, and it serves as a platform for attitude training and character building prior to unexpected real-life events on the job and elsewhere. Also included are student reflections on learning and a rubric to assess the professional skills learning outcomes.

Sustainable Innovation


Overview and audience: How to make innovation sustainable and how to introduce sustainable innovation regimens in teaching and research. For all PSM audiences and others wanting to teach sustainable innovation or improve innovation methods.

This book offers a guide to dramatically improve the quality of innovation and solution-making through the respectful use of existing and abundant but often ignored resources. Sustainable innovation is about creative combination of ideas, materials, methods and people, courage to derive value from opposition and diversity, integrative intelligence, virtuous planning, minimal consumption of resources and definition of alternative plans. Using the method successfully requires that we are truly interested in the common good of humankind, that we care about our environment and that we take time to think carefully about consequences before we act, invent or make decisions. It is a call for a much-needed collaboration between people of different backgrounds, skills and opinions with the intent to preserve individual and local integrity and adopt a win-win mindset.
PUBLICATIONS

New PSM Program

Sustainable PSM program management
GradEdge 1(7): 5-7, Washington DC, USA (2012).

Electronic management, advertising, assessment and planning tools
CGS Communicator 44 (9): 4-6, Washington DC, USA (2011).

Sustainable Innovation

Assessing Professional Skills and Alliances with Employers

Teaching, Learning and Assessing Essential Professional Skills

Guidance for Starting and Managing a PSM Program
The Graduate School, North Carolina State University, Raleigh, NC, USA (2009).
Please see Appendix 1 (updated version).

Creating Employer Alliances and Projects

Assessment of PSM Programs
Borbye, L. & Strausbaugh, L.: PSM Program Assessment from All Perspectives.

Essential Professional Skills
WORKSHOPS

How to Start a PSM Program

Recurring workshop

In this workshop participants learn how PSM programs differ from traditional master’s programs. The emphasis is on establishing employer alliances and educational projects, professional skills education, each step of the academic planning process and how to avoid common pitfalls. Instructional materials include those described earlier as well as an overview of the PSM affiliation criteria.

Creating Alliances and Educational Projects with Industry Partners

NC Biotechnology Center, November 2009

The UNC System PSM director joined with industry professionals from the Research Triangle Park to develop inquiry-based, industry-relevant educational materials that bridge the gap between the classroom and the workplace (described earlier). The purpose of this workshop was to disseminate these materials and to present a process that participants can use for engaging with industry — from contacting industry professionals to designing collaborative projects and teaching workplace skills — all with the aim of creating momentum for the statewide development and adoption of workforce-relevant curricula. A total of 18 participants from 11 universities and colleges in North Carolina learned to design projects with attending industry professionals and returned to their home institutions with instructional materials and basic project plans.

Quote from an attendee:

The “Creating Alliances” workshop was demanding and productive. I think this was one of the best workshops I have attended, since we were provided with timely and critical information, produced case studies with expert assistance, had a meaningful way in which to engage industry representatives and had outstanding networking opportunities. I suggest offering these again and letting institutions bring small teams (of three to four people) from the same institution to allow them to begin to build critical mass for building professional education opportunities.

–Elizabeth Wolfinger, Dean, Meredith College

Improving Performance Through Professional Self-Awareness and Self-Care

NC State University, November 2010

Participants in this workshop learned about the difference between performance indicators in academic and corporate environments and how these indicators condition students and employees. A set of common and frequently occurring, yet often unexpected, changes were described, as was how being out of one’s comfort zone may affect personal performance levels. Participants gained understanding about key aspects of professional self-awareness as a resource for sustainable resilience, peak performance and personal growth. A demonstration of Mindfulness Based Stress Reduction (MBSR) was given by a guest instructor from Duke Integrative Medicine.
ELECTRONIC MANAGEMENT TOOLS

Academic PSM Planning for North Carolina: A Geographical Tool
(Excerpt from Borbye and Edelman [2011], p. 24)

A web-based academic strategic planning tool has been developed by the Geospatial Information Science and Technology PSM program at North Carolina State University. The tool features interactive mapping of North Carolina’s potential for PSM development by visualizing where PSMs can connect to industry clusters, individual companies, nonprofits and government entities as well as individual UNC campus strengths and existing PSM programs. The intent is to ensure that academic planning is well-coordinated, all relevant industries have access to PSM programs, duplicate efforts are avoided, and resources are shared in an equitable and effective manner. The following example shows some of the information needs that the interactive map can satisfy.

Example: Environmental Engineering (EE) Business Locations (NAICS 541330)

Typical queries for a UNC administrator may be:
- Which universities have PSM programs, and how many of each kind are needed?
- What does the local graduate market base look like, i.e. Where is there a sufficient base of bachelor-level graduates within a given field to support a new graduate program?
- Where are the areas of high unemployment/poverty that could benefit from a PSM program?

Typical queries for a PSM director:
- Do other universities have this program and/or faculty/strengths within the field?
- Where are the relevant companies, and are there other organizations that support this field?
Electronic administration is essential in the quest to minimize resource consumption and the need for additional personnel when planning, developing, launching or managing PSM programs. Several innovative tools have been developed and are made available to PSM directors and PSM students through the new PSM information management system (PIMS). PSM directors can enter and update basic program descriptions in PIMS. PSM directors can also post employer project information, alumni feedback and relevant statistics. Users can browse the data and generate selective reports with information from one of more of the data collections. Since this information is accessible to all members of the UNC community, it serves as a method for sharing, publicizing, and marketing the features and statistics of the PSM programs.
Web-Based Assessment of Professional Skills
(Excerpt from Borbye and Edelman [2011], p. 24)

Resembling the peer performance assessment often carried out by companies, the Professional Skills Assessment tool is a comprehensive application based on the model currently used by the Analytics PSM program at North Carolina State University. PSM directors and PSM students can use this tool to measure student performance of work performed in teams and enhance essential skills such as effective communication, teamwork and leadership. Program directors create teams and evaluation rubrics, and they generate reports to assess individual student professional skills levels. The Detailed Report displays individual student assessment scores. Another report, the Class Report, provides self evaluation and peer evaluation average scores for the class. Scores are evaluated statistically and deviations are marked to encourage action. Students increase awareness about their professional capabilities and are incentivized by their peers to excel.
E-Mentoring Program
(Excerpt from Borbye and Edelman [2011], p. 24)

Connecting with industry leaders is something that is expected to benefit all PSM students. Many years ago, the successful mentorship program entitled “Adopt a Professional Student” was started by the Microbial Biotechnology PSM program at North Carolina State University. The program serves as the model for a new updated version of mentor-mentee matchmaking, the “e-mentoring” program. It facilitates interaction between PSM students and industry personnel. The e-mentoring program is being launched soon on UNC Online, a platform that is developed and maintained by UNC General Administration and offers online course sharing and exam proctoring. PSM directors invite mentors into the program and manage the matchmaking to the extent they desire. The e-mentoring program is anticipated to improve retention rates and job creation/job offer frequencies, as well as to be a venue for the provision of “live professional skills training.”
WEB-BASED DOCUMENTATION

Progress Report
Regularly, the UNC PSM director writes a progress report for the UNC PSM Program describing the status of existing/upcoming programs and projects. The report is available electronically on the central website and as a limited-edition hard copy.

Program Catalog
Descriptions of all PSM programs including employer projects are available electronically on the central website (please see the description of the PSM Portal). Individual or program clusters may be selected for download or print into hard-copy catalogs.

Employer and Alumni Testimonials
Alumni and employers who have interacted with the PSM programs are asked to provide feedback regarding the value of their interactions. Alumni success stories and employer testimonials may be posted through the PSM Portal.

Student Online Portfolio
Students can develop personalized Web-based portfolios including all their professional training and experience. The Geospatial PSM Group at NC State University is providing the template for this service.

PSM PROGRAM SUSTAINABILITY MODEL
(Adapted from “Quick Guide to Starting Professional Master’s Programs”)

A PSM program sustainability model for use at NC State has been developed. Other campuses are encouraged to adopt this model or develop similar or new models. The NC State model is dependent on financial support from the Provost’s Office (first two years) and has been based on enrollment projections and formula funding per student credit hour in the current enrollment year (institutional funding only). Each program must negotiate with the Provost as there is no guarantee that all or any portion of these funds will be available to a program. An example of a program budget is shown below, and there are many other models. When a program becomes profitable, a portion of the profit may be returned to the program home.

<table>
<thead>
<tr>
<th>Budget item</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salary PSM Director (25% FTE)</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td></td>
</tr>
<tr>
<td>Salary PSM Director (50% FTE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$60,000</td>
</tr>
<tr>
<td>Salary Assistant (50% FTE incl. benefits)</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
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<tr>
<td>PSM program planning and operational costs</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>Cost of buyouts of PLUS course components</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td></td>
</tr>
<tr>
<td>Year subtotal costs</td>
<td>$40,000</td>
<td>$100,000</td>
<td>$100,000</td>
<td>$100,000</td>
<td>$130,000</td>
</tr>
<tr>
<td>Projected student revenue (purpose 101) and total enrollment (year 1 and year 2 cohorts)</td>
<td>0 (0 students)</td>
<td>50,000 (5 students)</td>
<td>100,000 (10 students)</td>
<td>150,000 (15 students)</td>
<td>200,000 (20 students)</td>
</tr>
</tbody>
</table>
INTERDISCIPLINARY INTERNSHIP PLACEMENT

The UNC PSM Director has been working with Research Triangle Institute (RTI) and the Small Business and Technology Development Center (SBTDC) in North Carolina to establish a coordinated project and internship placement model. RTI is located in the Research Triangle Park and conducts research and assistance to the business community in a wide range of fields. The SBTDC has offices throughout North Carolina and has the potential to connect all UNC campuses to local small and medium-sized businesses. A similar service is already provided by the SBTDC to M.B.A, J.D. and graduate engineering students.

ONLINE GRADUATE CERTIFICATE

Professional Communication and Managerial Skills (PCOM) at NC State University

Not all UNC campuses have the resources to offer “professional skills” courses. That is why NC State University has developed a set of online courses that constitutes a separate professional skills certificate when completed. The certificate and related courses can serve as integral parts of a PSM program or as additional proficiencies added to existing PSM curriculum:

Required courses:

- Management Foundation – 3 CRH. This course is provided by the Poole College of Management at NC State.
  Students will gain an understanding of a variety of business and management disciplines, including basic accounting and finance.

- Project Management – 3 CRH. This course is provided by the Poole College of Management at NC State.
  Students will learn how to manage various project dimensions and their dynamics.

Add two of the following courses:

- Communication and Globalization – 3 CRH. This course is provided by the College of Humanities and Social Sciences at NC State.
  Students will learn how economic, political, and cultural dimensions of globalization impact the communication practices of science and technology organizations and professionals.

- Interpersonal Communication in Science/Technology Organizations – 3 CRH. This course is provided by the College of Humanities and Social Sciences at NC State.
  Students will acquire knowledge about how to interact effectively and professionally in individual and group interactions using a combination of pedagogical methods, including case studies.

- Seminar in Organizational Conflict Management – 3 CRH. This course is provided by the College of Humanities and Social Sciences at NC State.

In addition, a directory of all currently used PLUS courses (online and on campus) in all the UNC PSM Programs is found on pages 32–34.
<table>
<thead>
<tr>
<th>Institution</th>
<th>Program/Concentration</th>
<th>PLUS Courses (DE delivery option marked as gold box)</th>
</tr>
</thead>
</table>
| ASU        | Engineering Physics: Instrumentation and Automation Concentration | ACC/MBA 5240 – Accounting for Sustainability  
               ACC 5230 – International Accounting  
               COM/MBA 5311 – Conflict Management (ENG 5535 alternative)  
               ECO 5621 – Advanced Environmental Economics  
               ECO 5660 – Benefit-Cost Analysis  
               ENG 5535 – Technical Writing  
               MBA 5020 – International Experience  
               MBA 5110 – Economics for Decision Making  
               MBA 5200 – Problem Analysis & Quantitative Methods  
               MBA 5220 – Operations & Supply Chain Management  
               MBA 5230 – Global Information Systems  
               MBA 5220 – Managerial Accounting  
               MBA 5420 – Marketing Strategy & Applications  
               MBA 5600 – Managerial Finance  
               MBA 5680 – Six Sigma, Lean and Quality Management  
               MBA 5720 – International Seminar  
               MBA 5750 – Strategic Management  
               MBA 5800 – Practicum/Internship  
               MBA 5820 – Executive Skills  
               TEC 5149 – Entrepreneurship in Technology & Science |
| NC State   | Analytics                                                 | AA 500 – Analytics Tools and Techniques (embedded in course, Presentation skills, Problem Solving skills and Teamwork skills)  
               AA 504 – Analytics Practicum I (embedded in course, Legal Issues and Responsibilities, Communication skills, Project Management, Consulting Skills and Technical Writing skills)  
               AA 505 – Analytics Practicum II (embedded in course Project Management, Teamwork and Communication Skills and Technical Writing)  
               MBA 585 – Current Issues in BioSciences Management |
| Biomanufacturing |                                                      | MBA 586 – Legal/Market Dynamics in Pharmaceutical and Biotechnology Commerce  
               MBA 521 – Advanced Topics in Corporate Finance  
               MBA 542 – Supply Chain Logistics  
               MBA 563 – Product and Brand Management  
               MBA 570 – Managing the Growth Venture  
               MBA 576 – Technology Evaluation and Commercialization  
               BEC 620 – Leadership and Preparation for Industry Internship in Biomanufacturing  
               BEC 590 – Industry Practicum in Biomanufacturing  
               BEC 621 – Communications and Industry Internship in Biomanufacturing  
               BEC 669 – Biomanufacturing Research Projects  
               MBA 585 – Current Issues in BioSciences Management  
               COM 436 – Environmental Communication |
| Climate Change and Society |                                                      | COM 529 – Communication Campaigns  
               PHI 816 – Introduction to Research Ethics  
               MEA 593 (MEA 503) – Internship/Research  
               MEA 593 (MEA 502) – Climate Risk Analysis for Adaptation  
               MBA 514 – Technology, competition and the Law |
| Computer Networking: PSM Concentration |                                                      | MBA 541 – Supply Chain Relationships  
               MBA 542 – Supply Chain Logistics  
               MBA 543 – Planning and Control Systems  
               MBA 551 – Services Management and Marketing  
               MBA 553 – Business Process Analysis and Design  
               MBA 554 – Project Management  
               MBA 564 – Business Relationship Management  
               MBA 576 – Technology Evaluation and Commercialization Concepts  
               MBA 577 – High Technology Entrepreneurship  
               BUS 590 – Management Foundations  
               BUS 590 – Managing and Controlling Projects  
               COP 500 – Internship |
| Crop Science: Crop Management and Improvement Concentration |                                                      | COM 527 – Seminar in Organizational Conflict Management  
               BUS 590 – Business Management Foundations  
               BUS 590 – Special Topics: Fundamentals of Managing and Controlling Projects  
               COM 530 – Interpersonal Communication in Science and Technology Organizations  
               CS 620 – Industry Internship |
               ECE 592-19 – Power Engineering Practicum  
               ECE 592-22 – Electric Power Engineering Practicum II |
### Inclusion of Courses

<table>
<thead>
<tr>
<th>Institution</th>
<th>Program/Concentration</th>
<th>PLUS Courses (DE delivery option marked as gold box)</th>
</tr>
</thead>
</table>
| **Environmental Assessment** | | PS 536 – Global Environmental Law and Policy  
CE 564 – Legal Aspects of Contracting  
BUS 590 – Managing and Controlling Projects  
COM 530 – Interpersonal Communication in Science & Technology Organizations  
MBA 530 – People Management  
MBA 610 – Critical Analytical Thinking  
EA 685 – Professional Project |
| **Financial Mathematics** | | MBA 521 – Advanced Corporate Finance  
MBA 522 – Portfolio and Capital Market Theory  
MBA 524 – Equity Valuation  
MBA 526 – International Finance  
MBA 527 – Corporate Risk Management  
MBA 529 – New Firm Financing  
ECG 716 – Topics in Environmental and Resource Economics  
ECG 749 – Monetary Aspects of International Trade  
ECG/ST 751 – Econometrics  
ECG/ST 752 – Topics in Econometrics  
ECG 784 – Advanced Macroeconomics  
ISE 709 – Dynamic Programming  
ISE 712 – Bayesian Decision Analysis for Engineers and Managers |
| **Geospatial Information Science & Technology** | | BUS 590 – Strategic Management Foundations  
MBA 551 – Service Management and Marketing  
MBA 552 – Management Issues in Organizational Culture  
MBA 553 – Business Process Design and Analysis  
CSC 540 – Database Management Concepts and Systems  
COM 521 – Communication and Globalization  
COM 527 – Seminar in Organizational Conflict Management (Classroom sessions)  
COM 530 – Interpersonal Communication in Science & Technology Organizations  
LAR 500 – Landscape Design Studio  
PA 541 – GIS for Public Administration  
ST 507 – Statistics for the Behavioral Sciences I  
ST 508 – Statistics for the Behavioral Sciences II  
ST 511 – Experimental Statistics for Biological Sciences I  
ST 512 – Experimental Statistics for Biological Sciences II  
ST 733 – Applied Spatial Statistics  
GIS 590 – Geospatial Information Science Master's Project |
| **Microbial Biotechnology** | | MBA 503 – Survey of Accounting  
MBA 554 – Project Management  
MBA 555 – Product Design and Development  
MBA 576 – Technology Evaluation and Commercialization Concepts  
MBA 577 – High Technology Entrepreneurship  
MBA 586 – Legal and Marketing Dynamics in Pharmaceutical and Biotechnology  
MBA 590 – Classes are special topic classes and could vary by semester/year. Must be approved by MMB program director/staff before registering.  
MB 590 – Industrial Case Studies (embedded written and verbal communications, leadership, team-building, ambiguity management, flexibility and discipline). Must register for course all 4 semesters.  
MB 620 – Industry Internship Course  
MBA 562 – Research Methods in Marketing  
MBA 564 – Business Relationship Management  
MBA 570 – Managing the Growth Venture |
| **Nutrition: Food, Bioprocessing and Human Nutrition Concentration** | | Western Carolina University  
ENT - 610 – Entrepreneurial Creation  
Western Carolina University  
ENT - 600 – Entrepreneurial Planning  
UNC Pembroke  
MGT 5010 – Foundations of Marketing and Management  
Western Carolina University  
PM 650 – Fundamentals of Project Management  
FS 553 – Food Laws and Regulations Regulation  
PA 508 – Government & Public Administration Regulation and Administration  
PA 525 – Organizational Design Regulation  
TED 556 – Laboratory Management and Safety in TED Business Management and Safety  
FM 460 – Advanced Feed Mill Operations and Leadership Business Management  
BAE 578 – Agricultural Waste Management Business Management  
NTR 624/625 – Nutrition, Food and Feed Science Practicum  
Western Carolina University  
UNC Pembroke  
MGT 5010 – Foundations of Marketing and Management  
Western Carolina University  
PM 650 – Fundamentals of Project Management  
FS 553 – Food Laws and Regulations Regulation  
PA 508 – Government & Public Administration Regulation and Administration  
PA 525 – Organizational Design Regulation  
TED 556 – Laboratory Management and Safety in TED Business Management and Safety  
FM 460 – Advanced Feed Mill Operations and Leadership Business Management  
BAE 578 – Agricultural Waste Management Business Management  
NTR 624/625 – Nutrition, Food and Feed Science Practicum |
<table>
<thead>
<tr>
<th>Institution</th>
<th>Program/Concentration</th>
<th>PLUS Courses (DE delivery option marked as gold box)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online 15 CRH graduate certificate</td>
<td>Professional Communication and Managerial Skills:</td>
<td>FM/NTR 601 – Seminar (Communications and instructional skills training)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BUS 590 – Management Foundations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BUS 590 – Project Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>COM 521 – Communication and Globalization</td>
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<tr>
<td></td>
<td></td>
<td>COM 527 – Organizational Conflict Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>COM 530 – Interpersonal Communication in Science and Technology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VPH 554 – Trade Agricultural Health (Regulatory)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ENT 520 – Organic Agriculture (Regulatory)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Western Carolina University</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ENT 610 – Entrepreneurial Creation</td>
</tr>
<tr>
<td>UNCC</td>
<td>Bioinformatics</td>
<td>BINF 6151 – Professional Communications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BINF 6152 – Program and Professional Orientation</td>
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<tr>
<td></td>
<td></td>
<td>BINF 6153 – Career Development</td>
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<tr>
<td></td>
<td></td>
<td>BINF 5171 – Business of Biotechnology</td>
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<tr>
<td></td>
<td></td>
<td>BINF 5191 – Biotechnology and the Law</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BINF 6400 – Internship Project</td>
</tr>
<tr>
<td></td>
<td>Health Informatics</td>
<td>HCIP 6342 – Information Technology Project Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HCIP 6150 – Health Law and Ethics</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HCIP 6342 – Information Technology Project Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HCIP 6385 – Healthcare Communication and Leadership</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HCIP 6198 – Health IT Internship</td>
</tr>
<tr>
<td>UNCG</td>
<td>Nanoscience</td>
<td>UNCG MBA 701 – Quantitative Analysis for Decision Making</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UNCG MBA 702 – Financial and Managerial Accounting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UNCG MBA 703 – Economic Environment of the Firm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UNCG MBA 704 – Leadership Assessment and Career Enhancement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UNCG MBA 706 – Marketing Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UNCG MBA 710 – Ethical Leadership and Sustainable Business</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UNCG NANC 698 – Professional MS in Nanoscience Internship</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NC A&amp;T State University (NC A&amp;T)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NC A&amp;T – ACCT-708 – Seminar in Financial Concepts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NC A&amp;T BUAD 71 – Foundations of Enterprise Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NC A&amp;T BUAD 705 – Methods in Business Analysis</td>
</tr>
<tr>
<td>UNCW</td>
<td>Computer Science and Information Systems</td>
<td>MIS 513 – (MBA 513) Information Analysis and Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>POM 572 – Project Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CSC 594 (MIS 594) Research Project</td>
</tr>
<tr>
<td></td>
<td>12 CRH graduate certificate</td>
<td>Basic business certificate</td>
</tr>
<tr>
<td></td>
<td></td>
<td><a href="http://csb.uncw.edu/buscert/">http://csb.uncw.edu/buscert/</a></td>
</tr>
<tr>
<td>Year</td>
<td>Highlights</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
<td></td>
</tr>
</tbody>
</table>
| 2014 | • NC State university celebrates 10-year PSM anniversary for its two first programs  
• NC State University publishes 10-year legacy report and ends its leadership of the UNC PSM Program  
22 PSM programs are active and additional 26 PSM programs are at planning stages |
| 2013 | • Inclusion of PSM development into UNC’s Strategic Directions 2013–2018  
(Within chapters relating to improving graduate education, serving the people of North Carolina) |
| 2012 | • Launch of online PLUS course certificate in communication and management skills at NC State University  
• Inventories of UNC PLUS course usage and employer interactions  
• Publication of new professional education resource:  
  Sustainability in Professional Graduate Programs: Lessons in new Survival Strategies from the Professional Science Master’s |
| 2011 | • Publication of new professional education resources:  
  1. Automation of Systemwide PSM Program Management, Advertising, Professional Skills Assessment, Academic Planning and Electronic Mentoring  
• Launch of multiple administrative PSM e-tools  
• UNC System PSM Council meeting at UNC Wilmington: marketing plan  
• Development of a model sustainability plan for PSM programs at NC State University |
| 2010 | • Grant to NC State University from the Alfred P. Sloan Foundation for expansion of the UNC PSM Program  
• Grant from the UNC General Administration for development of multiple online tools  
• Workshop for deans, professors, PSM directors and students: “Improving Performance through Professional Self Awareness and Self Care”  
• Launch of a national Systems, State and Regional (SSR) PSM Group  
• Establishment of the UNC PSM Council  
• Formation of the NC State University PSM Council  
• Publication of new professional education resources:  
  1. Integrating Professional Abilities and Interaction With Employers in an Outcomes Assessment Plan: An Example From Professional Science Master’s Programs  
  2. Out of the Comfort Zone: New Ways to Teach, Learn, and Assess Essential Professional Skills |
| 2009 | • Workshop for deans, professors and PSM directors: “Creating Alliances and Educational Projects with Industry Partners”  
• First PSM focus group (geospatial/geographical information science and technology, members from NC State University and UNC-Charlotte)  
• Publication of new professional education resources:  
  1. Quick Guide to Starting a Professional Master’s Program  
• Grant from the North Carolina Biotechnology Center for development of a workshop for PSM directors  
• UNC General Administration transfers the leadership for the UNC PSM Program and the remainder of the 2005 grant to NC State University |
| 2008 | • Publication of new professional education resources:  
  1. Secrets to Success in Industry Careers: Essential Skills for Science and Business  
  2. Assessment of PSM Programs from All Perspectives  
• NC State University hires assistant dean for professional education to lead university-wide PSM development |
| 2007 | • Co-founding of the National PSM Association, NPSMA |
| 2006 | • Founding Directors from several states meet to plan a national PSM association |
| 2005 | • First MBA 1-year overlay to PSM program at NC State University  
• Launch of the “Adopt-A-Professional-Student” mentorship program at NC State University  
• UNC General Administration receives grant from the Alfred P. Sloan Foundation to scale-up PSM development in North Carolina |
| 2004 | • Presentation of the NC State PSM programs at UNC General Administration |
| 2003 | • Two first PSM programs are launched at NC State University |
| 2002 | • The Alfred P. Sloan Foundation provides grants for individual PSM program development |
During this past decade, PSM programs have become popular among students and external employers because of the promise to close the so-called “skills gap” between academia and industry. As indicated in this report, planning, implementation and growth of these programs are complex endeavors that require much nurturing, especially in the start-up phase. Great momentum has been built in North Carolina during the last five years; the PSM program portfolio has the potential to expand to involve 12 of the 16 UNC campuses. To sustain the PSM program expansion momentum and to keep the innovation edge, I suggest a number of specific actions for the next five years (most of which are included in the strategic directions for UNC):

1. Continue assistance for individual program implementation
2. Maintain existing PSM councils and establish additional campus PSM councils
3. Establish intra- and inter-campus resource sharing opportunities
4. Provide faculty training
5. Establish a central PSM Board and industry cluster focus groups and leverage industry funds
6. Develop central outcomes reporting system and establish economic impact indicators
7. Contribute to national and international PSM development

Continue assistance for individual program implementation
UNC General Administration recently conducted a survey to better understand the need for the services provided by the UNC PSM Director (please see pages 16–17) and whether or not individual campuses would pay for the services. Results showed that 88% of all new directors need assistance with a variety of specialized tasks at the program start-up level. Half of directors of seasoned programs need assistance with program management. There was a discrepancy between the need reported by the program directors and the level of financial support by the graduate deans. The NC State PSM Council Expert Inventory was developed based on these results. It contains an overview of both new and seasoned NC State PSM directors’ experience with the goal of creating an “assistance network” (please see pages 16–17). In addition, many need-based resources have already been developed during the years (please see pages 22–34 and Appendix 1: “Quick Guide to Starting a Professional Master’s Program”).

Maintain existing PSM Councils and establish additional campus PSM councils
The NC State PSM Council has been an effective vehicle for interdisciplinary planning and sharing of resources and ideas. Numerous topics have been discussed such as economic sustainability plans, intra- and inter campus course-sharing, professional skills certificate development, and central coordination of management, advertisement, data collection and internship provision. PSM Councils at other UNC campuses with PSM directors of programs at different stages of development/maturity may in the future assist each other with several of the essential services as well as their own intra-campus activities. The UNC PSM Council may continue to function as a forum for multi-campus strategic development with representatives from current and future campus PSM Councils and from UNC General Administration.

Establish intra- and inter-campus resource sharing opportunities
Focused, central leadership of core activities such as high-level advocacy, resource sharing, and new inter-campus and external employer interaction coordination provide cost cutting measures, and the continuation of these activities is greatly encouraged. Examples include the central website and advertisement materials and methods, external employer databases, professional course sharing, internship coordination, and fundraising efforts. A recent activity involves establishing intra- and inter-campus enrollment pipelines in and out of PSMs (from K-12, community college programs, undergraduate and certificate programs to PSMs and from PSMs to Ph.D. programs) as well as new PSM programs containing educational components from more than one campus.
Provide faculty training
A recurrent challenge is to ensure that PSM directors and faculty are competent and confident regarding external employer interaction and the essential skills and knowledge needed in the workplace outside the universities. Central workshops are an effective means of providing the necessary training to PSM directors of new and existing programs (examples are how to make alliances and projects with industry, how to teach and assess professional skills learning outcomes, how to use the newly-developed electronic management tools). Resources have permitted limited proof of concept training and this type of training is of great value to PSM directors. Pervasive hands-on training provided by individuals with an industry background would be a great next step towards sustained knowledge acquisition in this important area. The prospects of extrapolating the transferable professional components to undergraduate and Ph. D. levels to meet future demands for an employment-ready workforce at all levels may be an incentive for universities to “cross-train” faculty.

Establish a central PSM Board and industry cluster focus groups and leverage industry funds
Individual PSM programs have their own industry advisory boards. Additional visibility and outreach capacity to high-level external employers can be gained through a central PSM Board. Whether such a board should exist on each campus or only at the campus-wide level needs resolve. Also, industry-cluster or field-specific focus groups for PSM programs in similar fields could help establish future mechanisms for central fundraising.

Develop central outcomes reporting system and establish economic impact indicators
The development of a central data collection site (as seen on the UNC PSM website, p. 21) has spurred discussions regarding the future location, mechanism, and type of data to be collected. In addition to standard academic program data collection (enrollment, graduation, etc.), robust and unified ways to measure and report performance and outcome indicators (regarding professional skills training, external employer interaction, tracking of graduate employment, alumni satisfaction and economic impact) need development. Many suggestions can be found in the resources published by the UNC PSM Director.

Contribute to national and international PSM development
North Carolina’s PSM leadership status depends not only on PSM portfolio expansion but also on how the “best of the PSM practices” can be gleaned in regards to overall educational innovation and external employer interaction. By serving on national committees, such as the NPSMA and the SSR PSM Group and sharing data and new ideas with national and international audiences, North Carolina can continue to stay informed about and contribute to the worldwide trends.
Quick Guide
TO STARTING A
PROFESSIONAL MASTER’S
PROGRAM
(Updated April 2014)

Lisbeth Borbye, Ph.D.
Director of the UNC PSM Program
Assistant Dean for Professional Education
The Graduate School, North Carolina State University
# list of contents

1. **Why are professional master’s programs important?**
   - a. Professional master’s mission .................................................................40
   - b. N.C. State University effort .......................................................................40
   - c. “Our Time, Our Future” ...........................................................................40

2. **How do we determine whether we want to start a professional master’s program?**
   - a. Types of professional master’s programs ................................................40
   - b. Understanding the market, the employer base, and employers’ needs ........40
   - c. Reasons for employers to participate in a professional master’s program . . .41
   - d. Understanding basic professional master’s program characteristics and defining a program 41
   - e. Faculty benefits of creating a professional master’s program ...................42
   - f. Gauging departmental and interdepartmental interest ..................................42

3. **We have decided to start a professional master’s program. Who should be involved?**
   - a. Contacting the Graduate School for guidance in degree planning ............43
   - b. Identifying a director and participating faculty ..........................................43
   - c. Identifying employer contacts ..................................................................43

4. **What is the logical process for creating a professional master’s program?**
   - a. Adjusting an existing program ..................................................................44
   - b. Obtaining approval to plan and establish a new program .........................44
   - c. Designing the curriculum and example models ...........................................45
   - d. Basic principles for assembling the employer advisory board ....................46
   - e. Designing employment-specific courses ....................................................46

5. **How do we best advertise the program to students?**
   - a. Create an effective Web site ......................................................................46
   - b. Participate in career fairs ..........................................................................47
   - c. Inform directors of graduate programs and academic counselors .............47

6. **Which types of support does the Graduate School at N.C. State University provide?**
   - a. Support during program planning and launch ...........................................47
   - b. Training modules for new professional master’s directors .........................47
   - c. Mentoring of professional master’s directors .............................................47
   - d. New educational resources for professional master’s programs ................47
   - e. Organization of professional master’s course and certificate sharing ..........48
   - f. Program sustainability support plan: N.C. State University model ............48
   - g. Assessment of professional master’s programs: N.C. State University model .49
   - h. Centralized advertisement and advertisement support ..............................49

7. **How do we contact others involved in professional master’s programs?**
   - a. The Graduate School at N.C. State University ........................................49
   - b. Professional master’s directors’ network ..................................................49
   - c. Professional master’s student and alumni club ..........................................49
   - d. National professional master’s associations ..............................................49
1. Why are professional master’s programs important?

a. Professional master’s mission

Professional master’s degrees attempt to meet non-academic employers’ rising need for an improved graduate workforce. Students need to acquire a high level of technical aptitude; multiple professional competencies; an interdisciplinary, highly flexible, and collaborative attitude; and a globally oriented perspective. Professional master’s education seeks to provide these skills by adding employment-specific education to the curricula.

b. N.C. State University effort

N.C. State University has lead a pilot effort (2009–2014) to promote and implement professional master’s degree programs. The Graduate School has been devoted to serving all professional master’s programs and providing multiple services (see 6) at N.C. State University and other interested University of North Carolina campuses.

c. “Our Time, Our Future”

Professional master’s programs are part of UNC’s current strategic directions entitled “Our Time, Our Future.” Professional master’s programs are well-suited to meet many of the goals. Some examples are: enhancing global competitiveness, enhancing economic transformation and community development, and engaging and connecting with the State. Therefore, universities are strongly encouraged to embrace this concept and to plan and implement several programs. Programs may share or exchange components, and N.C. State University has assisted in the coordination and support of this effort. Long-term goals include creating a menu of possible iterations of professional master’s programs, professional certificates, and single courses that can satisfy any student and employer need in a “made-to-order” manner (see 6e).

2. How do we determine whether we want to start a professional master’s program?

a. Types of professional master’s programs

Existing master’s programs that train students for non-academic careers are by definition professionally oriented and may be classified as professional Master’s programs. They often include elements of employer interaction in their curriculum such as guest seminar series, internships or co-ops, or projects with employers. Professional Science Master’s (PSM) is a relatively new breed of graduate MS program that also caters to employers’ needs. The PSM curriculum is interdisciplinary and includes professional skills training and trade-specific management components. The National PSM Office (NPSMO) upholds guidelines for the PSMs that must be followed to earn the PSM affiliation. A parallel to the PSMs in the humanities is called the Professional Master’s of Arts (PMA). At this time there are no specific guidelines for the curriculum, but it is advisable to follow the guidelines for the PSMs while exchanging the STEM (science, technology, engineering, mathematics) courses with other relevant courses. Finally, new professional masters programs that contain hybrids of the above-mentioned components currently exist.

b. Understanding the market, the employer base, and employers’ needs

Before planning a new professional master’s program, it is important to assess the demand for graduates in the particular field. A so-called environmental scan can help establish the market potential for a new degree.
Consider asking the following questions (questions one through four must be answered):
1. Does the program fill a void or need in our society?
2. What does the employer base look like?
3. Can the need be met if a professional master’s program is created?
4. Can the traditional student base be expanded:
   a. Are there potential students who would continue their studies or return to school for a professional master’s degree?
   b. Are there existing employees who would return to school for this degree?
5. Would employers support the degree program by allowing their employees to return to school for this degree (flexibility, time, or other resources)?

It should be noted that employers are not always aware of their future needs. Sometimes employers like to see the “product” (the program and its graduates) before they will support a particular degree.

<table>
<thead>
<tr>
<th>Checklist for understanding the need for a professional master’s program:</th>
</tr>
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<tbody>
<tr>
<td>□ Identification of workforce need</td>
</tr>
<tr>
<td>□ Definition of employer base</td>
</tr>
<tr>
<td>□ Estimate of size and type of student base</td>
</tr>
</tbody>
</table>

c. Reasons for employers to participate in a professional master’s program
Employers benefit because they have an opportunity to:
1. Participate in curriculum design
2. Assist in training students to meet their own needs (improve upcoming graduate workforce)
3. Select upcoming employees and offer employment ahead of others
4. Learn about university research and collaboration potential in their field

d. Understanding basic professional master’s program characteristics and defining a program
There are several different categories of professional master’s programs:
1. STEM based (may be a PSM-type program)
2. Arts based
3. Hybrids of these

Typical components of a professional master’s program (here modeled from a PSM-type program) constitute a multidisciplinary or interdisciplinary academic core and one or more PLUS (professional skills) components from each of a) and b):
1. Main field(s) (STEM if a PSM program) (>50% of curriculum)
2. “PLUS” components (20% or more of curriculum)
   a. Supporting field (could be a 12 to 15 credit hours certificate)
      i. Business
      ii. Public policy
      iii. Non-profit management
      iv. Other (such as analytics, communication, or education,)
   b. Employment-specific core
      i. Employer-interactive and relevant course(s) (see examples in 4e and 6d)
      ii. Practicum
Checklist for defining the overall structure of a professional master’s program:

- Identification of professional master’s program category
- Selection of the professional master’s program’s main field(s)
- Identification of PLUS component(s)
- Commitment to developing a course with employer-interactive component(s)
- Definition of a practicum component (not always required)

The current guidelines for PSM affiliation can be found at www.sciencemasters.com

e. Faculty benefits of creating a professional master’s program

Some of the reasons for faculty to become involved in creating and managing professional master’s programs are:
1. Opportunity for networking with employers
2. Increased visibility through interaction with employers
3. Access to employer resources (including new technology, know-how, and funding)
4. Prospects for collaborative projects and student supervision
5. Potential to gain an understanding of the particular employment environment.
6. Potential for revenue

f. Gauging departmental/interdepartmental interest

A common barrier to success is a low level of faculty interest. Therefore, it is important that faculty is aware of the benefits of starting professional master’s programs (see above). It is unrealistic to expect unanimous support for such initiatives. For some people, change is both too risky and unwanted. Discussing both pros and cons is healthy. Some of the common issues relate to faculty expectations (see 6f, g), program resources (see 6f), and hesitation to interact with employers (see 6b). To start a program, there must be at least a small subset of faculty (often with an entrepreneurial mind-set) who understand and who are willing to spend some of their time and effort to start professional programs.

Checklist for gauging faculty interest (college(s) and department(s)):

- Discussion of the need for an improved graduate workforce
- Information about the professional master’s and “Our Time, Our Future”
- Discussion of employer base, student type, and number of prospects
- Discussion of the program and its components
- Discussion about creating the necessary components of the program
- Identification of individual faculty interested in participating
- Discussion about expectations, resources, and program sustainability (see 6f)
- Discussion about FTE requirements
3. We have decided to start a professional master’s program. Who should be involved?

a. Contacting the Graduate School for guidance in degree planning

Once it is evident that a group of faculty wants to discuss how to plan and manage a professional master’s program, the on-campus Graduate School should be contacted.

b. Identifying a director and participating faculty

Directing a professional master’s program involves coordinating the program effort, networking with employers, and teaching and mentoring students. In addition, this responsibility may require various administrative duties until an administrative assistant or coordinator can be hired (see 6f).

An effective director enjoys interacting with people. Experience in the external, employer-relevant area is not required, although it is clearly an advantage. If additional faculty has employer contacts, which can be deemed useful for the program, these contacts are particularly valuable assets for a director with no prior experience in networking outside the university setting. The Graduate School at N.C. State University has offered training and guidance for all new directors (see 6b, c, d) to help them learn how to build university-employer alliances and design and teach employment-specific curricula.

Participating faculty should be willing to include professional master’s students in existing courses (as resources permit). Faculty can help the director review and admit students, discuss curricula and employer interaction, and determine internal resource allocations.

<table>
<thead>
<tr>
<th>Checklist for identification of director and participating faculty:</th>
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</thead>
<tbody>
<tr>
<td>Identify a person who has interest, people skills and time</td>
</tr>
<tr>
<td>Evaluate a person as “champion” for the cause</td>
</tr>
<tr>
<td>Determine this person’s needs for success</td>
</tr>
<tr>
<td>Establish a backup plan if “champion” leaves</td>
</tr>
<tr>
<td>Identify person(s) with employer contacts</td>
</tr>
<tr>
<td>Identify supporting faculty members</td>
</tr>
<tr>
<td>Create a faculty support group</td>
</tr>
<tr>
<td>Discuss tasks</td>
</tr>
<tr>
<td>Identify existing resources</td>
</tr>
</tbody>
</table>

c. Identifying employer contacts

Employer interaction may be desired for a variety of tasks, such as teaching and mentoring, providing jobs and internships, or serving on an advisory board. Mapping the local, regional, and international employers with their specific interest, size, and future needs can help determine whom to contact. Faculty may already have employer contacts to help identify influential and interested parties. Alumni and mid-career professionals are also good candidates. The Graduate School at N.C. State University has provided guidance for mapping and contacting employers (see 6b).
Checklist for identification of employer contact:
- List desired employer services
- Map potential employers
- List alumni in fields related to the professional master’s program

4. What is the logical process for creating a professional master’s program?

a. Adjusting an existing program

If a master’s program already exists it may be possible to adjust the curriculum to that of a professional master’s program. Typically such an adjustment includes adding the components described in 2d and establishing employer interaction. Departments may choose to offer both a traditional master’s degree and a professional master’s degree or just one of these. PSM degree names are Master of, MS or MPS. PSM affiliation is obtained by application to the National Professional Science Master’s Office (NPSMO). The guidelines and application form for affiliation are found at www.scincemaster.com.

b. Obtaining approval to plan and establish a new program

Approval from the local UNC campus and the UNC General Administration (UNC-GA) is necessary to start a new program. Both UNC-GA Appendix A (Notification of Intent to Plan) and Appendix C (Request for Authorization to Establish a New Degree Program) must be filed. Please work with the on-campus College and Graduate School Administration to determine the appropriate steps involved.

Checklist for planning and implementing professional master’s programs:

An existing traditional master’s program will be converted into a professional master’s program.
- Obtain internal approval for the changes at the university level
  (UNC-GA approval may also be necessary)

A new professional master’s program will be developed.
- Follow campus-specific protocol, which will include:
  - Fill out and route Appendix A
  - Fill out and route Appendix C
c. Designing the curriculum and example models

There are several ways to satisfy the curriculum requirements for professional master’s programs (minimum 30 credit hours). Three examples are given below:

1. Two-year option (with 39 credit hours):
   i. Fall 1: 9 credit hours
   ii. Spring 1: 9 credit hours
   iii. Summer: 3 credit hours
   iv. Fall 2: 9 credit hours
   v. Spring 2: 9 credit hours

2. One-year option (with 33 credit hours):
   i. Fall 1: 15 credit hours
   ii. Spring 1: 15 credit hours
   iii. Summer: 3 credit hours

3. One-year option (with 30 credit hours):
   i. Fall 1: 12 credit hours
   ii. Spring 1: 12 credit hours
   iii. Summer: 6 credit hours

The curriculum may comprise a mix of required courses (including the traditional academic courses, the PLUS components, and elective courses or course modules. In fields with many specialties, it helps to first develop a core curriculum that can be built upon as needed.

Certificates comprising 12 to 15 credit hours can be fully or partially included in the curriculum. For example, a student in the Master’s of Microbial Biotechnology program can earn a certificate in biotechnology by taking extra credit hours in that subject. Also, some PLUS components may be counted as part of a later additional degree. An example is the one-year “overlay” MBA option in the Master’s of Microbial Biotechnology program (MMB). In the MMB program, the MBA courses and the employment-specific case can be credited toward an additional MBA degree following graduation from the MMB program and an additional year of study in the MBA program. In this way students are able to acquire a dual degree (Master of + MBA) in three years.

As mentioned earlier, an alternative to creating an entirely new degree program exists. Departments can use the model of an existing master’s program and add the necessary PLUS courses. Traditional and professional students may first share the original curriculum, after which the professional students will continue with PLUS courses:

1. Generic study period: All students enroll in basic master’s program
2. Professional study period: Students elect traditional or professional track
3. Additional degree study period: MBA, certificate, or other degree

Checklist for designing the professional master’s program curriculum:
- Years to complete program
- Courses and credit hours
- “Embedded” certificates
- Option to use credits toward other degrees or certificates
d. Basic principles for assembling the employer advisory board
Establishing an advisory board of employers is essential for guiding the direction of a professional master’s program and its director. The board should be comprised of members from organizations with a direct interest in the program’s components, and, at best, with hiring potential for future graduates. It is recommended that small, medium-sized and large organizations be represented to reflect different needs. Board members’ employment rank is likely to be directly correlated to their influence. A balance between high rank and availability must be achieved.

e. Designing employment-specific courses
The employer advisory board and individual employer contacts should help guide the design, content, and implementation of employment-specific courses. Such courses can be more or less dependent on employer instruction. Some examples of courses with employer interaction are:

1. Guest lecture seminar series (selection of employer speeches)
2. Case studies in the classroom (employers or faculty review past or current projects)
3. Case studies or externships at employer sites (employers provide real-time projects)
4. Internship course (short-term individual student employment)

5. How do we best advertise the program to students?

a. Create an effective Web site
Today’s students seek much of their information online, so a program homepage is an effective recruiting tool. The Graduate School at N.C. State University has continuously been developing and maintaining a central professional master’s homepage for the UNC campuses and for N.C. State University (see 6h). Individual program homepages may contain the information listed on the checklist below.

Checklist for program homepage:
- Introduction
- Mission and culture
- Program milestones
- Curriculum
- Career tracks
- Employment-specific training
- Internships or other employer interaction
- Student and alumni statistics
- Quotes from employers
- Frequently asked questions (FAQs)
- Publications
- Sponsorship opportunities
- Contact information
b. Participate in career fairs
Directors, alumni, and current students are some of the best recruiters, and participating in student career fairs is an effective way to create visibility for a professional master’s program. Students often participate because they are interested in jobs or internships, and many can be persuaded to enter into a master’s program instead, especially if future career prospects are promising. When students meet with their peers, they are likely to follow their peers’ recommendations. It is a good idea to provide a brochure to introduce the program, and include contact information.

c. Inform directors of graduate programs and academic counselors
All directors of graduate and undergraduate programs and other academic counselors should be made aware of the professional master’s initiatives currently existing and underway. It is recommended that student orientation sessions include information about professional master’s education.

6. Which types of support does the Graduate School at N.C. State University provide?

a. Support during program planning and launch at N.C. State University
In the past, the Graduate School at N.C. State University has worked with the Provost’s office to provide support for one or more of the following activities: performing an environmental scan to establish market potential, establishing employer alliances (travel to employer, employer advisory board meetings) and advertisement (Web site, other advertisement). In addition to monetary support, faculty release time was negotiable.
Additional program support was possible for a maximum of 2 years (post launch), after which the program had to be self-sustainable (see 6f).
Please note that these support options have changed, due to the current economic constraints.

b. Training modules for new professional master’s directors
The Graduate School at N.C. State University has been providing a variety of training modules for a new professional master’s program, including:
1. Starting a professional master’s program
2. Employer alliance building and case study development
3. New methods in case study teaching and innovation
4. Adding professional skills training to curricula
5. Understanding how self-care and self-awareness may impact performance

c. Mentoring of professional master’s directors
All new directors have been able to request mentoring from the Graduate School at N.C. State University. In addition, a director-to-director mentorship (expertise inventory) program has been established.

d. New educational resources for professional master’s programs
Several publications exist, which contain new employment-specific training for students and directors of most professional master’s programs. More information is available on the central professional master’s program homepage (see 6h).
e. Organization of inter-professional master’s course and certificate sharing

The Graduate School at N.C. State University has developed a list of PLUS courses, which can be shared between programs. The goal is to be able to tailor individual curricula, allowing for employment-specific tracks while ensuring the necessary requirements are met for each degree.

f. Program sustainability support plan: N.C. State University model

Financial support for the professional master’s program was earlier negotiated with the provost’s office. It was based on enrollment projections and formula funding per student credit hour, for the current enrollment year. Only purpose 101 (Institutional funding) was available. An example of a program budget is shown below, and there are many other models. Instead of a 25 percent full time equivalent (FTE) director and a 50 percent FTE assistant, a 50 percent director may be a priority. Alternatively, a 100 percent FTE assistant may be needed to assist a director. Operational costs may vary and buyouts of PLUS courses may not be necessary.

<table>
<thead>
<tr>
<th>Budget item/Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salary PSM director (25% FTE)</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td></td>
</tr>
<tr>
<td>Salary PSM director (50% FTE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$60,000</td>
</tr>
<tr>
<td>Salary assistant (50% FTE incl. benefits)</td>
<td></td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
</tr>
<tr>
<td>PSM program planning and operational costs</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>Cost for buyouts of PLUS course components</td>
<td></td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$30,000</td>
</tr>
<tr>
<td>Year subtotal costs</td>
<td>$40,000</td>
<td>$100,000</td>
<td>$100,000</td>
<td>$100,000</td>
<td>$130,000</td>
</tr>
<tr>
<td>Projected student revenue (purpose 101) and total enrollment (year 1 + year 2 cohorts)</td>
<td>0 (0 students)</td>
<td>$50,000 (5 students)</td>
<td>$100,000 (10 students)</td>
<td>$150,000 (15 students)</td>
<td>$200,000 (20 students)</td>
</tr>
</tbody>
</table>

Budget assumptions:
1. The revenue projections are calculated on an average tuition income basis. It is estimated that the revenue generated per student per year is $10,000 (academic funds only).
2. Student enrollment minimum numbers are 5, 10, 15, and 20 for years 2, 3, 4, and 5, respectively.
3. Director release time (% FTE) increases from 25% to 50% when the total number of enrolled students (year 1 + year 2 cohorts) exceeds 15.
g. Assessment of professional master's programs: N.C. State University model
The Graduate School at N.C. State University helps assess the outcomes of individual professional master's programs. The assessment tool includes evaluation of the following metrics:

1. Student learning
   a. Traditional academic metrics
   b. Professional skills development
   c. Employment-specific creativity and problem-solving
2. Program quality
   a. Employer alliances and projects
   b. Enrollment, graduation, and post-graduation metrics

The programs participate in the traditional 8-year review and outcome assessment process of the Graduate School. PSM Programs also undergo a 5-year re-affiliation review by the NPSMO.

h. Central advertisement and advertisement support
All PSM programs at N.C. State University are listed at a central N.C. State University Web site, while all UNC PSM programs are listed on a central UNC Web site currently found at www.ncsu.edu/grad/psm. Directors are encouraged to request information regarding creating effective advertisement materials for employers and students.

7. How do we contact others involved in professional master’s programs?

a. The Graduate School at N.C. State University
The Graduate School at N.C. State University has been serving as the coordinator for all professional master’s efforts. A central employer advisory board could be established to provide overall guidance in the future.

b. Professional master’s directors’ network
Professional master’s program directors are encouraged to interact with each other through regular gatherings. In addition, directors are invited to develop focus groups to explore and plan future interactions and director-director mentoring. At NC State, a council of 20 PSM directors meet regularly. Also, a UNC campus-wide PSM council exists.

c. Professional master’s student and alumni club
The professional master’s students have received encouragement to maintain a student and alumni club. It is expected that this organization will track alumni, plan events, establish a Web presence, and publish a newsletter.

d. National professional master’s associations
A large number of professional science master’s programs already exist in the United States. They are listed at www.sciencemasters.com. PSM program directors meet biannually to discuss progress and future undertakings. A national professional science master’s association (NPSMA) was established in November 2007. More information about its activities can be found on www.npsma.org. Students, individuals, organizations, and universities can become members.
In 2010, a systems, state-wide and regional (SSR) PSM group was formed with the intention to give leaders of large PSM programs a forum for interaction. It is expected that other associations will be created to organize efforts in additional fields such as the arts.
MASTER
Your Career

with Professional Science Master’s programs offered systemwide across North Carolina

Professional Science Master’s are interdisciplinary STEM programs that focus on educating students to solve today’s challenges and close the existing skills gap in the workplace. PSMs include trade-specific management in the curricula and have a high degree of engagement with local and global employers.

In North Carolina, the number and popularity of the PSMs are increasing rapidly. Examples are exciting new degrees in the fields of:

- biotechnology
- energy
- financial mathematics
- information technology
- diagnostics
- geospatial information
- climate change
- food supply
- analytics
- health
- environment
- nanoscience

Professionals from more than 200 companies, government agencies and nonprofit organizations have already contributed to the success of the UNC Systemwide PSM Program by providing:

- high tech projects
- workplace immersion experiences
- professional skills training
- networking and mentoring
- monetary support
- jobs

Because these degrees are designed in collaboration with local employers and tailored to meet their needs, most graduates are highly competitive and find employment quickly.

For more information and a complete list of participating North Carolina universities, visit us at our web site:

http://psm.northcarolina.edu
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