

Review of the Materials Science and Engineering Department, University of Texas, Dallas

Review Team:

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Preface: A team of external and internal reviewers (noted above) met on April 18 to evaluate the Materials Science and Engineering (MSE) Department at the University of Texas at Dallas (UTD). The team was sent the self-study document from the department and instructions from the Provost's office about the conduct of the review. The review began with dinner on the 17th, during which the Vice Provost and the Dean of Engineering gave broad overviews of UTD, the School of Engineering, and the MSE Department.

The Review Process: The review team consisted of equal numbers of both internal and external members, which is unusual compared to other reviews undertaken by the external participants. The viability of such an approach, and the limitations it may impose on open discussion, needs to be assessed by the university management. The format for the review also needs refinement. For example, the review should start with an overview by someone at least one level above the unit being reviewed, providing facts and figures, a discussion on how the unit fits into the larger vision of the University and School of Engineering, the expectations for the unit, and a brief statement of the charge to the committee. Such a more specific presentation might be part of the evening dinner, in conjunction with the broader overview that we did receive.

Overview of the Unit: The MSE Department was created in ~2008 within the Jonsson School of Engineering, with a primary focus on graduate education and research. The School of Engineering at UTD is in a dynamic phase of evolution. Its faculty has grown from 90 to ~130 with the aspiration to grow to 170. At the same time, the student body has grown from ~2700 to ~5500, confirming the need for a major engineering program in the Dallas Metropolis. In addition to the educational mission, the University and the School seek visibility and recognition as major research entities. Progress on this front can be seen by the fact that research expenditures in the School have doubled over this period, strongly suggesting a significant return on the investments made by the founders. Thus, the dual role of undergraduate education and graduate education/research, actively engaged in by most departments, is growing rapidly.

The MSE Department reflects primarily a research focus, with a much stronger emphasis on graduate education and research and may present a different business model than other departments within the university. It is critical for UTD to recognize that this department is a tremendous asset to the university. First and foremost, the research work of the collective faculty is highly regarded in the

broader materials community, an absolutely necessary prerequisite for UTD to achieve a high national and international ranking. One metric is the average H-factor (the number of papers, H, that have at least H citations, see table 1) is 32.3, which is competitive with the top programs in the country. Furthermore, the department is bringing in almost 6M\$/year of competitively awarded, external research funds.

The mission of the department is stated as: *“Initiating highly collaborative endeavors and using the diversity of the department as a source of innovation and technical excellence...achieving scientific breakthroughs...for industry and government initiatives... a global leader in educating students and exceeding stakeholder’s expectations”*. The department has assembled a high-quality faculty able to meet this mission. The experimental contingent is exceedingly well equipped. The spirit of the department is high, with a sense of cooperation and determination to succeed in their area of science and engineering, and also to contribute to the University as a whole. There is confidence in the departmental leadership.

Table 1: H factors for MSE Department faculty.

Faculty Name	H-Factor (Citations) : SCI	Google Scholar
R. Wallace	34 (9219)	47(14971)
M. Fischetti	42	47 (9509)
L. Gelb	14	
A. V.Walker	19(1142)	21(1373)
C. Young		25(1996)
C. Hinkle	18 (987)	21 (1323)
B.Gnade	28	43 (8100)
O. Auciello	37	41
K. Cho	37	39(9296)
J. Hsu	34	35(4966)
J. Kim	19	21
M. Kim	28(2608)	32(3372)
M. Quevedo-Lopez	22(1195)	24(1775)
W. Voit	5	6(121)
Y. Chabal	62(15300)	67(18706)
Average	32.3	

A note about comparisons: Materials Science has multiple personalities on US universities. Examples include departments without undergraduate programs such as UTD, traditional departments with undergraduate efforts (many with relatively small undergraduate numbers), materials science programs governed by interdisciplinary institutes that engage many different departments, and all combinations of the above. In some cases the formal materials department is centered on “traditional materials” (metals, ceramics, etc.) and centers are formed to engage in “modern materials science”, which tends to be more nano and electronics driven, and much more interdisciplinary. The UTD MSE Department is indeed engaged in modern materials science. Therefore the choice of “peer institutions” needs to be thought through by the department, in consultation with

the administration. Comparisons should take into account the great variability of MSE forms and the choice of peer institutions should be made accordingly. We would suggest having one set of “comparative” research institutions and another that are “aspire to” institutions. Even though such institutional comparisons can be difficult, faculty comparisons among those engaged in modern materials science is possible. As stated above, the UTD/MSE faculty is highly regarded and competitive.

The aim to be in the top 20 (or even 40) is admirable, but the path is likely to be arduous and the grouping even a bit ill-defined. The high rankings of the senior faculty are necessarily based on past performance at other institutions, and it will take some time for the UTD MSE Department to be credited with the high level of accomplishment. Therefore the Department would be well served by choosing achievable but elevated goals, thus displaying a realistic view of academic rankings and, at the same time, providing a systematic path to measurable success. Despite its enviable success so far, the Department will likely face several challenges, which include limited future space growth in NSERL, reduced local funding that has sustained new faculty via start-up packages, and continually increasing competition for federal grants and contracts. Early planning, with input from the administration, can help to anticipate and prepare for these challenges.

Faculty: The MSE Department has recruited an excellent group of faculty members, both at the senior and the untenured levels. Professor Chabal, the chair of the Department, one of the original hires (Gnade, Kim, and Wallace were the founders of the Department), is applauded for his perseverance, enthusiasm, and ability to recruit top-notch faculty. The faculty includes researchers who are widely recognized in their fields of materials science and engineering.

The faculty size (15) is on the small side, but is sufficient to excel in the areas of interest to the Department. The faculty spans established expertise in three most critical areas of current technology that can be significantly advanced via materials science breakthroughs: nanoelectronics, energy, and bio-materials. The Department has populated these areas with a balance of senior and junior scientists, consisting of both theorists and experimentalists with complementary interests. An advantage of building the Department from the ground up is that the university can assure the correct balance, synergy of interests, and trajectory.

We found the faculty to be uniformly highly motivated, committed to the education and research mission of the Department, and willing to push hard towards the larger goals of departmental and university distinction in both research and graduate education.

The departmental goal- *achieving scientific breakthroughs...for industry and government initiatives*...tends to focus on research of strong interest within the US. Indeed many of the MSE faculty are well known in the US and a few are internationally highly visible. At the highest levels, research prominence requires international recognition of a major fraction of department faculty—an

intermediate goal achievable primarily through attendance at international events and publication in high-profile journals. Beyond that one thinks of prizes, awards, and ultimately membership in the National Academies of Sciences or Engineering. We urge the Department to consider its research goals in light of such possibilities and start a process that will help it identify potential candidates. Such goals, although very lofty, raise the bar both for candidates and for research topics as the department matures.

Teaching/Curriculum: The main educational mission is centered on graduate programs. The Department is clearly making an important contribution to the training of highly educated and skilled professionals in the fields covered by the Department. We would expect this contribution to increase substantially as the newer programs become established. Clearly the extraordinary facilities and the talented faculty have the wherewithal to be leaders in this aspect of education. We spent quite a bit of time debating the graduate curriculum. At least one reviewer felt that the core courses could be strengthened through a course on mechanical properties of materials (the lack of such a course is perhaps reflective of a trend in the MSE field nation-wide, where the emphasis is more on functional, nano-, and biomaterials). The Department is well positioned to seek graduate level funding, such as NSF IGERTs, that will not only provide further financial support but also bring distinction to the educational mission.

Research and Graduate Students: The faculty are already well recognized as leading players with impact in the broad field of modern materials science. Included in the faculty are some of the leaders in the field—and the research output as measured in the metrics of citations and invited talks, is exemplary and on an upward slope (Table 2, pg. 13, Self-Study). The Department has established extraordinary equipment/facilities, enabling it to make significant future contributions. The combination of research talent, facilities, and drive can allow this department to become highly visible as a national and international research leader. This ambition could be enhanced by pursuing a plan for more far-reaching and speculative research goals, within the areas of expertise of the Department or through new faculty hires.

One sign of competitiveness of an academic institution/department is the ability to attract high-quality, domestic graduate students. More needs to be done in this respect in the MSE Department. A coherent approach must be instituted to attract such students and resources dedicated to this mission. We urge the Department to design an aggressive program of graduate student recruiting involving more marketing and intense enticement of the best and brightest! Visits, phone calls, fellowships, and an attractive open house all help the process. The REU plan is one step in the correct direction!

Our meeting with the graduate students was definitely one of the highlights of the review. The meeting with students had 70+ in attendance, including a few undergrads as well as a high-school intern. We found the students to be highly

motivated, committed, and quite articulate (those who spoke up), all extremely positive indicators in terms of the vibrancy of the Department. Whereas it was enjoyable to see the students as a group and to listen to them express (quite openly for some) their ideas, there was no way to gauge the quality of their individual research or what they actually knew. We suggest a poster session as part of the review process.

Of particular note and satisfaction to the Committee was the Department's non-traditional involvement in undergraduate education. Although the Department does not have a formal undergraduate program, it is quite deeply engaged in undergraduate research through REU programs (approximately 100 UG interns over the past 5 years). The committee notes that although the Department does not offer an undergraduate curriculum, it is quite active in undergraduate research engagement, averaging almost 2 UGs/faculty/year. The involvement of undergraduates in research should be further encouraged and grown.

The Department's research, focused on four broad topics, namely electronic materials, biomaterials, materials for energy, and nanomaterials, seems to positively engage and motivate the graduate student body. The students think very highly of their faculty, another key indicator. The students believe their faculty are very good and push the students to do scholarly work. Peer-reviewed publication is a typical requirement, but set individually by each faculty member. The Department should consider making this a formal, quantitative requirement for all students graduating with a Ph.D. degree.

There was quite a bit of discussion about the qualifying exam, how it is being conducted and possible pathways to improve the delivery of this exam. Particularly, some students felt that the exams should be available to them to look over (this is a debated point, as the faculty seemed to think that the students did get access to the exams). Overall, complaints about the qualifier were confined to a vocal few, and did not indicate a major issue. Nevertheless, the faculty should make sure that the students are well informed as to the qualifying-exam protocols and their consequences.

The graduate seminar is basically run by a small number of students. It is critical for the Department to formalize this process and make it mandatory for the students not only to attend the seminars (for credit) but also to participate by giving a seminar themselves. The faculty and Chair need to emphasize this aspect, critical to producing scientists with communication skills.

The students are, in general, pleased with their research work and research supervision. Deeper queries indicate that not many of them aspire to become faculty members—an interesting observation that might bear further consideration as to the “type” of graduate students being recruited. A mix, with different aspirations, some academic, might be ideal.

MSEN has demonstrated a creative and thoughtful approach to International graduate students exchange and collaborations in different aspects. They have organized group of grad students from Mexico, supported by CONACYT (analogous to NSF) and started the first UTD dual Ph.D. degree program (so called Cotutelle program, first initiated in France). One student, visiting from France will receive a double Ph.D. degree from UTD and from his home University. This is a good example to other Departments of UTD and hopefully will be growing in the future

Research Funding: There was detailed discussion about the amount of research funding, the sources of funding, how competitive these sources were, and how sustainable such funds were. The review committee sought quantitative information on funding from the Department and Chair Chabal provided them. We also solicited a detailed breakdown of the funds invested into the Department, in terms of faculty startup packages, and non-competed state funds. A detailed summary is presented as Appendix I. These numbers reflect a much healthier and “cash-positive” Department, in contrast to the general sentiments reflected in conversations at various levels. This favorable situation likely will become even better in the next few years as the newly hired faculty establish vibrant research programs. It is critical that the upper administration and the Department come to a common understanding on the definitions of financial success and sustainability going forward.

Service to Society, University, and Profession:

Society - The research thrusts chosen are precisely the topics of significant technological interest that challenge creativity and innovation. The technical thrusts serve some of the most pressing needs as recognized by our nation’s technology leaders. Such research topics not only challenge students, but motivate them as they address issues of significant societal importance.

University - As described above, the Department serves the University as a research leader—a model for other research intensive programs at the University. The MSE Department will be a major contributor to the UTD goal of being recognized as a leading research university.

In addition, UTD highlights opportunities for undergraduate research involvement. The MSE enterprise of both research competence and scholarly style is making a significant contribution to this important aspect of UTD and its appeal to high-quality undergraduates.

Profession - The members of the UTD MSE Department make significant contributions to the profession. One need only note that the MSE faculty includes a recent President of the Materials Research Society, the most prestigious society in the materials field, and recent leaders of international conferences, society committees, etc.

Space/Facilities/Technical Infrastructure: From several of our discussions, it appeared to the review committee that contiguous space for the department is an issue. A big part of this is clearly the rapid growth of other departments within the School, especially BioE and ME, all of which are reporting large undergraduate enrolments. There are some temporary solutions being planned that should alleviate this situation. Nonetheless, it appears that the broader space allocation issue needs to be dealt with in a comprehensive fashion at the university level.

Staff: The department has an extremely committed group of administrative staff. They hold the faculty in great regard and stated that they were happy to work in the department. By far, their main concern is the ever-changing "process paperwork", which they felt could be lot more efficient (this is likely driven by the recent migration to a new system). Conversations with the faculty and staff indicated a well functioning relationship where the faculty was generally appreciative of the staff and their contributions to the department and the staff was satisfied and supportive of the mission and activities of the faculty. Credit for this positive relationship undoubtedly goes to the Chair and the senior faculty.

Conclusion: The MSE Department, founded officially in 2008, has made a remarkable start in recruiting faculty with a mix of seniority, with established records of research productivity, and a younger faculty with high standards and promising career trajectories. The Department is well-positioned to grow a significant research reputation of an international scale. Some of the senior faculty already have achieved such recognition. The role of a research/graduate level department within the university, and the way such a department meets the broader goals of the institution, needs further definition and common understanding on the part of both the faculty and the administration at all levels.

Start Year of Faculty Number ->	Unassigned	Aucello	Chabai	Cho	Hackett	Colb	Grade	Hinkle	Hsu	J. Kim	M. Kim	Quarveto	2010	2011	2012	Young	Totals
176000	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00
Federal Sponsored Total	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00	\$ 1,162,000.00
Federal Passthrough																	
Federal Passthrough Total																	
Private Sponsored Programs																	
Private Sponsored Programs Total																	
Gifts																	
Gifts Total																	
Texas Competitive Research																	
Texas Sponsored Programs																	
Texas Sponsored Programs Total																	
Texas Research Total																	
UTD Costs (Inurement)																	
UTD Costs (Inurement) Total																	
Cost Share (EMBITT)																	
Cost Share (EMBITT) Total																	
Research Enhancement																	
Research Enhancement Total																	
Salaries (Services) Center																	
Salaries (Services) Center Total																	
UTD Costs (Investment)																	
UTD Costs (Investment) Total																	
Return on Investment (ROI) F112																	
Return on Investment (ROI) F112 Total																	

Category	Unassigned	Aucello	Chabai	Cho	Hackett	Colb	Grade	Hinkle	Hsu	J. Kim	M. Kim	Quarveto	2010	2011	2012	Young	Totals
Security																	
Unassigned																	
Chabai																	
Cho																	
Fiscad																	
Colb																	
Grade																	
Hsu																	
J. Kim																	
M. Kim																	
Quarveto																	
Vogel																	
Walker																	
Young																	
Totals																	

Category	Unassigned	Aucello	Chabai	Cho	Hackett	Colb	Grade	Hinkle	Hsu	J. Kim	M. Kim	Quarveto	2010	2011	2012	Young	Totals
Security																	
Unassigned																	
Chabai																	
Cho																	
Fiscad																	
Colb																	
Grade																	
Hsu																	
J. Kim																	
M. Kim																	
Quarveto																	
Vogel																	
Walker																	
Young																	
Totals																	

Grand total 4,877,671.69