# Academic Program Review

**Nanoscience and Microsystems Program**

**at the**

**University of New Mexico**

**Submitted by:**


**APR Team**

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**A. Overview**

The Review Committee was impressed by many aspects of the NSMS program, including:

- The vision and leadership of Professor Abhaya Datye and that of the NSMS Executive Committee
- An outstanding program manager who plays a crucial role in holding NSMS together
- The continued commitment of a cadre of highly interdisciplinary, entrepreneurial and productive faculty at all ranks (including 4 NSF CAREER awardees)
- The unique engagement of 5 major UNM schools (Engineering, Arts & Sciences, Medical School, Pharmacy, Business)
- An extraordinary success at self-sustaining the effort through highly competitive federal funding (NSF-IGERT, NSF-REU, GAAN, NSF-PSM, NSF-MRI, NCI R25) and with very little institutional support
- A highly engaged student body and student association
- A very diverse student body (27% URM)
- The development of a new and integrated multidisciplinary curriculum
- Extensive and highly successful community outreach and public education endeavors

Despite the fact that NSMS faculty originates from very different disciplines (physics, chemistry, chemical engineering, biology, materials science and engineering), all participants are enthusiastic about the effort and appear to be focused on the common goal of making the program successful. The Committee also noted various levels of enthusiasm and commitment by the administrators they interviewed. In particular, the Deans of Engineering and Arts and Sciences and the Vice President for Research, clearly see the value and impact of NSMS. *The fundamental challenge will be to implement a two-pronged approach that will sustain the momentum of the NSMS effort in the short run while defining a viable long-term path towards sustainability.* From this Committee's experience in establishing such cross-disciplinary programs, coordination and maintenance of the team constitutes a major part of the battle.

The synergistic activities that are already underway at NSMS in particular and UNM in general, have established the fundamentals for this ambitious goal. The use of the nanoscience and microsystems paradigm as a driver for economic advancement is a model that has been implemented across the country and indeed the world. Given proper attention - and more importantly stable financial resources - the NSMS team has tremendous potential for establishing a hub for research, education and job creation in the state of New Mexico. In addition, the formalization of a successful program will make the team and the school a valuable partner for external collaborations thereby extending the reach and visibility of UNM.

The Committee believes that NSMS will have a profound impact in enabling commercial development in nanotechnology and micro-engineered systems in the region. Once operating at steady state, NSMS will attract angel and venture capital investment and potentially, corporate partners. Further, it will raise awareness of local opportunities for receiving a world-class education in nanoscience and microsystems. In this respect, NSMS's connection to community colleges and K-12 education should be critical as we have found that involving students as early as possible spurs their interest in high-technology and is an effective way to retain them regionally. These students will attend UNM and eventually become tax paying employees to the betterment of the State.

Last but not least, by concentrating research and education activities in nanotechnology and microsystems, NSMS will act as a beacon for attracting bright young faculty to UNM (this is already happening). This will in turn increase the scientific "critical mass" and, through entrepreneurship, serve as a revenue generator for the region. *The ability of UNM to compete in recruiting such talented faculty might be at risk if NSMS and other multidisciplinary programs are allowed to fail.*

**B. Response to Questions**

As part of its charge, the Review Committee was asked to consider a set of specific questions which would lend insight, evaluation and guidance to the NSMS program.

*How are interdisciplinary programs at your institutions supported? What is a reasonable level of support for a graduate program that enrolls over 60 graduate students? What other sources of funding (external and internal) should we target?*

Since two of the review team's members' home institutions have cross disciplinary nano-centric programs, it was possible to provide comparative histories, operational models and status.

At the University of Washington (Professor Baneyx's home institution), the Center for Nanotechnology (CNT) receives about $500-450K/year of institutional support from an across the board 1% cut of all units implemented in 1997. CNT has also received significant other support from federal sources (2 NSF-IGERT, NSF-NNIN, T32 Cancer Nanotech, etc.). The CNT currently has about 45 students in their dual Ph.D. program.

While the CNT exemplifies a conventional evolution for a cross-disciplinary program, the College of Nanoscale Science and Engineering (CNSE) at the University of Albany (Professor

Castracane's home institution) has evolved along an entirely different path. CNSE was started as a New York State Center for Advanced Technology in 1995 with a $1M budget and approximately 7 people including 3 faculty. From this starting point, the organization grew rapidly and since the University at Albany-SUNY did not have a College of Engineering, most faculty was recruited from outside the university. CNSE was initiated in 2004 as a new College within the university and is currently a largely independent organization with 55 faculty, 150 grad students, 200 undergraduates and about $170-200M/year operating expenses. CNSE oversees the Nanotech Complex which currently employs nearly 300 people with a total investment of $14B, 80% of which was provided by private industry with the remaining coming from traditional funding agencies and the university.

Obviously, these two models differ widely but can be adapted for the evolution of NSMS. Targets for additional funding streams might include Sandia and other National Labs benefiting from the program. The envisioned mechanism would be the sponsorship of fellowships since an overwhelming number of the NSMS students (> 90%) are US citizens. In addition, NSMS should engage the industrial base to support students that they will eventually hire. Other targets are philanthropic organizations and teaming up with UNM development to establish endowed fellowships. While conducting these activities, NSMS should lobby the state legislature to raise awareness of the program's value and align its strategic directions with state and university priorities (e.g., economic development, entrepreneurship and job creation).

*What are effective models for the management of interdisciplinary programs? What are the advantages/disadvantages of centralized management models, e.g. under the Office of the Provost vs. collaborative models distributed across the Deans of two or more colleges? What are the budgetary consequences of adopting one model over the other?*

The answer to this question is that both models are valid depending on the institutional context. What is clear is that resources will have to be attached to the NSMS program both in the short term and in the long term. In addition, clear governance policies should be established for NSMS and other interdisciplinary programs at UNM. Policies addressing F&A cost distribution and policies defining how teaching credits are allocated to interdisciplinary programs should also be formulated. Included in this is the need to lay down clear rules for interdisciplinary faculty teaching and their consequences on workload. This last point should help generate buy-in from the Deans. By constituting a Provost-level committee to look into the organization and management of interdisciplinary educational and research programs, UNM has made a promising start in formulating policies and guidelines that would shepherd such programs and help assess the value added by them to the university's mission of achieving excellence and distinction among its peer institutions. Needless to say, it is imperative that this committee expeditiously

complete its charge, provide its recommendations, and propose a clear plan of resource allocation, hiring procedures, governance, and administrative oversight to foster successful programs like NSMS.

*What steps need to be taken to ensure the continued participating of faculty in the NSMS program? What mechanisms can be put in place to allow faculty to get credit for teaching in the NSMS. Can the management structure also provide growth opportunities? How, for example, can the NSMS program be included in the process of hiring tenure track faculty in the participating departments?*

First and foremost, NSMS must produce a mission statement, strategic plan and vision. This will give a concrete direction to the program and be a useful reference document to address issues and concerns both internally (to UNM administration) and externally (to potential partners).

As mentioned above, clear policies on governance, resource allocations and workload should address issues of faculty participation and teaching credit. Further, NSMS should be represented on the search committee of future interdisciplinary and cluster hires relevant to its mission. Finally, a full buy-in by the participating schools and departments with respect to teaching credit and faculty hires into interdisciplinary degree programs is critical to nurturing and growing such programs. Only such measures can both reinforce the program value to the wider University audience and serve as a testimony of UNM administration's continued endorsement.

*Is the current core curriculum appropriate? Should we have a flexible core to accommodate the breadth of student from the physical and biological science while preserving the essential features of the NSMS?*

The core curriculum provides a solid, cross-disciplinary skill set to students and leverages the expertise of participating faculty. It was deemed appropriate to the program's mission. However, courses should be periodically evaluated for content and rigor to dispel any misperceptions that the program may provide an "easier" pathway to a PhD degree than the more traditional department-centric programs. The Committee recommends elimination of the one-credit Ethics class and the inclusion of ethics case study modules in core courses.

The Committee also recommends that flexibility be provided through formal electives that build upon the research strengths of the instructors. Lastly and perhaps most importantly, the NSMS faculty/staff should conduct regular advising sessions with students and encourage periodic

thesis/dissertation committee meetings. This will help guarantee efficient progress to degree, reinforce the collegial atmosphere of the program, and go a long way in putting to rest the general undercurrent of student uneasiness that was sensed by the Committee.

*How should the NSMS program build on the success of the Professional Science Master Program? What can the NSMS program do to incorporate the vision of the innovation Academy to fundamentally transform graduate education?*

There is a great opportunity to build on the PSM program by incorporating an emphasis on entrepreneurship and economic development into NSMS activities and strategic planning. Part of this should include a significant role by NSMS to help secure resources, perhaps through partnerships with companies, and help bring the Innovation Academy vision to fruition.

**C. Conclusions and Recommendations**

Overall, the Review Committee feels that NSMS is a successful and high quality program that has a solid foundation of demonstrated success and great promise for future expansion. In fact, a formalized and stably funded NSMS has potential for transforming the educational, research and entrepreneurship landscape at UNM.

Our recommendations are as follow:

1. The UNM upper administration should recognize, and more importantly, communicate, the added value of interdisciplinary endeavors to its stakeholders.

2. The UNM upper administration should provide clear governance policies and an administrative home for NSMS and other interdisciplinary programs.

3. The UNM upper administration should provide clear policies regarding resource allocation, credit assignment, workload expectations and faculty evaluations for those involved in interdisciplinary programs.

4. UNM upper administration must ensure a more predictable revenue stream to NSMS to support its program administration, student recruitment, publicity, seminars/colloquia, and grant proposal development activities.

5. While these longer-term policies are being formulated, UNM should provide short-term resources to maintain NSMS' core activities and momentum (which to UNM's credit apparently has already happened).

6. NSMS should craft a mission statement, strategic plan, vision statement and an estimate/justification of its program cost.

7. NSMS should build on its strengths to proactively support the economic development initiatives of the university and state of New Mexico

8. UNM should provide a physical home for NSMS (at a minimum, a common space) to encourage collegiality, promote continued interactions between cohorts, maintain a sense of identity and breed new collaborations