AC 2011-205: ATTRIBUTES OF A GLOBAL ENGINEER

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Ms. Lynn G. Brown, The Boeing Company

Lynn Brown is the Boeing Corporate Program Manager for University Relations International for Strategic Workforce Planning and the Co-chair for the ASEE CMC Special Interest Group for International Engineering Education. Lynn was named as Boeing's University Relations Program Manager in 2004 expanding her responsibilities to international in 2007. In this position she has oversight of various strategies, funding, programs and projects for international and domestic higher education engagements including recommendations for policy, procedures and country and university relations global expansion. Lynn manages the company's domestic university relations portfolio of 172 higher education institutions and leads a global network of 22 Boeing Country/Regional Focals for alignment and implementation of Boeing's University Relations Strategies. Annually, Boeing's University Relations unit provides over $6.5 million dollars of charitable and business contributes for international and domestic higher education engagements. Lynn attend the University of Texas at Austin for her Ph.D. work in Higher Educational Administration; Northern Arizona University for her M.A. in Curriculum and Assessment and Arizona State University for her B.A. in Secondary Education: Communications.

Alan Jacobs, Quanser

As a member of ASEE since 1994, Alan Jacobs has served the Society in numerous leadership roles. He founded the ASEE Corporate Member Council (CMC) Special Interest Group on International Engineering Education and currently serves as co-chair of that SIG. Alan is presently serving his second terms on the ASEE CMC Executive Committee and the ASEE Projects Board. He also serves on the ASEE Journal of Engineering Education Advisory Board and was a contributor to ASEE's "Advancing the Scholarship of Engineering Education: A Year of Dialogue." Alan was previously a member of the ASEE International Strategic Planning Task Force, the International Federation of Engineering Education Societies (IFEES) Executive Committee and General Motors' Partners for the Advancement of Collaborative Engineering Education Core Team.

Alan has spent his professional career committed to helping colleges and universities gain enhanced access to teaching tools and to advancing the learning opportunities available to their students. By managing and growing innovative education initiatives for technology companies, Alan has provided programs and resources to assist institutions of higher learning in preparing their students for academic and career success.

Now, as Director, US Academic Relations for Quanser, Alan is responsible for leading and managing Quanser's commitment to inspiring and preparing the next generation of engineers to successfully compete in today's global workplace.

Prior to Quanser, Alan was the Senior Manager, Global Education for Autodesk, where he developed and managed Autodesk's Global Strategic University Program leading a team to improve colleges' and universities' access to and adoption of Autodesk's 3D solutions.

Previously, at Avid Technology, as Senior Manager, Worldwide Education, Alan had overall responsibility for creating and directing the implementation and optimization of programs and strategies to enhance schools' use of Avid's products globally. While at Avid, Alan was an Advisory Board member of the University Film & Video Association (UFVA), Centre International de Liaison des Ecoles de Cinma et de Tlvision (CILECT), Broadcast Education Association (BEA) and College Broadcasters, Inc. (CBI).

Earlier, Alan was the Director, Worldwide Education for Bentley Systems, Inc. and Executive Editor in Addison-Wesley Publishing Company's Educational Software division.

Alan holds a Masters of Education and a Masters of Regional Planning from the University of Massachusetts and has had special training as a Practitioner of Neuro-Linguistic Programming and in Mediation. Alan is a third-degree black belt in Tang Soo Do. He lives in Falmouth, MA with his wife and son.

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Patricia Fox, Indiana University Purdue University, Indianapolis

Patricia Fox is the Associate Chair of the Computer Information and Leadership Department and Clinical Assistant Professor in Organizational Leadership and Supervision in the Purdue School of Engineering and Technology, IUPUI. She currently serves as the ASEE Vice President for External Relations and First Vice President. Pat has been active in the ASEE Corporate Member Council since 2004, serving as the Chair of their Special Interest Group (SIG) for Engineering, Technology and Society Liaison since 2006. She also serves on the CMC International SIG.

Catherine Didion, National Academy of Engineering

Catherine Didion is a Senior Program Officer at the National Academy of Engineering (NAE). Her portfolio is the Diversity of the Engineering Workforce program with a charge to provide staff leadership to the NAE's efforts to enhance the diversity of the engineering workforce at all levels including the diversity of those being prepared to enter the future workforce. In addition to her duties at NAE, in March of 2007 Didion became the Director of the Committee on Women in Science, Engineering, and Medicine. This is a standing committee with a new mandate to work as a focal point on gender across the three National Academies.

Didion served as Executive Director for the Association for Women in Science (AWIS) for fourteen years (1990 to 2004). During tenure AWIS was awarded the U.S. Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring and she was the principle investigator for 17 government and foundation grants. Didion has presented testimony before the United States Congress and U.S. federal agencies and she was the editor for Women in Science Column for the Journal of College Science Teaching from 1993 - 2002. Didion has extensive experience on Capitol Hill including staff positions at the U.S. Senate Commerce, Science, and Transportation Committee, Office of Senator Robert Packwood (R-Oregon), the Senate Computer Center, and the Senate Press Gallery.

Didion's honors and awards include AAAS Fellow (2005); AWIS Fellow (2001); Drucker Foundation Fellow (2000); Texaco Management Institute Fellow (1999); Secretary of the US Air Force Inaugural Environmental Civic Leaders Tour (1996); and Certificate of Commendation and Distinguished Service, Embassy of the United States of America (1989).

Daniel R. Sayre, John Wiley & Sons, Inc.
Hans J. Hoyer, American Society for Engineering Education

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Attributes of a Global Engineer:
Findings from a Work-in-Progress International Survey

Abstract

What skills and experiences will today's engineering students need to develop while in school and throughout their careers to successfully compete in today's global workplace? This question is the focus for a group of corporations affiliated with the American Society for Engineering Education (ASEE) Corporate Member Council (CMC), whose mission is to foster, encourage, and support high-quality engineering education around the world to assure a global supply of well-prepared engineering graduates.

For two years, the ASEE CMC Special Interest Group for International Engineering Education developed, presented, and vetted with its stakeholders a series of attributes representing the desired competencies and characteristics needed by engineers in order to effectively live and work in a global context. An online survey was launched to validate the performance and proficiency levels of each attribute, including the stages at which attributes were essential to the preparation, performance, and employability of global engineers. Educators, employers, students, and professional engineers throughout the global engineering community were invited to participate in the survey. To promote input and obtain feedback from the largest possible global engineering audience, ASEE collaborated with the International Federation of Engineering Education Societies (IFEES) to make the survey available in Chinese, English, French, German, Italian, Japanese, Korean, Polish, Portuguese, Russian, Spanish and Turkish.

This paper describes the stakeholder-driven process to identify and define attributes of a global engineer; survey development and sampling procedures; summary of key findings-to-date; and brief discussion and next steps.

Stakeholder-drive Process to Identify and Define Attributes of a Global Engineer

The ASEE Board of Directors established the ASEE Corporate Member Council to convey the ideas and views of corporations to ASEE. With over 120 corporate and non-academic institutional members, the CMC's mission is to foster, encourage, and cultivate the dialogue between industry and engineering educators. Its strategic goals are:

- Diversity in engineering education
- Enhancing the K-12 educational pipeline/future workforce
- Reforming engineering education
- Collaborating on engineering research and intellectual property
- Liaison with engineering, technology, and the Society

CMC has several Special Interest Groups (SIGs), which exist to share information and advance key priorities of the CMC. The International Engineering Education SIG is the CMC sponsor of the Attributes of a Global Engineer Survey Project.

The Attributes of a Global Engineer Survey Project grew out of an expressed need by CMC members to identify and validate specific knowledge, skills, abilities, and perspectives that would be required of an engineer living and working in an increasingly global context. Specifically, the goal was to refine a list of attributes that would be applicable to engineers regardless of specialty, location, or background.

The process began in early-2008, led by the International Engineering Education SIG, and involved CMC members developing a list of competencies derived from representative job descriptions, literature reviews, and other reports. This initial list was consolidated through a series of SIG meetings and events throughout 2008 and 2009; thus, here are the attributes that emerged through this process:

- Engineering Science Fundamentals
    - Mathematics (including statistics)
    - Physical and Life Sciences
    - Political and Socio-economic Sciences
    - Information Technology - Digital Competency
- Engineering
    - Understanding of Design and Product Processes
    - Understanding of Product Life Cycle Development
    - Effective Teamwork/Common Goals
    - Possess a Multi-Disciplinary, Systems Perspective
    - Maintain Focus with Multiple Project Assignments
- Context in which Engineering is practiced
    - Economics/Finances of Projects
    - Basic Supplier Management Principles
    - Customer and Societal Emotions and Needs
    - Cultures, Languages, and Business Norms
    - Societal, Economic, and Environmental Impacts of Engineering Decisions
    - An International/Global Perspective
- Communication
    - Written (Memos, reports, email, letters, etc.)
    - Verbal (Technical & non-technical presentations plus an effective "elevator" speech)
    - Foreign Language (Technically fluent in at least two languages acknowledging English is considered a key global language)
    - Graphic (Design drawings, charts & graphs, presentation, and basic brochure design)
    - Digital Competency
    - Competent at Internet Collaboration and Communication Tools (Web-based meeting tools, team rooms, teleconferencing; file sharing, E-mail, etc.)
    - Listening
- Teamwork
    - Active and Effective Participation in Team Efforts
    - A Willingness to Respect the Opinions of Others and Support Team Decisions
- Leadership
    - An Acceptable Personal Image and a Positive Personal Attitude
    - Treating People with Fairness, Trust, and Respect

    - Respect for Diversity
    - Courtesy and Respect
    - An Eagerness to Help Others
- Flexibility
    - Self-Confidence to Adapt to Rapid/Continuous/Major Change
    - Thinking Both Critically and Creatively - Independently and Cooperatively
- Curiosity and Desire to Learn - For Life (Show initiative, Inquire & Learn)
    - Seeking Advice and Forming Daily Questions to Discover New Insights.
    - Commitment to Quality, Timeliness, and Continuous Improvement
    - Understanding Basic Project and Risk Management and Continuous Improvement Concepts (like LEAN+)
- Ethical Standards and Professionalism
    - Operate in Accordance With Acceptable Business, Societal, and Professional Norms
    - Maintain the Highest Level of Integrity, Ethical Behavior, and Professional Competence
    - Understand and Applies Good Personal Judgment

At the ASEE Annual Conference in 2010, SIG stakeholders attempted to translate the attributes into specific competencies that could be identified by levels of importance and proficiency at certain intervals of an individual's education and professional development. The initial list totaled 48; however, through in-person meetings at the Conference, and through bi-weekly telephone conference calls and other electronic communication, the list was ultimately synthesized and consolidated. After further review and validation from CMC members, a total of 20 competencies associated with the attributes of a global engineer emerged. These are:

1. Demonstrates an understanding of engineering, science, and mathematics fundamentals
2. Demonstrates an understanding of political, social, and economic perspectives
3. Demonstrates an understanding of information technology, digital competency, and information literacy
4. Demonstrates an understanding of stages/phases of product lifecycle (design, prototyping, testing, production, distribution channels, supplier management, etc.)
5. Demonstrates an understanding of project planning, management, and the impacts of projects on various stakeholder groups (project team members, project sponsor, project client, end-users, etc.)
6. Demonstrates an understanding of the ethical and business norms and applies norms effectively in a given context (organization, industry, country, etc.)
7. Communicates effectively in a variety of different ways, methods, and media (written, verbal/oral, graphic, listening, electronically, etc.)
8. Communicates effectively to both technical and non-technical audiences
9. Possesses an international/global perspective
10. Possesses fluency in at least two languages
11. Possesses the ability to think both critically and creatively
12. Possesses the ability to think both individually and cooperatively
13. Functions effectively on a team (understands team goals, contributes effectively to team work, supports team decisions, respects team members, etc.)
14. Maintains a positive self-image and possesses positive self-confidence

15. Maintains a high-level of professional competence
16. Embraces a commitment to quality principles/standards and continuous improvement
17. Embraces an interdisciplinary/multidisciplinary perspective
18. Applies personal and professional judgment in effectively making decisions and managing risks
19. Mentors or helps others accomplish goals/tasks
20. Shows initiative and demonstrates a willingness to learn

Survey Development and Sampling Procedures

After completing a stakeholder-driven process to develop the attributes of a global engineer, SIG members sought to validate the list of attributes with stakeholders beyond the CMC. Given the global dimensions and emphasis of the attributes, SIG members were desirous of a mechanism to receive widespread feedback from a truly global audience of engineering-oriented stakeholders. First, however, certain definitions were developed, as noted below:

Definition of Attributes:

Attributes: the desired competencies and characteristics needed by engineers in order to effectively live and work in a global context.

Definition of Role Levels:

Upon Graduation from a Secondary/High-School: graduation from a secondary/high-school and entering a tertiary/college/university to pursue an engineering program-of-study.

Upon Graduation from a Tertiary/College/University: graduation from a tertiary/college/university engineering program-of-study.

Early-Career Engineering Professional: employment in an engineering role during the 5 years immediately following graduation from a tertiary/college/university.

Definition of Importance Levels:

Extremely important: the knowledge, skills, abilities, and perspectives associated with this attribute are essential to successful performance outcomes of this role.

Important: the knowledge, skills, abilities, and perspectives associated with this attribute are generally needed for satisfactory performance outcomes of this role.

Slightly important: the knowledge, skill, abilities, and perspectives associated with this attribute are minimally needed for performance outcomes of this role.

Not important: the knowledge, skills, abilities, and perspectives associated with this attribute are not needed for performance outcomes of this role.

Definition of Proficiency Levels:

Advanced: specialized knowledge and complex functioning for this attribute have been acquired.

Intermediate: an increasing progression and familiarity beyond the fundamental or basic principles for this attribute have been acquired.

Basic: fundamental or basic principles for this attribute have been acquired.

The CMC partnered with the International Federation of Engineering Education Societies (IFEES) to accomplish the goal of widespread global stakeholder input and validation. IFEES consists of nearly 50 member organizations, representing engineering education associations and corporations from around the globe. Dr. Hans Hoyer, who serves as ASEE's Director of International Programs and Strategy and also as Secretary General of IFEES, facilitated connections between the SIG leading the attributes of a global engineer project and IFEES stakeholders around the globe. This purpose was two-fold: (1) to garner assistance in translating the survey into multiple languages (including validation of the survey once translated); and (2) to secure assistance in marketing the survey opportunity to IFEES stakeholders worldwide.

From July-September 2010, the survey was translated from English to the following languages: Chinese (Simplified and Traditional), French, German, Italian, Japanese, Korean, Polish, Portuguese, Russian, Spanish and Turkish. Translators also assisted in validating the survey with a small representative audience of likely survey responses. This was done to ensure that the intent behind attribute meanings was preserved across all translations. Translators were asked to make appropriate substitutions to words or phrases in the translated context to accomplish this goal.

Using SurveyMonkey as the data collection platform, the survey was launched in October 2010 and currently remains active; for more details, please visit: http://www.ifees.net/activities/ASEECMCSIG-IFEES.cfm. For the purpose of preparing this work-in-progress paper, data from all surveys was downloaded and summarized on January 10, 2011. There are several strengths and limitations to the sampling procedures involved in this survey's development and deployment.

Strengths include:

- The prolonged stakeholder-driven processes in which to conceptualize, collect, synthesize, summarize, and refine the list of 20 attributes of a global engineer;
- The involvement of both ASEE and IFEES members in providing input into and validating the initial survey; and
- The translation of the survey into multiple languages and the simultaneous global launch of the survey, including a coordinated communication plan inviting widespread participation.

Limitations include:

- The inability to accurately define a true sampling frame;
- The reliance on a vast network of international contacts through ASEE and IFEES to help promote the survey's availability;

- The English language-centric number of responses-to-date, despite multiple translations of the survey into multiple languages; and
- The presently less-than-anticipated number of total responses-to-date.

Against the backdrop of these strengths and limitations, SIG members felt it was important to update the engineering education community on the survey's progress. The next section highlights findings-to-date, provides a brief discussion of the findings, and outlines next steps in the data collection efforts of this project.

Summary of Key Findings-to-Date

Respondents by survey language translation:

Language	Respondent *n*
Chinese – Simplified	8
Chinese – Traditional	1
English	451
French	2
German	0
Italian	0
Japanese	4
Korean	1
Polish	0
Portuguese	4
Russian	0
Spanish	11
Turkish	81
TOTAL	563

Given the nature of responses-to-date, it is not surprising that overwhelmingly respondents are male (80%) and practice engineering in the United States (82%). Nearly 60% hold either a master's or doctorate degree; two-thirds are engineering practitioners, while over one-quarter are engineering researchers or academicians. Nearly 60% report their age range to be 40-59. Respondents could select from 20 engineering sub-disciplines to indicate their area of engineering practice. Nearly 20% of respondents were from Aerospace engineering, followed by Mechanical (15%) and Electrical (12%); all other respondents represented the range of different engineering sub-disciplines.

Below are descriptive statistics reported by attribute, importance by level, and proficiency by level; items in **bold** are the most frequently reported by question. In addition to questions concerning each of the 20 attributes, there were several open-ended questions that elicited verbatim comments from respondents. The open-ended questions are purposely excluded from this work-in-progress paper, as it will be important to translate all comments from their respective language in order to ensure analysis and presentation of the total array of comments from participants. Thus, the project's final report, which will likely be disseminated at a future

ASEE Annual Conference, will contain the summary of findings from analysis of the open-ended comments.

1. Demonstrates an understanding of engineering, science, and mathematics fundamentals

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	26.2%	**51.7%**	20.5%	1.3%	0.2%
Upon Graduation from a Tertiary/College/University	**68.8%**	30.6%	0.4%	0.0%	0.2%
Early-Career Engineering Professional	**71.7%**	24.6%	2.8%	0.2%	0.7%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	8.8%	28.1%	**62.7%**	0.4%
Upon Graduation from a Tertiary/College/University	38.5%	**56.0%**	5.3%	0.2%
Early-Career Engineering Professional	**59.9%**	34.9%	3.1%	2.2%

2. Demonstrates an understanding of political, social, and economic perspectives

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	3.5%	27.2%	**54.4%**	14.8%	0.0%
Upon Graduation from a Tertiary/College/University	11.8%	**60.5%**	25.7%	2.0%	0.0%
Early-Career Engineering Professional	25.2%	**60.3%**	13.0%	1.3%	0.2%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	1.1%	13.2%	**83.0%**	2.7%
Upon Graduation from a Tertiary/College/University	6.4%	**58.1%**	35.5%	0.0%
Early-Career Engineering Professional	24.1%	**56.5%**	16.3%	3.1%

3. Demonstrates an understanding of information technology, digital competency, and information literacy

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	13.9%	**62.6%**	22.0%	1.6%	0.0%
Upon Graduation from a Tertiary/College/University	46.2%	**50.7%**	2.9%	0.2%	0.0%
Early-Career Engineering Professional	**58.9%**	38.8%	2.2%	0.0%	0.0%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	5.0%	41.0%	**53.2%**	0.9%
Upon Graduation from a Tertiary/College/University	35.2%	**56.3%**	8.3%	0.2%
Early-Career Engineering Professional	**53.5%**	38.6%	6.3%	1.6%

4. Demonstrates an understanding of stages/phases of product lifecycle (design, prototyping, testing, production, distribution channels, supplier management, etc.)

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	2.0%	8.7%	34.9%	**53.7%**	0.7%
Upon Graduation from a Tertiary/College/University	10.4%	**55.5%**	30.3%	3.8%	0.0%
Early-Career Engineering Professional	45.5%	**46.8%**	7.3%	0.4%	0.0%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	1.4%	4.3%	**78.7%**	15.6%
Upon Graduation from a Tertiary/College/University	6.5%	**50.6%**	41.2%	1.8%
Early-Career Engineering Professional	36.2%	**48.0%**	14.1%	1.8%

5. Demonstrates an understanding of project planning, management, and the impacts of projects on various stakeholder groups (project team members, project sponsor, project client, end-users, etc.)

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	2.0%	12.2%	39.2%	**45.8%**	0.7%
Upon Graduation from a Tertiary/College/University	12.1%	**55.1%**	30.6%	2.2%	0.0%
Early-Career Engineering Professional	**51.6%**	41.0%	6.5%	0.7%	0.2%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	0.5%	6.5%	**77.6%**	15.5%
Upon Graduation from a Tertiary/College/University	6.3%	**53.1%**	39.7%	0.9%
Early-Career Engineering Professional	37.7%	**49.1%**	11.4%	1.8%

6. Demonstrates an understanding of the ethical and business norms and applies norms effectively in a given context (organization, industry, country, etc.)

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	10.8%	33.2%	**37.0%**	18.6%	0.4%
Upon Graduation from a Tertiary/College/University	24.9%	**54.0%**	19.3%	1.8%	0.0%
Early-Career Engineering Professional	**57.1%**	38.0%	4.4%	0.4%	0.0%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	2.3%	18.8%	**70.1%**	8.8%
Upon Graduation from a Tertiary/College/University	16.8%	**51.1%**	31.4%	0.7%
Early-Career Engineering Professional	**50.2%**	37.0%	11.4%	1.3%

7. Communicates effectively in a variety of different ways, methods, and media (written, verbal/oral, graphic, listening, electronically, etc.)

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	23.7%	**56.6%**	18.8%	0.9%	0.0%

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Tertiary/College/University	**55.7%**	42.6%	1.8%	0.0%	0.0%
Early-Career Engineering Professional	**79.6%**	19.0%	1.3%	0.0%	0.0%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	5.2%	42.6%	**51.7%**	0.5%
Upon Graduation from a Tertiary/College/University	35.7%	**55.1%**	9.2%	0.0%
Early-Career Engineering Professional	**67.9%**	27.4%	3.1%	1.6%

8. Communicates effectively to both technical and non-technical audiences

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	12.1%	33.6%	**39.8%**	13.6%	0.9%
Upon Graduation from a Tertiary/College/University	31.8%	**53.8%**	13.8%	0.7%	0.0%
Early-Career Engineering Professional	**61.6%**	35.3%	2.7%	0.2%	0.2%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	4.1%	22.1%	**68.7%**	5.0%
Upon Graduation from a Tertiary/College/University	20.7%	**57.9%**	21.4%	0.0%
Early-Career Engineering Professional	**55.4%**	39.0%	5.0%	0.7%

9. Possesses an international/global perspective

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	2.9%	17.4%	**46.7%**	32.3%	0.7%
Upon Graduation from a Tertiary/College/University	9.6%	**48.4%**	34.1%	7.4%	0.4%
Early-Career Engineering Professional	27.4%	**52.7%**	17.3%	2.2%	0.4%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	0.9%	8.1%	**79.9%**	11.1%
Upon Graduation from a Tertiary/College/University	6.4%	**47.9%**	42.9%	2.7%
Early-Career Engineering Professional	26.9%	**48.4%**	22.4%	2.3%

10. Possesses fluency in at least two languages

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	3.9%	19.0%	33.8%	**41.5%**	1.8%
Upon Graduation from a Tertiary/College/University	6.5%	26.5%	**38.2%**	27.2%	1.6%
Early-Career Engineering Professional	9.4%	27.6%	**39.1%**	21.8%	2.0%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	1.9%	11.7%	**68.2%**	18.2%
Upon Graduation from a Tertiary/College/University	5.3%	31.5%	**51.9%**	11.3%
Early-Career Engineering Professional	10.6%	31.9%	**45.3%**	12.2%

11. Possesses the ability to think both critically and creatively

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	25.7%	**51.8%**	20.0%	2.0%	0.5%
Upon Graduation from a Tertiary/College/University	**53.4%**	43.2%	3.2%	0.0%	0.2%
Early-Career Engineering Professional	**75.2%**	24.2%	0.5%	0.0%	0.2%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	4.6%	33.6%	**59.9%**	1.8%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Tertiary/College/University	31.6%	**57.4%**	10.5%	0.5%
Early-Career Engineering Professional	**67.7%**	27.8%	3.9%	0.7%

12. Possesses the ability to think both individually and cooperatively

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	17.8%	**49.8%**	28.8%	3.4%	0.2%
Upon Graduation from a Tertiary/College/University	38.9%	**53.6%**	6.8%	0.5%	0.2%
Early-Career Engineering Professional	**70.1%**	28.1%	1.6%	0.0%	0.2%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	3.0%	27.5%	**67.2%**	2.3%
Upon Graduation from a Tertiary/College/University	22.7%	**63.3%**	13.5%	0.5%
Early-Career Engineering Professional	**64.7%**	29.4%	4.6%	1.4%

13. Functions effectively on a team (understands team goals, contributes effectively to team work, supports team decisions, respects team members, etc.)

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	16.1%	**47.3%**	31.4%	5.0%	0.2%
Upon Graduation from a Tertiary/College/University	37.4%	**52.5%**	9.7%	0.5%	0.0%
Early-Career Engineering Professional	**72.9%**	25.1%	1.8%	0.2%	0.0%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	3.2%	28.6%	**65.9%**	2.3%
Upon Graduation from a Tertiary/College/University	22.4%	**62.0%**	15.1%	0.5%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Early-Career Engineering Professional	**65.1%**	29.1%	4.1%	1.6%

14. Maintains a positive self-image and possesses positive self-confidence

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	14.2%	**58.3%**	21.6%	5.0%	0.9%
Upon Graduation from a Tertiary/College/University	21.6%	**64.1%**	11.1%	2.3%	0.9%
Early-Career Engineering Professional	35.2%	**56.1%**	5.5%	2.0%	1.1%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	5.3%	31.1%	**59.2%**	4.4%
Upon Graduation from a Tertiary/College/University	15.7%	**55.7%**	25.9%	2.8%
Early-Career Engineering Professional	34.2%	**45.0%**	17.3%	3.5%

15. Maintains a high-level of professional competence

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	6.4%	31.4%	**37.8%**	21.5%	3.0%
Upon Graduation from a Tertiary/College/University	24.5%	**63.5%**	10.7%	1.1%	0.2%
Early-Career Engineering Professional	**66.4%**	32.4%	0.9%	0.2%	0.0%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	2.8%	14.8%	**72.5%**	9.9%
Upon Graduation from a Tertiary/College/University	13.8%	**63.1%**	22.1%	0.9%
Early-Career Engineering Professional	**60.4%**	31.6%	7.1%	0.9%

16. Embraces a commitment to quality principles/standards and continuous improvement

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	10.4%	**35.0%**	33.8%	18.3%	2.5%
Upon Graduation from a Tertiary/College/University	21.5%	**54.0%**	20.6%	3.4%	0.5%
Early-Career Engineering Professional	**51.4%**	43.8%	4.1%	0.2%	0.5%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	4.0%	16.7%	**70.0%**	9.3%
Upon Graduation from a Tertiary/College/University	12.1%	**56.5%**	29.8%	1.6%
Early-Career Engineering Professional	**49.7%**	38.7%	9.7%	1.9%

17. Embraces an interdisciplinary/multidisciplinary perspective

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	8.7%	26.4%	**38.6%**	23.4%	2.8%
Upon Graduation from a Tertiary/College/University	16.8%	**56.1%**	24.1%	2.3%	0.7%
Early-Career Engineering Professional	43.2%	**46.8%**	8.4%	0.9%	0.7%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	2.6%	13.6%	**74.0%**	9.8%
Upon Graduation from a Tertiary/College/University	10.6%	**53.8%**	33.7%	1.8%
Early-Career Engineering Professional	41.8%	**43.6%**	12.2%	2.3%

18. Applies personal and professional judgment in effectively making decisions and managing risks

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	5.3%	35.1%	**39.3%**	18.7%	1.6%

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Tertiary/College/University	16.7%	**60.9%**	19.5%	2.5%	0.5%
Early-Career Engineering Professional	**54.2%**	40.7%	4.6%	0.2%	0.2%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	1.6%	15.5%	**74.4%**	8.5%
Upon Graduation from a Tertiary/College/University	10.2%	**58.4%**	30.0%	1.4%
Early-Career Engineering Professional	**48.3%**	40.3%	10.0%	1.4%

19. Mentors or helps others accomplish goals/tasks

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	4.4%	18.8%	**43.3%**	31.9%	1.6%
Upon Graduation from a Tertiary/College/University	7.1%	**46.2%**	38.5%	7.7%	0.5%
Early-Career Engineering Professional	27.8%	**53.3%**	16.4%	1.8%	0.7%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	2.1%	8.9%	**76.1%**	12.9%
Upon Graduation from a Tertiary/College/University	4.9%	44.0%	**48.4%**	2.8%
Early-Career Engineering Professional	27.7%	**48.8%**	21.4%	2.1%

20. Shows initiative and demonstrates a willingness to learn

Importance by Level	Extremely Important	Important	Slightly Important	Not Important	Unable to Comment
Upon Graduation from a Secondary/High School	**54.5%**	40.0%	5.5%	0.0%	0.0%
Upon Graduation from a Tertiary/College/University	**69.9%**	29.6%	0.5%	0.0%	0.0%
Early-Career Engineering Professional	**79.7%**	19.1%	0.9%	0.2%	0.0%

Proficiency by Level	Advanced	Intermediate	Basic	Unable to Comment
Upon Graduation from a Secondary/High School	16.3%	35.3%	**47.4%**	0.9%
Upon Graduation from a Tertiary/College/University	38.6%	**52.0%**	8.8%	0.7%
Early-Career Engineering Professional	**70.1%**	23.6%	4.4%	1.9%

Brief Discussion and Next Steps

Brief Discussion

In general, respondents indicated that for most attributes, a "stair-stepping" of both importance levels and proficiency levels occurred over time. This means that there is a widespread expectation that graduates from a secondary/high school are at least introduced and exposed to attributes—most are noted as slightly important—and that these same graduates are provided basic levels of proficiency in each attribute. Notably, both the level of importance and level of proficiency increase for tertiary/college/university graduates, implying that both foundation and advanced level knowledge development and application must occur in these settings. Finally, for early-career engineering professionals, there is considerable agreement that the level of importance and level of proficiency in nearly all attributes is expected. This signifies that learning, growth, and individual and professional development truly occur across time and place, and that both practitioner and educational stakeholders play a role in ensuring attention to the attributes of a global engineer.

There are, however, a couple of findings that are exceptions to the "stair-stepping" dynamic of importance levels and proficiency levels. Notably:

- For all stages of a global engineer's development, the attribute "shows initiative and demonstrates a willingness to learn" are extremely important for all. This underscores the importance of stressing throughout the educational-professional continuum the need to encourage students to take ownership and personal responsibility for their work and to instill in them an appreciation for lifelong learning.

- For all stages of a global engineer's development, the following attributes are either important or extremely important (with the latter especially true for early-career professionals):
    - "Demonstrates an understanding of engineering, science, and mathematics fundamentals"
    - "Communicates effectively in a variety of different ways, methods, and media (written, verbal/oral, graphic, listening, electronically, etc.)"
    - "Possesses the ability to think both individually and cooperatively"
    - "Functions effectively on a team (understands team goals, contributes effectively to team work, supports team decisions, respects team members, etc.)"

- "Maintains a positive self-image and possesses positive self-confidence"
- "Embraces a commitment to quality principles/standards and continuous improvement"

- Two attributes were deemed not important for secondary/high school graduates:
  - "Demonstrates an understanding of stages/phases of product lifecycle (design, prototyping, testing, production, distribution channels, supplier management, etc.)"
  - "Demonstrates an understanding of project planning, management, and the impacts of projects on various stakeholder groups (project team members, project sponsor, project client, end-users, etc.)

- Finally, one of the most truly global attributes—" possesses fluency in at least two languages"—was reported to be either not important (secondary/high school graduate) or slightly important (the other two groups); the level of proficiency for all for this attribute is reported as basic. This is potentially significant, as English is widely spoken in most professional engineering contexts. The nature and demographic profile of survey respondents, however, makes it difficult to generalize this particular finding. Despite multiple language translations and a global rollout of the survey, the overwhelming respondents-to-date completed the English-speaking survey and reported living in the United States.

Next Steps

One specific next step in this project involves ongoing marketing of the survey's availability. This continues to be accomplished through electronic communications with ASEE and IFEES members, and the ASEE Annual Conference in 2011 will provide another platform to invite continued involvement in the survey. This will be augmented by similar announcements and invitations at various IFEES events throughout 2011. The SIG members will also provide an additional update on the project's progress at the Global Colloquium on Engineering Education in October 2011 in Shanghai, China.

During the ASEE Annual Conference in 2011, the CMC will use one of its dedicated presentation times to conduct a focus group with CMC stakeholders. The purpose of the focus group will be to elicit reaction to results-to-date, and to provide additional amplification to, discussion about, and understanding of these results. Plans will also be made to determine when to discontinue additional survey respondents and to finalize the analysis and dissemination of the attributes of a global survey results.

Although this paper represents a work-in-progress, the CMC nevertheless is excited about results-to-date. The additional marketing and outreach to global engineering stakeholders throughout 2011 should yield additional respondents to the survey. As such, there are numerous implications for policy, practice, and future research, including how to align the efforts of corporate, tertiary/college/university, and secondary/high school stakeholders.