

# Charting Tomorrow



Summary  
of Outcomes

2008 ABET  
Annual Meeting

October 30-31  
Louisville, KY



## **ABET VISION**

ABET will provide world leadership in assuring quality and in stimulating innovation in applied science, computing, engineering, and technology education.

## **ABET MISSION**

ABET serves the public through the promotion and advancement of education in applied science, computing, engineering, and technology.

## **ABET WILL**

- 1** Accredit educational programs.
- 2** Promote quality and innovation in education.
- 3** Consult and assist in the development and advancement of education worldwide in a financially self-sustaining manner.
- 4** Communicate with our constituencies and the public regarding activities and accomplishments.
- 5** Anticipate and prepare for the changing environment and the future needs of constituencies.
- 6** Manage the operations and resources to be effective and fiscally responsible.

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# About the Meeting

At the outset, ABET sought to convene a different kind of meeting — to provide a forum for knowledge sharing and discussion that would influence ABET’s future direction. The work took place October 30 and 31, 2008 in Louisville, Kentucky.

## Who Attended

- The conference drew leaders who hold the requisite position to make a difference and had knowledge, experience, and perspective, as well as memberships in professional associations and academic affiliations.
- The attendees included numerous thought leaders who engaged in a myriad of conversations relevant to ABET’s work.

## Meeting Approach

- The conference was to craft questions as thought-starters for discussion and to introduce expert speakers who would frame the context and imperatives for finding the best answers.
- The group demonstrated clearly that they are well-convinced of the problem and are prepared to change, if doing so will help their institutions.



Attendees consult a Louisville map during the 2008 ABET Annual Meeting.

- While the topics were familiar, participants had not — at least in prior ABET meetings — been asked to consider their implications more intimately. The speakers were particularly incisive and intentional about the value of their data and the strength of their message, and the facilitators were a creative and complementary extension of the team.
- ABET made every effort to ensure that subject matter experts and discussion leaders would stimulate conversation. They were open and engaged, and as a result, the dialogue was rich.

## Planning Committee

The 2008 ABET Annual Meeting could not have been possible without the contributions of the following individuals:

- Joseph L. Sussman (ABET President-Elect), Chair
- Daina M. Briedis (Former AIChE Director)
- William S. Clark (ABET Past President)
- L.S. “Skip” Fletcher (2008 ABET President)
- Liz Glazer (ABET Communications Manager)
- David K. Holger (2009 ABET President-Elect)
- Larry Jones (Accreditation Council Chair)
- George D. Peterson (ABET Executive Director)
- Gloria Rogers (ABET Managing Director for Professional Services)
- Susan O. Schall (IIE Director)
- Richard C. Seagrave (2006 ABET President)

## Facilitators

Thank you to this year’s professional facilitators, who helped to guide and direct discussions among the meeting’s participants:

- Jen Comeau  
I-Amplitude, LLC
- Karen Hinchliffe  
KSH Strategyhouse, LLC

# Charting Tomorrow

*ABET is a recognized leader in accreditation. A standard-setter, evaluator, and consultant, ABET is arguably the world's model for quality assurance in technological education. Given the issues facing technological education, ABET's mission demands more. In 2008, ABET ramped up its effort "to anticipate and prepare for changing environments and the future needs of constituents." As always, ABET stakeholders played a critical role in this exercise.*

ABET volunteers and meeting attendees — national and international administrators, faculty, and organization leaders in the ABET disciplines — explored the dynamic changes taking place in technological education today, as well as the impact of those changes on the foundation and framework of quality assurance. This report summarizes the results of that exploration.

## Key Topics

The time horizon considered for discussion was up to 2030, ABET's 100-year anniversary.

Expert presenters framed the four key topics, providing participants with context for their discussions. Professional facilitators kept attendees on time and task. The topics and their questions for discussion were as follows:

### Anticipating Needed Competencies

- What competencies must professionals possess in 2030 to successfully compete in a world marketplace?
- What disciplinary boundaries can handle the dynamic knowledge base of ABET's professions while still providing students enough value-added education to keep them viable in the knowledge-driven economy?
- Will the market drive stakeholders to accept needed changes, or block them?

### Organizing to Improve the Pipeline

- What needs to happen to improve the demographics of the ABET professions by 2030?
- Who should lead and participate in this effort?
- How can these entities work together to effect real, positive change?
- Ultimately, how could the pipeline be improved?

### Adapting to Millennial Learners

- What characteristics describe future students (demographics, learning styles, etc.)?
- Will educational paradigms respond to meet the next generation's need for flexible and responsive pedagogies?
- Ultimately, how will we adapt to millennial learners?

### Rethinking Quality Assurance

- How must current accreditation processes and policies evolve in response to new educational paradigms and the globalization of the ABET professions?
- How will accreditation models be modified or rebuilt to accommodate the necessary pedagogical changes and promote innovation?
- What alternative accreditation-related and organizational models must be considered to ensure that ABET remains relevant to its constituencies?

## Discussion Highlights

Several clear themes emerged that will provide guidance and direction to ABET and its constituencies:

### Technological education is in peril:

- It is insufficient for the needs of society, ill-fitted to the learner of the new millennium, and ill-supported by its many stakeholders.
- Many individuals and organizations are focused on the problem but are unclear on how best to address it. Collaboration is required for success.



Millennial learners, born between 1982 and 2000, present a unique challenge for educators. The vast majority are tech-savvy multi-taskers, accustomed to developing content and knowledge and having their opinions count.

### Today's technological education calls for retooled learning outcomes:

- For faculty and administrative leaders, new technology and applications of science and engineering the world over challenge the delivery of technological education and call for revised learning outcomes.
- Updating learning approaches may offer a unique opportunity to realign STEM with student demographics that were previously left out, such as women, underrepresented minorities, and international students.

### Meeting the needs of the "millennials" requires revised learning models:

- What differentiates the students of today is the way in which they are co-creators of knowledge. Faculty must enable a knowledge co-creation model and shift emphasis toward learning management and coaching.

### Drivers of learning outcomes will continue to change dramatically by 2030:

- The learning outcomes expected of technological graduates of 2030 will differ from ABET's current accreditation criteria. The key drivers of those outcomes will continue to change rapidly, including globalization, environmental sustainability, social and economic uncertainty, and technological development.
- Even as adaptations are made to meet today's technologies and learning models, reinvention must occur again in the future, acquiring the skills to be continuously flexible and adaptable to change.

### A new analogy is needed, from "filling a pipeline" to creating learning pathways:

- The pathways for learning are far broader and more diverse than the traditional mindset implied by a pipeline. Expanding entry points and providing more opportunities to step in and out of technological education makes a "pathway" a better analogy and a necessity.
- A culture change and recasting of the industry is underway already. The question is whether ABET and its constituencies are going to be on the receiving end of its emergence or part of its creation. ABET, by its position and reputation as an authority, is an obvious player and an agent for change.



The traditional view of education resembles a pipeline (*left*). Students moved forward in a linear progression. The need to accommodate diverse students calls for a new metaphor, that of a pathway (*right*) with expanding entry and exit points that provide more opportunities for students to step in and out of technology education.

## Implications for ABET

Attendees were asked to consider how the themes listed on the previous page would impact ABET, its service to the profession, and its quality assurance processes and policies. Their responses can be summarized as follows:

- ABET must continue its current work in quality assurance. The organization will become increasingly important as a provider of knowledge and know-how regarding technological education programs.
- ABET will continue to have influence as long as it remains closely attuned to its constituents and increases its contact, coordination, and collaboration with its respective interest groups.
- ABET could convene those who may not have critical mass or exposure or who have not been traditionally seen as feeding or benefiting from the pipeline for technological education.
- ABET can help drive change related to new education pedagogies, innovation, reinvention, student diversity, globalization of technological education, and use of new technologies for teaching and learning. By quickly adapting and modifying program outcomes, ABET can lead more effectively than other stakeholders.

## Next Steps

The ABET Board responded to the stimulating conversations with these agreements:

- ABET will increase its efforts to seek input from and partner with institutions and organizations around the globe to promote the growth of high quality technological education programs.
- ABET considers all those who participated in the meeting to be co-creators of action. As such, the ABET Board of Directors will communicate to these persons directly about the strategic decisions and actions ABET is instituting as a result of this meeting.

In publishing this document, ABET seeks to communicate the summaries and recommendations of consequence to an even broader audience.

# Speakers' Call to Action

*The dynamic challenges taking place in technological education today provide the backdrop against which ABET constituents are making short and long term decisions that impact programs ABET evaluates. To give weight to these challenges, attendees heard from several keynote speakers.*

## Keynote Address



**James J. Duderstadt, Ph.D.**  
President Emeritus  
University of Michigan

Duderstadt offered a provocative view of the future of technological education based upon the findings in his report, *Engineering for a Changing World: A*

*Roadmap to the Future of Engineering Practice, Research, and Education*, which resulted from the University of Michigan's Millennium Project. The following conclusions were suggested by his presentation:

- In a global, knowledge-driven economy, technological innovation is critical to competitiveness, long-term productivity, and the generation of wealth.
- The rapid evolution of high-quality engineering services in developing economies (with low labor costs) requires U.S. engineers to achieve several times the value of their counterparts in these countries.
- In spite of the fact that engineering professions continue to be responsible for profound changes in society, current trends suggest a decline in the interest in, investment in, and value of engineering professions.
- There is a need to elevate the status of engineering to a profession with a decisive contribution to society.
- The key to producing world-class engineers is to take advantage of the distinctively comprehensive nature of American universities and significantly broaden the educational experience of engineering students.

Duderstadt spoke predominately from the point of view of engineering. It was largely understood, however, that the predicament to which he referred is a shared dilemma for all technological education.

## Concurrent Speaker Sessions



**Irving Pressley MacPhail, Ed.D.**  
Executive Vice President and Chief  
Operating Officer  
National Action Council for Minorities  
in Engineering (NACME)

Pressley illustrated how various organizations (including, but not limited to, NACME) have been tackling challenges

and "achieving dreams." NACME is a council with an action plan for enriching the lives of young people, thereby changing America by increasing the number of traditionally under-represented minorities in the STEM professions.

Pressley made several recommendations for encouraging, inspiring, and informing elementary and secondary school students and their parents:

- To prepare for opportunities in math and science,
- To dream and believe they can achieve their goals,
- To demand that our systems provide all students with a quality educational experience,
- To demand that every classroom has a qualified teacher,
- To complete educations,
- To have the courage to confront barriers and be admitted to and receive support from the country's finest educational institutions,
- To work closely with each other at each point along the spectrum from pre-K to graduate school, and
- To do all these things with a sense of urgency.

Ultimately, Pressley's message was that action has the greatest impact on these problems. Pressley concluded by suggesting, "We must realize that this [work] is a marathon, not a sprint."

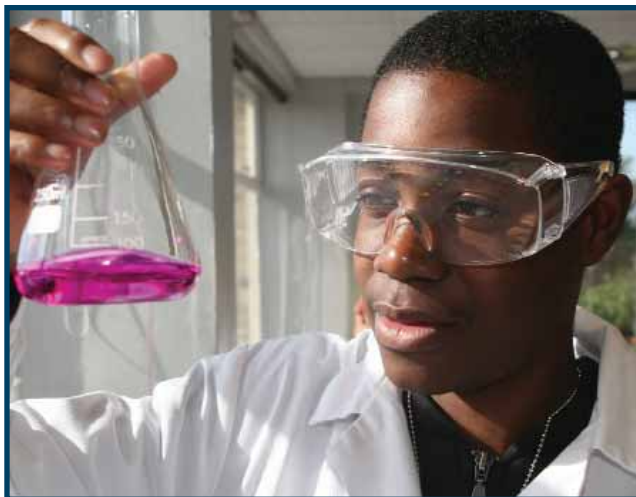


**Daryl Chubin, Ph.D.**  
 Director  
 Center for Advancing Science  
 and Engineering Capacity  
 American Association for the  
 Advancement of Science

Speaking on the pipeline issue, Chubin asked, “Should the engineering profession

be more ‘organized’ in the recruitment and/or retention of students?” He answered, “Yes.” Chubin detailed suggestions about leadership and the role of engineering societies, universities, employers, and ABET:

- Modernize the image of engineering,
- Support faculty with rewards, recognition, appointments, and team additions that would impact the number of matriculating engineering students as well as their composition,
- Reduce underrepresentation in ways that go beyond current formal education,
- Shift tone, expectations, transparency, and practice, and
- Have ABET host forums and “safe places” for candid conversation, considering policy changes and connecting with a broader community.



Speaker Dr. Irving MacPhail impressed upon the meeting attendees the importance of increasing underrepresented minorities in STEM professions, while Dr. Darryl Chubin said these fields should be more organized in recruiting and retaining students.



**Diana Rhoten, Ph.D.**  
 Program Director  
 Office of Cyber Infrastructure  
 National Science Foundation

Rhoten presented the questions being asked by the reports *Beyond Being There: A Blueprint for Advancing the Design, Development, and Evaluation*

*of Virtual Organizations* and *Fostering Learning in the Networked World: The Cyberlearning Opportunity and Challenge*, as well as other projects supported by the National Science Foundation.

Rhoten highlighted the many rich ways in which students fluidly move into and out of groups and problem-solving and how they are growing these areas. Actively engaged in web-based gaming, online blogging, and twittering, students are already co-creating solutions to shared problems all the time. Rhoten’s presentation

- Suggested the need to move away from traditional approaches to learning towards participatory learning paradigms of the 21<sup>st</sup> century;
- Challenged that adding software tools and interactive web resources to traditional formal coursework, workshops, and seminars would suffice;
- Showed the “insider’s view” with an introduction to MySpace, the nanoHUB.org, and an online simulation tool, as well as a YouTube video; and
- Outlined R&D requirements that point to infrastructure needs, Internet applications, and the need to reconceptualize instruction and interaction with the help of innovation.

# Concurrent Sessions

## Applied Science & Computing



**Linda Northrop**  
Director  
Software Engineering Institute  
Carnegie Mellon University  
Northrop made compelling the context in which change would need to occur and where the trends favored the industry as characterized by

- Increasing awareness that diversity supports innovation and enhances U.S. competitiveness,
- Open infrastructure that enables global reach and communication in ways never before available, and
- Technologies that support distance learning and allow non-traditional students to access online coursework and telecommuting to their part- and full-time jobs.

Nevertheless, change agents in the system would have to buck some countervailing trends to make inroads on the problem:

- A huge dependency upon software, requiring real software prowess;
- A trend toward ultra-large scale information systems, requiring skills in managing complex systems; and
- A trend toward increasing military systems, eco-sustainability, and multi-core information systems.

### Needed Competencies

Applied Science & Computing Session attendees anticipate that the professionals will need the following competencies to successfully compete in 2030:

### Internal and Reinvention Skills

- Ability to reinvent oneself multiple times (life-long, continual),
- Ability to take responsibility for own discovery and learning,
- Ability to see unintended consequences, and
- Ability to be comfortable with ambiguity.

### Systems and Critical Thinking Skills

- Ability to critically evaluate a “wall of information,”
- Ability to engage in business,
- Ability to understand impact of solutions in global context,
- Ability to think and relate globally,
- Ability to innovate, and
- Ability to envision change.

### Integrative and Collaborative Skills

- Ability to work in multidisciplinary, multicultural teams,
- Ability to experience horizontally and across ideas,
- Ability to develop systems that can interface,
- Ability to manage projects, and
- Ability to integrate ideas.

## Engineering & Technology



**Jeffrey Russell, Ph.D.**  
Chair  
Civil and Environmental Engineering  
University of Wisconsin-Madison



**Tom Lenox, Ph.D.**  
Senior Managing Director  
Professional and Educational Activities  
American Society for Civil Engineers

Russell and Lenox described civil engineering’s process to define the competencies of tomorrow’s engineers.

- They highlighted the mastery envisioned, where they provide not only plans, design, and construction but also the stewardship, integration, management, and leadership to enhance global quality of life.
- They shared implications for engineering and engineering technology programs.

- They corrected misperceptions of the “body of knowledge” concept and advocated for it as an essential foundation document for defining competencies and influencing accreditation criteria.
- They shared implications for assessment and evaluation of competencies via the accreditation processes.

### Needed Competencies

- Ability to function in multidisciplinary and multicultural environments;
- Ability to identify, formulate, and solve complex engineering problems, as well as problems in other fields that have engineering components;
- Ability to imagine, create, and innovate;
- Ability to challenge assumptions and evaluate issues where there is great uncertainty; and
- Ability to incorporate sustainability into design and use concepts.

### Improving the Pipeline

Five “solutions” emerged from the discussions. Aspects of each of these were further incorporated into the gestalt of a master solution:

- Redistribute the load carried by faculty.
- Ignite employer accountability.
- Modernize STEM brands.
- Methodically provoke culture change.

- Rewind the issue to the beginning; highlight the need to engage parents, early childhood educators, and counselors (pre-K through 8<sup>th</sup> grades); and thereby provoke culture change.

Attendees also recognized the following aspects of the challenge:

- There is a need to capture the attention of a society that depends on the sciences, technological advancement, computer proficiency, and engineering innovation for its livelihood.
- The pipeline analogy seemed weak in light of the current trickle of students entering STEM fields in the U.S. The image of a “pathway” suggested a far-reaching system with multiple access and entry points, as well as exit ramps and alternative points of departure. It became “easier” then to imagine flow in a system where a greater diversity of intake was not only allowed but also encouraged.
- By design, the pathway would produce outputs with variation. Value is created even if students did not gush forth as technologists or engineers in the traditional definition of the profession.
- By highly leveraging multi- and intergenerational opportunities, the pathway is self-sustaining and renewable — capable of disintegrating and reestablishing itself. The reconstructed pathway identified roles for and made demands on many stakeholders who today seem marginal or tangential to technological education development and use.



Participants convert the “pipeline” model for entry into and matriculation through STEM fields into a “pathway.”

## Adapting to Millennial Learners

Learning styles and today's undergraduates' expectations challenge current instructional delivery modes and traditional college educational paradigms. Coming generations will be adept at learning asynchronously (podcasts, streaming video, trillions of bytes of any information at the click of a mouse), leading interactive virtual lives (gaming, social networking, file-sharing), and diving into and out of complex subject areas and contexts with seemingly no sequential logic implied.

During this session, attendees formulated new strategies and discussed these questions:

- What characteristics will describe future students (demographics, learning styles, etc.)?
- Will educational paradigms respond to meet the next generation's need for flexible and responsive pedagogies?
- How will the pervasive access to technology require programs to rethink the role of faculty in an environment where students are adept at employing asynchronous learning opportunities?
- Ultimately, how will we adapt to millennial learners?

Conference speakers made a clear case. Millennial learners are a new and different being. They learn in cyberspace. They co-create their learning environment — interacting socially in many forms, learning as they go, and giving up and restarting themselves while sharing ideas with strangers whom they regard as classmates.

Because there were no millennial learners in attendance, the meeting provided a forum to consider each of the other stakeholders (faculty, administration, graduate schools, K-12 institutions, associations, government, and industry) and their roles in shaping the millennial learning agenda and having a shared role in their learning and learning outcomes.

Seven “themes” emerged:

- Faculty will need to evolve from professors to learning managers. Faculty will have to be collaborative, have broad knowledge, and integrate coaching and counseling into teaching formats while creating new ones made possible by the students themselves.
- Faculty have to discern and decide which of all their possible technological education content gets leveraged by new technology (i.e. gaming technology) and which is not best leveraged this way.
- Every presentation pointed to the need and inevitability of participatory learning.
- In a future of “knowledge co-creation,” faculty members are instructional design partners with persons from emerging technology companies, such as gaming companies. These faculty are continually considering their curricula and teaching plans. They see the limitations of the methods being employed by students and faculty alike. They may be first to see opportunities to meet a need with a solution in the interest of learning.
- Faculty then will be in a position to translate to the real world. Translation requires not only seeing what is happening but having the language to communicate between parties. Communication may be required in all directions; however, faculty have skills and commensurate authority to wield key messages to the many stakeholders in student learning.
- Administrators can support the evolution of faculty as learning managers through the implementation of technological infrastructure and support of mentoring and coaching environments.
- ABET can provide a vehicle for assuring quality in the way in which new developments are vetted and upgraded into competencies, in evaluating outcomes, and in supporting institution and faculty alike in collaborating with additional stakeholders in new learning paradigms.

2008 ABET Annual Meeting participants consider all of the parties involved as “millennials” learn and co-create knowledge.



# Implications for ABET

After 75 years, ABET has commissions, committees, task groups, and operating plans that work. Every year, ABET has made progress in support of its mission. At this Annual Meeting, however, ABET sought input from attendees in the form of answers to these questions:

- How must accreditation processes and policies evolve to respond to new educational paradigms and the globalization of the ABET professions?
- How will accreditation models be modified or rebuilt to accommodate the necessary pedagogical changes and promote innovation?
- What alternative accreditation-related and organizational models must be considered to ensure that ABET remains relevant to its constituencies?

The wish is for ABET to have earlier and more profound impact than it has today, especially if new competencies are not wholly embraced, continually updated, and authentically supported. In sum, it is suggested that ABET:

- Be a convener and facilitator of dialogue across institutions, associations, other partner organizations (NSF, NACME, ASEE), and atypical sources (4H, YMCA, Scouts) among parties who need brokers, between academia and industry on the international scene, and with students as they engage the accreditation process.
- Be an advocate for innovation, supporting innovative learning strategies. Actively partner and initiate outreach to ensure that conversations are taking place early and often by appropriate people.
- Be an advisor and mentor in administering training services for faculty on best practices, on post-accreditation processes, and on emerging thinking and practice in a timely fashion.

Tactically, ABET might also attend to a numerous accreditation issues, including the following:

- ABET must manage its brand nationally to better reflect its role. It is believed that ABET cannot help its constituents until it does this. If everyone looks the other way when hearing, “I’m from ABET and I’m here to help,” then progress cannot be made.

- Incorporate international advisors to evaluation teams and advise and facilitate international programs, not just evaluate them. Traction can be made in these places that will have mutual benefit if such a mini-team of advisor, facilitator, and evaluator could mobilize adoption more quickly in more places where there is serious commitment.
- Create a reward structure for best practice endorsement and recognition in areas of critical impact, such as diversity and reinvention.



Former and future ABET Presidents listen to constituent feedback about the meeting’s topics. *Left to right:* 2006 President Richard C. Seagrave, 2007 President William S. Clark, 2008 President L.S. “Skip” Fletcher, and 2008 President-Elect and 2008 Annual Meeting Chair Joseph L. Sussman.

Paradoxically, there was perceived a strong preference for and a strong caution against the extent to which

- The pathway problem is one for ABET to tackle, and
- ABET’s current accrediting role is lessened by taking on those additional focus areas.

That said, attendees recommended that ABET continues to demonstrate to constituents that

- It gets it and is willing to be part of the solution.
- ABET can and will convene larger and larger conversations, continuing to reach the populations to which it has access.

The ABET Board of Directors heard that it must be authentic, continue to listen, take the conversation of millennials and pathways seriously, continue to step up, expand partnerships wide and deep, and continue to recognize that it holds no answers without constituent faculty and universities — all of whom have a learning appetite and capacity to change.

Attendees recognized that ABET must initiate a few tangible actions immediately:

- Consider how new technologies could be used to improve the accreditation process;
- Broaden the range of constituents that ABET serves;
- Refine a list of most worthwhile objectives and their intended outcomes;

- Refine the competencies to emphasize diversity, innovation, and use of knowledge co-creation technology and pedagogies;
- Improve communication with constituents to facilitate collaboration and innovation;
- Continue to internationalize ABET;
- Introduce accreditation practices and educational systems to other countries;
- Increase the number of institutions and individuals participating fully in next year's annual meeting.

Above all, ABET is committed to continuing on its path of transformation and renewal. Please look to the 2009 Annual Meeting for continued conversation and progress.



**ABET, Inc., is a federation of 29 professional and technical societies representing the fields of applied science, computing, engineering, and technology:**

American Academy of Environmental Engineers (AAEE)  
American Congress on Surveying and Mapping (ACSM)  
American Industrial Hygiene Association (AIHA)  
American Institute of Aeronautics and Astronautics, Inc. (AIAA)  
American Institute of Chemical Engineers (AIChE)  
American Nuclear Society (ANS)  
American Society of Agricultural and Biological Engineers (ASABE)  
American Society of Civil Engineers (ASCE)  
American Society for Engineering Education (ASEE)  
American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE)  
American Society of Safety Engineers (ASSE)  
ASME  
Biomedical Engineering Society (BMES)  
CSAB, Inc.  
Health Physics Society (HPS)  
IEEE, Inc.  
Institute of Industrial Engineers, Inc. (IIE)  
International Council on Systems Engineering (INCOSE)  
International Society of Automation (ISA)  
Materials Research Society (MRS)  
The Minerals, Metals, and Materials Society (TMS)  
National Council of Examiners for Engineering and Surveying (NCEES)  
National Institute of Ceramic Engineers (NICE)  
National Society of Professional Engineers (NSPE)  
SAE International  
Society of Manufacturing Engineers (SME)  
Society for Mining, Metallurgy, and Exploration, Inc. (SME-AIME)  
Society of Naval Architects and Marine Engineers (SNAME)  
Society of Petroleum Engineers (SPE)

