

The Future of Minerals Education

Keynote Address

Landmines & Opportunities

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Value Share

A Common Hazard in the Mining Industry

There are more than 10,000,000 motor vehicle accidents in the United States annually. On average, these accidents account for a minimum of 2.5 million injuries and nearly 40,000 deaths. This translates to a staggering 110 fatalities everyday – one person being killed every 14 minutes. A significant percentage of these accidents are attributed to impaired drivers, which in addition to drugs and alcohol includes individuals suffering from **sleep deprivation and mental fatigue**. (National Highway Traffic Safety Administration & U.S. Census Bureau, Statistical Abstracts). In North America, traffic accidents kill and injury more people in the mining industry than all other causes.

There is No Substitute for Sleep



Defining Success

- Sustaining high quality degree-granting program in Minerals Engineering that are **valued** by both Industry Constituencies **and** Academic Administrations
- To be recognized for producing well-prepared students with a broad range of skills & knowledge who are capable of solving problems, communicating & working with others, learning, understanding the big picture, and have a work & safety ethic.
- Strong, stable student population who can successfully find employment in their field of study.
- Develop research capabilities and expertise deemed important to industry, as opposed to internal influences
- Maintain global acceptance of Mining & EM/MP as distinctly recognized engineering disciplines

Key Factors: Faculty, Facilities, Financial Support & Admin Leadership

Implied Assumptions: Students, Alumni & Industry

Academic Crisis (?)

- Reduction of Accredited U.S Mining Engineering Departments from 25 in 1982 to 14 currently.
- Decline in faculty numbers: 42 percent reduction in the total number of T/TT Mining faculty since 1984, with 70 mining faculty in 2013.
- Of the 74 mining faculty reported in 2009/2010, 100 percent of the Senior faculty in the U.S. (39 professors) are eligible for retirement by 2020. [®]
- The number of Adjunct faculty have dropped more than 50% between 2015 to 2019
- Only 13.5 percent of the U.S. Mining Faculty are 40 years of age or younger.
- The average nationwide graduation rate for Mining Ph.Ds. who may become faculty members has historically been less than 20 annually, where a vast majority are international students.
- Excluding China, India & Iran, the global number of BS graduates in mineral engineering has continued to decline for the last 5 years and is believed to be well-below the current industry attrition rate due to retirements

Academic Crisis (?)

- There are six remaining U.S. academic programs in Extractive Metallurgy and another five mineral processing programs contained in materials, physical metallurgy, mining, or chemical engineering programs.
- Of the six EM programs, they contain approximately 22 tenured and tenure-track faculty.
- Of these programs, an estimated 10 of the T/TT faculty will be eligible within the next eight years.

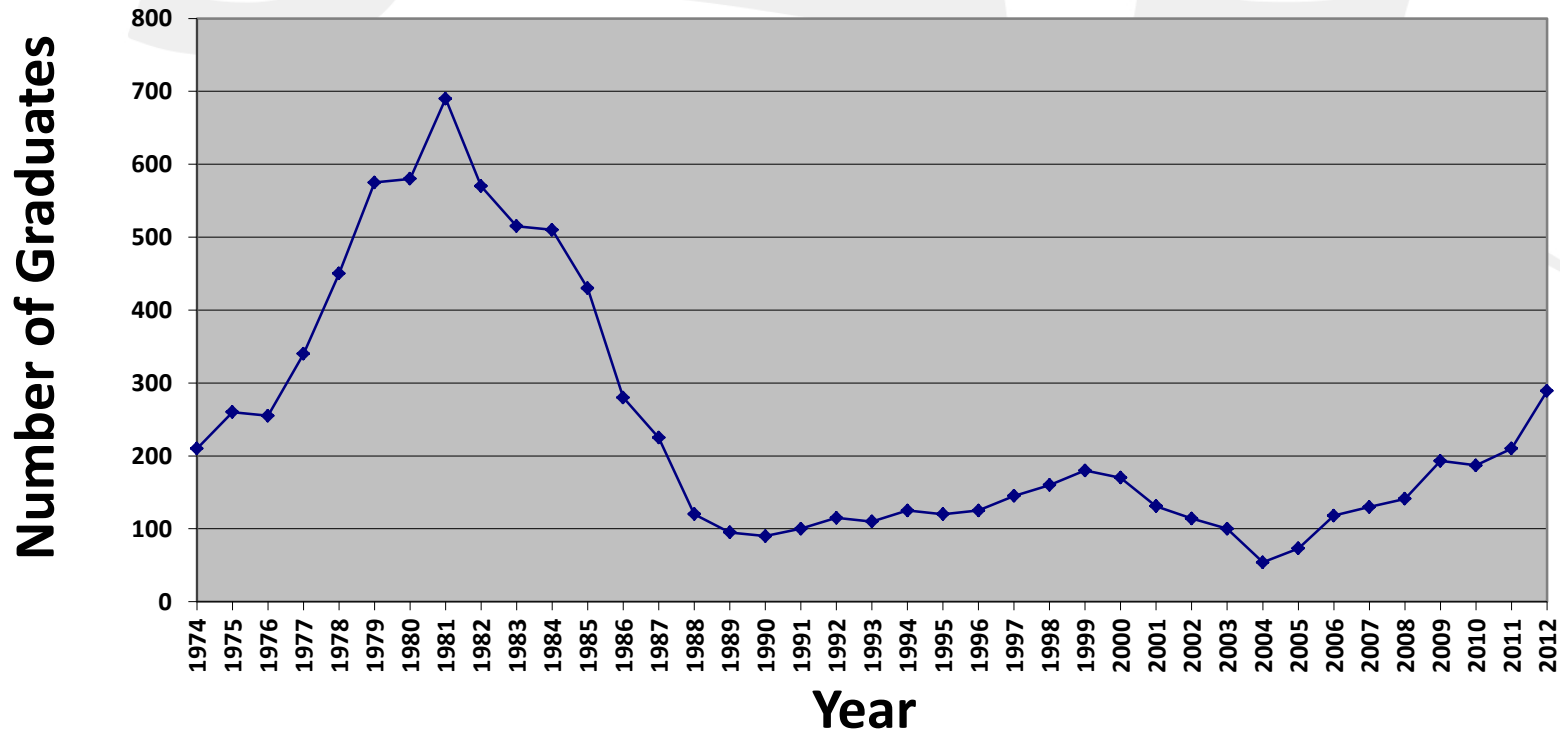
References

McCarter, M. (2007), "Mining faculty in the United States: current status and sustainability", *Mining Engineering*, SME Publication, September, pp 28-33.

Poulton, M. (2012), "Analysis of the Mining Engineering Faculty Pipeline", 2012 SME Annual Meeting, Conference Proceedings, February, pp 1-9.

Mineral School Department Heads Surveys, SME Annual Meetings, 2013-2019.

Mining Engineers - Graduate Count from Accredited U.S. Programs (1974-2012)



Survey Results

- Student Enrollment in U.S. Mining Departments

	2015	2017	2019
BS	1489	1136	874
MS	216	157	144

- Student Graduation from U.S. Mining Departments

	2015	2017	2019*
BS	390	319	219
MS	140	58	72

* Projected

(after SME Mineral Department Heads Meetings; 2015-2019)

Global Trends

- Similar trends are being seen in other western countries
- Australia facing critical decline of new mining engineers to unprecedented levels
 - Despite nearly guaranteed employment and high starting salaries, current enrollments at the 8 mining universities continues to drop:

University of New South Wales

- Current mining enrollment down to 6 students from 120 students 4 years ago

(after Jarrod Lucas, ABC Goldfields, June 2018)

- Exception being China, India & Iran

Survey of Academic Departments

- Survey of 16 university offering degrees in Mining Engineering & MP/EM
 - Not Included: SIU & Michigan Tech
- Survey Questions
 - Current & Approved T/TT Faculty Positions
 - Anticipated T/TT Faculty Openings over next 5 years
- Focus on T/TT academic faculty positions and not on Adjunct, Professors-of-Practice, and Research Faculty engaged in academic instruction

Survey of Academic Departments

Current & Approved T/TT Faculty Positions

- Dept. Heads/Chairs: 3
- Mining Engineering: 5
- MP/EM: 4

Anticipated Total 5-Year Employment

- Dept. Heads/Chairs: 4
- Mining Engineering: 21-28
- MP/EM: 17-19
- Consistent with 2013/2014 Projections

Perceived Underlying Causes

Performance Assessment

- There is a growing disparity in how departments are evaluated by industry constituencies, peers, ABET, students, and University administrators.
- Failure of programs to achieve ABET accreditation is a death sentence.

Research Support

- Research funding is critical to faculty promotion and tenure, graduate student enrollment and retention, maintenance of laboratory equipment and facilities (used both for education and research) and the allocation of resources (i.e., space and operating funds) from university administrators.
- Many companies want only graduates and see little value in funding research; however, the two are intimately linked.

Financial Support

- High cost degree programs
- Most public universities are driven by student tuition, where few schools with mining and extractive metallurgy/processing departments receive significant support from the state.

Perceived Underlying Causes

Faculty Scarcity

- Faculty demographics and the failure of traditional career paths to facilitate faculty development and replacements
- High attrition rates from the start of a Ph.D. program through the tenuous process of achieving tenure at a given university.
- Absence of Ph.D. students and working professionals with the interest, skill-sets, and expertise traditionally required for success in academia.
- Direct, indirect, and opportunity costs associated with pursuing a Ph.D. degree.
- The number of M.Sc. Students pursuing technical degrees.
- Disincentives associated with pursuing a career in academia (wage disparity and workload).

Other Considerations

Performance Matrix

- Student Credit Hours
- Research Volume
- Ph.D. Generated
- Scholarly Publication in Ranked Journals
 - New SME Mining, Metallurgy & Exploration Journal (MME Journal)
 - Thank you Dr. Komar Kawatra & MPD!
- Number of UG Students Entering Graduate School

What's Missing???

Conventional Wisdom Has Changed

- No such thing as a generalist – research drives specialization
- Industry Experience vs. Strict Academicians
- Given shortages of candidates and students, alternative philosophies are being employed

Other Considerations

Mixed Messages

- New Associate Professors hired from industry with no academic experience; great in the classroom but no research or publication record. While respected by industry, getting them engaged to compete for tenure often difficult
- New Assistant Professors hired with no industry experience. Often have good publication records but the absence of industry experience greatly hampers their teaching and research capabilities. Often respected by academics but not by industry. Again, tenure can be a challenge.

Education Sustainability Committee

- Created during the September 2013 SME Mid-Year Meeting with Committee members selected by incoming SME President John Marsden, in consultation with Dave Kanagy and SME staff.
- **Committee Mission:** *The mission of this tactical committee is to develop specific actionable recommendations for the SME Board of Directors and the SME Foundation Trustees that seek to address the long-term challenges that threaten the sustainability of U.S. Mining and Mineral Processing/Extractive Metallurgy academic degree granting programs.*

Strategic Approach

- Quantify the underlying factors that threaten the short-term and long-term sustainability of the current programs.
 - Analyze existing data and information previously collected (included input from numerous committees and sources internal and external to SME).
 - Determine deficiencies in this data and seek additional information as required.
 - As a committee, develop causation factors that attempt to explain the trends seen in the data (commonalities between programs).
- Evaluate and prioritize these identified underlying causes (threats) relative to potential impact, cost, and the time required for implementation.

Strategic Approach – Identified Priorities

- The development of marketing materials and the effective dissemination of information to industry constituencies on the specific needs and challenges facing academic programs.
- Methods to improve the faculty pipeline:
 - Ph.D. Fellowship & Career Development Grants
 - Recruiting initiatives to encourage M.Sc. Student and industry professionals to pursue advanced degrees
 - Educating industry professionals interested in academia
 - Mentoring and Professional development for new faculty by Industry (Summer Experiences)
- Reorganization of Academic Related Committees within SME
- Continued Support for the Mineral School Reinvestment Act.
- Greater collaboration between U.S. academic programs.
- Research consortiums and industry initiatives.
- Continued collection of data.

Focused Initiatives

SME Ph.D. Fellowship Program

- Intended to partially offset the cost of tuition, fees, books, and other educational activities, as well as the living expenses (does not cover all expenses).
- Fellowship: Direct disbursement of \$60,000/year - maximum of four years
- Program: Three new Fellowships annually up to a maximum of 12 students
- Great consideration given to:
 - Fellowship amount and number awarded
 - Eligibility Guidelines and Selection/Application Process
 - Candidate Obligations
 - The program builds from “lessons learned” from previous SME fellowship and scholarship programs, as well as those offered by other professional organizations and government entities
 - Intended to leverage additional support from other sources in order to conduct meaningful research and other scholarly activities

Focused Initiatives

SME Career Development Grant Program

- Intended to provide newly employed, tenure-track Assistant or Associate Professors with the financial support needed to assist them in engaging in activities required for tenure and promotion (research, publication and internal/external service).
- Grant: Disbursement of \$100,000/year - maximum of three years
- Program: Two new Grant recipients annually up to a maximum of six faculty.
- Great consideration given to:
 - Grant amount and number awarded
 - Eligibility Guidelines and Selection/Application Process
 - Candidate Obligations
 - Career development grant guidelines from other professional organizations and government entities were used as a model
 - University overhead capped at 6.5 percent

SME

THANK YOU!

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