University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

Educational Administration: Theses, Dissertations, and Student Research

Educational Administration, Department of

8-2010

Global Competence: Determination of its Importance for Engineers Working in a Global Environment

Gregg M. Warnick
University of Nebraska at Lincoln, gmw@byu.edu

Follow this and additional works at: https://digitalcommons.unl.edu/cehsedaddiss

Part of the Higher Education Administration Commons, and the Mechanical Engineering Commons

Warnick, Gregg M., "Global Competence: Determination of its Importance for Engineers Working in a Global Environment" (2010). *Educational Administration: Theses, Dissertations, and Student Research*. 35.
https://digitalcommons.unl.edu/cehsedaddiss/35

This Article is brought to you for free and open access by the Educational Administration, Department of at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Educational Administration: Theses, Dissertations, and Student Research by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

GLOBAL COMPETENCE: DETERMINATION OF ITS IMPORTANCE FOR ENGINEERS WORKING IN A GLOBAL ENVIRONMENT

by

Gregg M. Warnick

A DISSERTATION

Presented to the Faculty of

The Graduate College at the University of Nebraska

In Partial Fulfillment of Requirements

For the Degree of Doctor of Philosophy

Major: Educational Studies
(Educational Leadership and Higher Education)

Under the Supervision of Professor Larry L. Dlugosh

Lincoln, Nebraska

August, 2010

GLOBAL COMPETENCE: DETERMINATION OF ITS IMPORTANCE FOR ENGINEERS WORKING IN A GLOBAL ENVIRONMENT

Gregg M. Warnick, Ph.D.

University of Nebraska, 2010

Advisor: Larry L. Dlugosh

We live and work in a world that is even more interconnected and interdependent than ever before. Engineers must now not only develop technical engineering competence, but must also develop additional skills and competencies including global competence to obtain success within a global engineering environment.

The purpose of this study was to determine whether multinational companies considered global competence an important skill in mechanical engineering graduates when making hiring decisions. The study was an exploratory study that utilized an extensive literature review to identify eight global competencies for engineering success within a global environment and also included a survey instrument completed by Brigham Young University (BYU) mechanical engineering alumni in 48 states and 17 countries.

The study focused on an evaluation of standard hiring technical engineering competencies with eight global competencies identified in the literature review. The study established that standard engineering technical competencies were the most important consideration when hiring mechanical engineers, but global competence was also considered important by a majority of all survey respondents with six of the eight

global competencies rated important by 79 to 91% of respondents with an ability to communicate cross-culturally the highest-rated global competence. The importance of global competence in engineers when making hiring decisions, as considered by large companies who employed more than 10,000 employees or who had annual revenue exceeding $1 billion (US$) per year, was particularly strong. The majority of respondents (70%) indicated that companies were willing to provide training and experience to help engineers obtain success in a global engineering environment. In addition, a majority of respondents (59.9%) indicated that companies valued the efforts of higher educational engineering institutions to prepare engineers for success in a global environment with only 4.8% of respondents indicating that they did not value the efforts of higher education engineering institutions. However, only 27% of respondents agreed that colleges and universities were successful in this endeavor.

Globalization is not a passing phenomenon, it is here to stay. Colleges and universities throughout the world need to recognize the importance of globalization and the interdependence and interconnectedness among the world's population. Therefore, it is important to identify, develop, and provide opportunities for international collaboration and interaction among students and faculty throughout the world and to focus on developing global competence as an important outcome for engineering graduates.

Acknowledgement

The completion of this study and all associated experiences connected to my doctoral pursuit would not have been possible without the help, encouragement, guidance, and support of many different people. First and foremost, I would like to thank and acknowledge the love and support of my wife Kimberly and our eight children, Ashley, Austin, Ammon, Landon, Riley, Ethan, Logan and Emma who have helped me in so many different ways. My family has patiently and consistently encouraged and supported me throughout my life, but particularly in the past six years of this Ph.D. journey. For my wife and me, we have in these six years experienced the birth of our three youngest children, changed careers from working in the medical device industry to academia, and relocated our family from Nebraska to Utah. Each of these changes created challenges for my Ph.D. completion, but my family was consistently by my side with love and encouragement especially in times of difficulty or discouragement. I would also like to acknowledge the love and support of my parents, Waldo and Karolyn Warnick and my wife's parents, Alan and Vivian Nicol.

I would like to thank my advisor Dr. Larry L. Dlugosh who has helped and encouraged me throughout this journey as he took an early interest in my career and education. His words of encouragement and support along the way have been invaluable. I appreciate that even though we were separated through many miles that he was always available via e-mail or telephone for the needed advice and support. I would also like to thank my committee members: Dr. Richard Hoover, Dr. Ron Joekel, and Dr. John Barbuto. I had the fortune of taking classes from each of these individuals early in my

doctoral pursuit and have enjoyed the association in recent months and years in the completion of my Ph.D. Their feedback has helped improve the results of my study.

I would like to particularly thank Dr. Robert H. Todd from Brigham Young University (BYU). I have had the fortune to work with him over the past four years and his example, encouragement, and support in my doctoral pursuit is sincerely appreciated. Even though he was not a formal member of my committee, he has spent many hours reviewing progress and providing feedback to improve the outcomes of this study. He together with Dr. Alan Parkinson, Dr. Spencer Magleby, and Dr. Tim McLain enabled me to utilize regular working hours to devote to this research. Each of these individuals has mentored and encouraged me throughout this process and has consistently provided positive encouragement throughout my academic career. Dr. Alan Parkinson's research on global competence was particularly helpful as a basis for this study.

In addition, I would like to thank Eva Bachman (UNL Doctoral Programs Specialist) who provided guidance on the doctoral completion requirements and the paperwork necessary for graduation, Dr. Paul Fields (BYU) who provided statistical analysis guidance, and Laura Rawlins (BYU Faculty Editing Service) who helped improve the writing quality of this dissertation. I would also like to acknowledge and thank my previous employer (BD Medical) who provided early financial support in my Ph.D. pursuit.

Table of Contents

Acknowledgement iv

Table of Contents vi

Chapter I: Statement of the Problem 1

Purpose Statement 1

Context or Background Statement 1

Research Questions 8

Reason for Use of BYU in Study 8

Methodology Overview 10

Assumptions, Limitations, and Delimitations 10

Assumptions of the study. 10

Limitations of the study. 11

Delimitations of the study. 11

Definition of Terms 12

ABET accreditation 12

Global competence 12

Mechanical engineer. 13

Multinational company. 13

Significance of the Study 13

Chapter II: Literature Review 14

Globalization 14

"Hard" technical skills. 19

"Professional" Skills 19

Global Competence 21

1. Exhibit a global mindset 24

2. Appreciate and understand different cultures 25

3. Demonstrate world and local knowledge 26

4. Communicate cross-culturally 27

5. Speak more than one language including English 28

6. Understand international business, law, and technical elements 29

7. Live and work in a transnational engineering environment 30

8. Work in international teams 31

Academic Institution Efforts to Prepare Engineers to be Globally Competent 31

Chapter III: Methodology 41

Purpose of the Study 41

Study Type 41

Research Questions 42

Rationale and Description of the Study 42

Survey instrument development. 46

Additional informed consent considerations. 51

Summary 53

Chapter IV: Results and Analysis 54

Profile of the Respondents 54

Demographics. 55

Education. 58

Employment. 60

Research Questions 69

Research question 1: Is global competence considered by hiring managers at multinational firms in their hiring practices of mechanical engineering graduates? 69

Research question 1a: Is global competence an important consideration for employment in multinational companies? 74

Research question 1b: To what extent are multinational companies willing to train engineers in global competence? 95

Research question 1c: To what extent do multinational companies expect higher education engineering departments and programs to prepare engineers for working in a global environment? 98

Additional Survey Results 102

Chapter IV Summary 109

Chapter V: Conclusions and Recommendations 113

Dissertation Overview 113

Purpose of the Study 114

Summary and Significance of Findings, Including Conclusions 115

Study population. 115

Research question 1: Is global competence considered by hiring managers at multinational firms in their hiring practices of mechanical engineering graduates? 117

Research question 1a: Is global competence an important consideration for employment in multinational companies? 119

Research question 1b: To what extent are multinational companies willing to train engineers in global competence? 123

Research question 1c: To what extent do multinational companies expect higher education engineering departments and programs to prepare engineers for working in a global environment?..... 124

Recommendations for Implementation..... 125

Recommendations for Future Research 130

References..... 132

Appendices..... 140

Appendix A: Informed Consent and Online Survey Instrument 141

Appendix B: UNL IRB New Protocol Submission 159

Appendix C: BYU IRB Approval Letter 167

Appendix D: UNL IRB Approval Letter 169

Appendix E: Survey Invitation 171

Appendix F: Survey Invitation Follow-up 173

Appendix G: Survey Results 175

Appendix H: Informed Consent and Survey Instrument Flow 242

Appendix I: Inferential Statistics Cross-tab Analysis and Results 250

List of Tables

Table 1. Foreign Language Proficiency and the Number of Survey Respondents Who Speak a 2nd, 3rd, or 4th Language Beyond English 58

Table 2. Competency Comparison Including Summary Descriptive Statistics for Question 13, "How Important is it for Mechanical Engineers Hired by Your Company Who Will Either Work Immediately or Eventually in a Global Environment to have:" 71

Table 3. Job Title Transformation From Seven Values to Three 76

Table 4. Number of Employees Worldwide by Company Reduced From Six Values to Three 77

Table 5. Annual Revenue (US$) of Company Reduced From Six Values to Four 77

Table 6. Likert Scale Importance Categories Reduced From Five Values to Three 78

Table 7. Cross-tab Analysis Summary of Different Variables and Each Competency 80

Table 8. Results of Z–Test for Two Proportions Comparing Total Number of Employee Categories for Importance (Important and Very Important) 81

Table 9. Results of Z–Test for Two Proportions Comparing Annual Revenue Categories for Importance (Important and Very Important) 82

Table 10. Mode Analysis of Company's Willingness and Success and the Perceived Value and Success of Colleges/Universities to Prepare Engineers for Success in a Global Environment for Question 15, "Please Indicate Your Agreement With the Following Statements:". 96

Table 11. Rank Order of Each Competence by Importance 110

List of Figures

Figure 1. Type of degree received from BYU. 59

Figure 2. Completion year of most recent BYU mechanical engineering degree. 60

Figure 3. Employment status of survey respondents. 61

Figure 4. Industry type that most closely matches respondent company. 62

Figure 5. Job title of survey respondents. 63

Figure 6. Number and percentage of employees (worldwide) as categorized by survey respondents according to different employee size groups (i.e., less than 50).. 64

Figure 7. Approximate annual revenue (US $) of respondent companies. 65

Figure 8. Response rates to the survey question: "Does your company conduct business internationally or have at least one operation in a different country?" 66

Figure 9. Percentage of total company revenues that comes from operations outside of the United States. 67

Figure 10. Response rates to the survey question: "Are you directly involved in making hiring decisions for new engineers with your company?" 68

Figure 11. Additional competencies considered by companies when hiring new mechanical engineers to work in a global environment. 74

Figure 12. Correlation between job title and the importance of a high GPA. 83

Figure 13. Correlation between job title and the importance of an ability to speak more than one language including English. 84

Figure 14. Correlation between number of employees worldwide and the importance of a high GPA. 85

Figure 15. Correlation between number of employees worldwide and the importance of an ability to exhibit a global mindset. 86

Figure 16. Correlation between number of employees worldwide and the importance of an ability to appreciate and understand different cultures. 87

Figure 17. Correlation between number of employees worldwide and the importance of an ability to understand international business, law, and technical elements. . 88

Figure 18. Correlation between number of employees worldwide and the importance of an ability to live and work in a transnational engineering environment. 89

Figure 19. Correlation between number of employees worldwide and the importance of an ability to work in international teams. 90

Figure 20. Correlation between the annual revenue (US$) per company and the importance of a high GPA. 91

Figure 21. Correlation between the annual revenue (US$) per company and the importance of an ability to appreciate and understand different cultures. 93

Figure 22. Correlation between the annual revenue (US$) per company and the importance of an ability to live and work in a transnational engineering environment. 94

Figure 23. Correlation between the annual revenue (US$) per company and the importance of an ability to work in international teams. 95

Figure 24. Responses to the survey question, “My company is willing to provide the appropriate training/experience for engineers to be successful in a global environment.” 97

Figure 25. Responses to survey question, “My company is successful at providing the appropriate training/experience for engineers to be successful in a global environment?” 98

Figure 26. Responses to survey question, “My company values the efforts of college/university engineering departments / programs to prepare engineers to work in a global environment.”..... 99

Figure 27. Responses to survey question, “My company considers college/university engineering departments/programs successful at preparing engineers to work in a global environment.” 100

Figure 28. What college engineering departments and programs can do to better prepare engineers for success in a global engineering environment..... 101

Figure 29. Responses to the survey question, “Have you worked in a global engineering environment during part of your career?” 103

Figure 30. Frequency distribution of survey respondent visits to different countries in the context of their career..... 104

Figure 31. Continents visited by survey respondents in the context of their career. 104

Figure 32. What do you wish you would have known upon completion of college to better prepare you to work successfully in a global engineering environment? 105

Figure 33. What has best helped you prepare for and obtain success when working in a global engineering environment?..... 107

Chapter I: Statement of the Problem

Chapter I provides an overview of the purpose and the context or background of this study. The chapter also includes the associated research questions, study summary, and methodology overview along with the assumptions, limitations, delimitations and key definitions. The final portion of the chapter includes a statement about the significance of the study.

Purpose Statement

The purpose of this study was to determine if multinational companies considered global competence an important skill in mechanical engineering graduates when making hiring decisions**.** The study included an evaluation of standard technical engineering competencies in addition to a list of global competencies for engineering. This research may provide benchmark information for college and university engineering departments and programs that they can use to evaluate their approach in preparing engineers to work in a global environment.

Context or Background Statement

The nature of engineering education and the practice of engineering have been affected dramatically throughout history. A classical education worked well during colonial times because clergymen primarily controlled the curriculum and focused on educating clergymen, doctors, teachers, and lawyers. The curriculum served to identify members of the educated class. However, the industrial and professional era created a need for new technology and professional fields with a focus on human development and practical training. The emphasis shifted from a cultural education to a curriculum focused

on useful knowledge and employment (Westmeyer, 1985). The change in emphasis created the need for specialization and ultimately increased curricular offerings.

As time progressed, science, physics, chemistry, geology and biology started to receive more attention, particularly at wealthier institutions (Church & Sedlak, 1997). In addition, the establishment of the Morrill Land-Grant Acts provided support for establishing colleges in each of the states and territories with a curriculum focused on agriculture and mechanical arts (Morrill Land Grant Acts, 2008).

While it may be common practice in other academic disciplines for higher education to define and guide future curriculum areas, engineering education is often guided by the needs of industry. Many engineering departments and programs utilize industry advisory committees (American Society for Engineering Education, 2010; Genheimer & Shehab, 2009) that include representatives from industry to help provide feedback and suggestions on how to better prepare engineering students to be successful within the work environment, including recommendations for curriculum modification. In fact, colleges and universities have adapted programs, research interests, and curricula focus to satisfy the needs of private business and industry ensuring continued funding and the marketability of their programs. The response of satisfying the needs of business and industry has been evident in both public and private higher education institutions.

Companies will look elsewhere for needed engineering talent if engineering education does not strive to meet the needs of industry, thus creating a challenging job market for future engineering graduates. According to the American Society for Engineering Education (2010):

> While U.S. engineering education has served the nation well, there is broad recognition that it must change to meet new challenges. This is fully in keeping with its history of changing to be consistent with national needs. Today, engineering colleges must not only provide their graduates with intellectual development and superb technical capabilities, but following industry's lead, those colleges must educate their students to work as part of teams, communicate well, and understand economic, social, environmental and international context of their professional activities (para. 5).

Rapid changes in technology and the opening of additional trade markets throughout the world have created a need for engineers who not only possess core technical skills, but who also demonstrate broader professional capabilities, including global competence. Although standards of living have changed, a historical review of society would illustrate that it used to be quite common for families to be primarily self-sufficient; many families had a farm with animals and other means to provide themselves with food and some source of income.

Throughout history within the United States and in many developing nations, it was not uncommon for individuals and families to identify natural resources and then use them to their advantage. Families focused primarily on providing shelter, food, and clothing to ensure their survival and utilizing timber, rock, and other items to construct dwellings. They tilled the earth, planted seeds, and tended their crops to grow food. They hunted or fished to provide meat and clothing items. Each of these efforts led to an increased likelihood of survival for each family member.

However, over the years things changed for many industrial societies. The Industrial Revolution, which began in England in the mid eighteenth century, created a societal change from an individualistic or family-based society to an industrial-based society. Developments in textile machinery and iron processing, as well as the invention of steam power, led to more automated production in factories. These changes transformed the mainly agrarian world economy focused on manual labor to one of industry and manufacturing by machines (Wilde, n.d.). The Industrial Revolution spread throughout the western world and influenced the United States, improving transportation, effectively harnessing electricity, and improving industrial processes to accelerate production (Kelly, n.d.).

With the advent of the Industrial Revolution, people started to specialize to focus their efforts in one particular area (manufacturing, agriculture, medicine, law, education, etc). Individuals and families focused on developing specialized skills and capabilities to provide an income sufficient to acquire necessary items rather than expending manual agrarian efforts to provide everything for their needs.

For example, in the United States, innovation in industry continued to occur through the efforts of modern-day industrial pioneers like Henry Ford. Ford developed unique concepts such as the moving assembly line, division of labor, mass production, interchangeable parts and focused on making every product meet strict specifications (Degarmo, Black, & Kohser, 2003). These improvements, along with others associated with the Industrial Revolution, drastically changed how things were done throughout the world and created a need for specifically trained individuals who had an interest and aptitude for technology.

Educational institutions responded by implementing changes to improve and enhance the educational outcomes for engineers and others to meet the needs of industry created through innovation. It was essential for graduating engineers and people with technical skills to be prepared to work in a rapidly changing world.

Today we are experiencing an increasing rate of significant change in parts of society in which, it used to be common for companies to manufacture and sell everything locally or within a region; it is now not only common but necessary to participate and compete on a global scale. Companies of all sizes are involved in many different regions throughout the world, and it is even common for small companies to have manufacturing operations in China, India, Mexico, or other developing areas. Multinational companies continue to grow and expand throughout the world (Friedman, 2007). While it was once sufficient for an engineer to develop technical knowledge and skills, engineers must now also adequately prepare to live and work in a global environment. Engineers in almost any company will have interaction with people who live or work in many parts of the world. The ability to communicate, understand cultural differences, and collaborate across time zones is now necessary for engineers to be successful.

Developing and integrating global competence skills into a compacted curriculum is a challenge facing many higher educational institutions; however, past experience demonstrates that engineering departments and programs within the United States can adapt to such challenges. The launch of *Sputnik* in 1957 created an educational shift from merely teaching applied technical courses to focusing on engineering research. In the 1980s, industry began to convey the need for professional skills such as leadership, communication, and team experience. There was a concern that a focus on professional

skills would reduce the effectiveness of technical skills among engineering graduates, but research indicated that incorporating professional skills into the curriculum increased students' technical proficiency (Lattuca, Terenzini, & Volkwein, 2006). Engineering educators now have an opportunity to define and develop global competency as part of engineering education to better prepare its graduates to be successful in a global environment.

We live and work in a global environment that presents many new and interesting challenges for engineers and many other professionals. As engineering educators, it is no longer sufficient to merely prepare students to understand the fundamentals of math, science, and engineering; we must also prepare them to work effectively in international environments and across different cultures (Warnick, Magleby, Todd, & Parkinson, 2008). It has become much more common for mechanical engineering graduates to work at global or multinational companies; they may work with international suppliers, provide services or outsourcing to international product markets, or be involved in developing products that will be used internationally.

Understanding the global environment will become increasingly vital for higher educational institutions to adequately prepare mechanical engineering graduates for success in a global environment. Globalization is forcing colleges and universities to evaluate and change their educational approach. Sam Zamrik (2007-2008 American Society of Mechanical Engineering president) commented in his 2007 keynote address at the Middle East Mechanical Expo Conference and Exhibit that:

> While the requirement to master the fundamentals of engineering – that is, thermodynamics, Newton's laws, or heat transfer – will never change, some

> additional skill sets will need to be developed. In order to prepare engineering students to work abroad and function effectively on international design teams, educators must refocus curricula, augmenting technical course work with the study of foreign languages and project management. Beyond this, colleges and universities must develop academic programs in such nontraditional areas as intercultural teaming, distance learning, and cross-cultural communication. (The Best Engineers section, para. 3-5)

A further illustration of the importance of global competence among engineers comes from Ken Kohrs (n.d.), former vice president of the Ford Motor Company, who said:

> What's the relevance of globalization to you personally, and to your future in engineering? I can answer that in one word: Everything. No matter what area of engineering you enter, your ability to remain on the leading edge, and to progress in our organization, will depend largely on your capacity to connect and communicate globally. (p. 5)

To understand where adjustments or improvements are needed in curriculum, it is vital that areas of deficiency, as assessed by global companies, are addressed in order to provide feedback to colleges and universities to help their administrators and faculty to determine what, if any, curriculum modifications are necessary to better prepare their graduates. Higher educational institutions will need to adapt and respond to global changes to ensure that their graduates are adequately prepared to be successful to live and work in a global environment.

Research Questions

1. Is global competence considered by hiring managers at multinational firms in their hiring practices of mechanical engineering graduates?
    a. Is global competence an important consideration for employment in multinational companies?
    b. To what extent are multinational companies willing to train engineers in global competence?
    c. To what extent do multinational companies expect higher education engineering departments and programs to prepare engineers for working in a global environment?

Reason for Use of BYU in Study

Brigham Young University's mechanical engineering program started in the early 1950s and continues to grow and expand each year. The Mechanical Engineering Department at BYU ranked 38th (Gibbons) in the nation in 2008 for the total number of bachelor's degrees awarded in mechanical engineering per year averaging from 115 to 150 per year. Since the inception of the mechanical engineering program at BYU there have been 5,149 graduates from the Mechanical Engineering Department as indicated below:

- 3,984 students graduated with a Bachelor of Science degree in ME
- 1,084 students graduated with a master's degree in ME
- 81 students graduated with a PhD degree in ME

More than 70% of BYU students speak a language other than their native tongue, many as a result of having served a voluntary two-year church service mission for The

Church of Jesus Christ of Latter-day Saints. Missionary volunteer service has provided many BYU students the opportunity of living and interacting with people in different locations and cultures throughout the world. Students at BYU come from 115 different countries, and the variety of their language skills has enabled the university to provide a rich forum for language instruction. More than 50 language courses are taught regularly at BYU, with an additional 30 available when student interest justifies offering courses in those languages (Languages at BYU, n.d.). The foreign language and cultural experience of its students coupled with their high-caliber academic preparation provides BYU a unique opportunity to prepare its graduates to be successful leaders in a global environment.

Many BYU graduates are employed by multinational firms because of their previous international and foreign language experience, and they work in many different industries and locations throughout the world. To better understand the importance of global competence and the competencies that are considered by multinational firms when hiring mechanical engineering graduates, a survey of BYU mechanical engineering graduates was conducted. The survey included both quantitative and qualitative assessments of individuals involved in the hiring process of new engineers who will work immediately or eventually in a global environment. The intent of the survey was to determine the importance of global competence as defined in Chapter II of this study compared with standard engineering technical competencies when making hiring decisions.

Methodology Overview

The survey was developed and administered using the online Qualtrics software that was available at BYU. Qualtrics has been used by more than 150 universities and 90 of the nation's top businesses (Qualtrics, n.d.). The survey instrument was distributed to all BYU mechanical engineering alumni who had e-mail addresses registered with the BYU alumni group, which included approximately 2,816 alumni from throughout the world. A copy of the online survey instrument administered to BYU alumni is located in Appendix A. The survey included the appropriate informed consent for those who would be taking the survey.

Assumptions, Limitations, and Delimitations

Assumptions of the study.

For the purpose of this study, the following assumptions were made:

- We live and work in a global environment and engineers must be prepared to work successfully within this environment.
- Large multinational companies care about globalization, its effect on their operations, and the importance of preparing engineers to work within a global environment.
- Engineers need to develop additional skills including global competence to work successfully in a global environment.
- Individuals involved in hiring new engineers know what skills, qualities, and abilities are needed for engineers to work and be successful in a global environment.
- Global competence can be defined in terms of knowledge, skills, abilities, and other characteristics among engineers.

- Higher education engineering programs care about the education and preparation of their students to be successful in industry and are willing to assess practices and make improvements to better prepare their graduates for success in a global environment.
- Learning among engineers can be enhanced and improved by collecting and analyzing data for global competence.

Limitations of the study.

Limitations are restrictions created by the selected methodology that may affect the study and are not under the control of the researcher (Mauch & Birch, 1998). The invitation to participate in the survey was originally sent to 2,816 BYU alumni who had e-mail addresses registered with the BYU alumni group with only 106 kickbacks (invalid e-mails), for a delivery rate of 96.2% (2,710). The response to the survey invitation was generally good; 561 (20.7% total response rate) alumni participated, including 558 (99.5%) who completed the survey and 3 who chose not to participate after reading the informed consent introduction of the survey. Survey respondents were given a voluntary opportunity to provide personal contact information and of the 561 respondents that participated in the survey, 461 (82.2%) provided their contact information. Respondents who provided their contact information represented 26 states, 3 countries, and more than 79 different companies, including many large multinational firms: Hewlett-Packard, Boeing, 3M, Alliant Techsystems Inc (ATK), United Parcel Service, Browning, Intel, Honeywell, ExxonMobil, Ford Motor Company, ConocoPhillips, Cessna, Adobe Systems, Northrop Grumman, Monsanto, Siemens, Bard Access Systems, and Stryker.

Delimitations of the study.

The scope of this study was framed by the following delimitations:

1. The study involved only mechanical engineering graduates to reduce potential differences among engineering disciplines.
2. Only alumni from BYU were assessed in this study.
3. The majority of BYU alumni have served voluntary 2-year church service missions in countries different than their native country. This global and often-times foreign language experience may bias the results of this study to some degree.
4. Targeted respondents to the survey were individuals employed at least part time who worked for companies that conducted business or had operations in at least one other country, and who were involved in making hiring decisions for mechanical engineers.

Definition of Terms

For the purpose of this study, the definitions listed below were utilized to provide a common meaning for each term:

ABET accreditation. Non-governmental peer review process that assures the quality of the postsecondary education students receive and assures that a college or university program meets the quality standards established by the profession for which it prepares its students. ABET is the recognized accreditation organization within the United States for college and university programs in applied science, computing, engineering, and technology (What is ABET accreditation?, n.d.).

Global competence. Although it was difficult to come to a common agreement for global competence, a Delphi technique was utilized that included senior international educators, participants from human resources at top transnational companies, United Nations officials, intercultural trainers, and foreign government officers. Three rounds of debate led to the Delphi panel concluding that global competence was “having an open

mind while actively seeking to understand cultural norms and expectations of others, leveraging this gained knowledge to interact, communicate and work effectively outside one's environment" (Hunter, White, & Godbey, 2006, p. 270).

Mechanical engineer. A graduate of an ABET-accredited engineering institution. Mechanical engineering is a discipline that involves the application of the principles of physics for analysis, design, manufacturing, and maintenance of mechanical systems. Mechanical Engineers require a solid understanding of core concepts including mechanics, kinematics, thermodynamics, fluid mechanics, and energy. (Mechanical Engineering, n.d.)

Multinational company. A company that has business operations or conducts business in more than one country.

Significance of the Study

This research provided a quantified assessment from industry of the competencies considered by individuals involved in the hiring process of mechanical engineering graduates, including considerations given to global competence. The study provided both quantitative and qualitative data that may prove valuable to engineering programs in higher educational institutions to determine what curriculum modifications (if any) should be made to better prepare their graduates for opportunities within industry and help them be successful in today's global environment.

Chapter II: Literature Review

In this chapter, the literature is divided into three main categories. The first section of the literature review focuses on the occurrence of globalization and the fact that we live and work in a global environment. The second section focuses on identification of common attributes of global competence as it applies to mechanical engineers and many other disciplines as well. The third section provides examples of efforts academic institutions are making to prepare engineers to live and work in a global environment.

Globalization

There are powerful globalization forces, such as rapidly changing technologies and economic and geopolitical changes that affect the practice of engineering throughout the world. The effects of globalization have led to an increase in the frequency of interactions among people of different cultural and ethnic backgrounds. The ability of individuals to interact in a global environment is due in part to their ability to understand cultural differences (Reimers, 2008). The American Society of Mechanical Engineering's Committee on Issues Identification report (as cited in Allan & Chisholm, 2009) identified the need for engineers to operate in complex and dynamic multidisciplinary and transnational environments:

> "The economics of nations are becoming increasingly interconnected. Information technology and knowledge cross borders through international telecommunications and on-line services. Computer-based engineering work is handed off around the world. Business, R&D, design, manufacturing, marketing

and distribution are going global and engineering and engineering standards must go with them." (p. 1)

The rapid development of technology and information exchange has created new challenges for engineering education and industry to prepare engineers to operate not only within a complex and multidisciplinary environment, but also within a global environment dealing with many different contextual issues (Allan & Chisholm, 2008).

Advances in communications and computers have reduced or eliminated many of the previous barriers to international project collaboration. An example of the rapid technological developments in the past two decades is illustrated with the rapid increase of Internet usage throughout the world. Internet usage has grown dramatically over the past 15 years, from less than 0.5% (16 million users) of the world's population using the Internet in 1995 to over 25% (1.7 billion users) in September 2009 (History and growth of the Internet, n.d.)

International commerce has increased through developments such as the European Union and the North American Free Trade Agreement (NAFTA). Many formerly closed societies, such as the former Soviet Union, have adopted economic policies and political practices that have opened free trade, and multinational corporations continue to expand throughout the world (Parkinson, 2009).

The world's economy is becoming vastly more interdependent, with exports accounting for an increasing percentage of economic activity. It is common for manufacturing activity, capital, and jobs to move rapidly from one continent to another (Roth, Cattani, & Froehle, 2008). As a result, engineering graduates are likely to work on internationally distributed teams with people of varying cultural and linguistic

backgrounds (Doerry, Doerry, & Bero, 2003). Multinational companies indicate they prefer engineers with international mobility in order to provide diversity in engineering and R&D skills in locations throughout the world (Lucena, Downey, Jesiek, & Elber, 2008). The need for international mobility has created challenges, and engineers may not be adequately prepared to live and work in different countries without developing global competence.

Ferraro (2006) cites several examples of how interdependent we have become with other industrialized nations and how much interdependence is increasing:

- Direct foreign investments in the United States increased from $141 billion in 1990 to $895 billion in 2001, an increase of 630%. And, in the opposite direction, U.S. investment abroad grew from $81 billion in 1990 to $439 billion in 2001, an increase of 540% (p. 2).
- In the past quarter of a century, the percentage of the U.S. population that is foreign born grew from 4.8% in 1970, to 6.2% in 1980, to 7.9% in 1990, and to more than 9% at the turn of the last century (p. 2).
- A significant number of corporations make more than half their total sales in foreign markets. To illustrate, Coca-Cola sells more of its product in Japan than it sells in the United States (p. 2).
- The United States remains highly reliant on other countries for a number of important minerals. For example, the United States imports 100% of its graphite, manganese, mica, columbium, and strontium as well as more than 90% of its bauxite and diamonds (p. 2).

It is important to recognize that the world we live in has become more interconnected and interdependent. We all face many challenges, including global poverty, health, economic recessions, trade imbalances and political instability (Reimers, 2009). The connectedness of the world is reflected in the "Grand Challenges for Engineering" which addresses the future challenges for engineering. Many of these challenges are global in nature, as indicated in the report introduction:

> The century ahead poses challenges as formidable as any from millennia past. As the population grows and its needs and desires expand, the problem of sustaining civilization's continuing advancement, while still improving the quality of life, looms more immediate. Old and new threats to personal and public health demand more effective and more readily available treatments. Vulnerabilities to pandemic diseases, terrorist violence, and natural disasters require serious searches for new methods of protection and prevention. And products and processes that enhance the joy of living remain a top priority of engineering innovation, as they have been since the taming of fire and the invention of the wheel.
>
> In each of these broad realms of human concern — sustainability, health, vulnerability, and joy of living — specific grand challenges await engineering solutions. The world's cadre of engineers will seek ways to put knowledge into practice to meet these grand challenges. Applying the rules of reason, the findings of science, the aesthetics of art, and the spark of creative imagination, engineers will continue the tradition of forging a better future.
>
> Foremost among the challenges are those that must be met to ensure the future itself. The Earth is a planet of finite resources, and its growing population

> currently consumes them at a rate that cannot be sustained. Widely reported warnings have emphasized the need to develop new sources of energy, at the same time as preventing or reversing the degradation of the environment. (National Academy of Engineering, n.d., para 4-5)

The grand challenges identified by the committee are as follows (Grand Challenges, n.d.):

- Make solar energy economical
- Provide energy from fusion
- Develop carbon sequestration methods
- Manage the nitrogen cycle
- Provide access to clean water
- Restore and improve urban infrastructure
- Advance health informatics
- Engineer better medicines
- Reverse-engineer the brain
- Prevent nuclear terror
- Secure cyberspace
- Enhance virtual reality
- Advance personalized learning
- Engineer the tools of scientific discovery (p. 1)

Many of these challenges are global in nature and cut across national, cultural, and ethnic boundaries. Making progress with these challenges will require the cooperation of individuals and nations to overcome governmental and institutional,

political and economic, and personal and social barriers that could impede the solutions to these problems. To make progress engineers will need to not only navigate these barriers, but also possess an understanding of the technologies involved and provide the leadership necessary to implement solutions (Parkinson, 2009).

The Accreditation Board for Engineering and Technology (ABET) states that engineering programs must demonstrate that their baccalaureate students attain certain outcomes for graduation. A set of 11 outcomes are described in Criterion 3 that can be divided into two categories: five "hard" technical skills and a second set of six "professional" skills (Shuman, Besterfield-Sacre, & McGourty, 2005). The ABET outcomes clearly demonstrate a focus on core technical skills as well as other skills including global elements (ABET, Engineering Accreditation Division, 2008):

"Hard" technical skills.

- An ability to apply knowledge of mathematics, science and engineering (3.a).
- An ability to design and conduct experiments, as well as to analyze and interpret data (3.b).
- An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability (3.c).
- An ability to identify, formulate, and solve engineering problems (3.e).
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (3.k).

"Professional" Skills

- An ability to function on multidisciplinary teams (3.d).

- An understanding of professional and ethical responsibility (3.f).
- An ability to communicate effectively (3.g).
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context (3.h).
- A recognition of the need for, and an ability to engage in life-long learning (3.i).
- A knowledge of contemporary issues (3.j).

The fact that ABET is focused on the importance of providing not only core technical skills but also a broad "professional" education including global elements underscores the importance for engineering programs within higher education to assess their current approach and make appropriate adjustments to better prepare their graduates to be successful living and working in a global environment.

Engineering now includes work that involves interaction in a transnational environment. It is not uncommon for engineers to be involved in large, complex, and multinational projects. These projects include working in teams with members distributed throughout the world. Diversity within teams is common with many different cultural and language characteristics (Lohmann, Rollins, & Hoey, 2006; Parkinson, Magleby, & Harb, 2009). Many engineers will live and work in different countries during part of their career and many others interact on a regular basis with people of different languages and cultures. These interactions increase the need for improved language and communication skills and the ability to interact with people of different cultures (Malone, Rifkin, Christian, & Johnson, 2003).

Recent trends within the United States indicate an ongoing effort to outsource high-technology jobs to other countries which is creating an uncertainty about the long

term future of engineering employment within the United States. What seems apparent is that global career competition is likely to continue, and therefore engineering graduates must develop a greater awareness of and familiarity with the global world in which we live to remain competitive (Williams, Mossbrucker, Reyer, & Petersen, 2005).

Globalization is not a passing phenomenon it is here to stay. Colleges and universities throughout the world need to recognize the importance of globalization and the interdependence and interconnectedness of the world's population (Mehta & Kou, 2005). Therefore, it is important to identify, develop and provide opportunities for international collaboration and interaction among students and faculty throughout the world and to focus on developing global competence as an important outcome for engineering graduates.

Global Competence

The following literature helped to further define global competence as it applies to engineers and prove that global competence, or a strong interest in becoming globally competent, has become a clear differentiator in an engineering graduate's ability to obtain employment, to progress in a career, and to remain viable in the future (Allan & Chisholm, 2008). Globalization has created challenges for academia to produce engineering graduates who can perform effectively and comfortably in different international engineering scenarios (Lozano, Sanchez, & Mucino, 2001). The Commission on International Education (as cited in Hunter et al., 2006) emphasized that:

> "America's future depends upon our ability to develop a citizen base that is globally competent…The United States needs more people who understand how

other people think, how other cultures work, and how other societies are likely to respond to American action." (p. 272)

Patricia Galloway, former president of the American Society of Civil Engineers, discussed globalization issues in her book, the 21st-century engineer: A proposal for engineering reform, (as cited in Parkinson, 2009) and indicated that:

> "A solid understanding of globalization is key to an engineer's success in today's global society. [Development of global competence] will enable 21st-century engineers to develop into professionals capable of working successfully both domestically and globally, highly respected by the general public and regarded…the world over as professionals of the highest order." (p. 3)

In recent years there has been an increasing awareness that the practice of engineering now transcends cultural and national boundaries and that to remain competitive engineers must develop professional skills beyond the core technical skills including development of global competence. Although the term "*global competence*" is becoming widely used in industry and education, its meaning is still ambiguous. Downey et al. (2006, p. 4) described global competence as the development of "knowledge, ability, and predisposition to work effectively with people who define problems different than they do." The challenge to define global competence is occurring at the same time that colleges and universities are working to internationalize their curricula and provide more global opportunities for their students.

Hunter et al., (2006) acknowledged that in comparing definitions of global competence either proposed or assumed, there was little commonality among many of the definitions and most were American derived. As a result, the authors pursued efforts to

advance the intellectual core. A Delphi technique was utilized to further define global competence that included participants from human resources at top transnational companies, senior international educators, United Nations officials, intercultural trainers, and foreign government officers. Three rounds of debate led to the Delphi panel concluding that global competence was "having an open mind while actively seeking to understand cultural norms and expectations of others, leveraging this gained knowledge to interact, communicate and work effectively outside one's environment" (Hunter et al., 2006, p. 270). In general, global competence can be referred to as "the ability to work knowledgeably and live comfortably in a transnational engineering environment and global society" (Lohmann et al., 2006, p. 119).

Many researchers have worked to further the body of knowledge concerning global competence and its importance for engineers in the future. Development of global competence is now becoming essential for engineers to be effective in a multinational environment. A review of the literature was conducted to identify common categories for global competence. This section provides a summary of the literature categorized by global competency attributes for engineers. To be successful in a global environment an engineer should have the ability to:

1) Exhibit a global mindset (Caligiuri & Santo, 2001; Georgia Institute of Technology, 2005; Hunter, 2004; Parkinson et al., 2009; Reimers, 2008).
2) Appreciate and understand different cultures (Brustein, 2007; Galloway, 2008; Georgia Institute of Technology, 2005; Mariasingam, Smith, & Courter, 2008; Parkinson, et al., 2009; Renganathan, Gerhardt, Blumenthal, & Greenwood, 2008).

3) Demonstrate world and local knowledge (Brustein, 2007; Delauder, 2004; Galloway, 2008; Georgia Institute of Technology, 2005; Parkinson et al., 2009; Reimers, 2008; Zamrik, 2007).
4) Communicate cross-culturally (Allan & Chisholm, 2008; Brustein, 2007; Doerry et al., 2003; Gilleard & Gilleard, 2002; Mariasingam et al., 2008; Olson & Kroeger, 2001; Parkinson et al., 2009).
5) Speak more than one language including English (Allan & Chisholm, 2008; Delauder, 2004; Galloway, 2008; Georgia Institute of Technology, 2005; Gilleard & Gilleard, 2002; Lohmann et al., 2006; Mariasingam et al., 2008; Parkinson et al., 2009; Reimers, 2008; Renganathan et al., 2008; Zamrik, 2007; Zhao, 2009).
6) Understand international business, law, and technical elements (Hunter, 2004; Mariasingam et al., 2008; Parkinson et al., 2009; Renganathan et al., 2008).
7) Live and work in a transnational engineering environment (Brustein, 2007; Caligiuri & Santo, 2001; Georgia Institute of Technology, 2005; Gilleard & Gilleard, 2002; Lohmann et al., 2006; Parkinson et al., 2009).
8) Work in international teams (Allan & Chisholm, 2008; Doerry et al., 2003; Galloway, 2008; Mariasingam et al., 2008; Parkinson et al., 2009).

This section includes a brief description of each identified global competency attribute and provides supporting evidence from the literature.

1. Exhibit a global mindset**:** The ability of individuals to establish self awareness, understand cultural norms and expectations, and realize that they are part of a global world, or in other words that they are citizens of the world as well as citizens of a particular country. An ability to exhibit a global mindset includes an understanding

and avoidance of ethnocentrism, the idea that one's own culture is superior to all other cultures. An ability to exhibit a global mindset is a state of mind that provides a positive disposition to be successful in a global environment (Caligiuri & Santo, 2001; Georgia Institute of Technology, 2005, March; Hunter, 2004; Parkinson et al., 2009; and Reimers, 2008)

Engineers who exhibit a global mindset are "able to place technology in a global context, recognize the multidisciplinary and multicultural approaches to problem solving…and achieve a greater understanding of diversity" (Zamrik, 2007, Culture of Growth and Innovation section, para. 5). Each engineer should also comprehend the international dimensions of his/her major field of study (NASULGC, 2004).

Hunter developed and administered a survey instrument entitled "Determining Global Competence" which was distributed to representatives from universities who had indicated success in internationalizing their campus and to human resource personnel from transnational companies who sent between 50 and 200 employees abroad annually. The survey indicated that the most critical step to becoming globally competent is developing a clear understanding of one's own cultural norms and expectations. It is important for a person to first establish self-awareness and then pursue language, cultural, social and international diversity (Hunter W. D., 2004).

2. Appreciate and understand different cultures**:** A developed awareness, appreciation, and understanding of, as well as adaptability to diverse cultures, perceptions, and approaches with an ability to interact with people from other cultures and countries (Brustein, 2007; Galloway, 2008; Georgia Institute of Technology, 2005, March; Mariasingam et al., 2008; Parkinson, et al., 2009; and Renganathan et. al., 2008).

It is essential to be open to new and different cultures. Daniel Bates and Fred Plog (as cited in Zhao, 2009, p. 4) described culture as "the system of shared beliefs, values, customs, behaviors, and artifacts that the members of society use to cope with their world and with one another, and that are transmitted from generation to generation through learning." Curran (as cited in Hunter, 2004) indicated that one must have the ability to become familiar with an environment without causing a rift when experiencing something new, which includes cross-cultural sensitivity and adaptability. Cross-cultural awareness includes the ability to understand how another culture feels from the perspective of an insider (Olson & Kroger, 2001). From an engineering perspective cross-cultural awareness also includes a realization that culture affects how decisions are made and how tasks are completed (Parkinson, et al., 2009).

3. Demonstrate world and local knowledge: An ability to understand the major currents of global change and its implications and demonstrate knowledge within a global and comparative context. Demonstration of world and local knowledge includes familiarity with history, geography, government, market, and public policy issues around the world and in several target countries along with an understanding of the workings and close linkages of the global economy to promote critical and creative thinking concerning the current global challenges (Brustein, 2007; Delauder, 2004; Galloway, 2008; Georgia Institute of Technology, 2005; Parkinson et al., 2009; Reimers, 2008; and Zamrik, 2007).

   Demonstration of world and local knowledge also includes a broad knowledge of the world coupled with specific knowledge of target countries, which provides

improved understanding of local customs and strategies. Thus, engineers are able to recognize and understand issues of sustainability and to design products and solve problems that are culturally appropriate with local populations. A broad knowledge of the world and local areas also improves each engineer's ability to better understand the implications of their work (Galloway, 2008; Renganathan et. al., 2008; Shuman, Besterfield-Sacre, & McGourty, 2005).

4. Communicate cross-culturally: An ability to interact with and understand people from different cultures and recognize the importance of both appropriate verbal and nonverbal communication including the ability to communicate and interact in a globally interdependent world. An ability to communicate cross-culturally also includes the ability to communicate across time and space since we live in a technological world where it is common for individuals to interact across many different time zones (Allan & Chisholm, 2008; Brustein, 2007; Doerry et al., 2003; Gilleard & Gilleard, 2002; Mariasingam et al., 2008; Olson & Kroeger, 2001; Parkinson et al., 2009).

Multicultural environments within organizations are more common than ever and the need to communicate both internally and externally in an organization is constantly increasing as engineers encounter people who define and solve problems differently (Downey et al., 2006; Mariasingam et al., 2008). Communication in general is difficult; when communicating across cultures, miscommunication may occur that could lead to conflict. For example, in some cultures just because someone says yes does not mean they agree with what you are saying; it only indicates that they are listening to you. Nonverbal behavior arises from our common culture, and

interpetation of these behaviors is also often misunderstood across cultures. What is considered normal or effective in one culture may be considered inappropriate in another.

Time also means different things in different cultures; one culture may perceive completing tasks in a timely manner as important, while other cultures may see time as a variable that is secondary to developing relationships. The ability to understand these implications and communicate effectively will enable engineers to be more successful in a global environment.

5. Speak more than one language including English: An ability to communicate in the international business language of English both orally and in writing, and the ability to speak another language (Allan & Chisholm, 2008; Delauder, 2004; Galloway, 2008; Georgia Institute of Technology, 2005; Gilleard & Gilleard, 2002; Lohmann et al., 2006; Mariasingam et al., 2008; Parkinson et al., 2009; Reimers, 2008; Renganathan et al., 2008; Zamrik, 2007; Zhao, 2009).

   Across many countries in Europe and Asia, English has been and continues to be taught as a second language. English has fast become a common language for engineering and science throughout the world and many universities now provide instruction in English. The ability to speak another language even at a basic level helps foster goodwill relationships, breaks down cultural barriers, and facilitates an appreciation for others who have learned a different language. An ability to communicate at a technical or professional level in a second language also helps to reduce any misunderstandings that may occur due to language and cultural barriers (Parkinson et al., 2009).

Proficiency in English and the ability to speak another language, especially that of a host country, provide engineers access to additional information, experiences, and understanding within their profession (Georgia Institute of Technology, 2005, Mariasingam et al., 2008). The development of foreign language proficiency also provides insight into and increases understanding of the values, beliefs, behaviors, practices, customs, and artifacts of other cultures (Zhao, 2009).

6. Understand international business, law, and technical elements: An ability to understand the different cultural contexts of how business, law, engineering and technology might be approached and applied and the implications of each within an international environment, including an appreciation of ethics and its application in different countries and cultures (Hunter, 2004; Mariasingam et al., 2008; Parkinson et al., 2009; Renganathan et al., 2008).

   Engineers involved in conducting business in other countries or cultures are often confronted with different laws, methods of conducting business, and engineering practices. An understanding of the business culture and customs within each country, together with a respect for different worldviews, helps improve one's ability to conduct business in an efficient manner. It is also important to understand the law in the country of operation and the differences between countries in order to avoid legal implications (Mariasingam et al., 2008).

   An appreciation for new and developing markets provides unique engineering opportunities for engineers to design and implement appropriate engineering solutions. For example, an engineering solution that may work for the United States would potentially not work in certain parts of Africa due to the lack of accessibility to

electricity, clean water, telephone and the Internet. Engineering solutions and product use may also be affected by customs, cultural practices, or the availability of materials and supplies. Therefore, it is important that engineers deliver product development and engineering systems that are culturally appropriate and meet the needs of a diverse global community (Allan & Chisholm, 2008).

Variances in laws, the conduct of business, and the practice of engineering vary across countries and cultures; what is considered ethical in one country may not be considered ethical in another country. For example, it is common in some countries for companies to provide bribes or kickbacks to conduct business, while in other countries this practice would be considered unethical or illegal (Parkinson et al., 2009). Therefore, as engineers interact with individuals from diverse backgrounds, it is important that they show ethical behavior in all aspects of their behavior, both personally and professionally (Allan & Chisholm, 2008).

7. Live and work in a transnational engineering environment: An ability and awareness to live and work effectively in international settings. This also includes the ability to transact business in different countries and cultures, to practice engineering in a global context, and to think critically and solve problems within the context of at least one other country or culture (Brustein, 2007; Caligiuri & Santo, 2001; Georgia Institute of Technology, 2005; Gilleard & Gilleard, 2002; Lohmann et al., 2006; Parkinson et al., 2009).

   Authentic international experiences provide unique opportunities to learn about the world and the practice of engineering. These experiences may be provided through interaction and collaboration with people who think or act differently,

through virtual collaboration with people in different countries, international internships, study abroad programs, service and humanitarian efforts, and through other opportunities where individuals interact with people from different cultures and countries.

8. Work in international teams: An ability to collaborate and contribute professionally in multicultural work environments either in person or in geographically distributed teams with persons of different cultures and linguistic backgrounds where diverse ways of thinking, being, and doing are the basis of practice (Allan & Chisholm, 2008; Doerry et al., 2003; Galloway, 2008; Mariasingam et al., 2008; Parkinson et al., 2009).

   In essence the ability to work in international teams focuses on the ability of the engineer to get along with other people and work with a team in a multicultural, multilingual and multicontextual business environment (Mariasingam et al., 2008; Zamrik, 2007, November; Zhao, 2009).

Academic Institution Efforts to Prepare Engineers to be Globally Competent

In recent years there have been many credible sources citing the need to better prepare engineers to live and work in a global environment. Duane Abata (2004), former president of the American Society for Engineering Education (ASEE), indicated that there needs to be a "major revolution in engineering education. We must internationalize our curriculum; to include…intercultural interaction…We must mold our students to be entrepreneurs, and spirited international adventures as well" (p. 62).

James Duderstadt (2008), former president and dean of engineering at the University of Michigan, indicated that engineering education needs to respond to changes

associated with globalization. He also indicated that it is important to stress the importance of global perspective for engineering practice and for engineers to develop a deep understanding of global markets and organizations. The capacity to work in multidisciplinary teams is important; characterized by high cultural diversity while exhibiting the nimbleness and mobility to address rapidly changing global challenges and opportunities.

One of the greater challenges facing engineering departments and programs in universities and colleges is how to incorporate international preparation into an already content-full and highly-sequenced curriculum (Lohmann et al., 2006). Many programs are including ways to incorporate globalization in the curriculum: international internships, study-abroad programs, faculty-led courses while on international travel, international design projects, research experiences, and language study, among other programs. However, much of what is occurring is an add-on approach made up of short summer programs, minors, and certificates (Georgia Institute of Technology, 2005). Many of these efforts provide limited cultural immersion and do not typically provide significant opportunities to gain second-language proficiency. These programs are often expensive and have other constraints that make it difficult for students to participate. It is estimated that less than 20% of students participate in global experiences like study abroad programs (Mariasingam et al., 2008), and given the relatively low percentage of participation of students in international experiences, what can be done to provide global experiences for all engineering students? It is anticipated that a more comprehensive and integrated approach that helps all students develop global competence is needed (Lohmann et al., 2006).

As mentioned previously, the cultural and economic effects of globalization have created a need for fundamental changes in engineering education. Although internationalization and the development of global competence may originally have begun in the social sciences and humanities, engineering programs now recognize the importance of developing international skills within its graduates to succeed in today's global society (Sadat-Hossieny, Allameh, & Rajai, 2005). The following discussion highlights what some academic institutions have done to better prepare their students to live and work successfully in today's global society.

The Georgia Institute of Technology has a long history of encouraging its students to participate in international experiences. In 1975 the Georgia Tech College of Architecture established a program in Paris, France, for its senior students. In 1989 the university established a campus in Metz, France, now known as the Georgia Tech Lorraine campus. The Georgia Tech Lorraine campus provides both graduate and undergraduate students the opportunity to earn credit toward their degree while gaining international experience and pursuing improved language skills.

Georgia Tech now offers the International Plan, which is a coherent degree-long baccalaureate program focused on developing global competence in its graduates. Global competence is characterized by each graduate's proficiency in a second language; knowledge about comparative international relations, the world economy, and the socio-political systems and culture of at least one other country or world region; and the graduate's ability to practice his or her discipline within an international context (Georgia Institute of Technology, 2005).

Georgia Tech utilizes an integrated approach to develop student global competence as part of their international plan. The program is intended to be completed within four years, and students completing the requirements receive a special "International Plan" designation on the Georgia Tech degree and transcript. The program requires students to engage in at least 26 weeks of international experience (i.e., work, research, or study) that is related to their discipline, develop second language proficiency through at least the second year of study (with a proficiency exam for assessment), and take internationally oriented coursework including international relations, global economy, and society/culture. In addition, each student's capstone design experience must meet certain international requirements; in an ideal situation the project would include Georgia Tech students working with students from a foreign university (Georgia Tech, n.d.). Georgia Tech indicated that basic global competence is characterized by several abilities to (Georgia Institute of Technology, 2005):

1. Second language proficiency
    - Communicate in a second language via speaking, listening, reading, and writing.
2. Comparative global knowledge
    - Demonstrate cultural knowledge within a global and comparative context.
    - Demonstrate knowledge of global issues, processes, trends, and systems.
    - Demonstrate knowledge of at least one other culture, nation, or region, in relation to beliefs, values, perspectives, practices, and products.
3. Intercultural assimilation
    - Readily use second language skills and knowledge of other cultures to extend access to information, experiences, and understanding.

- Convey an appreciation for different cultures in terms of language, art, history, and so on.
- Interact comfortably with persons in a different cultural environment and be able to seek out further international or intercultural opportunities.

4. Global disciplinary practice
    - Use cultural frames of reference and alternative perspectives to think critically and solve problems within the discipline in the context of at least one other culture, nation or region.
    - Collaborate professionally with persons of different cultures and function effectively in multicultural work environments (p. 17).

Purdue University's College of Engineering established the Purdue Global Engineering Alliance for Research and Education (GEARE) program in partnership with other universities (Universität Karlsruhe – Germany; Shanghai Jiao Tong University – China; Indian Institute of Technology Bombay – India; and the Instituto Technlogico De Estudios Supreriores De Monterrey – Mexico) and leading global companies. The focus of the GEARE program has been to educate students to be global engineers and global citizens. The undergraduate program includes five aspects (Hirleman, Eckard, & Atkinson, 2007):

1. Language and orientation work.
2. A domestic engineering professional experience with a global component.
3. An international professional posting.
4. A semester abroad taking engineering coursework.

5. Two semesters of global design work (one at home, one abroad) on projects where the diversity of cross-cultural values affects the project decisions (p. 3).

The University of Rhode Island started its International Engineering Program as early as 1987. Students in the International Engineering Program major in both engineering and a foreign language. The program included either spending a semester or more abroad with an industrial internship or taking a study abroad program at a partner university. Because of these additional requirements the program takes 5 years to complete instead of the usual four (Blumenthal & Grothus, 2008).

Rensselaer Polytechnic Institute (RPI) is currently in the process of implementing its mandatory initiative to have all undergraduate engineering students involved in an international experience. The program is called Rensselaer Education Across Cultural Horizons (REACH). The focus is on the junior class, with initial efforts increasing student participation in a semester abroad at a partner university from 25% to 100%. The REACH program is basically an exchange environment where RPI sends students to partner universities for a semester and the partner universities send an equivalent number of students to RPI (Renganathan et al., 2008).

The number of universities that have developed international programs for engineering students to help prepare them to live and work in a global environment has grown, but most do not list global competence as a goal. In an effort to address the challenges facing engineers in working successfully in a global environment, the Ira A. Fulton College of Engineering and Technology at BYU created a strategy that involved five key areas of focus (Harb, Rowley, Magleby, & Parkinson, 2007):

1. Technical excellence

2. Leadership
3. Character development
4. Global awareness
5. Innovation (p. 1)

The focus on global awareness at BYU included a developed outcome for students to appreciate how cultural differences affect how people think and prepare students to lead in a global context. BYU is working to provide global technical experience for at least half of its graduates. These efforts have included the following:

- Engineering study abroad opportunities in China, France, Singapore, Mexico, and other locations.
- Global product development courses in Asia and Europe, providing students the opportunity to learn more about the product development process by visiting many different international companies and universities.
- International Capstone (senior design-and-build) projects provided by multinational firms and humanitarian projects provided by non-governmental organizations (NGOs) in Mexico, Denmark, Ireland, Germany, China, India, Mozambique, Kenya, Tanzania, and Ghana.
- Virtual international collaboration efforts including PACE (Partners for the Advancement of Collaborative Engineering Education), in which BYU partners with many other universities to design and build in a collaborative virtual environment. BYU, because of the extensive language capabilities of its students (more than 70% of students speak a foreign language), has taken the lead in coordinating design efforts across all universities involved in the PACE program.

- The Global Engineering Outreach (GEO) program, encapsulating a global engineering projects course and participation in the BYU non-profit humanitarian club, which partners with developing communities worldwide to improve their quality of life. GEO has completed sustainable engineering projects in Tonga, Ghana, and Peru.

Work continues to define and develop the most appropriate method of developing global competence in engineering graduates. A German automotive supplier Continental supported a study entitled "In search of global engineering excellence: Educating the next generation of engineers for the global workplace." Participants in the study included the following universities: ETH Zurich (Switzerland), Georgia Institute of Technology (USA), Massachusetts Institute of Technology (USA) Shanghai Jiao Tong University (China), Technische Universität Darmstadt (Germany), Tsinghua University (China), Universidade de São Paulo (Brazil), and the University of Tokyo (Japan). The participants evaluated engineering in a global context and educational approaches being utilized to prepare global engineers and developed the following four recommendations (Widdig & Lohmann, 2007):

1. Global competence needs to become a key qualification of engineering graduates. Global preparation of engineering students needs to move beyond the add-on approach and be integrated into engineering programs.
2. Transnational mobility for engineering students, researchers, and professionals need to become a priority, which would help remove barriers to working, studying, conducting research, and attending meetings while providing expanding incentives to encourage these activities.

3. Global engineering excellence depends critically on a mutual commitment to partnerships, especially those that link engineering education to professional practice. Industry must take the lead in developing opportunities for students to practice engineering in a global context through employment, projects and other experiential learning opportunities.
4. Research on engineering in a global context is urgently needed. A theoretical foundation needs to be developed as well as development of processes/methods to instill global competence in engineers. Government agencies should support research to further the body of knowledge of engineering in a global context (pp. 4-5).

What seems apparent is that many institutions have focused on trying to improve the global outcomes for their engineering students. While international efforts to improve global competence among graduates of engineering programs continue to increase, the percentage of students who have participated is still relatively small. Real success is likely to be achieved as colleges and universities focus on their own curricula to make global competency an essential part of a student's education (Downey & Lucena, 2007). Many challenges must be overcome, including how to incorporate global elements into an already packed curriculum, develop foreign language capabilities, and deal with timing differences in semesters of international schools. Improvement of global outcomes will require commitment from higher educational institutions to produce globally competent engineers. Faculty need to not only focus on helping students acquire technical skills, but also provide opportunities to gain international experience (Renganathan et al., 2008). The incorporation of global elements will likely require a review and modification

of existing curricula to make sure that it is comprehensive, coherent and accessible to all students (Brustein, 2007).

Chapter III: Methodology

This chapter is organized into four different sections. The first section discusses the purpose of the study, the second section describes the type of study, the third section provides a list of the research questions, and the fourth section provides a rationale and description of the study.

Purpose of the Study

The purpose of this study was to determine whether multinational companies considered global competence an important skill in mechanical engineering graduates when making hiring decisions. The study included an evaluation of standard technical engineering competencies with a list of global competencies for engineering developed from the literature in Chapter II. This research provides benchmark information for college and university engineering departments and programs that they can use to evaluate their approach in adequately preparing engineers to work in a global environment.

Study Type

Global competence has become a topic often cited in literature and is an area of focus for many higher educational institutions. However, there was relatively little agreement in how to develop and assess global competence among engineering graduates and its importance compared to standard engineering technical competencies. To facilitate a more foundational comparative approach (as measured by companies and organizations who employ mechanical engineers) to understanding the relative importance of global competencies compared to standard engineering technical competencies an exploratory study method was utilized. An exploratory study is used

when not much is known about a particular issue or topic and the objective of such studies is tentative (Bryant, 2004). Research is typically exploratory when no previous models are used as the basis of study (Routio, 2007).

The study used a survey instrument that evaluated both quantitative and qualitative elements. A Likert scale approach was utilized to gather data for quantitative comparison, and survey participants were also given an opportunity to provide responses to open-ended questions that offered qualitative insights into the importance of global competence for mechanical engineers.

Research Questions

1. Is global competence considered by hiring managers at multinational firms in their hiring practices of mechanical engineering graduates?
    a. Is global competence an important consideration for employment in multinational companies?
    b. To what extent are multinational companies willing to train engineers in global competence?
    c. To what extent do multinational companies expect higher education engineering departments and programs to prepare engineers for working in a global environment?

Rationale and Description of the Study

The study identified, documented, and discussed the relative importance of global competence as compared to standard engineering competencies within companies that conduct business or have operations in more than one country. The study population was limited to alumni from BYU who graduated from the mechanical engineering department

from the early 1950s through 2010. The alumni represented a wide population base and lived and worked in 48 different states and 17 countries. The accessibility of BYU mechanical engineering alumni data including the fact that alumni were distributed throughout many different industries and locations led to the identification of BYU mechanical engineering alumni for the study's purpose. To better understand the reasons for selecting BYU and the mechanical engineering department for the survey, a brief history and overview is presented.

Brigham Young Academy was established October 16, 1875, on a little over one acre of land in downtown Provo, Utah. Despite steady growth in its early years, the academy faced a series of financial and physical setbacks, but with the help of Abraham O. Smoot the campus was moved, the curriculum strengthened, and the enrollment stimulated. In 1903, the name of the school was officially changed to BYU and in 1909 work began on the first building of many on the university's present site (History of BYU, n.d.).

From its humble beginnings, BYU has expanded its main campus to approximately 560 acres and 295 buildings, with a total enrollment of approximately 33,000 students from all 50 states and 115 different countries (Brigham Young University Communications, 2009-2010). During the 2009-2010 academic year, the Ira A. Fulton College of Engineering and Technology had an enrollment of approximately 3,300 students with more than 900 enrolled in the mechanical engineering department.

More than 70% of BYU students speak a language other than their native tongue. Students come from 115 different countries and the variety of language skills among students has enabled the university to provide a rich forum for language instruction.

Courses in more than 50 languages are taught regularly at BYU, with courses in an additional 30 languages available with sufficient student interest (Languages at BYU, n.d.). The previous foreign language and cultural experience of many students coupled with high-caliber academic preparation has provided BYU with a unique opportunity to prepare its graduates to become successful leaders in a global environment.

BYU's mechanical engineering department started in the early 1950s and continues to grow and expand each year. In 2008, BYU's mechanical engineering department ranked 38th (Gibbons, 2008) in the nation for the total number of bachelor's degrees awarded in mechanical engineering with 113 graduates. BYU Alumni Relations maintains a database of all BYU alumni, including all mechanical engineering graduates. This database was used to determine that since the inception of the mechanical engineering program at BYU, 5,149 students have graduated from the program.

Due to the accessibility to and quantity of BYU mechanical engineering alumni and since many were employed by multinational firms, the alumni were well situated to evaluate the competencies that are important for engineers to live and work in a global environment. The following steps were taken to gather the data for this study:

1. An extensive literature search was conducted to identify and categorize a list of global competencies.
2. A survey instrument was developed with the assistance of faculty from both the University of Nebraska-Lincoln (UNL) and BYU who were considered experts in their respective fields.
3. An Institutional Review Board (IRB) application including the survey instrument was submitted to the UNL IRB on April 5, 2010. A copy of the IRB protocol submission

is included in Appendix B. IRB applications are used to receive approval for human subject testing and the administration of survey instruments. Preliminary approval was provided from the UNL IRB, facilitating approval from BYU's IRB (see Appendix C). The approval letter from BYU's IRB was sent to the UNL IRB for final approval. See Appendix D for a copy of the final approval provided April 13, 2010.

4. The survey was developed and tested for an online environment utilizing Qualtrics software, which is currently used by more than 150 universities and 90 of the nation's top businesses (Qualtrics, n.d.). Qualtrics provided the means to collect data confidentially and included excellent summary and reporting tools for analysis.
5. A pilot survey was administered to 22 BYU alumni who had from 5 to over 40 years of industry experience. Fifteen (68%) alumni completed the survey and also provided feedback and suggestions for improvement via e-mail.
6. The survey instrument was updated and refined based on feedback from and analysis of the data from the pilot as well as additional input from survey experts at BYU.
7. An invitation to participate in the survey was sent via e-mail to BYU alumni who have e-mail addresses registered with the BYU alumni group, which included 2,816 of the 5,149 (54.7%) mechanical engineering alumni from throughout the world encompassing 48 states and 17 countries (BYU Alumni Relations, 2010). The e-mail contained a link to the survey instrument. The survey instrument administered to BYU alumni is included in Appendix A.
8. The survey was opened for data collection from April 22 to May 8, 2010. The initial survey e-mail invitation is included in Appendix E. A follow-up survey e-mail invitation was sent on May 3, 2010 and is included in Appendix F. The follow-up

invitation was sent to all alumni included on the initial invitation, thanking those who had already participated in the survey and inviting alumni who had not completed the survey to do so within the week. Both the initial e-mail invitation and the follow-up invitation included a link to the survey instrument.

9. The survey data, included in Appendix G, was analyzed for descriptive and inferential statistics utilizing the data output functions of Qualtrics, Microsoft Excel 2007, and the statistical analysis software SPSS. SPSS is part of the IBM Company and is considered a leading global provider of predictive analytics software and solutions (SPSS [Statistical Package for the Social Sciences], 2010). In addition, the qualitative data was exported from Qualtrics into Microsoft Excel 2007 and grouped into common categories based upon responses; then histograms were developed to represent the data in a quantitative manner.
10. The final data results were analyzed and a summary of findings, conclusions, and recommendations for further research was developed.

Survey instrument development.

An extensive literature review identified a lack of common agreement on the importance of global competence for mechanical engineers, or in general for that matter. Significant effort went into identifying categories of global competence. The review also identified a lack of existing instruments to collect the type of data this study gathered.

The developed list of global competencies was reviewed by researchers currently involved in globalization both at BYU and UNL. The experience of these researchers included many years of employment in multinational companies based both within the United States and in other countries throughout the world. In addition, many of the

collaborative faculty researchers have developed and led study abroad programs in Europe, Asia, North America, and South America. Most have also been involved in conducting research on preparing engineers for success in a global environment. For example, Alan Parkinson (dean of the Ira A. Fulton College of Engineering and Technology at BYU) is considered by many to be a leading researcher in the field of globalization as it applies to engineering. The quantity and quality of the research papers he has produced, together with the many invitations he has received to share his research and experience at different international educational conferences, provide evidence of his consideration as a lead researcher in the area of globalization.

Researchers for this study included college and associate deans, education department chairs, and engineering professors with many years of both industrial and academic experience. The collective experience of these researchers together with the more than 20 years of global experience of the author was utilized to finalize the eight global competency categories identified in Chapter II.

Based on the review of the literature, it was apparent that a survey instrument to compare global competence with standard engineering competencies would need to be developed. Fifteen competencies were identified including 8 global competencies identified during the literature review and 5 engineering competencies taken from the "hard" technical skills section of the ABET criterion 3 described in Chapter II. GPA and work experience were also identified for the comparison as these are often utilized to sort and assess candidates for employment.

The survey instrument, which contained 25 questions (see Appendix H), was developed to gather both quantitative and qualitative data on the relative importance of

global competence for engineers to be successful in a global environment. Survey branch and skip logic were used to move respondents through applicable sections of the survey, based on their selections at key points in the survey.

The survey instrument was divided into six main sections: informed consent, education, employment, competencies considered when hiring new engineers, global experience, and demographics. Each of these sections will be described in greater detail below.

Informed consent.

This section included question 1 and informed potential survey participants of the survey purpose, procedures, risks or discomforts, benefits, compensation, confidentiality, opportunity to ask questions and freedom to withdraw. This section was utilized to make sure that all potential participants understood the survey intent and understood their rights as a participant. All participants were provided the opportunity to opt out of the survey if they desired at the beginning or at any point throughout the survey.

Participants in the survey received the informed consent document on the first page of the web-based survey and were provided the opportunity to acknowledge their participation in the survey instrument by selecting “Yes” and confirming their response by selecting the arrow key at the bottom right corner of the page. The informed consent document is included on the first page of the survey (in Appendix H).

Education.

This section included questions 2 through 3 and gathered data on the mechanical engineering degree types (BS, MS, PhD) completed at BYU by each participant and the

year of the latest degree in mechanical engineering at BYU. All participants were required to complete the education section to move forward with the survey.

Employment.

This section included questions 4 through 12 and was used to identify survey participants that met the required criteria for completing the entire survey. The employment section included questions concerning employment status, industry type, job title, size of company both in number of employees and annual revenue, and percentage of revenues outside the United States. To complete the entire survey including the competency comparison section, a participant needed to be employed at least part-time, work for a company that conducted business internationally or had at least one operation in a different country, and be involved in the hiring process of new engineers with their company. Survey participants were also given the opportunity to explain how hiring decisions were made within the company. If participants did not meet the requirements for employment, the online Qualtrics survey utilized the skip logic and took them to the global experience section.

Competencies considered when hiring new engineers.

This section included questions 13 through 16 and utilized a five-point Likert scale assessment to determine the importance of 15 different competencies including global competencies considered by multinational firms when making hiring decisions for mechanical engineers to work in a global environment. The 15 different competencies were numbered from 1 to 15 with the global competencies intermixed among the standard engineering competencies. This resulted in a list that primarily alternated from technical to global competencies. Participants were provided an opportunity to describe

additional competencies considered when making hiring decisions for new engineers. The competencies section identified the willingness and success of companies in providing appropriate training and experience for engineers to be successful in a global environment, as well as the perceived value and success of college and university engineering programs in preparing engineers to work in a global environment. Participants were provided an open-ended response opportunity to identify what college and university engineering programs could do to better prepare engineers for success in a global engineering environment.

Global experience.

This section included questions 17 through 21 and provided all survey respondents the opportunity to indicate whether they had worked in a global engineering environment. If they had not worked in a global environment, the skip logic in the online survey took them to the demographics section. If they had worked in a global engineering environment, they were provided the opportunity to indicate how many countries and continents they had visited in the context of their career. In addition, respondents were given the opportunity to provide qualitative comments concerning what they wished they would have known coming out of college and what best helped them prepare for and obtain success in a global engineering environment

Demographics.

The last section included questions 22 through 25, which gathered basic demographic information, including gender and the foreign language capability of survey participants. Survey participants were also given the opportunity to provide their personal

contact information if they wanted to be involved in a random drawing for BYU mechanical engineering T-shirts and Leatherman® multi-tools.

Additional informed consent considerations.

The study required human subjects to complete a web-based survey form. Human subjects participating in research are afforded protections including understanding: survey procedures, risks or discomforts, benefits, compensation, confidentiality, opportunity to ask questions, and freedom to withdraw.

Procedures.

Participants were notified that it would take approximately 15 minutes to complete the survey. They were also provided an overview of the types of questions asked.

Risks or discomforts.

There were no known risks or discomforts associated with this research or the participation in the survey instrument.

Benefits.

There were no known direct benefits associated with this research or the participation in the survey instrument. However, the information gathered in the study could help college and university engineering programs better assess the importance of global competence as perceived by industry to determine the appropriateness of their efforts.

Compensation.

There was no direct compensation associated with this research or the participation in the survey instrument. However, survey participants who chose to

provide their personal contact information were eligible for a random opportunity to win 1 of 10 BYU mechanical engineering T-shirts (retail value of $9.95) or one of two Leatherman® multi-tools (retail value of $46.00). Each participant who provided their contact information was assigned a numerical number in Microsoft Excel 2007, and the 12 winners were randomly selected utilizing Microsoft Excel's random number generation function. The formula for this function is as follows:

=RANDBETWEEN(a,b)

The RANDBETWEEN function returns random numbers from the interval [a,b] including *a* and *b* in the potential for selected numbers. Since there were 461 survey respondents who included their contact information, the following formula was used to identify the winners:

=RANDBETWEEN(1,461)

The 12 survey participants who were randomly selected to receive an item were contacted to verify their address, and the items were sent to them via the U.S. Postal Service.

Confidentiality.

The survey instrument was web-based and hosted by a third party known as Qualtrics, which maintains strict confidentiality procedures. Any information obtained during the study that could identify participants was kept strictly confidential. Electronic records were stored on a computer with password access and all printed data was stored in a locked cabinet in the investigator's locked office. The data will be retained for a period of 3 years after the study is complete. It is important to note that survey participants were notified that information obtained in the study may be published in

professional journals or national and international conferences, but the data would be presented only as aggregate data.

Opportunity to ask questions.

Survey participants were provided with contact information for the researcher, the dissertation advisor, and IRB contacts at both UNL and BYU. The contact information provided participants the opportunity to ask questions concerning the survey instrument and their rights as survey participants.

Freedom to withdraw.

All survey participants were notified that their participation was voluntary and that they could withdraw without penalty or refuse to participate entirely without harming their relationship with the researcher, UNL, or BYU. They were also notified that leaving the study would not affect any benefits to which they were otherwise entitled.

Summary

The methodology for this study included an emphasis on data collection and analysis. The importance of standard technical engineering competencies compared with global competencies (as defined in Chapter II) was assessed as determined by individuals involved in the hiring process of new engineers for multinational firms. The study was primarily exploratory including also quantitative and qualitative components.

Chapter IV: Results and Analysis

This chapter is organized to first provide a profile of the respondent group and then address the research questions for this study, including the data collected from the survey instrument, results, analysis and interpretation. Additional survey results are included to provide information considered potentially valuable to higher educational engineering departments and programs as they consider the importance of preparing engineers to work successfully in a global environment.

The purpose of this study was to determine if multinational companies considered global competence an important skill in mechanical engineering graduates when making hiring decisions**.** The study included an evaluation of standard technical engineering competencies in addition to a list of global competencies for engineering. This research may provide benchmark information for college and university engineering departments and programs that they can use to evaluate their approach in preparing engineers to work in a global environment.

Profile of the Respondents

Data utilized in this study was drawn from the literature review results and from a survey instrument distributed to alumni of BYU's mechanical engineering program. An invitation to participate in the survey was sent via e-mail to BYU alumni who had e-mail addresses registered with the BYU alumni group, which included 2,816 of the 5,149 (54.7%) mechanical engineering alumni from 48 different states and 17 countries (BYU Alumni Relations, 2010). Of the 2,816 alumni that had e-mail addresses registered with the BYU alumni group, only 106 kickbacks (invalid e-mails errors) were received, for a delivery rate of 96.2% (2,710). The response to the survey invitation was generally good,

with 561 (20.7% total response rate) alumni participating. Survey respondents were given a voluntary opportunity to provide personal contact information, and of the 561 respondents that participated in the survey, 461 (82.2%) provided their contact information representing 26 states and 3 countries and more than 79 different companies, including many large, multinational firms such as: Hewlett-Packard, Boeing, 3M, ATK, United Parcel Service, Browning, Intel, Honeywell, Exxon Mobil, Ford Motor Company, ConocoPhillips, Cessna, Adobe Systems, Northrop Grumman, Monsanto, Siemens, Bard Access Systems, and Stryker.

To complete the entire survey, including the competency comparison section, a participant needed to be employed at least part-time, work for a company that conducted business internationally or had at least one operation in a different country and be involved in the hiring process of new engineers with their company. Of the 558 respondents who completed the survey, 149 (26.7%) qualified to complete the competency section. Responses from survey participants who completed the competency section of the survey were used to address the research questions listed below.

Demographics.

There were 558 BYU mechanical engineering alumni who participated in the survey instrument beyond the initial informed consent page, and 539 alumni responded to the question concerning gender, with 514 (95%) male and 25 (5%) female respondents. The low percentage of females in mechanical engineering and subsequently the survey participation is not atypical. For many years, the average percentage of graduating seniors in mechanical engineering at BYU who were female was less than 4%, compared to the 2008 national average of 11.9% (Gibbons, 2008, p. 12). However, efforts made in recent

years have increased the approximate percentage of female mechanical engineering students at BYU to nearly 12% in 2010.

Survey participants were asked to indicate if they spoke a foreign language, and of the 540 that responded to this question, 381 (70.6%) said yes and 159 (29.4%) said no. The percentage of respondents who indicated that they spoke a foreign language (70.6%) corresponds with the percentage (more than 70%) of BYU students who speak a foreign language. These results verify that the study population within mechanical engineering is representative of the typical foreign language capabilities of BYU students in general.

The Interagency Language Roundtable (ILR) scale (n.d.) is commonly used by the United States Foreign Service Institute to rate language communication abilities. The ILR scale includes five language proficiencies from level 1 (elementary) to level 5 (native or bilingual). The language ability scale used for this study was reduced to 4 levels combining level 4 (full professional proficiency) with level 5. Survey respondents who indicated they spoke a foreign language were asked to rate their language proficiency according to the following criteria:

- Elementary: Can fulfill basic travel needs and behave in a polite manner. Able to use questions and answers for simple topics within a limited level of experience.
- Limited working: Able to satisfy routine social demands and limited work requirements and can handle most basic social situations with confidence. Can handle limited work requirements, but needs help handling any complications or difficulties. Can get the gist of most conversations on non-technical subjects (i.e. topics that require no specialized knowledge).

- Professional working: Able to speak the language with sufficient structural accuracy and vocabulary to participate effectively in most conversations on practical, social, and professional topics. Can discuss particular interests and special fields of competence with reasonable ease and has comprehension that is quite complete for a normal rate of speech.
- Native/Fluent: Has a speaking proficiency equivalent to that of an educated native speaker. Has complete fluency in the language.

Of the survey respondents who indicated they spoke a foreign language, 381 (70.6%) spoke a second language beyond English, 85 (15.7%) a third language, and 26 (4.8%) a fourth language with the proficiencies shown in Table 1. Forty different languages, besides English, were spoken by the survey respondent group with the top 10 languages by percentage as follows:

1. Spanish (49.9%)
2. German (12.9%)
3. Portuguese (11.6%)
4. Japanese (10%)
5. French (9.7%)
6. Mandarin Chinese (5.8%)
7. Italian (5.3%)
8. Russian (4.5%)
9. Korean (2.4%)
10. Dutch (1.6%)

Table 1

Foreign Language Proficiency and the Number of Survey Respondents Who Speak a 2nd, 3rd or 4th Language Beyond English

#	Question	Elementary	Limited working	Professional working	Native / Fluent	Responses
1	2nd language	29	178	125	49	381
2	3rd language	46	25	10	4	85
3	4th language	18	5	3	0	26

Details of languages spoken and the respective proficiencies and percentages are included in Appendix G, question 24.

Education.

Figure 1 illustrates that of the alumni who completed the survey, 500 (89.6%) completed their bachelor's degree, 136 (24.4%) completed their master's degree, and 14 (2.5%) completed their doctorate at BYU. The data included survey respondents who completed only one degree at BYU and others who completed two or more degrees within the Ira A. Fulton College of Engineering and Technology at BYU. Additional details are located in Appendix G, question 2.

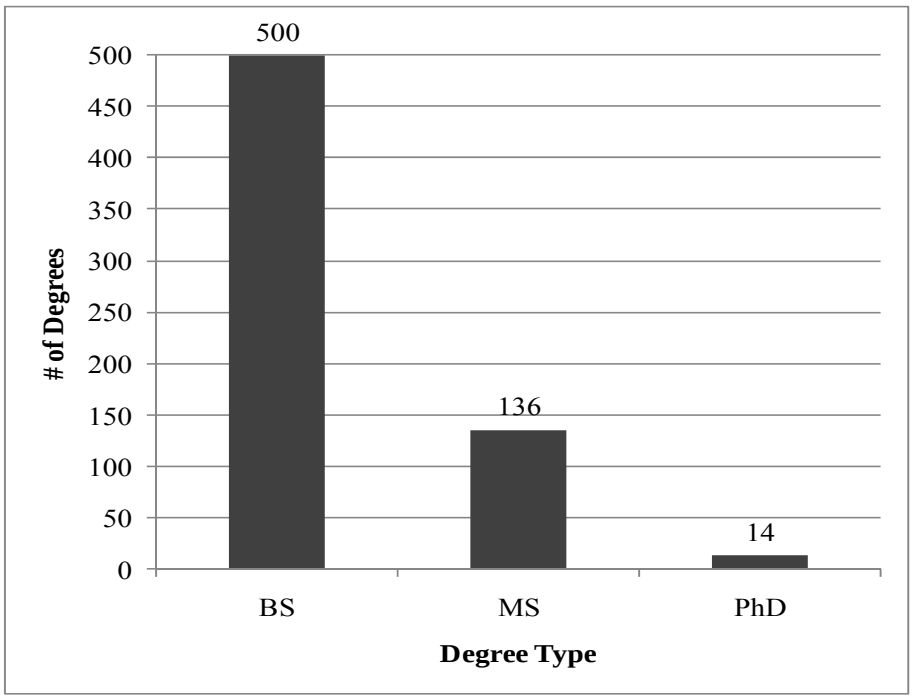


Figure 1. Type of degree received from BYU.

Survey respondents were also invited to indicate the year they completed their most recent degree received from BYU, as indicated in Figure 2. The majority of respondents completed their degree within the past 20 years, but the distribution of respondents spans over 50 years, with one survey respondent who had completed a BYU degree in 1959. Additional details are located in Appendix G, question 3.

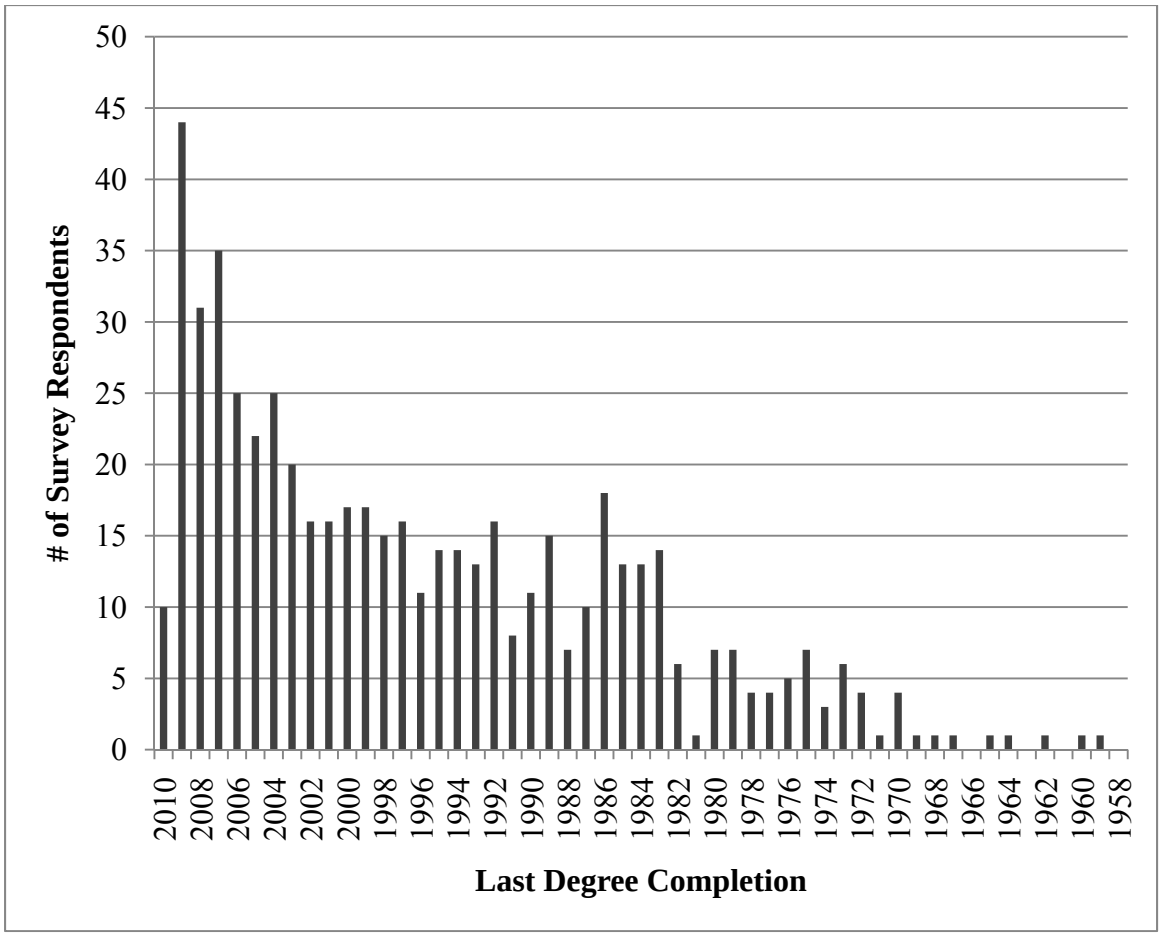


Figure 2. Completion year of most recent BYU mechanical engineering degree.

Employment.

Survey respondents provided information concerning their employment status, as shown in Figure 3, which provides a graphical representation of the survey respondents' employment status. A total of 552 alumni responded to this survey question, including 445 (80.6%) alumni who listed their employment status as working at least 30 hours or more per week, 3 (0.5%) who were working part-time, and 22 (4%) who indicated they were self-employed. The remaining survey respondents included 6 (1.1%) stay-at-home parents, 11 (2%) alumni who were not employed at the time of the survey, 10 (1.8%) respondents who were retired, and 55 (10%) students. Survey respondents who were not working at least part-time or who were not self-employed were not able to answer the

competency portion of the survey, and the online survey routed them to the global experience portion of the survey. Based upon employment status, 470 (85.1%) respondents qualified to continue to the competency portion of the survey. Additional details are provided in Appendix G, question 4.

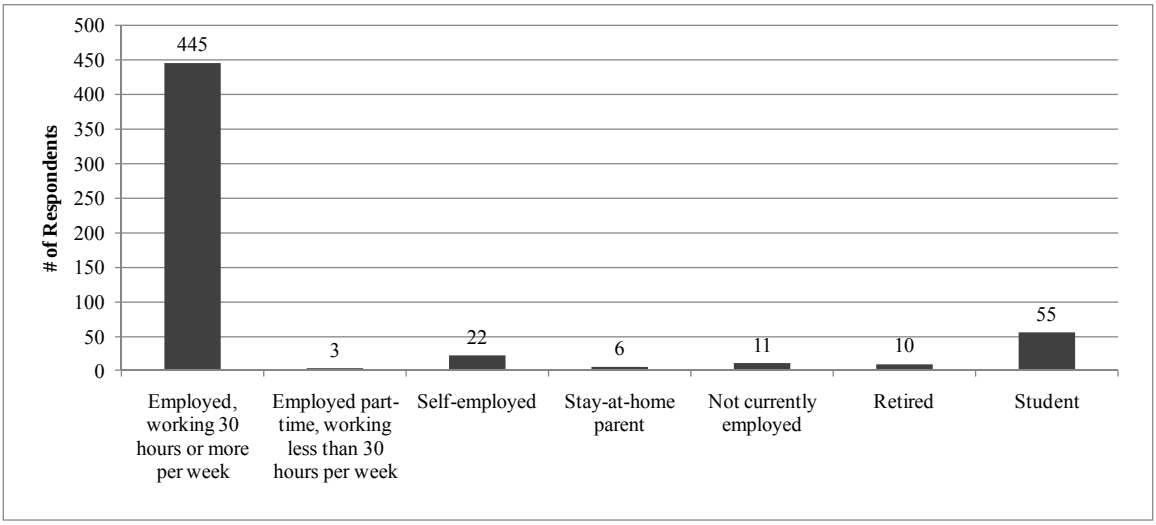


Figure 3. Employment status of survey respondents.

To better understand the industries represented in the survey respondent population, respondents were asked to identify the type of industry that most closely matched their current employment. A total of 469 alumni responded to this survey question, and the distribution by industry type, including quantity and percentage of respondents for each category, is shown in Figure 4. The top five industries by percentage of respondents: are aerospace/aviation (24%), government/military (12%), other (11%), manufacturing (11%) and petroleum/energy (10%). These top five industries represented more than two-thirds of all respondents for this question. Additional details are provided in Appendix G, question 5.

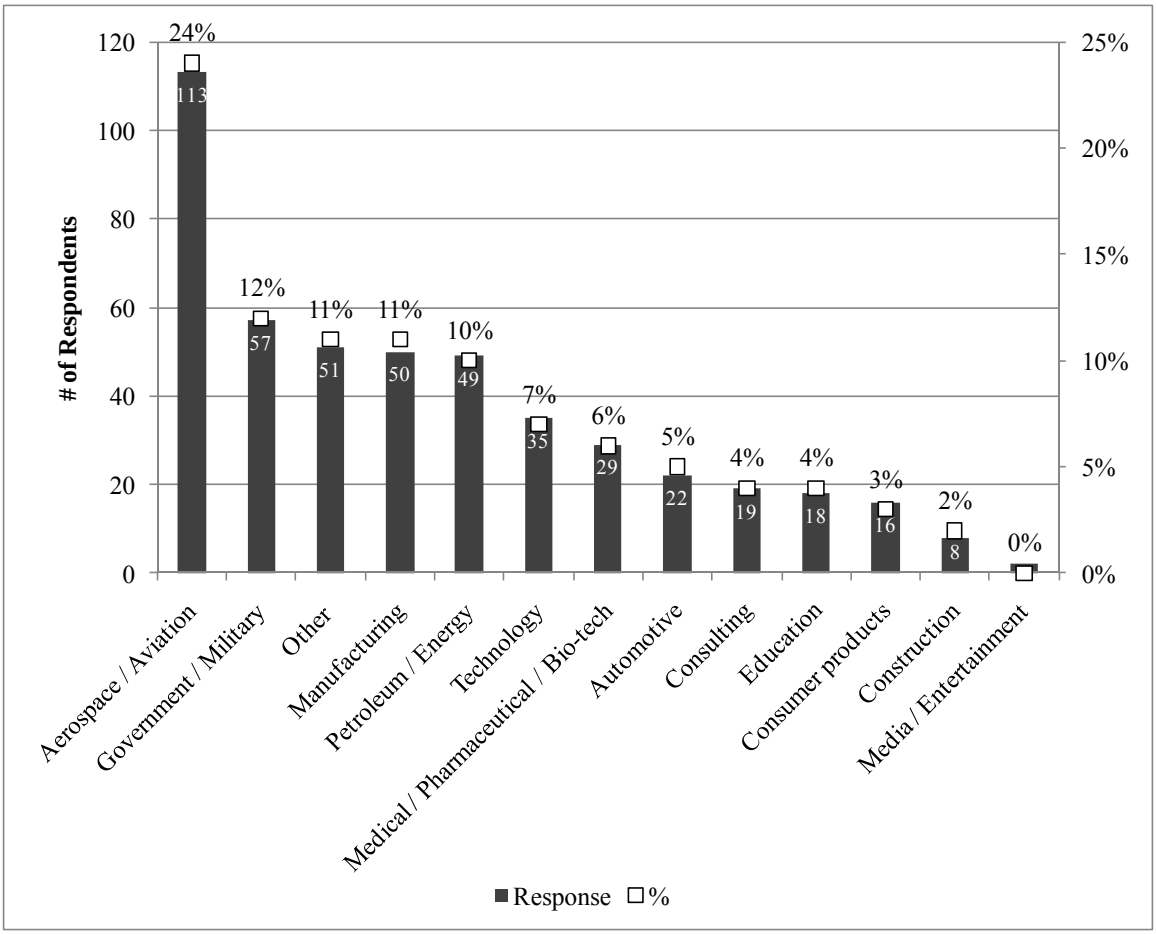


Figure 4. Industry type that most closely matches respondent company.

The job title of respondents was also included in the survey and Figure 5 illustrates the distribution of respondents by job title. Nearly half (47.1%) of respondents were currently working as an engineer at the time of the survey, 12% as an engineering manager, 8.8% as an engineering supervisor, 7.2% as a director, 6.4% as CEO/President/Owner, 3.4% as a vice president, and 15.1% in self reported positions in the other category including attorneys, professors, consultants, and other titles. Additional details are located in Appendix G, question 6.

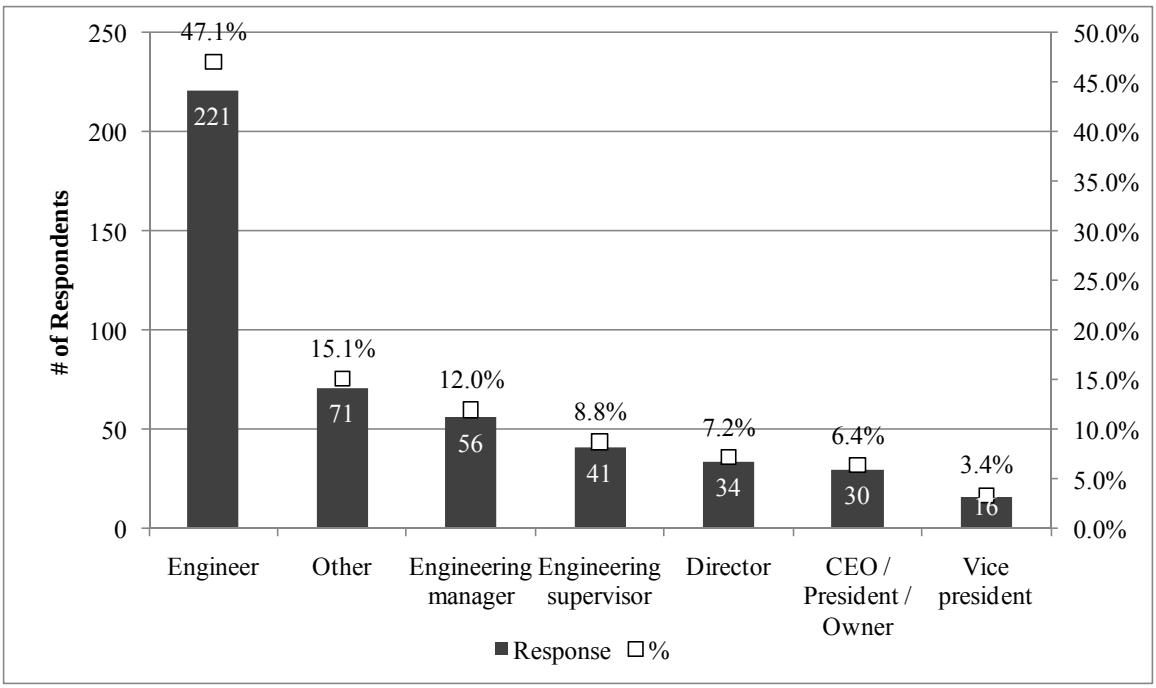


Figure 5. Job title of survey respondents.

The majority (68%) of survey respondents worked for larger companies that employ more than 1,000 employees with nearly half (45%) who worked for companies with more than 10,000 employees. Figure 6 provides a histogram of the number of employees (worldwide) of the respondents' companies. Addition details are included in Appendix G, question 7.

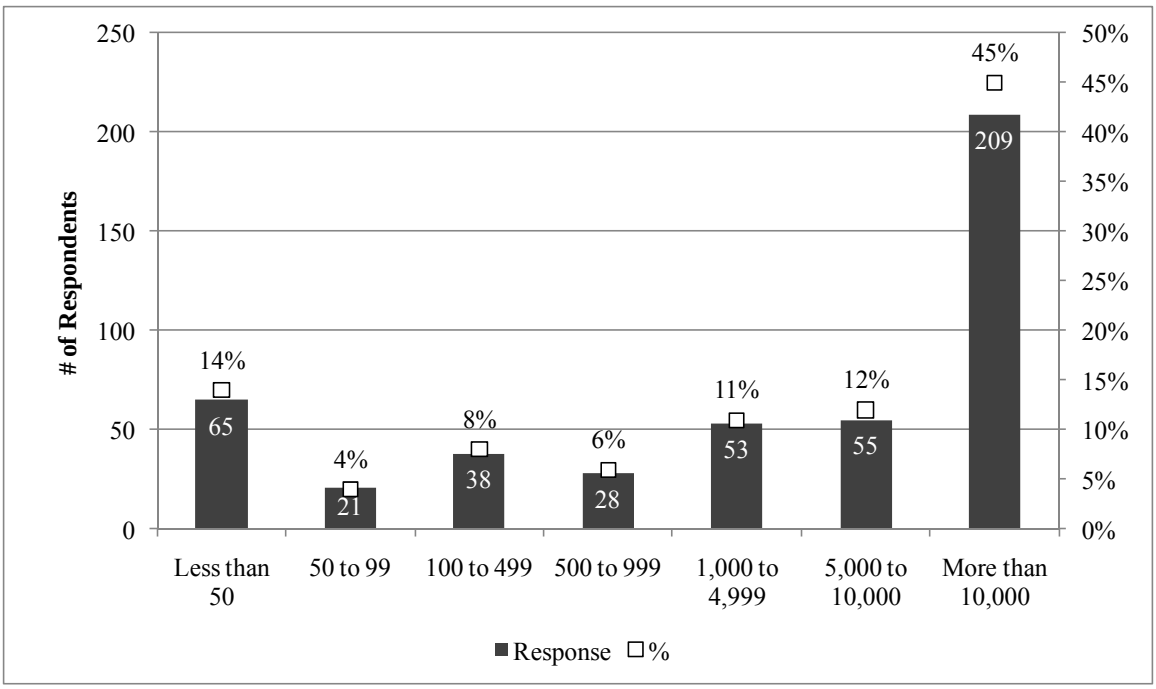


Figure 6. Number and percentage of employees (worldwide) as categorized by survey respondents according to different employee size groups (i.e., less than 50).

Similar to the results shown previously, Figure 7 illustrates that the majority of survey respondents were employed by larger companies, with 55% of respondents employed by companies with annual revenue exceeding US$1 billion. Both the size of company by total employees and by annual revenue indicated that the majority of respondents worked for large companies, and it is probable that many of these companies are global in nature.

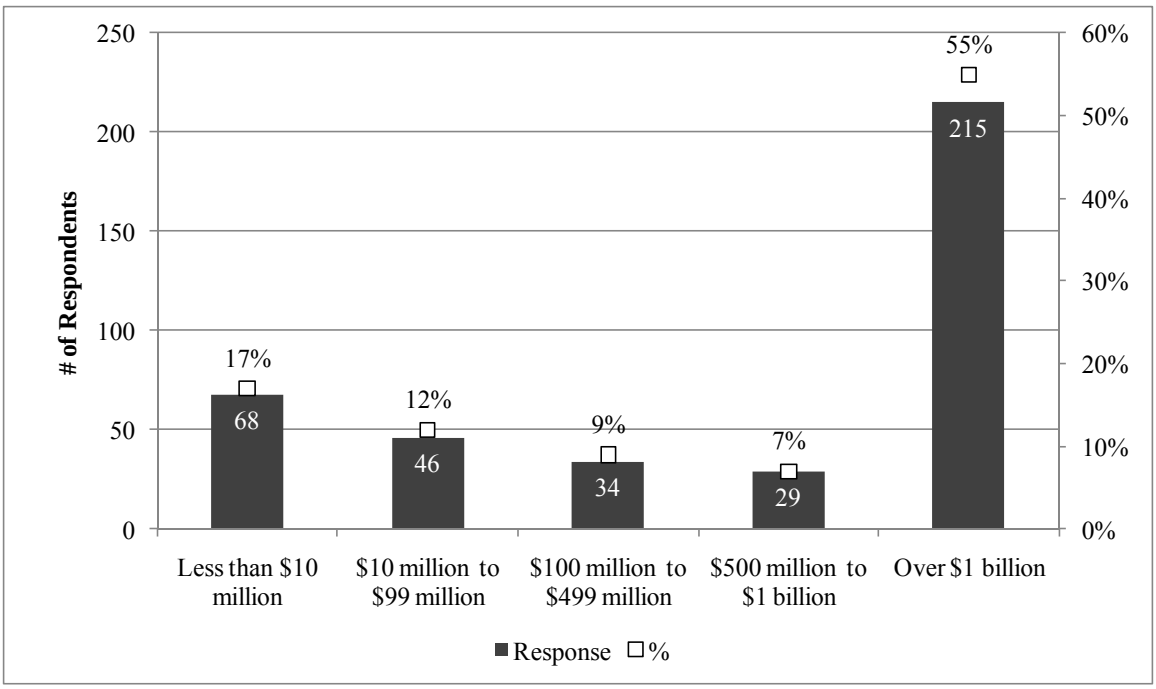


Figure 7. Approximate annual revenue (US $) of respondent companies.

To better understand the percentage of companies involved in conducting business internationally, survey respondents were asked to indicate if their employer conducted business internationally or had at least one operation in a different country; responses are shown in Figure 8. Of the 469 respondents, 392 (84%) indicated that their company was involved in international operations and 77 (16%) indicated the contrary. Those respondents who worked for companies not involved with international operations were routed in the online survey to the global experience section and did not participate in the global competency section of the survey.

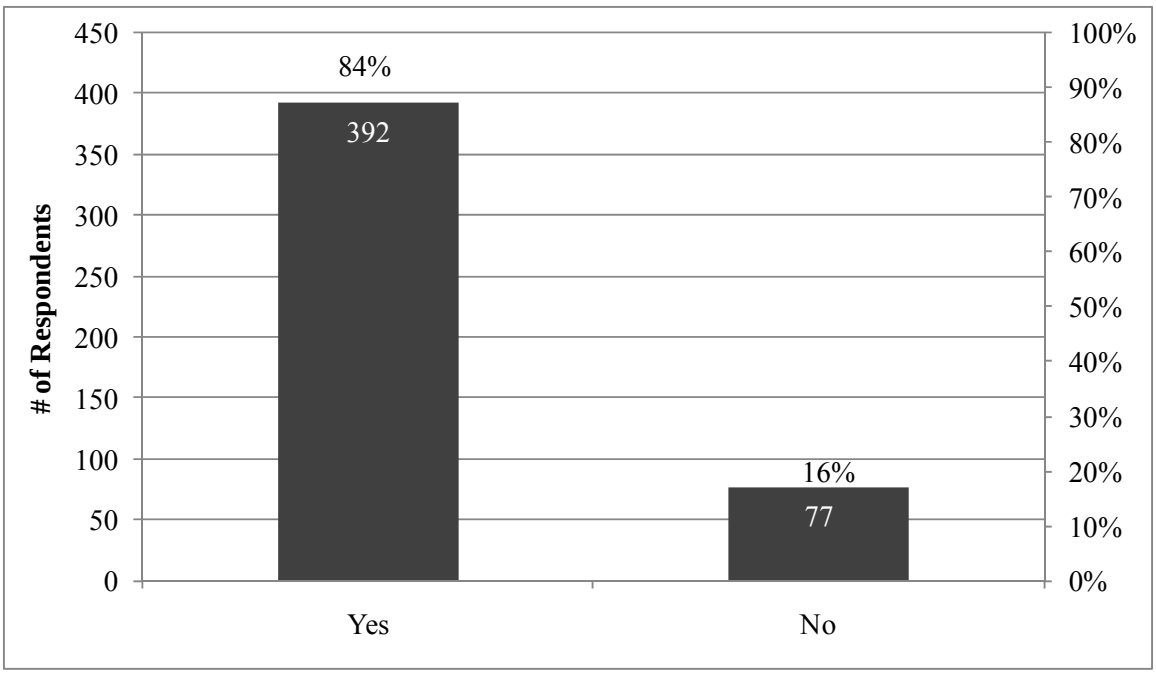


Figure 8. Response rates to the survey question: "Does your company conduct business internationally or have at least one operation in a different country?"

To further understand the amount of involvement in international operations by company, survey respondents were asked to indicate the percentage of annual revenue that came from operations outside of the United States. Figure 9 illustrates that approximately one-fourth of respondents worked for companies with relatively low revenue (less than 20%) that comes from international operations and approximately one-third of respondents worked for companies with at least 40% of the revenue coming from international operations. It was interesting to note that nearly 27% of respondents did not know what percentage came from operations outside of the United States. Additional detail is located in Appendix G, question 10.

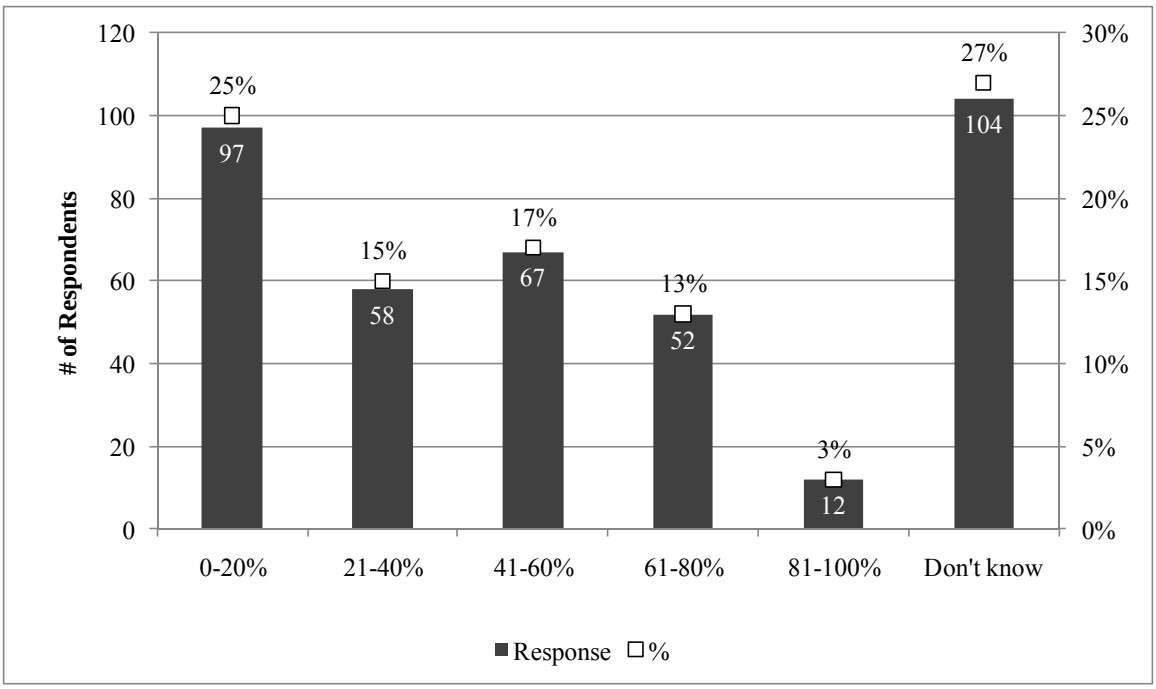


Figure 9. Percentage of total company revenues that comes from operations outside of the United States.

One of the last qualifying employment questions for survey respondents was to determine if they were directly involved in making hiring decisions for new engineers with their company. Of the 391 respondents who answered this question, only 154 (39%) were directly involved in making hiring decisions with their company and 237 (61%) indicated that they were not involved in hiring decisions. Responses to previous questions had indicated that a high percentage of survey respondents were employed as engineers and therefore were not likely involved in the hiring process of their peers. Figure 10 provides a graphical illustration of the results.

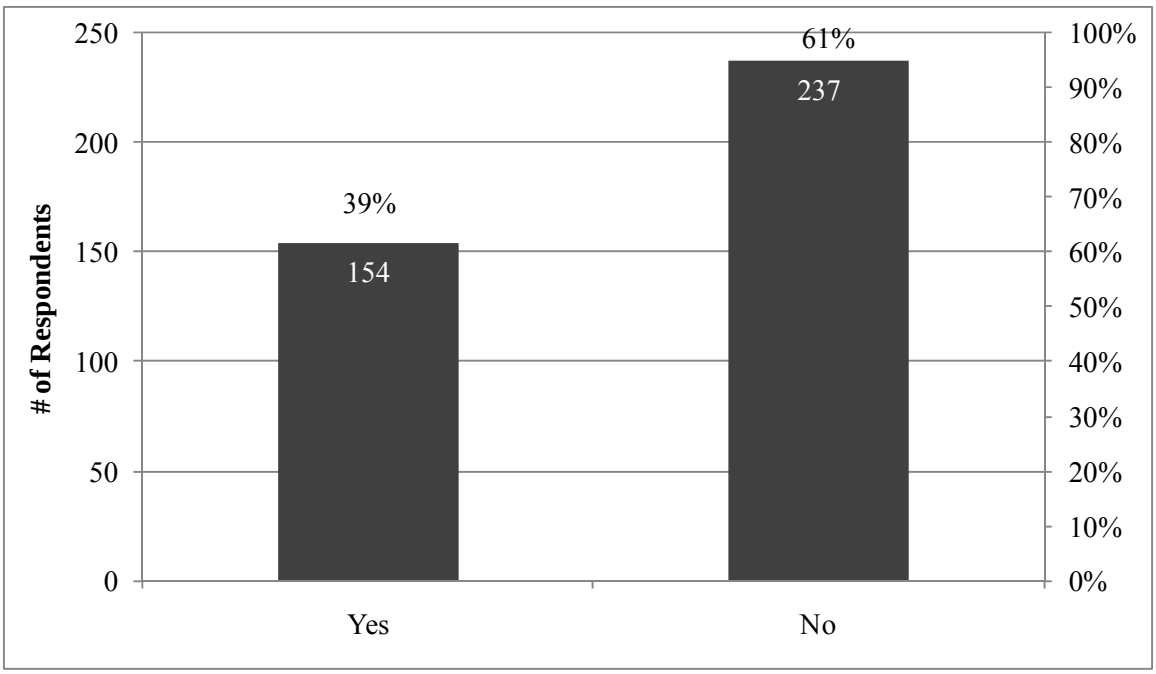


Figure 10. Response rates to the survey question: "Are you directly involved in making hiring decisions for new engineers with your company?"

Survey question 12 asked respondents to briefly describe how hiring decisions were made within their company. The response rate for this question was very good at 147 responses. Appendix G, question 12 includes these responses as provided by survey participants. An initial attempt to categorize the qualitative data was made, but the variation in hiring procedures prohibited any consolidation of real value. Therefore, the survey responses are listed as provided in the online survey instrument results. Many involved human resources in an initial screening effort, which typically included a resume review and initial interviews, but there is not much agreement beyond this initial step taken by most companies.

Research Questions

The primary purpose of this study was to determine if multinational companies considered global competence an important skill in mechanical engineering graduates when making hiring decisions. The following research questions were utilized to address this purpose:

1. Is global competence considered by hiring managers at multinational firms in their hiring practices of mechanical engineering graduates?
    a. Is global competence an important consideration for employment in multinational companies?
    b. To what extent are multinational companies willing to train engineers in global competence?
    c. To what extent do multinational companies expect higher education engineering departments and programs to prepare engineers for working in a global environment?

Each research question was addressed individually, with the corresponding survey data results utilized to present support for each question.

Research question 1: Is global competence considered by hiring managers at multinational firms in their hiring practices of mechanical engineering graduates?

Survey results of BYU mechanical engineering alumni were utilized to address this question. To complete the entire survey including the competency comparison section, a participant needed to be employed at least part-time, work for a company that conducted business internationally or had at least one operation in a different country, and be involved in the hiring process of new engineers with their company. Of the 558

alumni who took the survey, only 149 (26.7%) qualified to answer the competency section of the survey.

The competencies respondents were asked to evaluate included GPA, work experience, 8 global competencies identified during the literature review in Chapter II, and 5 engineering competencies taken from the "hard" technical skills section of the ABET criterion 3. Question 13 of the survey asked each respondent to rate 15 different competencies on a 5-point importance Likert scale as shown below:

- 1 = Unimportant
- 2 = Of little importance
- 3 = Moderately important
- 4 = Important
- 5 = Very important

Survey question 13 utilized an initial question, "How important is it for mechanical engineers hired by your company who will either work immediately or eventually in a global environment to have" which was followed by a question addressing each of the 15 competency statements. Each competency statement and the summary results are provided in Table 2. Additional detailed results are provided in Appendix G, survey question 13.

Table 2

Competency Comparison Including Summary Descriptive Statistics for Question 13, "How Important is it for Mechanical Engineers Hired by Your Company Who Will Either Work Immediately or Eventually in a Global Environment to have:"

Competency	Valid	Missing	Mean	Median	Mode
a. A high GPA	149	414	3.47	3.00	3
b. An ability to exhibit a global mindset	149	414	3.46	4.00	4
c. An ability to apply knowledge of mathematics, science and engineering.	149	414	4.42	5.00	5
d. An ability to appreciate and understand different cultures	149	414	3.69	4.00	4
e. An ability to design and conduct experiments, as well as to analyze and interpret data	149	414	4.30	5.00	5
f. An ability to demonstrate world and local knowledge	149	414	3.19	3.00	3
g. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	149	414	4.23	4.00	5
h. An ability to communicate cross-culturally	149	414	3.88	4.00	4
i. An ability to speak more than one language including English	149	414	2.76	3.00	3
j. An ability to identify, formulate, and solve engineering problems	149	414	4.63	5.00	5
k. An ability to understand international business, law, and technical elements	149	414	3.02	3.00	3
l. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	149	414	4.36	4.00	5
m. An ability to live and work in a transnational engineering environment	149	414	3.42	3.00	3
n. An ability to work in international teams	149	414	3.70	4.00	4
o. Pertinent applicable work experience	149	414	3.96	4.00	4

Competencies 13a (GPA) and 13o (work experience) are considered by many organizations as part of standard selection criteria when hiring new engineers. Competencies 13c, 13e, 13g, 13j, and 13l are standard engineering technical competencies that measure general technical proficiency in engineers and competencies 13b, 13d, 13f, 13h, 13i, 13k, 13m, and 13n are the global competencies identified and developed in Chapter II of this study. When utilizing a Likert scale for analysis, results are most often ordinal-data, meaning they have an inherent order of sequence, but one cannot assume that respondents perceive all pairs of adjacent levels as equidistant. A common mistake made by many researchers is to calculate a numerical average (mean) but the mean is an average of coded responses. However, an average of coded responses is not a valid method for analyzing Likert scale data and therefore the most common analysis method is the mode, or the most frequent response (Hall, 2010).

Table 2 provides an overview of the results, including the mode for each competency. Of the 15 competencies evaluated, 10 competencies were identified according to a mode analysis as either important (4) or very important (5) when hiring mechanical engineers. Competencies considered important or very important according to a mode analysis included all of the standard engineering technical competencies, pertinent applicable work experience, and four of the global competencies: an ability to exhibit a global mindset, an ability to appreciate and understand different cultures, an ability to communicate cross-culturally, and an ability to work in international teams. The remaining global competencies: a high GPA; an ability to demonstrate world and local knowledge; an ability to speak more than one language including English; an ability to understand international business, law, and technical elements; and an ability to live and

work in a transnational engineering environment were considered only moderately important (3) by the survey respondents. None of the competencies were considered less than moderately important when making hiring decisions for new engineers.

These results indicated that not only are standard engineering technical competencies important, but global competence is an important consideration when making hiring decisions for mechanical engineers who will work immediately or eventually in a global environment. In particular the ability to exhibit a global mindset, an ability to appreciate and understand different cultures, an ability to communicate cross-culturally, and an ability to work in international teams are important competencies for engineers to develop.

Survey question 14 invited respondents to list any additional competencies their company considered when hiring new mechanical engineers to work in a global environment. Of the 149 respondents that rated competencies considered when hiring mechanical engineers, 51 (34.2%) provided additional qualitative responses. Figure 11 illustrates the categorized qualitative responses of survey respondents. Only two of the additional competencies (communication and people skills and ability to travel) were significantly different than the competencies identified in question 13. The data indicated that an ability to communicate effectively was an important consideration when hiring mechanical engineers to work in a global environment; nearly 30% of respondents considered it important. In addition, the ability and willingness to travel was an important consideration for some with nearly 8% indicating that it was an important consideration when hiring new engineers. For a detailed list of all respondent responses per category see Appendix G, question 14.

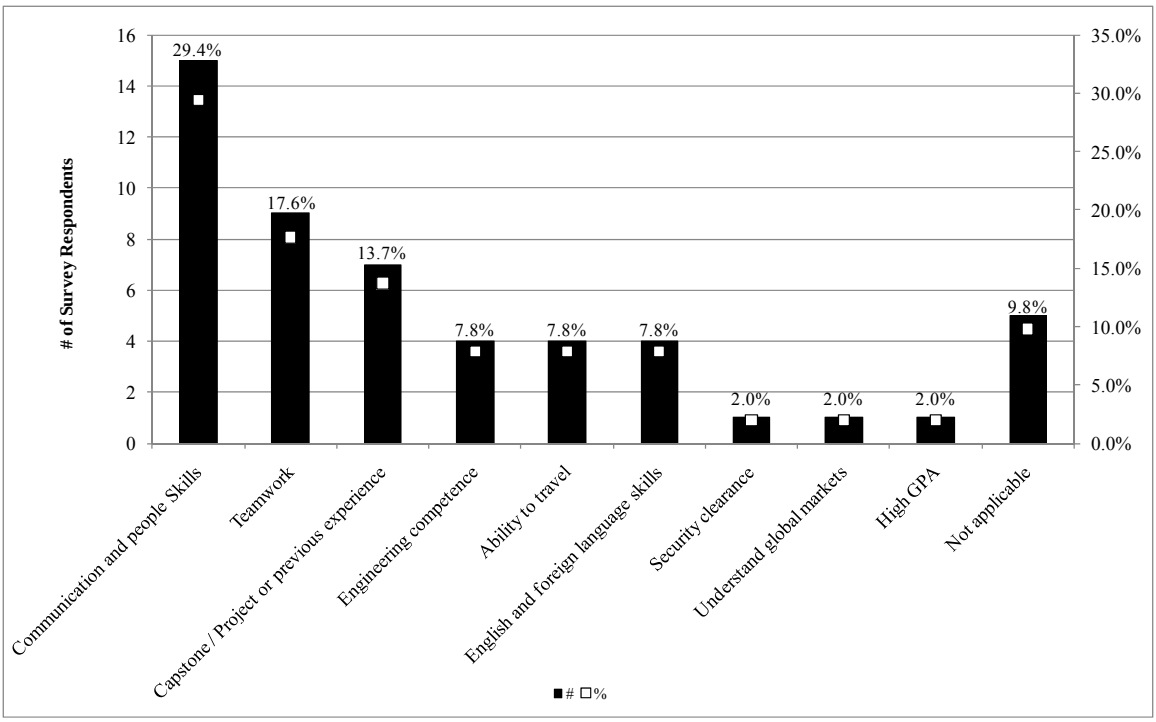


Figure 11. Additional competencies considered by companies when hiring new mechanical engineers to work in a global environment.

Research question 1a: Is global competence an important consideration for employment in multinational companies?

As indicated previously, 4 of the identified global competencies were considered important according to mode analysis (most frequent response) for employment in multinational companies. To further understand the importance and significance of these results and since the majority of the survey data was ordinal level data, a cross-tab analysis was conducted. The cross-tab analysis was conducted on various independent variables to determine the statistical significance and correlation on each of the 15 competencies considered when making hiring decisions for mechanical engineers. When conducting cross-tab analysis it is important to remember that there are three main parameters of correlation (White & Korotayev, 2003).

1. The sign of the correlation. The correlation can be either positive or negative. Theoretically, the correlation may be 0 or have no sign at all. The sign is positive if an increase in the value of variable X is accompanied by an increase in the value of variable Y. The sign is negative if an increase in the value of variable X is accompanied by a decrease in the value of variable Y. (p. 5)
2. The strength of the correlation. Strength is measured with different correlation coefficients, such as *Pearsons' r*, *Kendall's tau-b*, *Gamma*, and *Somer's d*. Most values range from -1 to +1. If the absolute value is closer to 1, then the association is high, either with a positive (+1) or negative association (-1). But as the value approaches zero, even if the *p*-value is considered statistically significant, then the association is weak at best. (p. 6)
3. The significance of the correlation. The significance is measured by the p-value. If the p-value is low (generally less than 0.05) it is considered statistically significant; if it is less than 0.10 but higher than 0.05, it is considered marginally significant; and if it is higher than 0.10, no statement of association can be made. This last point does not mean that there is not an association; it means simply that the data does not provide evidence of the association. (p. 7)

Initially a Chi-square approach was utilized since it is the typical approach to determining if there is a relationship between two categorical variables. However, the samples within the cells for analysis typically need to have more than five values for validity and the majority of cells within the analysis did not meet this requirement. The data was transformed to reduce the number of categories for each variable in an effort to

increase the number of values for each cell and utilize Chi-square for analysis. Each of the tables below describes the transformations that were conducted.

Survey question 6, “What title most closely matches your current job title?” initially had seven answer possibilities, which were reduced to three possibilities as shown in Table *3*. The transformation focused on logical groupings including senior leadership, managers, and engineers. The category labeled as *other* was included in the manager/supervisor category as many of the responses from survey participants indicated some sort of management such as program manager or project manager.

Table 3

Job Title Transformation From Seven Values to Three.

Code	Answer	
1	CEO / President /Owner	
2	Vice president	
3	Director	
4	Engineering manager	
5	Engineering supervisor	
6	Engineer	
7	Other	
New Code	**Transformed Answer**	**Notes**
1	Senior leadership	Includes CEO / President /Owner, Vice president, and Director
2	Manager/Supervisor/Other	Includes engineering manager, engineering supervisor, and Other
3	Engineer	Same as original

Survey question 7, “How many employees (worldwide) does your company employ?” initially had six answer possibilities, which were reduced to three possibilities, as shown in Table *4*. The transformation focused on logical groupings for smaller companies below 1,000 employees, middle-sized companies with employees between 1,000 and 10,000 employees, and large companies with more than 10,000 employees.

Table 4

Number of Employees Worldwide by Company Reduced From Six Values to Three

Code	Answer
1	Less than 50
2	50 to 499
3	499 to 999
4	1,000 to 4,999
5	5,000 to 10,000
6	More than 10,000
New Code	**Transformed Answer**
1	Less than 1,000
2	1,000 to 10,000
3	More than 10,000

Survey question 8, "What is the approximate annual revenue (US$) of your company?" initially had six answer possibilities, which were reduced to four possibilities, as shown in Table 5. The transformation focused on logical groupings for revenue, with low revenue less than $100 million, medium revenue from $100 million to $1 billion, and high revenue over $1 billion. The category entitled "Don't know" remained the same as there were no transformation possibilities with this value.

Table 5

Annual Revenue (US$) of Company Reduced From Six values to Four

Code	Answer
1	Less than $10 million
2	$10 million to $99 million
3	$100 million to $499 million
4	$500 million to $1 billion
5	Over $1 billion
6	Don't know
New Code	**Transformed Answer**
1	Less than $100 million
2	$100 million to $1 billion
3	Over $1 billion
4	Don't know

Survey question 13 was a Likert scale question that asked survey respondents to rate on a scale from 1 to 5 the importance of 15 different competencies. The Likert scale responses were transformed from five categories to three, as shown in Table 6. The transformation combined responses of "Unimportant" and "Of little importance," and also combined responses of "Important" and "Very important."

Table 6

Likert Scale Importance Categories Reduced From Five Values to Three

Code	Answer
1	Unimportant
2	Of little importance
3	Moderately important
4	Important
5	Very important
New Code	**Transformed Answer**
1	Unimportant / Of little importance
2	Moderately important
3	Important / Very Important

A Chi-square analysis was conducted and obtained results similar to the results of the first analysis, with many cells that did not meet the requirement for at least five values per cell. Therefore, the Gamma and Somers' d approaches were utilized because they work for smaller sample sizes with ordinal data. Gamma tests the strength of association of cross-tabulations when both variables are ordinal level. Somer's d is similar to Gamma, but it is an asymmetric measure of association between two variables working in situations when the number of rows and columns are not equal. Inferential statistics were utilized to determine relationships using correlation coefficients and to determine statistical significance (White & Korotayev, 2003).

An important consideration in reviewing the survey data was to determine the influence that different variables had on the relative importance of competencies when

hiring mechanical engineers to work in a global environment. In other words, did things like job title, company size, and total revenue impact how survey respondents felt about the importance of different competencies? For example, does a CEO rate the importance of communicating cross-culturally differently than an engineer, and if so, is the difference statistically significant?

A cross-tab analysis was conducted to determine which variables had a correlation to the importance of different competencies. Detailed results including the cross-tab analysis, correlation value, and significance are located in Appendix I for only those variables that were statistically significant or marginally significant. Table 7 summarizes the results of the cross-tab analysis. Cross-tab comparisons that were statistically significant (p-value less than 0.05) are identified in the shaded cells. Cross-tab comparisons that were marginally significant (p-value between 0.05 and 0.10) are identified in the bold and italicized cells.

Table 7

Cross-tab Analysis Summary of Different Variables and Each Competency

Competency	Inferential Correlation Statistic					
	Job Title * Global Competence		# of Employees Worldwide * Global Competence		Annual Revenue (US $) of Company? * Global Competence	
	p	Gamma	*p*	Gamma	*p*	Somer's d
High GPA	0.011	0.319	0.011	0.305	***0.098***	***0.121***
Exhibit a global mindset	0.322	-0.111	0.009	0.288	0.128	0.112
Apply knowledge of mathematics, science, and engineering	0.716	0.102	0.715	-0.103	0.665	-0.025
Appreciate and understand different Cultures	0.559	0.073	0.000	0.476	0.020	0.181
Design and conduct experiments	0.490	-0.120	0.939	-0.014	0.254	-0.084
Demonstrate world and local knowledge	0.642	-0.052	0.272	0.120	0.309	0.072
Design a system, component, or process	0.730	-0.063	0.254	0.202	0.730	0.024
Communicate cross-culturally	0.507	-0.090	0.381	0.112	1.000	0.000
Speak more than one language	0.023	-0.252	0.630	0.053	0.604	-0.035
Identify, formulate and solve engineering problems	0.610	-0.147	0.267	0.322	0.389	0.047
Understand international business, law, and technical elements	0.710	-0.043	***0.072***	***0.196***	0.814	0.017
Use techniques, skills and modern engineering tools	0.646	-0.108	0.326	0.217	0.995	0.000
Live and work in transnational engineering environment	0.809	-0.029	0.000	0.505	0.050	0.153
Work in international teams	0.339	-0.128	0.002	0.358	***0.058***	***0.149***
Applicable work experience	0.881	0.022	0.533	-0.090	0.540	-0.044

Note. ***p*** = significance
shaded cells = statistically significant (p < 0.05)
bold italic cells = marginally significant (p 0.05 – 0.10)

Two-proportion z-tests were conducted on items identified as statistically significant in Table 7. A one-tailed z-test was utilized for all comparisons, since this is the method utilized to determine if one proportion is greater (or lower) than another (Z-test for two proportions, 2005). A p-value of 0.05 or a 95% confidence level was utilized

to determine if proportion results were statistically significant. A p-value of 0.05 "means that there is one chance in twenty that the two proportions are not really different" (p. 1).

These tests were conducted to determine whether a statistically significant proportional difference existed between variable categories. The data utilized to conduct the proportional z-tests for each cross-tab analysis, including the identification of base size (number of respondents answering the question) and sample size (the frequency or percentage of respondents answering the question in the manner to be tested) for each group comparison, is located in Appendix I. Categorical comparisons were completed for importance, by company size (number of employees) and Table 8 provides summary results including the corresponding p-value and z-test statistic for each comparison.

Table 8

Results of Z-Test for Two Proportions Comparing Total Number of Employee Categories for Importance (Important and Very Important)

Competency	Value	# of Employees Worldwide		
		More than 10,000 vs 1,000 to 10,000	More than 10,000 vs. Less than 1,000	1,000 to 10,000 vs. Less than 1,000
High GPA	Z-value	0.659	2.093	0.864
	p-value	.255	.018	.194
Exhibit a global mindset	Z-value	1.695	2.730	0.412
	p-value	.045	.003	.340
Appreciate and understand different cultures	Z-value	2.276	3.967	0.959
	p-value	.011	.000	.169
Live and work in transnational engineering environment	Z-value	.823	4.274	2.667
	p-value	.205	.000	.004
Work in international teams	Z-value	-0.012	3.026	2.243
	p-value	.505	.001	.012

Categorical comparisons were completed for importance, by company size (annual revenue in US$) and Table 9 provides summary results including the corresponding p-value and z-test statistic for each comparison.

Table 9

Results of Z-Test for Two Proportions Comparing Annual Revenue Categories for Importance (Important and Very Important)

Competency	Value	Over $1 billion vs $100 million to $1 billion	Over $1 billion vs less than $100 million	$100 million to $1 billion vs. less than $100 million
Appreciate and understand different cultures	Z-value	2.264	3.592	0.427
	p-value	.012	.000	.335
Live and work in transnational engineering environment	Z-value	0.751	3.054	1.408
	p-value	.226	.001	.080

Additional inferential statistical data is presented in this section of the study for each cross-tab combination in Table 7 that was identified as statistically significant or marginally significant.

The correlation between an individual's job title and the perceived importance of a high GPA when hiring new engineers was significant, with gamma = $\gamma(149) = .319$ ($p = .011$). The positive correlation was particularly true for engineers' perceptions of the importance of GPA but less so for senior leadership, as evidenced in Figure 12. In other words, the majority of respondents felt that GPA was moderately important to important, but to senior leadership a high GPA was only moderately important when making hiring decisions. Senior leadership's view of a high GPA being less important than others could be due in part to the fact that senior leadership often looks for other qualities in new hires versus GPA because senior leadership is typically not involved in hiring recent college graduates.

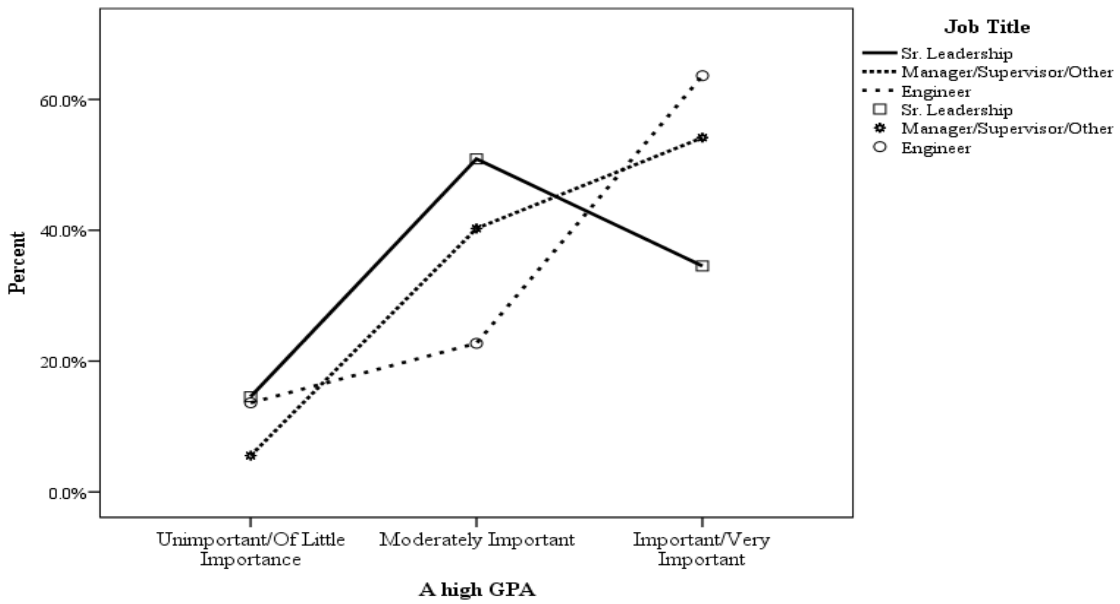


Figure 12. Correlation between job title and the importance of a high GPA.

Results indicated a statistically significant negative correlation between job title and the importance of speaking more than one language including English with $\gamma(149) = -.252$ ($p = .023$). Based on survey results, engineers do not consider the ability to speak more than one language including English important when making hiring decisions for new engineers. However, 18% of senior leadership and 18% of managers and supervisors felt that the ability to speak more than one language including English was important or very important. A summary of the results by percentage is shown in Figure 13.

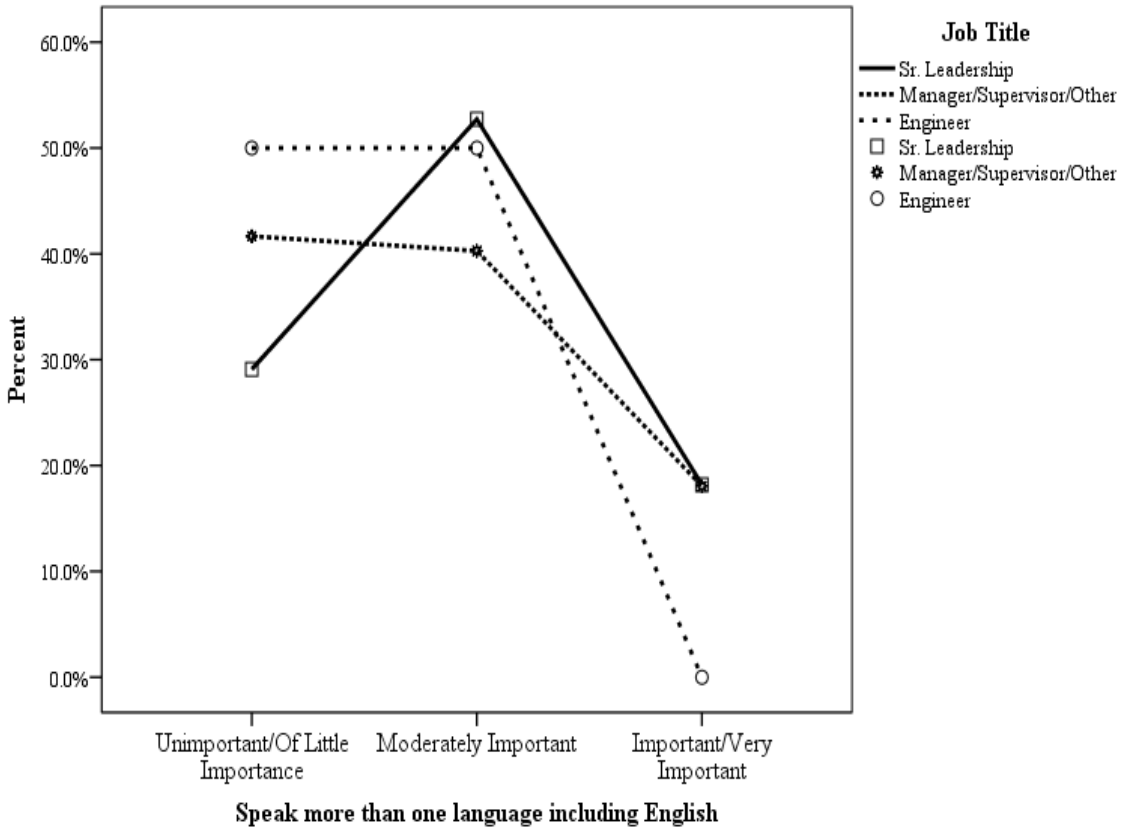


Figure 13. Correlation between job title and the importance of an ability to speak more than one language including English.

The number of employees worldwide and the importance of a high GPA had a statistically significant positive correlation, with $\gamma(149) = .305$ ($p = .011$). Approximately 57% of survey respondents who worked for companies with more than 10,000 employees rated the importance of a high GPA as important or very important. Slightly more than 48% of respondents who worked for companies with 1,000 to 10,000 employees and 36.5% of respondents who worked for companies with less than 1,000 employees also rated a high GPA as important or very important. The larger the company the more important GPA was considered when hiring new engineers. This is particularly true when comparing companies who employ more than 10,000 employees compared to companies with less than 1,000 employees. The proportional difference is statistically

significant with Z = 2.093, and p = .018. Figure 14, provides a graphical representation of the percentages by company size and importance categories.

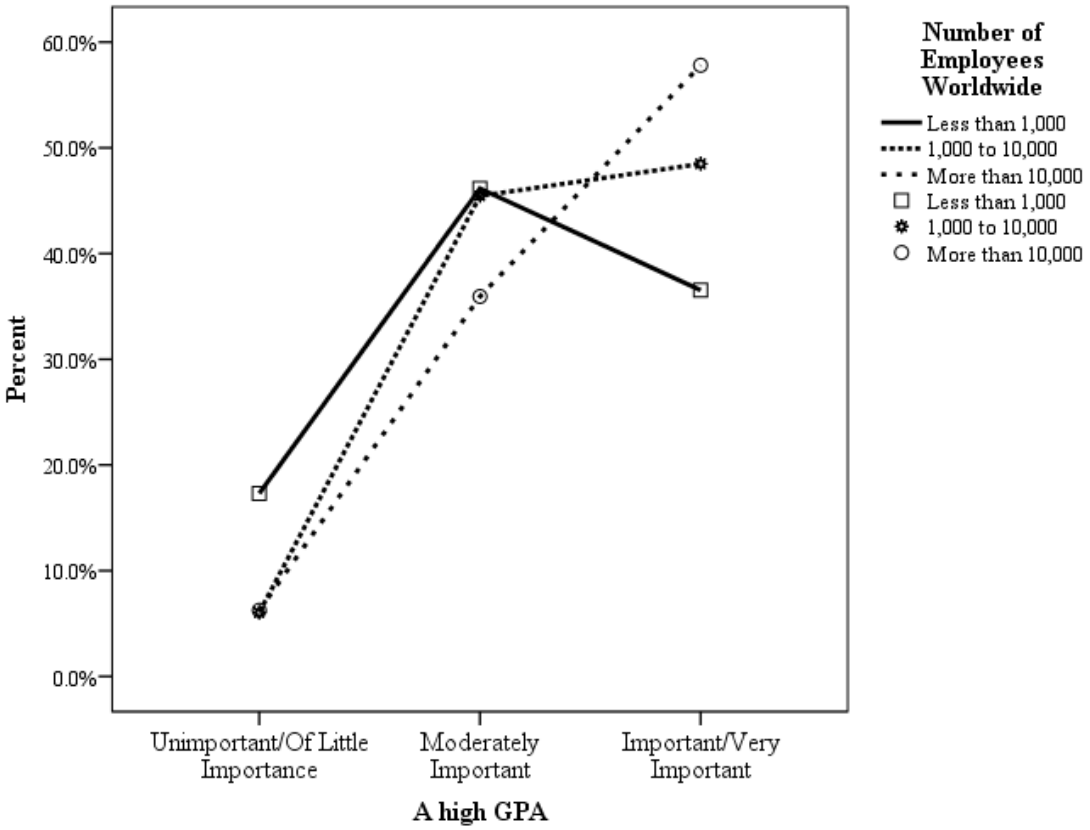


Figure 14. Correlation between number of employees worldwide and the importance of a high GPA.

The number of employees worldwide and the importance of an ability to exhibit a global mindset had a statistically significant positive correlation, with $\gamma(149) = .288$ ($p = .009$). More than 65% of survey respondents who worked for companies with more than 10,000 employees rated an ability to exhibit a global mindset as important or very important. Over 45% of respondents who worked for companies with 1,000 to 10,000 employees and 38.5% of respondents who worked for companies with less than 1,000 employees also rated an ability to exhibit a global mindset as important or very important. These results indicate that the perceived importance of new engineers to

exhibit a global mindset is stronger in companies with more employees particularly in comparing companies who employ more than 10,000 employees compared to companies with less than 1,000 employees. The proportional difference is statistically significant with Z = 2.730, and p = .003. Figure 15 provides a graphical representation of percentages and importance categories.

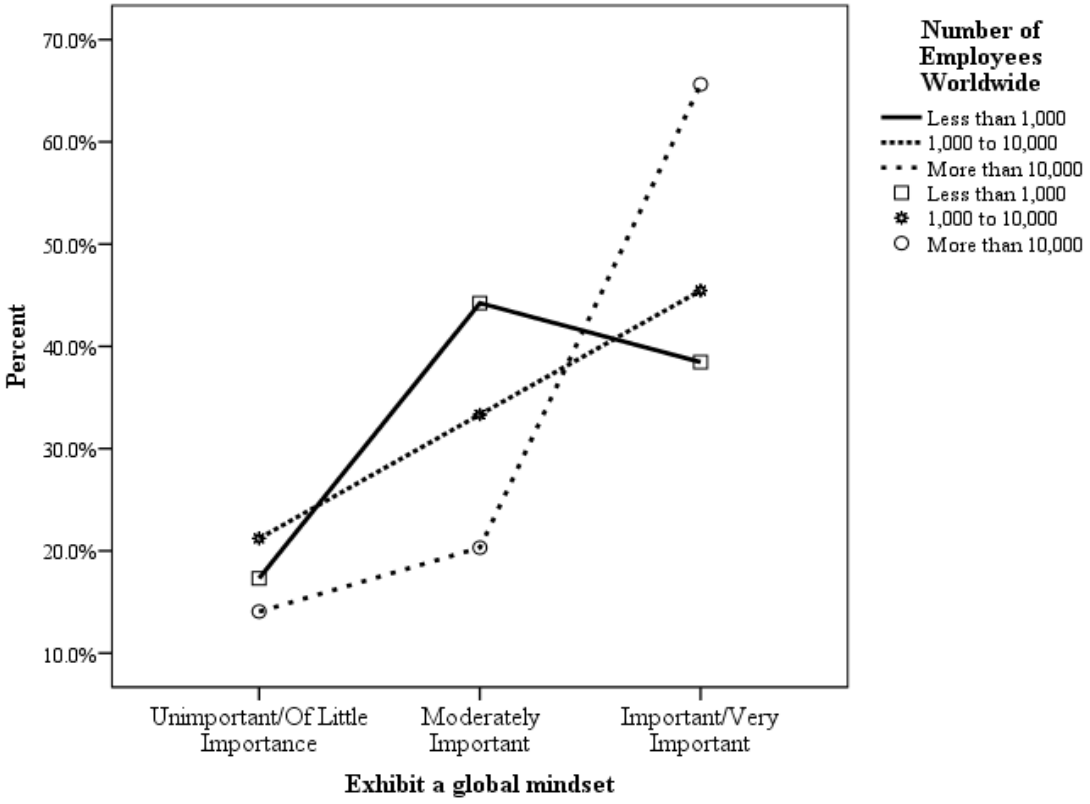


Figure 15. Correlation between number of employees worldwide and the importance of an ability to exhibit a global mindset.

The number of employees worldwide and the ability to appreciate and understand different cultures had a statistically significant positive correlation, with γ(149) = .476 (*p* = .00). Nearly 77% of survey respondents who worked for companies with more than 10,000 employees rated an ability to appreciate and understand different cultures as important or very important. More than 51% of respondents who worked for companies with 1,000 to 10,000 employees and 38.5% of respondents who worked for companies

with less than 1,000 employees also rated an ability to appreciate and understand different cultures as important or very important. The correlation was strong indicating that an ability to appreciate and understand different cultures was important and even more important with larger companies based upon the total number of employees. Comparing companies who employ more than 10,000 employees with companies who employ less than 1,000 employees, the proportional difference is statistically significant with Z = 3.967, and p = .000. Figure 16 provides a graphical representation of percentages and importance categories.

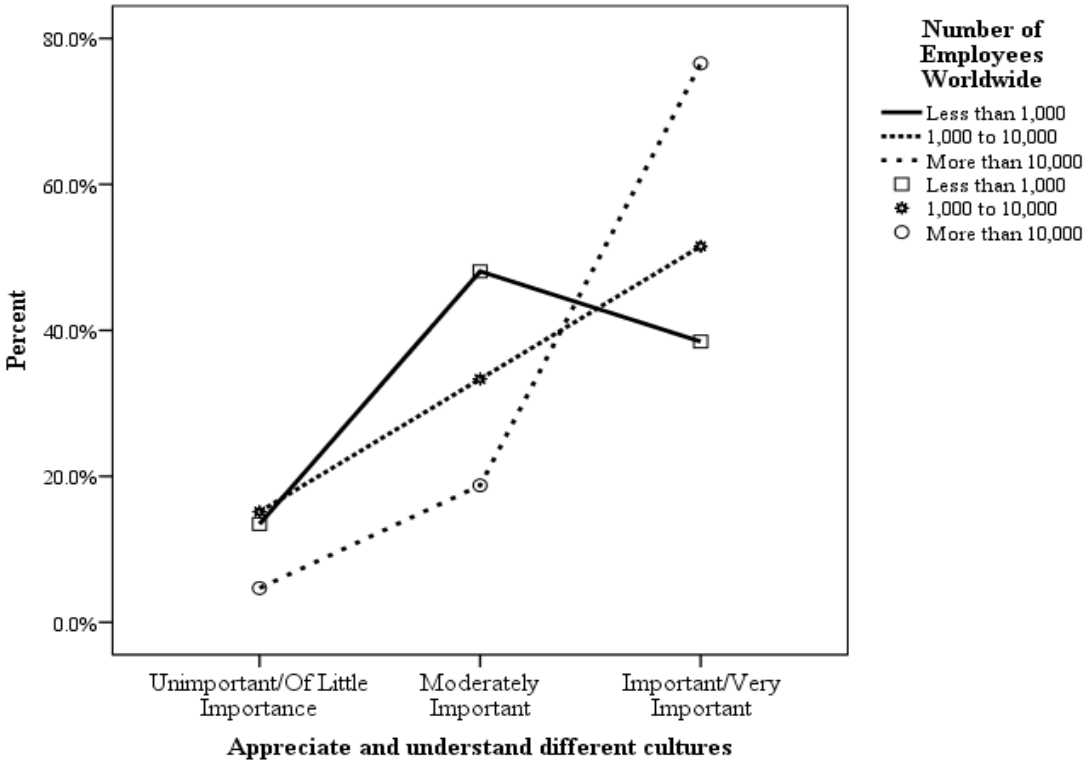


Figure 16. Correlation between number of employees worldwide and the importance of an ability to appreciate and understand different cultures.

The number of employees worldwide and an ability to understand international business, law, and technical elements had a marginally significant positive correlation, with $\gamma(149) = .196$ ($p = .072$). Slightly more than 39% of survey respondents who worked

for companies with more than 10,000 employees rated an ability to understand international business, law, and technical elements as important or very important. Over 27% of respondents who worked for companies with 1,000 to 10,000 employees and 26.9% of respondents who worked for companies with less than 1,000 employees also rated an ability to understand international business, law, and technical elements as important or very important. Figure 17 illustrates that the ability to understand international business, law, and technical elements may be more important to survey respondents who work for larger companies with more than 10,000 employees.

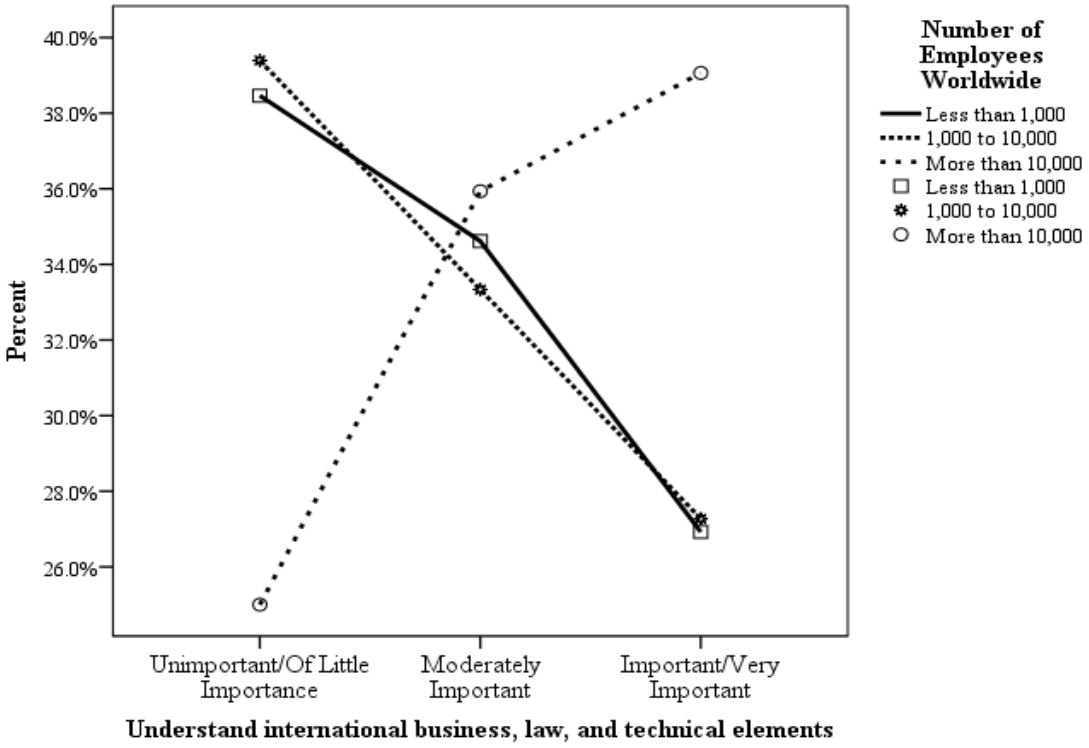


Figure 17. Correlation between number of employees worldwide and the importance of an ability to understand international business, law, and technical elements.

The number of employees worldwide and an ability to live and work in a transnational engineering environment had a statistically significant positive strong correlation, with $\gamma(149) = .505$ ($p = .00$). Nearly 63% of survey respondents who worked

for companies with more than 10,000 employees rated an ability to live and work in a transnational engineering environment as important or very important. More than 51% of respondents who worked for companies with 1,000 to 10,000 employees and 21.2% of respondents who worked for companies with less than 1,000 employees also rated an ability to live and work in a transnational engineering environment as important or very important. The correlation was strong indicating that an ability to live and work in a transnational engineering environment was important and even more so with larger companies with more than 10,000 employees compared with smaller companies with less than 1,000 employees. The proportional difference is statistically significant with Z = 4.274, and p = .000. Figure 18 provides a graphical representation of percentages and importance categories.

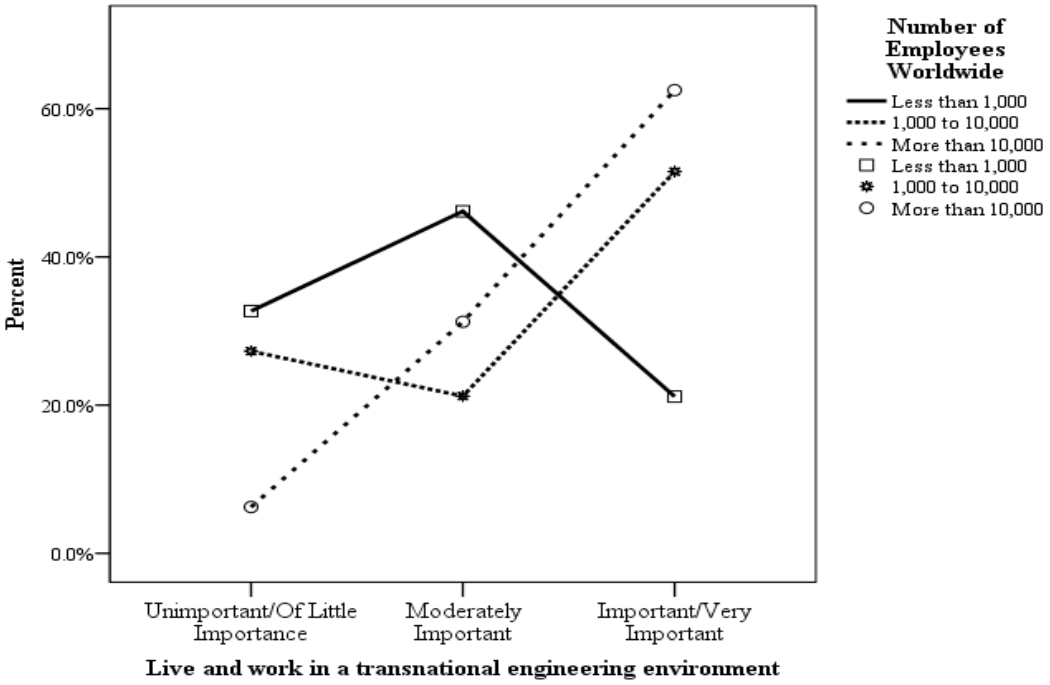


Figure 18. Correlation between number of employees worldwide and the importance of an ability to live and work in a transnational engineering environment.

The number of employees worldwide and an ability to work in international teams had a statistically significant positive correlation, with $\gamma(149) = .358$ ($p = .002$).

Approximately 80% of survey respondents who worked for companies with more than 10,000 employees rated an ability to work in international teams as important or very important. Nearly 70% of respondents who worked for companies with 1,000 to 10,000 employees and 42.3% of respondents who worked for companies with less than 1,000 employees also rated an ability to work in international teams as important or very important. The correlation was strong indicating that an ability to live and work in a transnational engineering environment was important and even more so with larger companies with more than 10,000 employees, compared with companies with less than 1,000 employees. The proportional difference is statistically significant with Z = 3.026, and p = .001. Figure 19 provides a graphical representation of percentages and importance categories.

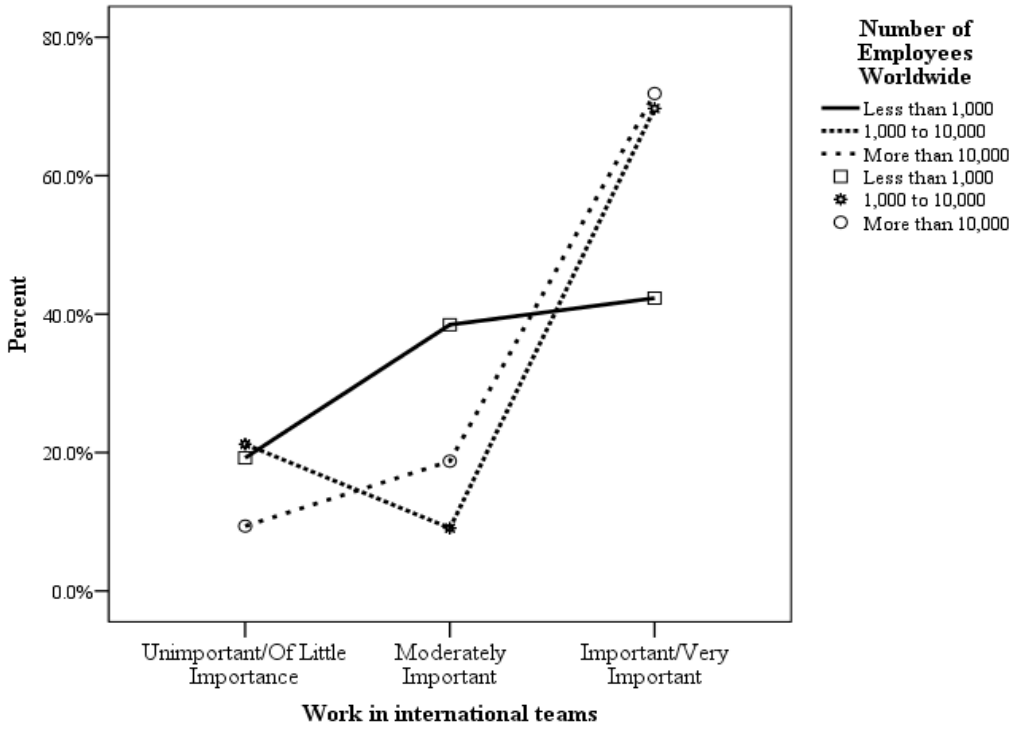


Figure 19. Correlation between number of employees worldwide and the importance of an ability to work in international teams.

The annual revenue (US$) per company and the importance of a high GPA had a marginally significant positive correlation, with the Somer's d correlation value (N=149) = .121 (p = .098). Approximately 58% of survey respondents who worked for companies with annual revenue (US$) over $1 billion rated a high GPA as important or very important. Almost 42% of respondents did not know their company's annual revenue, but 40% of respondents who worked for companies with an annual revenue (US$) between $100 million to $1 billion, and 39.5% of respondents who worked for companies with an annual revenue (US$) less than $100 million rated a high GPA as important or very important. Figure 20 provides a graphical representation of the percentages by annual revenue (US$) and importance categories.

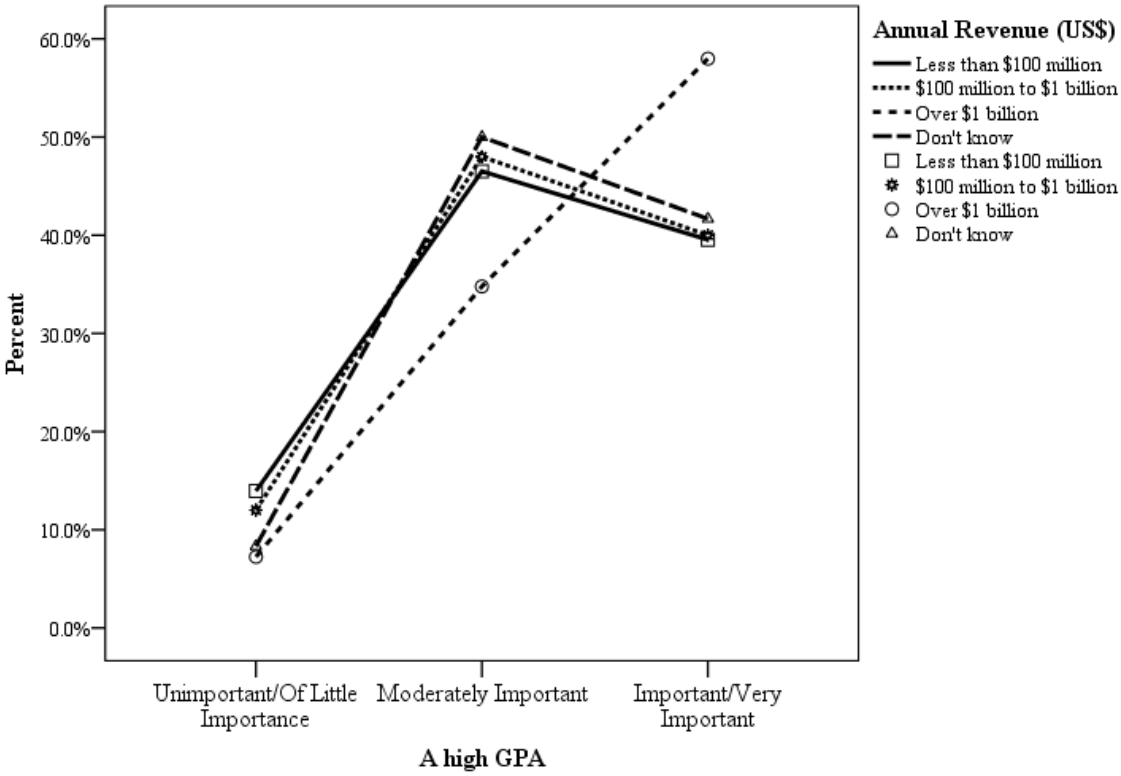


Figure 20. Correlation between the annual revenue (US$) per company and the importance of a high GPA.

The annual revenue (US$) per company and an ability to appreciate and understand different cultures had a statistically significant positive correlation, with the Somer's d correlation value (N=149) = .181 (p = .02). Over 75% of survey respondents who worked for companies with annual revenue over $1 billion rated the importance of an ability to appreciate and understand different cultures as important or very important. And while nearly 42% of respondents did not know their company's annual revenue, 48% of respondents who worked for companies with annual revenue between $100 million to $1 billion, and 39.5% of respondents who worked for companies with annual revenue less than $100 million rated an ability to appreciate and understand different cultures as important or very important. Based upon survey results, the perceived importance of being able to appreciate and understand different cultures was particularly strong with companies whose annual revenue exceeded $1 billion compared with companies whose annual revenue was less than $100 million. The proportional difference is statistically significant with Z = 3.592, and p = .000. Figure 21 provides a graphical representation of the percentages by annual revenue and importance categories.

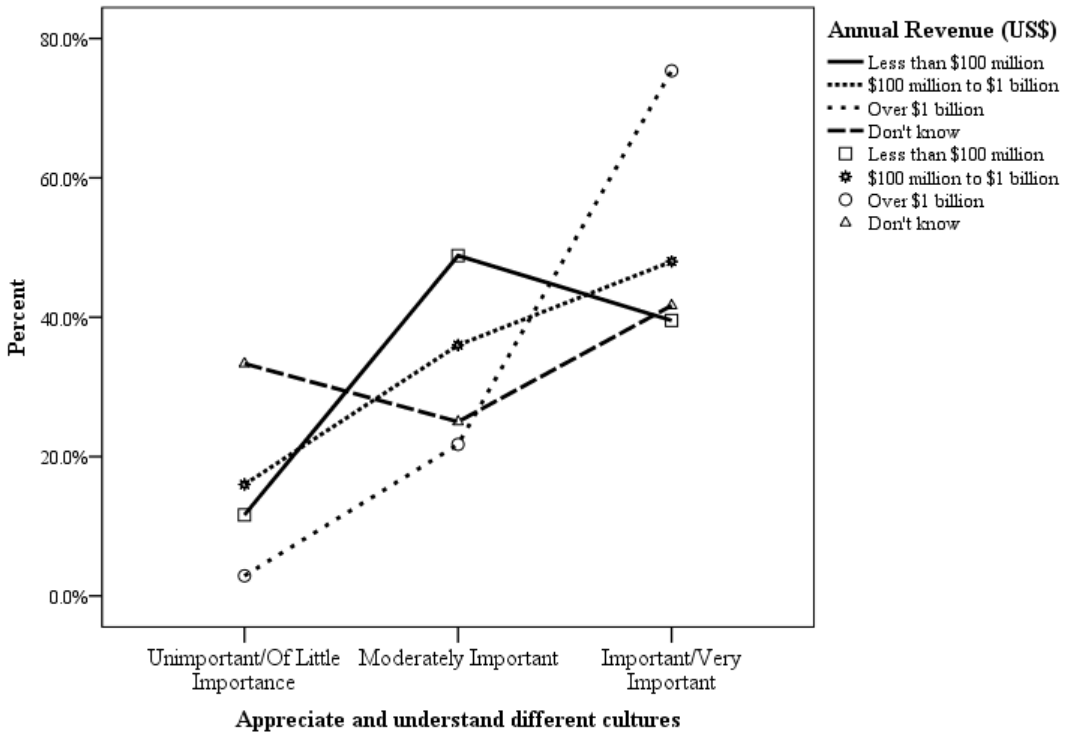


Figure 21. Correlation between the annual revenue (US$) per company and the importance of an ability to appreciate and understand different cultures.

The annual revenue (US$) per company and an ability to live and work in a transnational engineering environment had a statistically significant positive correlation, with the Somer's d correlation value (N=149) = .153 (p = .05). Just over 59% of survey respondents who worked for companies with annual revenue over $1 billion rated an ability to live and work in a transnational engineering environment as important or very important. Approximately 25% of respondents did not know their company's annual revenue, but 48% of respondents who worked for companies with an annual revenue between $100 million to $1 billion, and 27.9% of respondents who worked for companies with an annual revenue less than $100 million rated an ability to live and work in a transnational engineering environment as important or very important. Based upon survey results, the perceived importance of being able to live and work in a transnational engineering environment was particularly strong with companies whose annual revenue

exceeded $1 billion compared with smaller companies with less than $100 million in annual revenue. The proportional difference is statistically significant with Z = 3.054, and p = .001. Figure 22 provides a graphical representation of the percentages by annual revenue and importance categories.

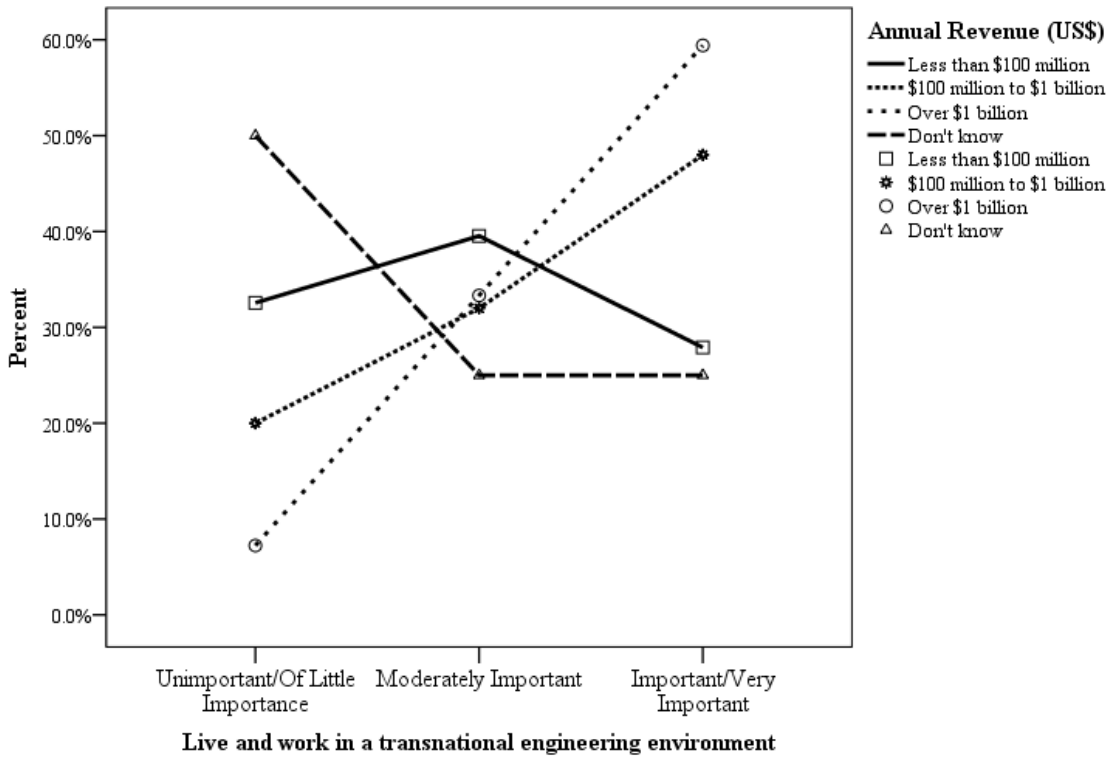


Figure 22. Correlation between the annual revenue (US$) per company and the importance of an ability to live and work in a transnational engineering environment.

The annual revenue (US$) per company and an ability to work in international teams had a marginally significant positive correlation, with the Somer's d correlation value (N=149) = .149 (*p* = .058). Almost 77% of survey respondents who worked for companies with annual revenue over $1 billion rated an ability to work in international teams as important or very important. Nearly 42% of respondents did not know their company's annual revenue, but 60% of respondents who worked for companies with annual revenue between $100 million to $1 billion, and 41.9% of respondents who

worked for companies with annual revenue less than $100 million rated an ability work in international teams as important or very important. Figure 23 provides a graphical representation of the percentages by annual revenue and importance categories.

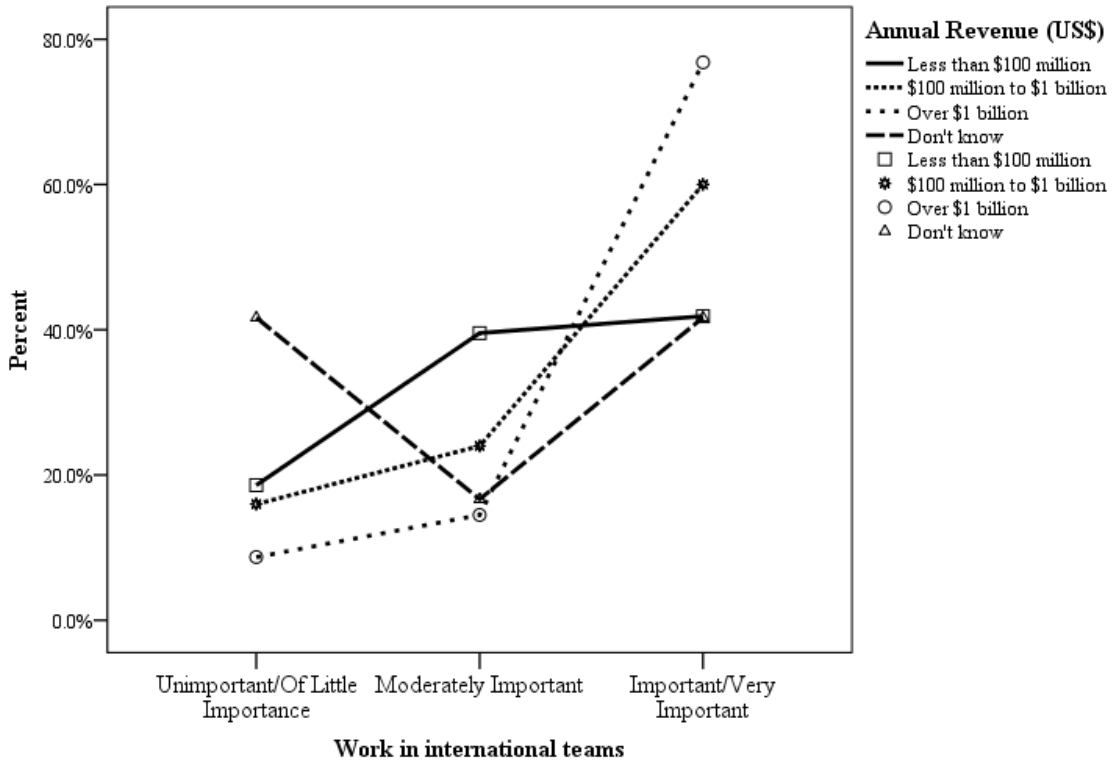


Figure 23. Correlation between the annual revenue (US$) per company and the importance of an ability to work in international teams.

Research question 1b: To what extent are multinational companies willing to train engineers in global competence?

Question 15 of the survey asked respondents to indicate their agreement on a 5-point agreement Likert scale as shown below:

- 1 = Strongly disagree
- 2 = Disagree
- 3 = Neutral
- 4 = Agree

- 5 = Strongly agree

Of the 558 respondents, 147 (26.3%) respondents qualified to complete this portion of the survey. Table *10* provides a mode analysis (most frequently cited response) for each of the four sub-questions within question 15.

Table 10.

Mode Analysis of Company's Willingness and Success and the Perceived Value and Success of Colleges/Universities to Prepare Engineers for Success in a Global Environment for Question 15, "Please Indicate Your Agreement With the Following Statements:"

My company:	Valid	Missing	Mean	Median	Mode
a. is willing to provide the appropriate training / experience for engineers to be successful in a global environment	147	416	3.85	4.00	4
b. is successful at providing the appropriate training / experience for engineers to be successful in a global environment	147	416	3.64	4.00	4
c. values the efforts of college/university engineering departments/programs to prepare engineers to work in a global environment	147	416	3.68	4.00	4
d. considers college/university engineering departments/programs successful at preparing engineers to work in a global environment	147	416	3.20	3.00	3

Question 15a, asked respondents to indicate their agreement with the following statement: "My company is willing to provide the appropriate training / experience for engineers to be successful in a global environment." The results in Figure 24 indicate that 103 out of 147 (70%) respondents agreed or strongly agreed that their company was willing to provide training and experience to engineers to be successful in a global engineering environment. Only 7 of 147 (4.8%) respondents indicated that their company

was not willing to provide the appropriate training or experience. The data clearly indicated that most companies were willing to provide training and experience to help engineers obtain success in a global engineering environment.

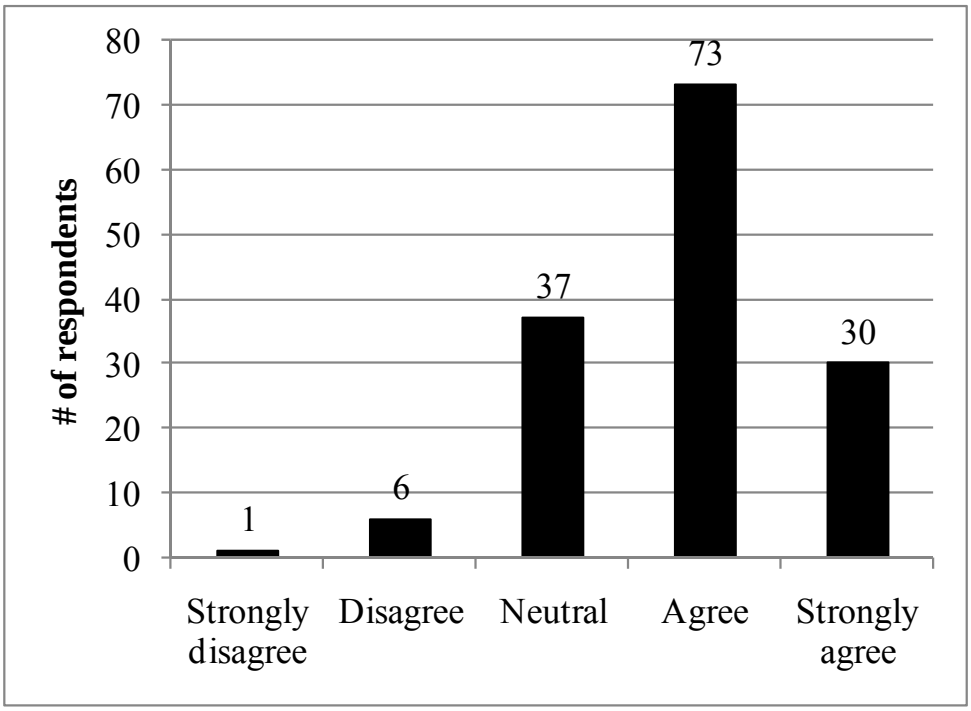


Figure 24. Responses to the survey question, "My company is willing to provide the appropriate training/experience for engineers to be successful in a global environment."

Of importance to note, a company's willingness is not the same as their perceived success. Question 15b, asked survey respondents to indicate their agreement with the following statement: "My company is successful at providing the appropriate training / experience for engineers to be successful in a global environment." Results in Figure 25 show a decrease in the perceived success compared to the willingness of companies to provide the appropriate training and experience mentioned previously. Of the 147 respondents, 88 (59.9%) respondents agreed or strongly agreed that their company was successful at providing the appropriate training and experience for engineers to be successful in a global environment.

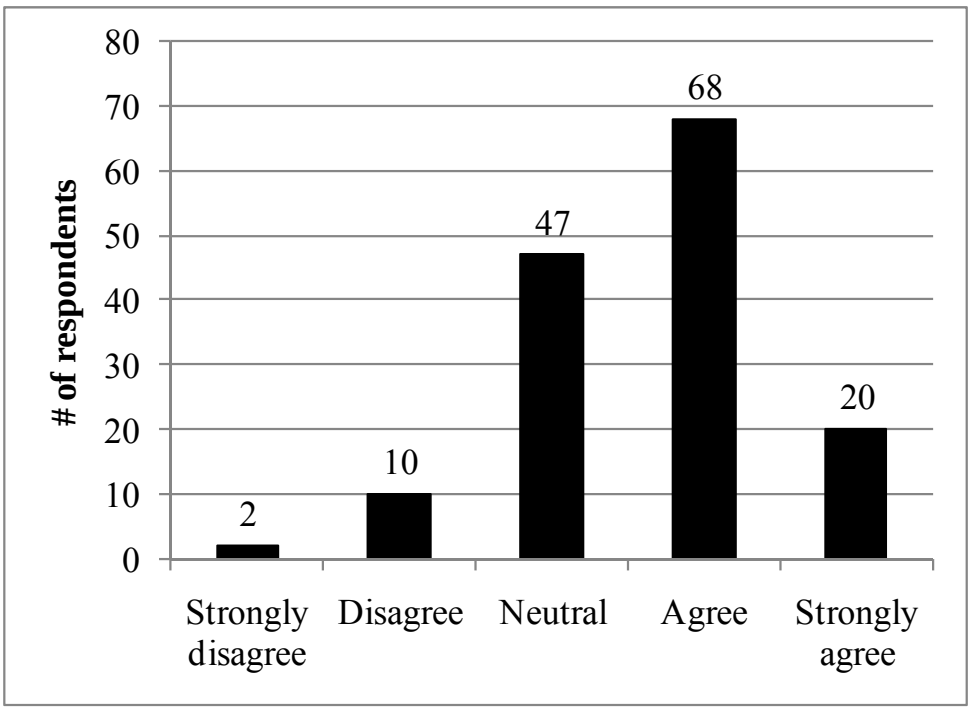


Figure 25. Responses to survey question, "My company is successful at providing the appropriate training/experience for engineers to be successful in a global environment?"

Research question 1c: To what extent do multinational companies expect higher education engineering departments and programs to prepare engineers for working in a global environment?

Question 15c, asked respondents to indicate their agreement with the following statement: "My company values the efforts of college/university engineering department/programs to prepare engineers to work in a global environment." The intent of this question was to determine the expectations that companies have of higher education programs in preparing engineers for success in a global environment. Results in Figure 26 indicate that 88 of 147 (59.9%) respondents agreed, or strongly agreed that their company valued the efforts of colleges and universities in preparing engineers for success in a global environment. An additional 47 (32%) of respondents were neutral and only 7 of 147 (4.8%) respondents indicated that the efforts of higher education engineering institutions to prepare engineers for a global environment was not important

for their company. An overall conclusion that can be drawn from these results is that companies consider higher educational institutions an important component in preparing engineers for success in a global environment.

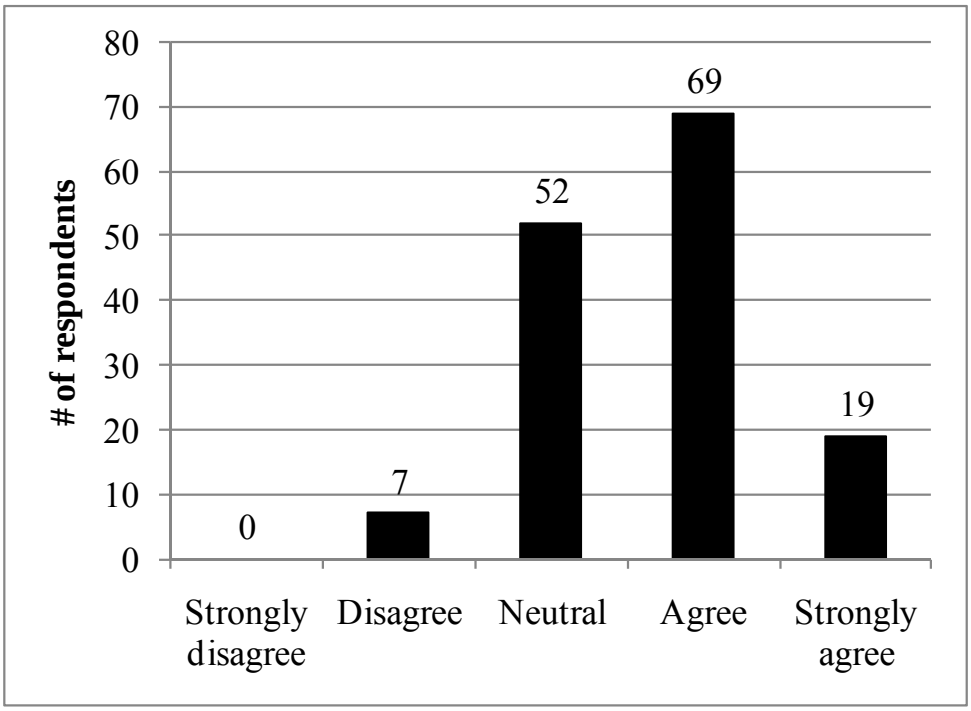


Figure 26. Responses to survey question, "My company values the efforts of college/university engineering departments / programs to prepare engineers to work in a global environment."

Question 15d, asked survey respondents to indicate their agreement with the following statement: "My company considers college/university engineering departments/programs successful at preparing engineers to work in a global environment." The rated success of colleges and universities in preparing engineers for success in a global environment was lacking as evidenced in the data shown in Figure 27. Only 40 of the 147 (27.2%) respondents indicated that colleges and universities were successful at preparing engineers for working in a global environment. The majority of respondents – 90 out of 147 (61.2%) – were neutral, while 17 of 147 (11.6%) indicated that universities were not successful. These results indicate that companies do not

consider university and college engineering departments and programs very successful in their efforts to prepare mechanical engineers for work in a global environment.

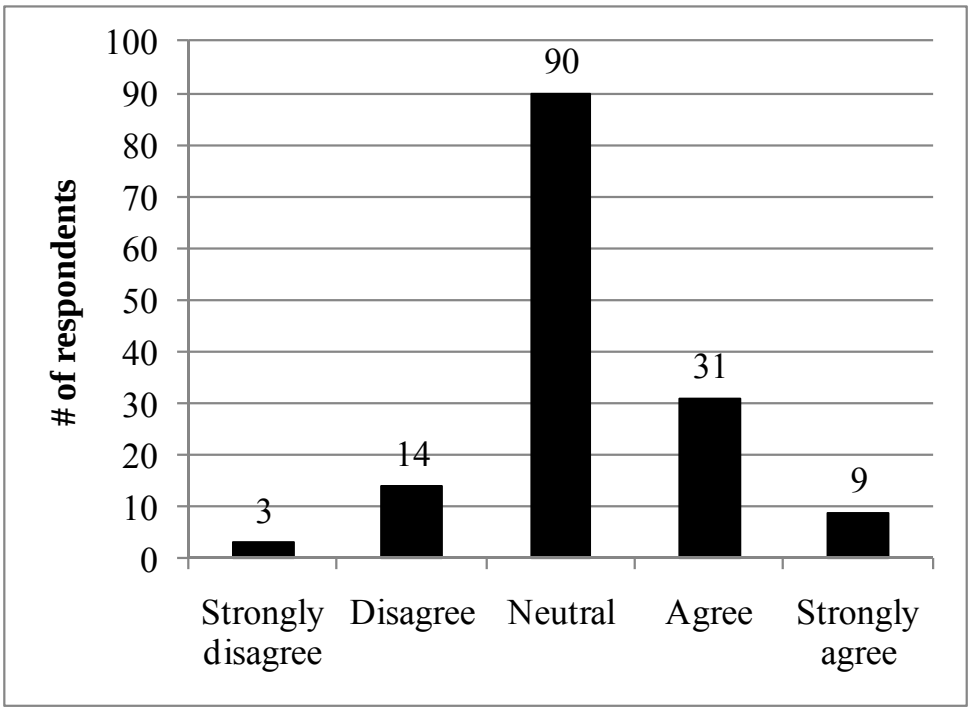


Figure 27. Responses to survey question, "My company considers college/university engineering departments/programs successful at preparing engineers to work in a global environment."

In general, survey respondents considered their companies much more successful than colleges and universities at preparing engineers for success in a global environment. Survey participants were also provided an opportunity to recommend what college and university engineering departments can do to better prepare engineers for success in a global engineering environment and 66 of 147 (44.9%) survey respondents for this section provided suggestions for improvement. Each of the qualitative responses was categorized into common themes and a histogram was developed that illustrates each category by percentage of respondents as seen in Figure 28; additional details are available in Appendix G, question 16.

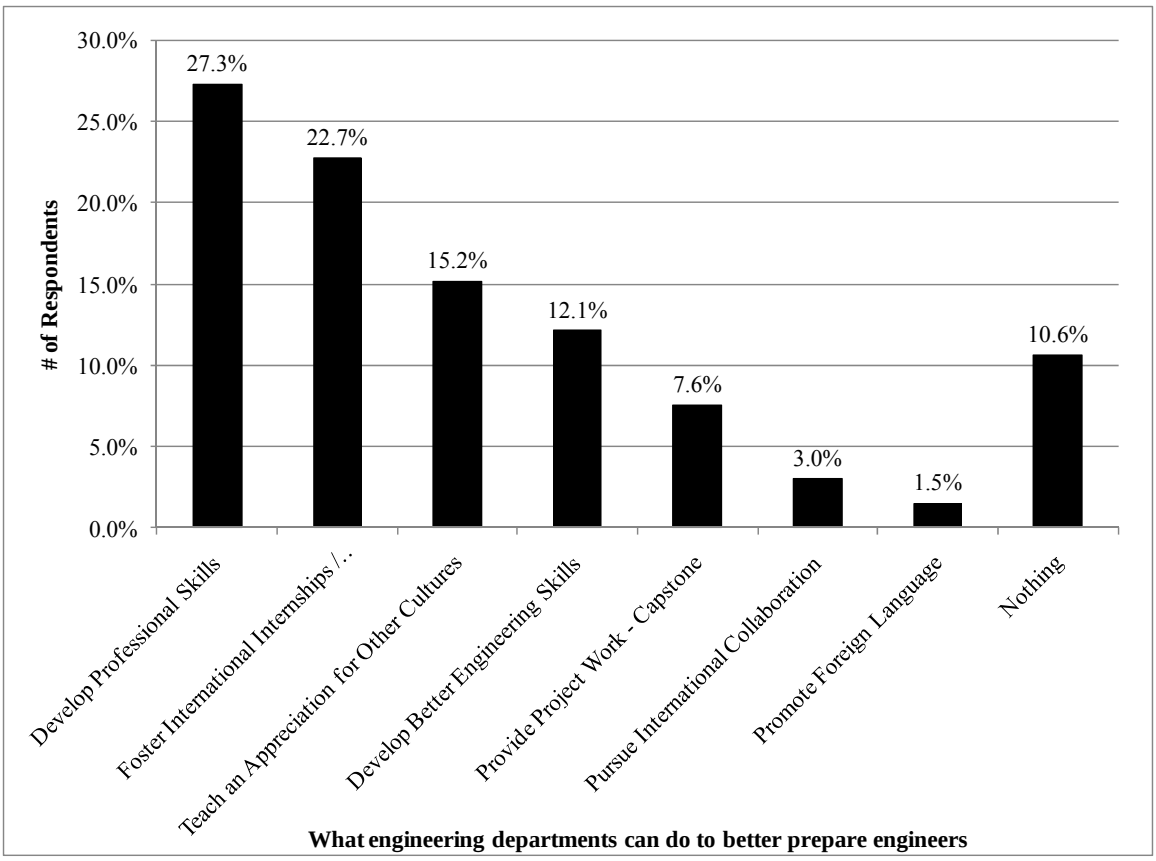


Figure 28. What college engineering departments and programs can do to better prepare engineers for success in a global engineering environment.

Although professional skills were purposely excluded from the survey because the focus of the study was to compare the importance of global competencies with standard technical competencies, 27% of survey respondents indicated that professional skill development—including communication, presentation, and writing skills—is an important focus area for college engineering programs. This result supports what was already a commonly agreed upon competency requirement for engineers as identified by ABET and many scholars throughout the literature

Respondents' remaining suggestions for college and university engineering programs to improve their preparation of engineers for a global environment can be

broken into two primary categories: the development of standard engineering technical competence and the development of global competence.

1. Standard engineering technical competence
    a. Develop better engineering skills (proficiency in design, analysis, problem solving, fluid and thermal sciences, and so forth)
    b. Provide project work (i.e., Capstone)
2. Global competence
    a. Foster international internships / experiences
    b. Teach an appreciation for other cultures
    c. Provide project work (i.e., Capstone)
    d. Pursue international collaboration
    e. Promote foreign languages

Almost 10% of survey respondents indicated there was nothing more that colleges and universities could do to better prepare engineers for success in a global engineering environment.

Additional Survey Results

An important part of the study was to better understand the study population including their global experiences. Of the 544 respondents in this portion of the study, 318 (58%) had worked in a global engineering environment during part of their career and 226 (42%) had not, as shown in Figure 29. Additional survey result details for the global experience section are included in Appendix G.

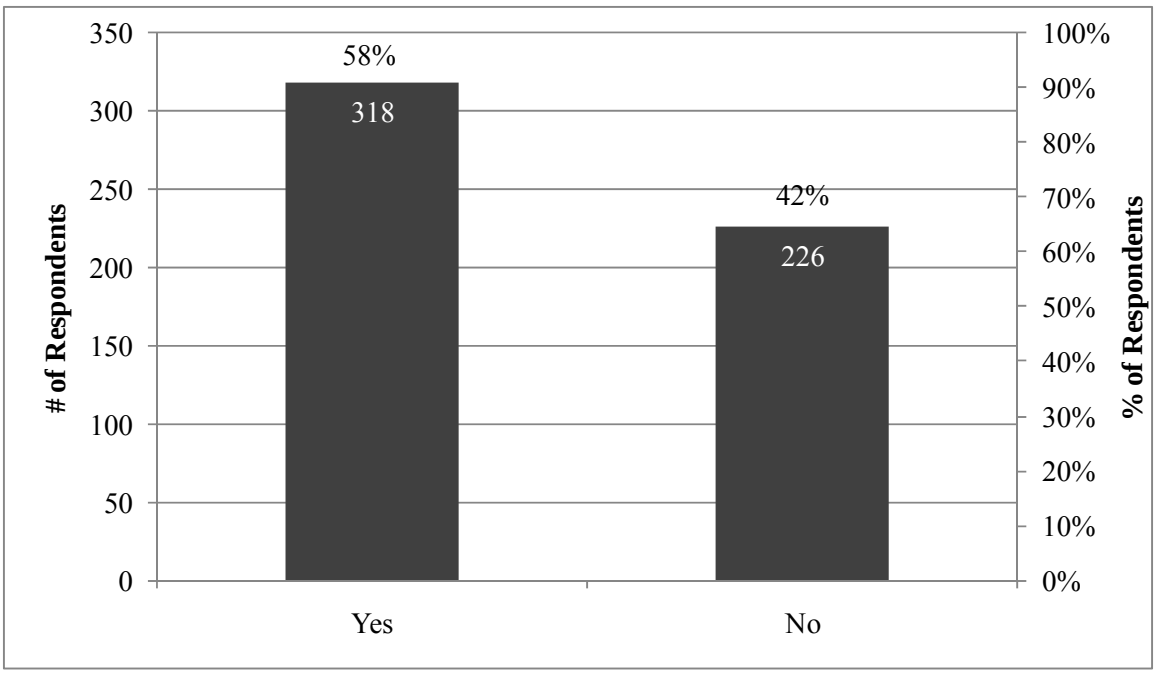


Figure 29. Responses to the survey question, "Have you worked in a global engineering environment during part of your career?"

Survey question 18 asked survey respondents to indicate how many different countries they had visited in the context of their career; countries visited only for vacation purposes were not included in the results. Figure 30 shows the distribution of the 315 responses to this question. There were 62 (20%) that had not visited a different country as part of their career, 119 (38%) who had visited 1–3 different countries, 55 (17%) who had visited 4–6 different countries, 35 (11%) who had visited 7–9 different countries, 15 (5%) who had visited 10–12 countries and 29 (9%) who had visited more than 13 countries. The ability of an engineer to be involved in a global environment is not limited only to his or her having visited a different country because technology has created many unique ways to interact and conduct business internationally without ever leaving one's home business location.

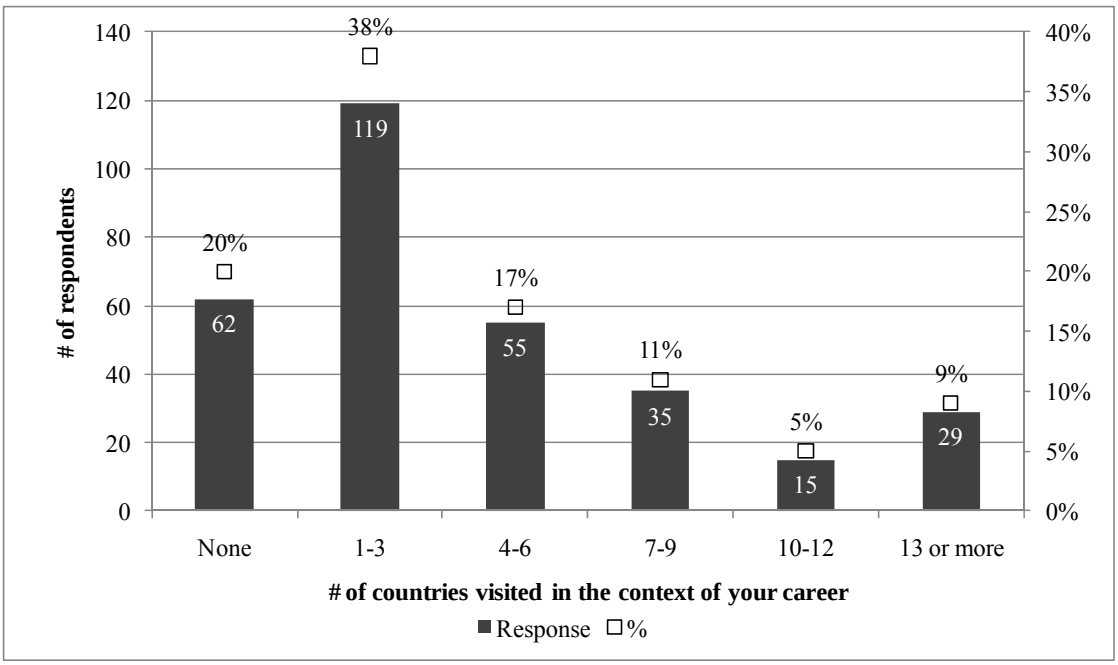


Figure 30. Frequency distribution of survey respondent visits to different countries in the context of their career.

Figure 31 illustrates that the vast majority of global engineering travel to different continents took place in North America, Europe, and Asia. These results make sense especially given that the majority of engineering work throughout the world occurs in North America, Europe and Asia.

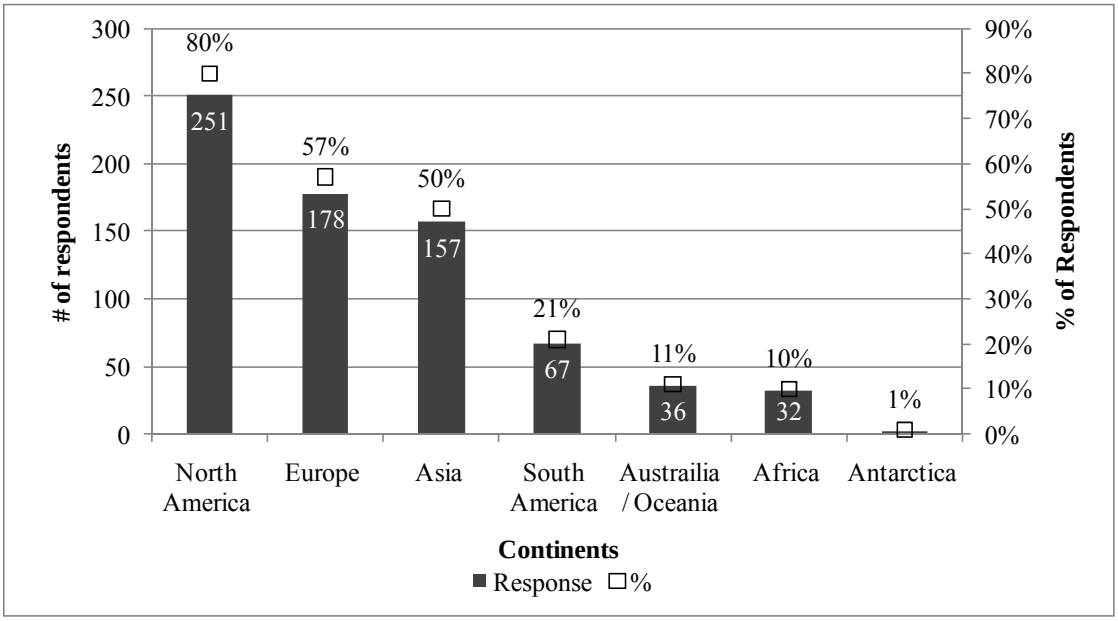


Figure 31. Continents visited by survey respondents in the context of their career.

Survey participants who had worked in a global environment during part of their career were also given the opportunity to provide qualitative comments. Survey question 20 asked survey participants, "What do you wish you would have known upon completion of college to better prepare you to work successfully in a global engineering environment?" All responses were categorized into common themes, as shown in Figure 32, with additional details of survey responses included in Appendix G, question 20.

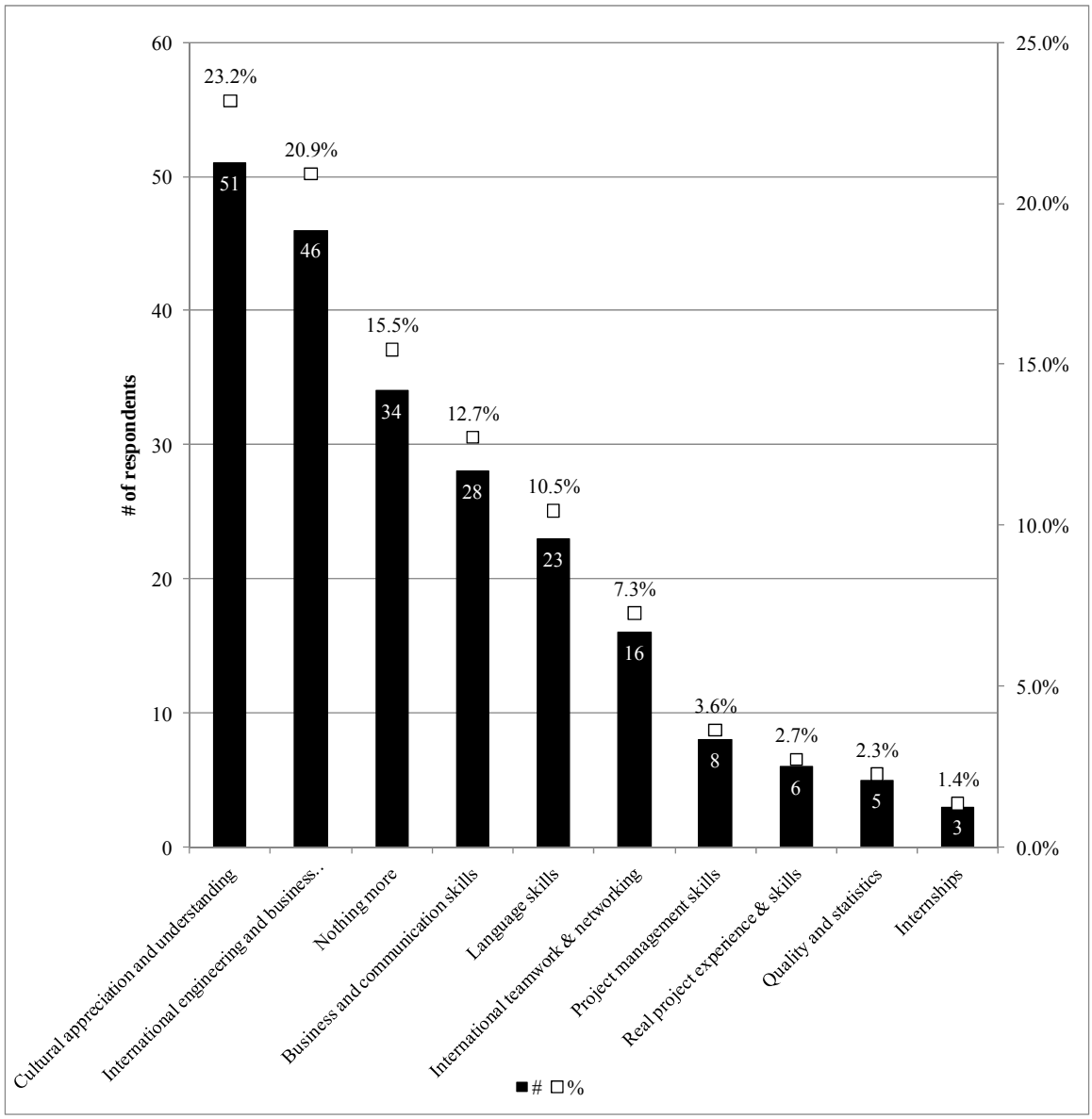


Figure 32. What do you wish you would have known upon completion of college to better prepare you to work successfully in a global engineering environment?

Of 220 respondents 51 (23.2%) indicated that they wished they would have had better cultural appreciation and understanding. This result supported the evidence presented previously concerning the importance of engineers developing an appreciation and understanding of different cultures. Thus, both the quantitative and the qualitative data support the importance of an ability to appreciate and understand cultures. In addition, 46 (20.9%) indicated a desire to have been better prepared to conduct business and engineering in an international environment. The competency to understand international business, law, and technical elements was not considered as important as other competencies based upon the competency portion of the study. However, with more than 20% of survey respondents indicating that they wished they would have had a better understanding of international business, law, and technical elements, it seems apparent that an ability to understand these elements was an important competency for engineers to obtain success in a global engineering environment.

Thirty-four (34) out of 220 (15.5%) respondents felt that they were adequately prepared for success in a global engineering environment. A few commented that previous international experience was helpful in preparing them for the future. Language skills were identified by 23 of 220 (10.5%) survey respondents as something that could have helped them in their career. This gives some validity to the global competence of an ability to speak more than one language including English. Many of the qualitative comments provided by survey participants supported the validity of the identified global competencies developed in the literature review mentioned in Chapter II. International teamwork was also mentioned by 16 of 220 (7.3%) participants which also supports the importance of the global competency of working in international teams. Eight (8) of 220

(3.6%) survey participants wished they would have had better project management skills, with others indicating a desire for real project experience, quality and statistics, and also internships.

Survey question 21 asked respondents to "describe what has best helped them prepare for and obtain success when working in a global engineering environment." All responses were categorized into common themes, as shown in Figure 33, with additional details of survey responses included in Appendix G, question 21.

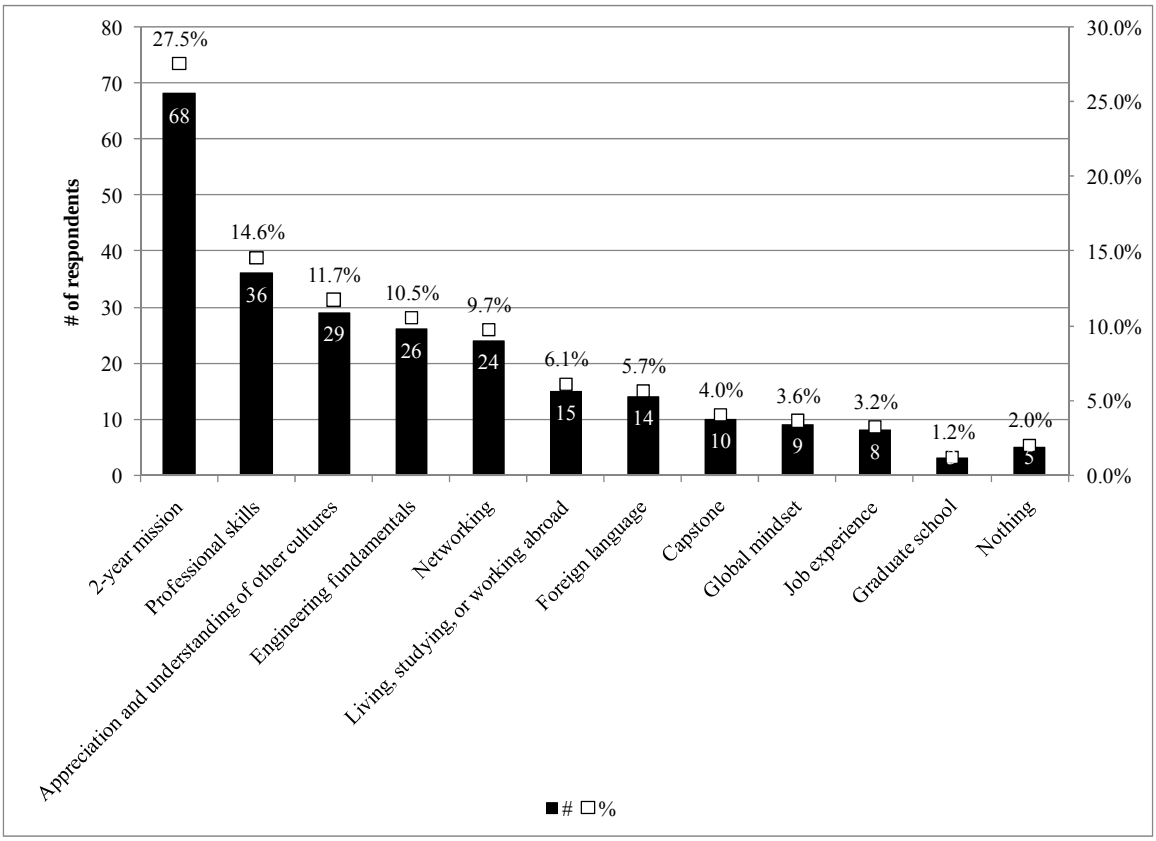


Figure 33. What has best helped you prepare for and obtain success when working in a global engineering environment?

BYU is a private church-owned university sponsored by The Church of Jesus Christ of Latter-day Saints. A majority of BYU students serve voluntary 2-year service missions, and it is not surprising that 68 out of 247 (27.5%) respondents indicated that their mission best helped them prepare for success in a global engineering environment.

Many missionaries serve in countries that are not their native countries and have an opportunity to learn a different language. The immersion of living in a different culture and in a different country for 2 years should and does help individuals develop a greater appreciation and understanding of different cultures and as indicated by the survey responses is seen as a contributing factor to success in a global engineering environment.

Professional skills were mentioned by 36 of 247 (14.6%) respondents as being most helpful in their career. Professional skills included communication, teamwork, writing, and other business related skills. Twenty-nine (29) of 247 (11.7%) indicated that an appreciation and understanding of other cultures was important for their success. Comments were given about the importance of being culturally sensitive and understanding work styles and attitudes in different countries. Still others felt that fundamental engineering skills were the most helpful item in their career with 26 of 247 (10.5%) survey respondents indicating the importance of engineering fundamentals. Networking and the utilization of technology for communication to better understand people was seen as an important skill by 24 of 247 (9.7%).

Figure 33 also illustrates the other responses that were seen as important by survey participants. These responses include living, studying and working abroad; foreign language skills; capstone or project experience; possessing and exhibiting a global mindset; previous job experience; and graduate school. In effect, these responses while limited in number provide validity to the selected competencies included in this study especially the importance of foreign language skills, living and working in a transnational engineering environment, and the ability to exhibit a global mindset.

Chapter IV Summary

In this chapter, the data was presented, analyzed and interpreted. The data indicated that 70% of companies, as rated by survey respondents were willing to provide training and experience for engineers to be successful in a global environment. However, the rated success of survey respondent companies was lower with only 59.9% of respondents indicating their company was successful at providing the appropriate training and experience for success in a global environment.

On a similar note, survey respondent indicated that their companies valued the efforts of higher educational engineering programs in preparing engineers to work within a global environment, with 59.9% in agreement on its importance. The success of higher education programs as perceived by survey respondent companies was much lower, with only approximately 27% of respondents who were in agreement on the success of colleges and universities to prepare engineers for success in a global environment.

To further understand whether global competence was an important consideration for employment in multinational companies, the survey responses were consolidated into two categories the first being unimportant or of little importance and the second including moderately important, important, and very important. The competencies were rank ordered from most important to least important based on survey respondent responses as shown in Table 11.

Table 11

Rank Order of Each Competency by Importance

Rank	Competency	Unimportant / Of Little Importance		Moderately Important to Very Important	
		#	%	#	%
1	an ability to identify, formulate, and solve engineering problems	2	1%	147	99%
2	an ability to apply knowledge of mathematics, science and engineering.	4	3%	145	97%
3	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	5	3%	144	97%
4	an ability to design and conduct experiments, as well as to analyze and interpret data	6	4%	143	96%
5	an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	7	5%	142	95%
6	pertinent applicable work experience	10	7%	139	93%
7	an ability to communicate cross-culturally	14	9%	135	91%
8	a high GPA	15	10%	134	90%
9	an ability to appreciate and understand different cultures	15	10%	134	90%
10	an ability to work in international teams	23	15%	126	85%
11	an ability to exhibit a global mindset	25	17%	124	83%
12	an ability to live and work in a transnational engineering environment	30	20%	119	80%
13	an ability to demonstrate world and local knowledge	32	21%	117	79%
14	an ability to understand international business, law, and technical elements	49	33%	100	67%
15	an ability to speak more than one language including English	57	38%	92	62%

All 15 competencies were considered at least moderately important (3 or higher on a scale of 1 to 5) by a majority of respondents, with the least important competency

being an ability to speak more than one language including English, with only 62% who indicated it was moderately important to very important. An ability to understand international business, law, and technical elements was also viewed as less important than other competencies, with 67% of respondents who perceived it was moderately important to very important when making hiring decisions for new engineers. Even though these two competencies were rated lower by respondents for importance, nearly 21% of respondents indicated they wished they had been better prepared to conduct business and engineering in an international environment and nearly 11% felt that better foreign language experience would have helped them within their career when asked "What do you wish you would have known upon completion of college to better prepare you to work successfully in a global engineering environment?"

The remaining 13 competencies were considered moderately important to very important by more than 79% of respondents. The 6 remaining global competencies were considered moderately important to very important by 79% to 91% of respondents. Given these results, one may conclude that, for BYU mechanical engineering alumni involved in hiring decisions for their company, global competence is an important consideration when hiring new engineers who will work either immediately or eventually in a global environment.

A summary of the data indicated that a majority (68%) of respondents worked for larger companies who employed more than 1,000 employees and 55% of respondents were employed by companies with annual revenue (US$) exceeding $1 billion. In general, survey respondents who worked for larger companies placed a higher importance on global competence than did those who worked for smaller companies. It is not

unreasonable to conclude from these results that larger companies recognized and valued the importance of engineers who were not only technically competent, but who also possessed global competencies applicable to work within a global environment.

Chapter V: Conclusions and Recommendations

In this chapter, an overview of the dissertation is presented, followed by a reminder of the purpose of this study. A summary and significance of the findings with conclusions is then provided, followed by recommendations for implementation and future research.

Dissertation Overview

We live and work in a world that is more interconnected and interdependent than ever before. Engineers must now not only develop technical engineering competence, but must also develop additional skills and competencies, including global competence, to be successful within a global engineering environment. To better understand the importance of global competence and the competencies that were considered by multinational firms when hiring mechanical engineering graduates, a study, including the distribution and analysis of a survey instrument, was conducted of 2,816 BYU mechanical engineering alumni living in 48 states and 17 different countries.

The survey included both a quantitative and qualitative assessment of the importance hiring managers placed on standard technical competencies compared with global competencies when making hiring decisions for new engineers in multinational companies. Qualitative comments were evaluated and grouped into common categories to determine if there were any missing competencies for success in a global environment and to determine what colleges and universities can do to better prepare engineers for a global environment and also to identify success elements within a global engineering career. The results of the survey should provide both qualitative and quantitative data for higher education engineering programs to consider in relation to both the importance of

developing global competence in engineers and the potential deficiencies within their programs to prepare engineering graduates for success within a global engineering environment as perceived by multinational companies.

Purpose of the Study

The purpose of this study was to determine whether multinational companies considered global competence an important skill in mechanical engineering graduates when making hiring decisions. An evaluation of standard hiring technical engineering competencies in addition to a list of global competencies for engineering was included. The research may provide benchmark information for college and university engineering departments and programs to evaluate their approach in preparing engineers to work in a global environment. The following research questions were utilized to address the purpose of this study:

1. Is global competence considered by hiring managers at multinational firms in their hiring practices of mechanical engineering graduates?
    a. Is global competence an important consideration for employment in multinational companies?
    b. To what extent are multinational companies willing to train engineers in global competence?
    c. To what extent do multinational companies expect higher education engineering departments and programs to prepare engineers for working in a global environment?

Summary and Significance of Findings, Including Conclusions

This section will summarize the study population and the research findings, and will include specific conclusions based on study results and the researcher's own experience.

Study population.

The study population was made up of BYU mechanical engineering alumni. BYU's mechanical engineering program was started in the early 1950s and continues to grow each year. In 2008, the BYU mechanical engineering department was ranked 38th (Gibbons, 2008) in the nation for the total number of bachelor's degrees awarded with 113 mechanical engineering graduates. Since the inception of the mechanical engineering program at BYU there have been 5,149 graduates including bachelors, masters and PhD graduates.

More than 70% of BYU students speak a language other than their native tongue as a result of many having served a volunteer two-year church service mission for The Church of Jesus Christ of Latter-day Saints. Voluntary missionary service has provided many BYU students the opportunity of living and interacting with people in different locations and cultures throughout the world. The global experiences obtained through missionary service of many BYU alumni may have biased the results of this study to some degree since previous global experience among students is not as common at other higher education engineering institutions. However, it is important to note that this study focused on the importance of global competence when hiring new engineers from any higher education engineering institution.

Students at BYU come from 115 different countries and the variety of language skills enable the university to provide a rich forum for language instruction. Previous foreign language and cultural experience coupled with high caliber academic preparation has provided BYU a unique opportunity to prepare its graduates to be successful leaders in a global environment. Many BYU graduates were employed by multinational firms because of their previous international and foreign language experience.

The study population included 2,816 of the 5,149 (54.7%) mechanical engineering alumni throughout the world, which included 48 states and 17 countries (BYU Alumni Relations, 2010). Of the 2,816 alumni that had e-mail addresses registered with the BYU alumni group, only 106 kickbacks (invalid e-mails errors) were received for a delivery rate of 96.2% (2,710). The response to the survey invitation was generally good with 561 (20.7% total response rate) alumni participating. Survey respondents were given a voluntary opportunity to provide personal contact information, and of the 561 respondents that participated in the survey, 461 (82.2%) provided their contact information, representing 26 states and 3 countries and more than 79 different companies including many large multinational firms such as Hewlett-Packard, Boeing, 3M, ATK, United Parcel Service, Browning, Intel, Honeywell, Exxon Mobil, Ford Motor Company, ConocoPhillips, Cessna, Adobe Systems, Northrop Grumman, Monsanto, Siemens, Bard Access Systems, and Stryker.

The study was an exploratory study to determine the importance of global competence in engineers. An extensive literature review identified a lack of a common agreement for global competence within Mechanical Engineers or in general for that matter. Significant effort went into identifying and categorizing competencies for global

competence. The review also identified a lack of existing instruments to collect the type of data collected for this study. The developed list of global competencies and the developed survey instrument was reviewed by researchers currently involved in globalization research both at BYU and the UNL.

Research question 1: Is global competence considered by hiring managers at multinational firms in their hiring practices of mechanical engineering graduates?

Fifteen different competencies were evaluated by survey respondents including the eight global competencies identified in the literature review section of this study. Survey respondents rated each competency on a five-point Likert scale for importance ranging from 1 (unimportant) to 5 (very important) according to the following question "How important is it for mechanical engineers hired by your company who will either work immediately or eventually in a global environment to have?" followed by each stated competency. A mode analysis, which is one of the most appropriate methods for analysis of a Likert scale response, was conducted to determine the most frequently cited response. According to the Likert scale rating, each of the five standard engineering technical competencies as shown below were rated a 5 (very important).

- An ability to apply knowledge of mathematics, science, and engineering.
- An ability to design and conduct experiments, as well as to analyze and interpret data
- An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- An ability to identify, formulate, and solve engineering problems

- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Four of the eight global competencies using a mode analysis were identified according to the five-point Likert scale response as 4 (important) along with pertinent applicable work experience as shown below.

- An ability to exhibit a global mindset
- An ability to appreciate and understand different cultures
- An ability to communicate cross-culturally
- An ability to work in international teams
- Pertinent applicable work experience

Survey respondents considered each of the remaining global competencies and a high GPA moderately important (rank of 3).

Conclusion 1.

Possessing and demonstrating standard engineering technical competencies is essential if one is to be employed as an engineer, regardless of whether the engineer is working in a international environment or not. However, global competence is also an important consideration for employment, and engineers should focus particularly on developing the ability to exhibit a global mindset, an ability to appreciate and understand different cultures, an ability to communicate cross-culturally, and an ability to work in international teams.

Research question 1a: Is global competence an important consideration for employment in multinational companies?

Table 11 in Chapter IV provides a rank order of competencies from most important to least important. A majority of respondents considered all 15 competencies at least a 3 or moderately important on a five-point Likert scale. Sixty-two percent of the respondents considered the ability to speak more than one language including English moderately important to very important, and 67% of respondents considered an ability to understand international business, law, and technical elements as moderately important to very important when making hiring decisions for new engineers.

Even though these two competencies were rated lower by respondents for importance, nearly 21% indicated that they wished they had been better prepared to conduct business and engineering in an international environment, and nearly 11% felt that better foreign language experience would have helped them within their career when asked the question, "What do you wish you would have known upon completion of college to better prepare for success in a global engineering environment?" The remaining thirteen competencies were considered moderately important to very important by more than 79% of respondents, with the 6 remaining global competencies rated as important (moderately important to very important) by 79% to 91% of survey respondents.

Conclusion 2.

Given these results, one may conclude that for BYU mechanical engineering alumni involved in hiring decisions for their companies, global competence is an important consideration when hiring new engineers who will work either immediately or

eventually in a global environment. The rank ordered competency list in Table 11 of chapter IV provides a basic prioritization in competency development. Assuming that higher educational engineering institutions are currently proficient in developing technical competence among engineering graduates, efforts should be made to evaluate current practices and to improve global competence in the following areas:

1. An ability to communicate cross-culturally
2. An ability to appreciate and understand different cultures
3. An ability to work in international teams
4. An ability to exhibit a global mindset
5. An ability to live and work in a transnational engineering environment
6. An ability to demonstrate world and local knowledge
7. An ability to understand international business, law, and technical elements
8. An ability to speak more than one language including English

An important consideration in reviewing the survey data was to determine the influence that different variables had on the relative importance of competencies when hiring mechanical engineers to work in a global environment. A cross-tab analysis was conducted to determine which variables had a correlation or association to the importance of different competencies. The following items were found to be statistically significant (p-value < 0.05):

1. A positive correlation exists between job title and the importance of a high GPA.
2. A negative correlation exists between job title and the importance of an ability to speak more than one language including English.

3. A positive correlation exists between the number of employees worldwide per company and the importance of a high GPA.
4. A positive correlation exists between the number of employees worldwide per company and the importance of an ability to exhibit a global mindset.
5. A positive correlation exists between the number of employees worldwide per company and the importance of an ability to appreciate and understand different cultures.
6. A positive correlation exists between the number of employees worldwide per company and the importance of an ability to live and work in a transnational engineering environment.
7. A positive correlation exists between the number of employees worldwide per company and the importance of an ability to work in international teams.
8. A positive correlation exists between the annual revenue (US$) per company and the importance of an ability to appreciate and understand different cultures.
9. A positive correlation exists between the annual revenue (US$) per company and the importance of an ability to live and work in a transnational engineering environment.

The cross-tab analysis also identified the following items as marginally significant (p-value between 0.05 to 0.10):

1. A positive correlation exists between the number of employees worldwide per company and the importance of an ability to understand international business, law, and technical elements.

2. A positive correlation exists between the annual revenue (US$) per company and the importance of a high GPA.
3. A positive correlation exists between the annual revenue (US$) per company and the importance of an ability to work in international teams.

Sixty-eight percent of BYU mechanical engineering graduates worked for companies who have more than 1,000 employees and 55% worked for companies whose annual revenue exceeded US$1 billion. These results are likely to be important for higher education engineering programs, because it is probable that graduates of other engineering institutions are similarly employed in larger companies.

Conclusion 3.

Survey results indicate that companies with a large employee base (greater than 10,000 employees) or companies that have high annual revenues (over US$1 billion) placed a higher importance on global competencies when making hiring decisions for new engineers than smaller companies. Large companies indicated that the following global competencies were important for the success of engineers in a global environment: an ability to exhibit a global mindset, an ability to appreciate and understand different cultures, an ability to live and work in a transnational engineering environment, and an ability to work in international teams.

Additional evidence of the importance placed on global competence by larger companies comes from the researcher's own experience of working more than 12 years for a multinational medical technology company with over US$6 billion in annual revenue and approximately 25,000 employees worldwide. Communication with colleagues throughout the world on different projects and programs occurred daily, and

global competence among engineers was considered an important capability for success. In addition, at a recent engineering education conference, the researcher encountered a manager from a multinational aerospace company with more than 120,000 employees worldwide who indicated that global competence was essential for engineers within their company.

To illustrate the importance of global competence among engineers even further, Ken Kohrs (n.d., p. 5), former vice president of the Ford Motor Company said, "What's the relevance of globalization to you personally, and to your future in engineering? I can answer that in one word: Everything. No matter what area of engineering you enter, your ability to remain on the leading edge, and to progress in our organization, will depend largely on your capacity to connect and communicate globally".

Research question 1b: To what extent are multinational companies willing to train engineers in global competence?

Of the survey respondents surveyed, 103 of 147 (70%) agreed or strongly agreed that their company was willing to provide training and experience for engineers to be successful in a global engineering environment. Only 7 of 147 (4.8%) respondents indicated that their company was not willing to provide the appropriate training or experience. However, survey respondent companies' success did not match their willingness. Only 88 of 147 (59.9%) respondents agreed or strongly agreed that their company was effective at providing the appropriate training and experience for engineers to be successful in a global engineering environment.

Conclusion 4.

The data from this study indicates that most companies are willing to provide training and experience to help engineers succeed in a global engineering environment. However, the success of companies to develop global competence among engineers is lower than their willingness and therefore leaves room for improvement. Companies who conduct business in more than one country or who have operations in multiple countries should evaluate their current efforts and training procedures to determine how to improve global competence among employees.

Research question 1c: To what extent do multinational companies expect higher education engineering departments and programs to prepare engineers for working in a global environment?

A majority (88 of 147, or 59.9%) of respondents agreed or strongly agreed that their company valued the efforts of colleges and universities to prepare engineers for success in a global environment. Only 7 of 147 (4.8%) respondents indicated that the efforts of higher educational institutions to prepare engineers for global competence were not important for their company.

The success of colleges and universities in preparing engineering graduates for a global engineering environment was perceived by survey respondents to be much lower than the success of the company's own efforts. Only 40 of 147 (27.2%) survey respondents agreed or strongly agreed that colleges and universities were successful at preparing engineers to work in a global environment.

Conclusion 5.

An overall conclusion that can be drawn from these results is that companies generally consider higher education institutions an important component in preparing engineers for success in a global environment. However, the perceived success of higher education institutions to prepare engineers to work in a global environment is significantly lacking. As indicated in Chapter II, some higher education institutions are involved in efforts to develop global competence among engineers. The majority of institutions employ an add-on approach, as discussed in Chapter II of this study, to develop global competence, which includes instruction, study-abroad, and international certificate options. Based on the results of this study, with only 27.2% of respondents who consider engineering colleges and programs successful at preparing engineers for work in a global environment, current practices are just not sufficient.

Recommendations for Implementation

The study data clearly indicates an opportunity for higher education engineering programs to assess their educational efforts and identify ways to improve global competence among their engineering graduates. Higher education engineering institutions need to evaluate current efforts to prepare engineers for success in a global environment and to identify the changes that are necessary to increase global competence among their graduates.

What seems apparent is that many institutions have focused on trying to improve the global outcomes for their engineering students. While international efforts to improve global competence among graduates of engineering programs continue to increase, the percentage of students who have participated is still relatively small. Real success is

likely to be achieved as colleges and universities focus on their own curricula to make global competency an essential part of a student's education (Downey & Lucena, 2007).

Many challenges must be overcome, including incorporating global elements into an already packed curriculum, developing foreign language capabilities among engineering students, and dealing with timing differences in academic schedules of international schools. Improvement of global outcomes will require commitment from higher education institutions in producing globally competent engineers. Faculty will need to not only focus on helping students acquire technical skills but also on providing opportunities for students to gain international experience as well (Renganathan et al., 2008). The incorporation of global elements will likely require a review and modification of existing curriculum to make sure that it is comprehensive, coherent, and accessible to all students (Brustein, 2007).

Faculty members in engineering institutions throughout the world are encouraged to identify opportunities within each course they teach to facilitate interaction of engineers within a global environment. Efforts to develop global competence among engineering students may include team-based projects, work-focused projects in different countries, interaction of engineers in a multicultural environment, international educational partnerships among colleges and universities throughout the world, and the use of technology to develop cross-cultural competence through virtual teams.

Students' involvement in a global environment throughout their education versus a single study abroad experience will greatly enhance the capabilities of engineering graduates to succeed in a global environment. Based on this study, particular focus

should be placed on incorporating each of the following global competencies into the curriculum:

1. An ability to communicate cross-culturally
2. An ability to appreciate and understand different cultures
3. An ability to work in international teams
4. An ability to exhibit a global mindset
5. An ability to live and work in a transnational engineering environment
6. An ability to demonstrate world and local knowledge
7. An ability to understand international business, law and technical elements
8. An ability to speak more than one language including English

Based on the results of this study, it is the opinion of the author that success in developing global competence among engineering students will require a deviation from the current practices of providing a few add-on international courses or experiences. Improving global outcomes in engineering will require a total integration of global competence across the curriculum. It is the opinion of the researcher, based on this study, that higher education engineering institutions should consider the following to improve global competence among their students:

1. Utilize the list of eight global competencies developed as part of this study and assess current student proficiencies for global competence. This would help establish a baseline of current performance and could serve as a benchmark to assess efforts to improve global competence among graduates. A five-point Likert scale assessment could be utilized to determine agreement for each competency using the agreement scale shown here:

- 1 = Strongly disagree (SD)
- 2 = Disagree (D)
- 3 = Neutral (N)
- 4 = Agree (A)
- 5 = Strongly agree (SA)

Each student or graduate could be asked to rate their agreement with the following statements, "I consider myself proficient in":

Global Competency	SD	D	N	A	SA
Communicating cross-culturally	O	O	O	O	O
Appreciating and understanding different cultures	O	O	O	O	O
Working in international teams	O	O	O	O	O
Exhibiting a global mindset	O	O	O	O	O
Living and working in a transnational engineering environment	O	O	O	O	O
Demonstrating world and local knowledge	O	O	O	O	O
Understanding international business, law and technical elements	O	O	O	O	O
Speaking more than one language including English	O	O	O	O	O

2. Evaluate current curricular offerings to determine which courses include global elements and to what degree and incorporate global elements into all curricular offerings.
    a. For example, an engineering design course that previously had students gain experience in designing engine parts for General Motors could modify the assignment to design a non-electric water-pump for a village in Mozambique.
3. Identify global partner institutions and establish working relationships with these institutions to provide opportunities for students to interact with people from different cultural backgrounds and countries. These partnerships could include:

   a. Cross-cultural virtual teams: Utilization of technology to facilitate team interaction on different assignments or projects for a given course.
   b. Study-abroad: Students travel internationally to gain exposure to different cultures and countries.
   c. Senior design or Capstone projects: Student teams from different universities and countries collaborating to complete an industry sponsored project.
   d. Collaborative international research: Faculty and students from different international locations collectively conduct research utilizing the strengths and capabilities of each individual and institution.
   e. Student exchange: Students from partner institutions are exchanged to experience a semester or more at the host institution.
4. Encourage students to complete a foreign language minor.
5. Add a requirement for all juniors and seniors to attend a weekly one-hour seminar focused on globalization.
   a. This seminar would be a 1/2 credit hour course each semester and would count towards graduation requirements.
   b. Faculty and guest speakers would provide instruction on different topics pertinent to globalization including: awareness of the cultural environment, ethnocentrism, linguistic diversity, communicating across cultures (verbal and nonverbal), international business, international law, cross-cultural negotiation, implications of international teams, and other global elements.

Recommendations for Future Research

The purpose of this study was to determine whether multinational companies consider global competence an important skill in mechanical engineering graduates when making hiring decisions. The study established that standard engineering technical competencies were the most important consideration when hiring mechanical engineers, but global competence was also an important consideration when hiring new engineers to work in a global environment.

The analysis of the data presented in this study generated the following topics and considerations for further research:

1. Do the findings of this study apply to an engineering population larger than BYU mechanical engineering graduates?
2. Do the findings of this study apply to other academic disciplines when considering the importance of global competence in engineering graduates?
3. Does global competence predict actual outcomes in engineers?
4. Is it possible to identify the antecedents of global competence and if so, what are they?
5. Conduct a comparison of leading engineering institutions to determine the importance placed on preparing engineers for success in a global environment.
6. Identify and assess outcomes and metrics to measure the effectiveness of global competence instruction in higher education engineering institutions.
7. Reduce the number of categories per question for inferential statistic comparison (e.g., job titles, industry type, and company size) and increase sample size (if possible) to facilitate a Chi-square analysis.

8. Structure questions to include continuous data versus interval or ordinal data to facilitate additional analysis including trends.

Globalization is not a passing phenomenon, it is here to stay. Colleges and universities throughout the world need to recognize the importance of globalization and the interdependence and interconnectedness among the world's population (Mehta & Kou, 2005). Therefore, based on this study, it is important to identify, develop and provide opportunities for international collaboration and interaction among students and faculty throughout the world and to focus on developing global competence as an important outcome for engineering graduates.

References

Abata, D. (2004). A successful path for engineering and engineering education. *ASEE Today: ASEE Prism Magazine, 13* (9), p. 62.

ABET, Engineering Accreditation Division. (2008). *Criteria for accrediting engineering programs.* Retrieved from http://www.abet.org/Linked%20Documents-UPDATE/Criteria%20and%20PP/E001%2009-10%20EAC%20Criteria%2012-01-08.pdf

Allan, M., & Chisholm, C. U. (2008). The development of competencies for engineers within a global context. *EE2008* (pp. 1-12). Loughborough: Higher Education Academy Engineering Subject Centre and the UK Centre for Materials Education.

American Society for Engineering Education. (2010). *The Green Report - Engineering Education for a Changing World*. Retrieved from http://www.asee.org/resources/beyond/greenreport.cfm

Blumenthal, P., & Grothus, U. (2008). Developing global competence in engineering students: U.S. and German approaches. *Online Journal for Global Engineering Education, 3* (2), 1-12.

Brigham Young University Communications. (2009-2010). Y-Facts. Provo, UT: Author.

Brustein, W. I. (2007). *Paths to global competence: Preparing American college students to meet the world*. Retrieved from http://www.iienetwork.org/page/84657/

Bryant, M. T. (2004). *The portable dissertation advisor.* Thousand Oaks, CA: Corwin Press.

BYU Alumni Relations. (2010). BYU mechanical engineering alumni data [Internal databse]. Provo, UT: Author.

Caligiuri, P., & Santo, V. D. (2001). *Global competence: What is it, and can it be developed through global assignments?* Retrieved from http://www.entrepreneur.com/tradejournals/article/print/81626936.html

Church, R. L., & Sedlak, M. W. (1997). The Antebellum college and academy. In L. F. Goodchild, & H. S. Wechsler, *The history of higher education* (2nd ed., pp. 131-148). Boston, MA: Pearson.

Degarmo, E. P., Black, J. T., & Kohser, R. A. (2003). *Materials and processes in manufacturing* (9th ed.). Hoboken, NJ: Wiley.

Doerry, E., Doerry, K., & Bero, B. (2003). The global engineering college: Exploring a new model for engineering education in a global economy. *Proceedings of the 2003 ASEE Annual Conference & Exposition. Session 1279.* Nashville, TN: ASEE.

Downey, G. L., & Lucena, J. C. (2007). Globalization, diversity, leadership, and problem definition in engineering education. *1st International Conference on Research in Engineering Education. ISBN: 0-87823-193-5.* Honolulu, HI: ASEE.

Downey, G. L., Lucena, J. C., Moskal, B. M., Parkhurst, R., Bigley, T., Hays, C., …Nichols-Belo, A. (2006). The globally competent engineer: Working effectively with people who define problems differently. *Journal of Engineering Education, 95* (2), 107-122.

Duderstadt, J. J. (2008). *Engineering for a changing world: A roadmap to the future of engineering practice, research, and education.* Retrieved from http://milproj.ummu.umich.edu/publications/EngFlex_report/download/EngFlex%20Report.pdf

Ferraro, G. P. (2006). *The cultural dimension of international business* (5th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

Friedman, T. L. (2007). *The world is flat: A brief history of the twenty-first century.* New York, NY: Picador / Farrar, Straus and Giroux.

Galloway, P. D. (2008). *The 21st century engineer: A proposal for engineering reform.* Reston, VA: ASCE Press.

Genheimer, S. R., & Shehab, R. L. (April 2009). A survey of industry advisory board operation and effectiveness in engineering education. *Journal of Engineering Education, 98* (2), 169-180.

Georgia Institute of Technology. (2005). *Strengthening the global competence and research experiences of undergraduate students.* Retrieved from http://www.assessment.gatech.edu/wp-content/uploads/QEP.pdf

Georgia Tech. (n.d.). *International Plan*. Retrieved from http://www.internationalplan.gatech.edu/

Gibbons, M. T. (2008). *Engineering by the numbers.* Retrieved from http://www.asee.org/publications/profiles/upload/2008ProfileEng.pdf

Gilleard, J., & Gilleard, J. D. (2002). Developing cross-cultural communication skills. *Journal of Professional Issues in Engineering Education and Practice, 128* (4), 187-200.

Grand Challenges. (n.d.). Retrieved from http://www.engineeringchallenges.org/cms/challenges.aspx

Hall, S. (2010). *How to analyze Likert scales*. Retrieved from http://www.ehow.com/how_5692331_analyze-likert-scales.html

Harb, J., Rowley, R., Magleby, S., & Parkinson, A. (2007). Going global: Implementation of a college-wide initiative to prepare engineering and technology students for the 21st century. *Proceedings of the ASEE Annual Conference & Exposition. AC-2007-2912.* Honolulu, HI: ASEE.

Hirleman, E. D., Eckard, A. G., & Atkinson, D. L. (2007). The three axes of engineering education. *Proceedings of the International Conference on Engineering Education.* Coimbra, Portugal.

History and growth of the Internet. (n.d.). Retrieved from http://www.internetworldstats.com/emarketing.htm

History of BYU. (n.d.). Retrieved from http://yfacts.byu.edu/viewarticle.aspx?id=137

Hunter, B., White, G. P., & Godbey, G. C. (2006). What does it mean to be globally competent? *Journal of Studies in International Education, 10* (3), 267-285.

Hunter, W. D. (2004). Got global competency. *International Educator, 13* (2), 6-12.

Hunter, W. D. (2004). Knowledge, skills, attitudes, and experiences necessary to become globally competent. Bethlehem, PA: Unpublished Doctoral Dissertation.

ILR scale. (n.d.). Retrieved January 14, 2010, from Wikipedia: http://en.wikipedia.org/wiki/ILR_scale

Kelly, M. (n.d.). *Overview of the industrial revolution: The United States and the industrial revolution in the 19th century*. Retrieved from http://americanhistory.about.com/od/industrialrev/a/indrevoverview.htm

Kohrs, K. (n.d.). Program in global engineering [Brochure]. Ann Arbor, MI: University of Michigan College of Engineering.

Languages at BYU. (n.d.). Retrieved from http://yfacts.byu.edu/viewarticle.aspx?id=139

Lattuca, L. R., Terenzini, P. T., & Volkwein, J. F. (2006). *Engineering change: findings from a study of the impact of EC2000, final report.* Baltimore, MD: ABET.

Lohmann, J. R., Rollins, H. A., & Hoey, J. J. (2006). Defining, developing and assessing global competence in engineers. *European Journal of Engineering Education, 31* (1), 119-131.

Lozano, A., Sanchez, E., & Mucino, V. H. (2001). Engineering education across disciplines and cultures: A Mexico/USA industrial outreach program. *Proceedings of the 2001 ASEE Annual Conference & Exposition.* Albuquerque, NM: ASEE.

Lucena, J., Downey, G., Jesiek, B., & Elber, S. (2008). Competencies beyond countries: The re-organization of engineering education in the United States, Europe, and Latin America. *Journal of Engineering Education, 97* (4), 433-447.

Malone, M. E., Rifkin, B., Christian, D., & Johnson, D. E. (2003). Attaining high levels of proficiency: Challenges for language education in the United States. *Proceedings of the Conference on Global Challenges and U.S. Higher Education.* Durham, NC: Duke University.

Mariasingam, M., Smith, T., & Courter, S. (2008). Internationalization of engineering education. *Proceedings of the ASEE Annual Conference & Exposition. AC 2008-1144.* Pittsburgh, PA: ASEE.

Mauch, J., & Birch, J. (1998). *Guidebook to the successful thesis and dissertation: A handbook for students and faculty.* New York, NY: Marcel Dekker.

Mechanical Engineering. (n.d.). Retrieved February 13, 2009, from http://en.wikipedia.org/wiki/Mechanical_engineering

Mehta, S., & Kou, S. (2005). Designing better education in the age of globalization by building partnerships, connecting people, and promoting innovation. *Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition. Session 1460.* Portland, OR: ASEE.

Morrill Land Grant Acts. (2008). Retrieved from http://www.higher-ed.org/resources/morrill_acts.htm

NASULGC. (2004). *A call to leadership: The presidential role in internationalizing the university.* A Report of the NASULGC Task Force on International Education. Washington, D.C.: Author.

National Academy of Engineering. (n.d.). *Introduction to the grand challenges for engineering*. Retrieved from http://engineeringchallenges.org/cms/8996/9221.aspx

Olson, C. L., & Kroeger, K. R. (2001). Global competency and intercultural densitivity. *Journal of Studies in International Education, 5* (2), 116-137.

Parkinson, A. (2009). The rationale for developing global competence. *Online Journal for Global Engineering Education, 4* (2), 1-15.

Parkinson, A., Magleby, S., & Harb, J. (2009). Developing global competence in engineers: What does it mean? What is most important? *Proceedings of the 2009 ASEE Annual Conference and Exposition.* Austin, TX: ASEE.

Qualtrics. (n.d.). Retrieved January 13, 2010, from http://www.qualtrics.com/

Reimers, F. (2008). Educating for Global Competency. In J. E. Cohen, & M. B. Malin (Eds.), *International perspectives on the goals of universal basic and secondary education.*

Reimers, F. M. (2009). Leading for global competency. *Educational Leadership, 67* (1).

Renganathan, V., Gerhardt, L., Blumenthal, P., & Greenwood, A. (2008). Incorporating global perspectives in U.S. engineering education. *Proceedings of the 2008 ASEE Annual Conference & Exposition. AC 2008-2603.* Pittsburgh, PA: ASEE.

Roth, A. V., Cattani, K. D., & Froehle, C. M. (2008). Antecedents and performance outcomes of global competence: An empirical investigation. *Journal of Engineering and Technology Management, 25* (1-2), 75-92.

Routio, P. (2007). *Models in the research process*. Retrieved from http://www2.uiah.fi/projects/metodi/177.htm

Sadat-Hossieny, M., Allameh, S. M., & Rajai, M. (2005). Globalization of engineering curricula in the United States and abroad. *Proceedings of the 2005 ASEE Annual Conference & Exposition.* Portland, OR: ASEE.

Shuman, L. J., Besterfield-Sacre, M., & McGourty, J. (2005). The ABET "Professional Skills" - Can they be taught? Can they be assessed? *Journal of Engineering Education, 94* (1), 41-55.

SPSS [Statistical Package for the Social Sciences]. (2010). Retrieved from http://www.spss.com/corpinfo/

Warnick, G., Magleby, S., Todd, R., & Parkinson, A. (2008). Globalization: A New Frontier for Capstone Courses. *Proceedings of the 2008 ASEE Annual Conference & Exposition. AC 2008-1230.* Pittsburg, PA: ASEE.

Westmeyer, P. (1985). *A history of American higher education.* Springfield, IL: Charles C. Thomas.

What is ABET accreditation? (n.d.). Retrieved from http://www.abet.org/the_basics.shtml

White, D., & Korotayev, A. (2003). *Statistical analysis of cross-tabs.* Retrieved from http://eclectic.ss.uci.edu/~drwhite/xc/Advice4Contingency_Tables.pdf

Widdig, B., & Lohmann, J. (2007). Educating engineers for the global workplace. *Proceedings of the 2007 ASEE Annual Conference & Exposition. AC 2007-854.* Honolulu, HI: ASEE.

Wilde, R. (n.d.). *The industrial revolution - An overview*. Retrieved from http://europeanhistory.about.com/od/theindustrialrevolution/p/OverIndRev.htm

Williams, S., Mossbrucker, J., Reyer, S., & Petersen, O. (2005). Preparing for uncertainty - Addressing globalization in an engineering curriculum. *Proceedings of the 2005 ASEE Annual Conference & Exposition. Session 2661.* Portland, OR: ASEE.

Zamrik, S. (2007). Workforce issues and partnerships in mechanical engineering. *Proceedings of the Middle East Mechanical Expo Conference and Exhibit.* Manama, Kingdom of Bahrain: Mechanical Engineering.

Zhao, Y. (2009). Needed: Global villagers. *Teaching for the 21st Century, 67* (1), pp. 60-65.

Z-test for two proportions. (2005). Retrieved from http://www.dimensionresearch.com/resources/calculators/ztest.html

Appendices

Appendix A: Informed Consent and Online Survey Instrument

BYU

MECHANICAL ENGINEERING

INFORMED CONSENT TO PARTICIPATE IN RESEARCH AND SURVEY

IRB Approval Number (IRB#20100410438 EX)

Title of Research Project: An Evaluation of Competencies Considered by Multinational Companies When Hiring Mechanical Engineers to Work in a Global Environment

The purpose of this study is to ***identify if multinational companies consider global competence an important skill in mechanical engineering graduates when making hiring decisions.*** This will include an evaluation of standard hiring technical engineering competencies with a list of global competencies for engineering. This research will provide benchmark information for college and university engineering departments and programs to evaluate their approach in adequately preparing engineers to work in a global environment. You were invited to participate because you are a BYU Mechanical Engineering alumnus.

This survey is being conducted by Gregg Warnick (Mechanical Engineering External Relations Coordinator) at Brigham Young University (BYU) and PhD candidate in the Educational Administration department at the University of Nebraska-Lincoln (UNL). We invite you to take part in this research study.

Procedures:

Participation in this study will require approximately 15 minutes or less of your time to complete the survey. Questions include general information concerning your education, employment, company, and a comparison of competencies for engineers considered by your company when making hiring decisions for mechanical engineers to be successful working in a global environment.

Risks or Discomforts:

There are no known risks or discomforts associated with this research.

Benefits

You may not benefit directly as a result of taking part in this study, but knowledge may be gained that might benefit others.

Compensation:

Survey participants who choose to provide contact information will be eligible for a random drawing to receive one of two BYU Mechanical Engineering Leatherman® multi-tools (Retail value of $46.00) or one of ten Mechanical Engineering T-shirts (Retail value of $9.95).

Confidentiality:

Any information obtained during this study which could identify you will be kept strictly confidential. The data will be stored in a locked cabinet in the investigator's office and will only be seen by the investigators during the study and for the three years after the study is complete. The information obtained in this study may be published in professional journals or national and international conferences but the data will be reported as aggregate data only.

Opportunity to Ask Questions:

You may ask any questions concerning this research and have those questions answered before agreeing to participate in or during the study. If you have questions regarding this study you may contact:

- Gregg Warnick, Mechanical Engineering Department External Relations Coordinator. Tel: (801) 422-6322; E-mail: gmw@byu.edu
- Dr. Larry Dlugosh, Educational Administration Department Chair and Professor. Tel: (402) 472-0975; E-mail: ldlugosh1@unl.edu

If you have any questions about being a research participant or to report any concerns about the study, you may contact the UNL Institutional Review Board at (402) 472-6965

Please contact the BYU Institutional Review Board Administrator at (801) 422-1461, A-285 ASB, Campus Drive, Provo, UT 84602, irb@byu.edu if you have additional questions regarding your rights as a research participant.

Freedom to Withdraw:

Participation in this study is voluntary. You may withdraw at any time without penalty or refuse to participate entirely without harming your relationship with the researchers, the University of Nebraska-Lincoln, or Brigham Young University. Leaving the study will not cause a penalty or loss of any benefits to which you are otherwise entitled.

We appreciate your efforts in helping us improve our program. We invite you to **print** a copy of this informed consent page for your records.

Please select "Yes" to provide your informed consent to participate in this survey or select "No" if you choose not to participate. *To confirm your response, please click on the arrow button at the bottom right.*

Yes ○ No ○

0% 100%

>>

BYU

MECHANICAL ENGINEERING

Please indicate the type of Mechanical Engineering degree(s) you received from Brigham Young University (BYU). If you received more than one degree type from BYU, please select all that are applicable (Due to consolidation of engineering programs - Design Engineering Technology (DET) and Manufacturing Engineering (MFE) graduates are included in the Mechanical Engineering data).

BS	MS	PhD
☐	☐	☐

Please indicate the year that you received your latest degree in Mechanical Engineering from BYU.

0% 100%

BYU

MECHANICAL ENGINEERING

Which of the following best describes your employment status?

- Employed, working 30 hours or more per week
- Employed part time, working less than 30 hours per week
- Self-employed
- Stay-at-Home Parent
- Not currently employed
- Retired
- Student

0% 100%

BYU

MECHANICAL ENGINEERING

The industry that you currently work for is best categorized by which one of the following?

- ○ Aerospace/Aviation
- ○ Automotive
- ○ Construction
- ○ Consulting
- ○ Consumer Products
- ○ Education
- ○ Government/Military
- ○ Manufacturing
- ○ Media / Entertainment
- ○ Medical / Pharmaceutical / Bio-tech
- ○ Petroleum / Energy
- ○ Technology
- ○ Other

What title most closely matches your current job title?

- ○ CEO / President / Owner
- ○ Vice President
- ○ Director
- ○ Engineering Manager
- ○ Engineering Supervisor
- ○ Engineer
- ○ Other

How many employees (worldwide) does your company employ?

- Less than 50
- 50 to 99
- 100 to 499
- 500 to 999
- 1,000 to 4,999
- 5,000 to 10,000
- More than 10,000

What is the approximate annual revenue (US $) of your company?

- Less than $10 million
- $10 million to $99 million
- $100 million to $499 million
- $500 million to $1 billion
- Over $1 billion
- Don't know

Does your company conduct business internationally or have at least one operation in a different country?

Yes No

0% 100%

<< >>

BYU

MECHANICAL ENGINEERING

What is the approximate percentage of total company revenues that comes from operations outside of the United States?

- 0-20%
- 21-40%
- 41-60%
- 61-80%
- 81-100%
- Don't know

Are you directly involved in making hiring decisions for new engineers with your company

Yes	No
○	○

0% 100%

BYU

MECHANICAL ENGINEERING

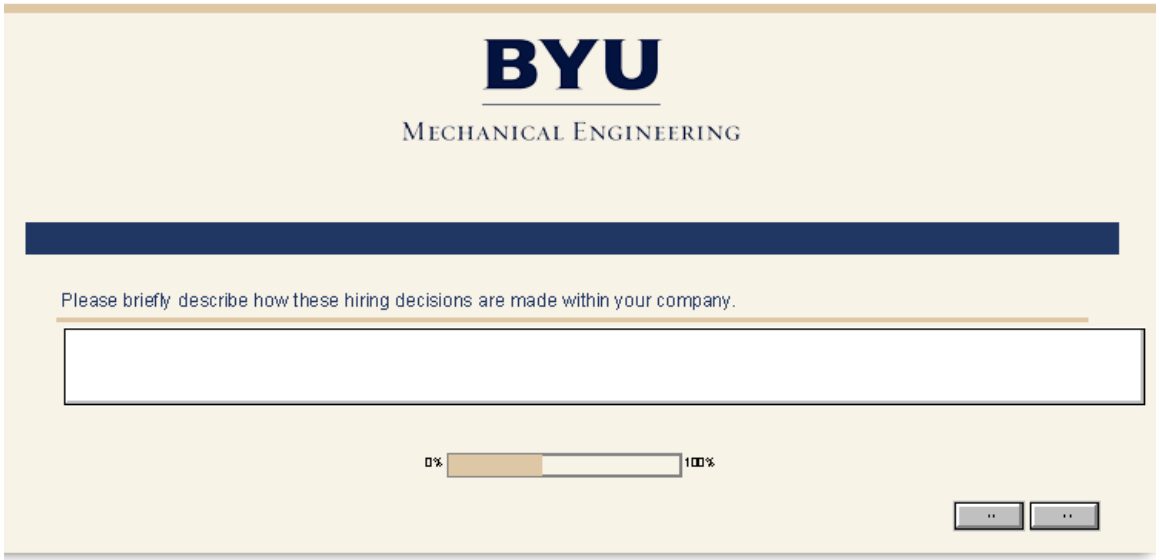
What is the approximate percentage of total company revenues that comes from operations outside of the United States?

- 0-20%
- 21-40%
- 41-60%
- 61-80%
- 81-100%
- Don't know

Are you directly involved in making hiring decisions for new engineers with your company

Yes No

0% 100%


BYU
MECHANICAL ENGINEERING
Please briefly describe how these hiring decisions are made within your company.
0%
100%

BYU

MECHANICAL ENGINEERING

NOTE: To ensure consistency, please read the definition provided for each competency by placing your mouse cursor over the statement and a pop-up screen will be displayed. To have it reappear, move your cursor away from the statement and then back to the statement.

How important is it for Mechanical Engineers hired by your company who will either work immediately or eventually in a global environment to have:

	Unimportant	Of little Importance	Moderately Important	Important	Very Important
a high GPA	○	○	○	○	○
an ability to exhibit a global mindset	○	○	○	○	○
an ability to apply knowledge of mathematics, science and engineering.	○	○	○	○	○
an ability to appreciate and understand different cultures	○	○	○	○	○
an ability to design and conduct experiments, as well as to analyze and interpret data	○	○	○	○	○
	Unimportant	Of little Importance	Moderately Important	Important	Very Important
an ability to demonstrate world and local knowledge	○	○	○	○	○
an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	○	○	○	○	○
an ability to communicate cross-culturally	○	○	○	○	○
an ability to speak more than one language including English	○	○	○	○	○
an ability to identify, formulate, and solve engineering problems	○	○	○	○	○
	Unimportant	Of little Importance	Moderately Important	Important	Very Important
an ability to understand international business, law, and technical elements	○	○	○	○	○
an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	○	○	○	○	○
an ability to live and work in a transnational engineering environment	○	○	○	○	○
an ability to work in international teams	○	○	○	○	○
pertinent applicable work experience	○	○	○	○	○

Please list any additional competencies your company considers when hiring new Mechanical Engineers to work in a global environment.

0% 100%

>>

BYU

MECHANICAL ENGINEERING

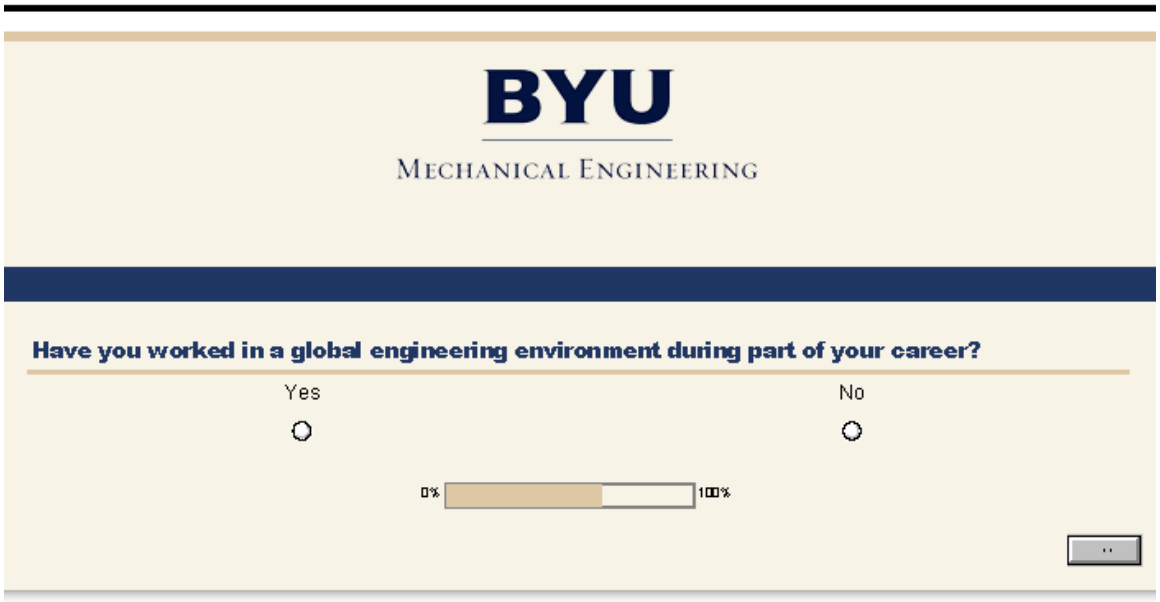
Please indicate your agreement with the following statements

My company:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
is willing to provide the appropriate training / experience for engineers to be successful in a global environment	○	○	○	○	○
is successful at providing the appropriate training / experience for engineers to be successful in a global environment	○	○	○	○	○
values the efforts of college/university engineering departments/programs to prepare engineers to work in a global environment	○	○	○	○	○
considers college/university engineering departments/programs successful at preparing engineers to work in a global environment	○	○	○	○	○

What can college/university engineering departments do to better prepare engineers for success in a global engineering environment?

0% 100%


BYU
MECHANICAL ENGINEERING
Have you worked in a global engineering environment during part of your career?
Yes
No
0%
100%

BYU

MECHANICAL ENGINEERING

How many different countries have you visited in the context of your career? *Note: do not include countries visited only for vacation purposes*

- None
- 1-3
- 4-6
- 7-9
- 10-12
- 13 or more

Please select all the continents you have visited in the context of your career. *Note: do not include continents visited only for vacation purposes*

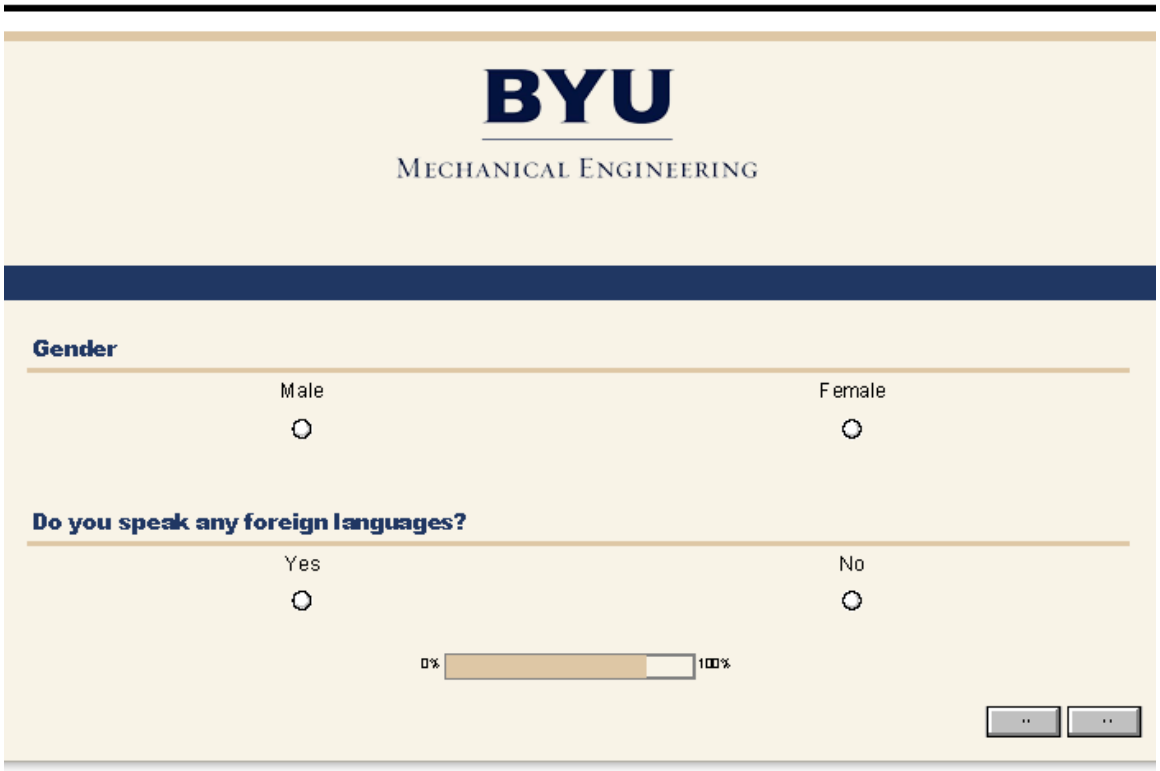
- Africa
- Antarctica
- Asia
- Austrailia / Oceania (Austrailia, New Zealand, Polynesia, etc.)
- Europe
- North America
- South America

What do you wish you would have known upon completion of college to better prepare you to work successfully in a global engineering environment?

Please describe what has best helped you prepare for and obtain success when working in a global engineering environment.

0% 100%

<< >>


BYU
MECHANICAL ENGINEERING
Gender
Male
Female
Do you speak any foreign languages?
Yes
No
0%
100%

BYU

MECHANICAL ENGINEERING

Language Proficiency

Please list and rate your foreign-language proficiencies (do not include English)

* *Elementary* = can fulfill basic travel needs and conduct yourself in a polite manner. Able to use questions and answers for simple topics within a limited level of experience

* *Limited working* = able to satisfy routine social demands and limited work requirements and can handle with confidence most basic social situations; can handle limited work requirements, needing help in handling any complications or difficulties; can get the gist of most conversations on non-technical subjects (i.e. topics which require no specialized knowledge).

* Professional working = able to speak the language with sufficient structural accuracy and vocabulary to participate effectively in most conversations on practical, social, and professional topics; can discuss particular interests and special fields of competence with reasonable ease and has comprehension which is quite complete for a normal rate of speech.

* *Native/Fluent* = has a speaking proficiency equivalent to that of an educated native speaker; has complete fluency in the language.

	Elementary	Limited Working	Professional Working	Native/Fluent
2nd Language	○	○	○	○
3rd Language	○	○	○	○
4th Language	○	○	○	○

0% 100%

BYU

MECHANICAL ENGINEERING

Thank you for your participation in this survey. If you *do not* wish to provide your contact information and do not want to be eligible for the Leatherman® multi-tool or BYU Mechanical Engineering T-shirt please click on the arrow key (bottom right).

If you *would like* to be eligible for a random drawing to win one of two BYU Mechanical Engineering Leatherman® multi-tools (Retail value of $46.00) or one of 10 Mechanical Engineering T-shirts (Retail value of $9.95) please complete the personal contact information below. Once you have completed the personal information, please click on the arrow key (bottom right).

Personal Contact Information

First Name	
Last Name	
Employer	
Street Address	
City	
State	
Country	
Zip Code	
E-mail	
Phone (e.g. 5552221111)	
T-shirt Size (S, M, L, XL, XXL)	

0% 100%

BYU

MECHANICAL ENGINEERING

We thank you for your time spent taking this survey.
Your response has been recorded.

0% 100%

Survey Powered By Qualtrics

Appendix B: UNL IRB New Protocol Submission

Nebraska Lincoln

University of Nebraska-Lincoln Institutional Review Board (IRB) 312 N. 14th St., 209 Alex West Lincoln, NE 68588-0408(402) 472-6965 Fax (402) 472-6048 irb@unl.edu	FOR OFFICE USE ONLY IRB #: 20100410438 EXIRB Decision Date: 04/13/2010 Date Received: 04/05/2010 Code #: IRB Project ID: 10438 Form ID: 10438 Status: Approved by the IRB

IRB New Protocol Submission

Project Title: Comptencies Considered by Multinational Companies When Hiring Mechanical Engineers to Work in a Global Environment

Investigator Information:

Principal Investigator:	Gregg Warnick	Secondary Investigator:	Larry Dlugosh
Department:	Department of Educational Administration	Department:	Department of Educational Administration
Contact Phone:		Contact Phone:	(402)472-0975
Contact Address:	967 E 370 S Santaquin, UT 84655	Contact Address:	141C TEAC, UNL, 68588-0360
Email Address:	gregg_warnick@byu.edu	Email Address:	ldlugosh1@unl.edu

* Student theses or dissertations must be submitted with a faculty member listed as Secondary Investigator or Project Supervisor

Principal Investigator Is: Graduate Student
Type of Project: Research

Does the research involve an outside institution/agency other than UNL? Yes

If yes, please list the institutions/agencies:
Brigham Young University (Provo, UT)

Where will participation take place? (e.g., UNL, at home, in a community building, etc)
BYU plans to review the IRB approval from UNL and then would submit a letter in support of the application if UNL approves it. BYU alumni would be the group used for human subject research through an administered survey of hiring managers working for multinational firms.

* Note: Research can only begin at each institution after the IRB receives the institutional approval letter

Nebraska Lincoln

Project Information:

Present/Proposed Funding Source:
Project Start Date: 04/09/2010
Project End Date: 09/30/2010

1. Does the research involve prisoners?

No

2. Will the research only be conducted in schools or educational settings?

No

3. Does the research involve only the use of educational tests, survey procedures, interview procedures, or observation of public behavior? (The use of pre-existing data does not fall into this category.)

Yes

Does the research involve children (under 19 years of age)?

No

Is the information recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects?

No

Could any disclosure of the human subjects' responses outside the research reasonably place the subjects at risk of criminal or civil liability or be damaging to their financial standing, employability, or reputation?

No

4. Does the research involve only the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens?

No

5. Does the research involve only studying, evaluating or examining public benefit or service programs?

No

6. Does the research involve only a taste and food quality evaluation or food consumer acceptance study?

No

Description of Subjects:

Total number of participants (include 'controls'): 3200

Will participants of both sexes/genders be recruited? Yes
Will participation be limited to certain racial or ethnic groups? No
What are the participants' characteristics?
Mechanical Engineering alumni of Brigham Young University. Focus will be on individuals who work for multinational companies and who are involved in hiring decisions

Type of Participant: (check all appropriate blanks for participant population)

X	Adults, Non Students		Pregnant Women		Persons with Psychological Impairment
	UNL Students		Fetuses		Persons with Neurological Impairment
	Minors (under age 19)		Persons with Limited Civil Freedom		Persons with Mental Retardation
	Adults with Legal Representatives		Persons with HIV/AIDS		

Other (Explain):
It is unknown if any alumni are pregnant, but this is not a consideration for completing a survey instrument

Unique Research Methodology or Data Sources

Will your project involve audio taping? No

Is this project web-based research? Yes

For web-based studies, how will the data be handled? Will the data be sent to a secure server? Will the data be encrypted while in transit? Will you be collecting IP addresses?

A standardized survey instrument will be utlized to distribute the survey and to collect responses. IP addresses are collected by the survey system to ensure unique identifiers of data.

Is this study utilizing Protected Health Information (PHI; e.g., information obtained from a hospital, clinic, or treatment facility)? No

Does this project involve genetic data/sampling/analysis, illegal drug use, or criminal activity that places the participant at risk for legal action? No

Does this project involve photography? No

Does this project involve videotaping? No

Does this project involve archival or secondary data analysis? No

Does this project involve biological samples? No

Project Personnel List:

Please list the names of all personnel working on this project, starting with the principal investigator and the secondary investigator/project advisor. Research assistants, students, data entry staff and other research project staff should also be included. For a complete explanation of training and project staff please go to http://www.unl.edu/research/orr/index.shtml.

Name	Role	UNL Status	Is Involved In Design/Supervision	Is Involved In Data Collection

Project Description

1. Describe the research purpose of the project.

What is the purpose of the study? (Please provide a brief 1-2 paragraph explanation in lay terms, to include a brief literature justification.)

The purpose of this research will be to identify if multinational companies consider global competence an important skill in mechanical engineering graduates when making hiring decisions. This will include an evaluation of standard hiring engineering competencies with a list of global competencies for engineering. This research will provide benchmark information for college and university engineering departments and programs to evaluate their approach in adequately preparing engineers to work in a global environment.

2. Description of the Methods and Procedures.

Describe the data collection procedures and what participants will have to do.

BYU Mechanical Engineering alumni who have an e-mail address filed indicated in the BYU alumni database will receive an e-mail with an invitation to participate in this research survey. En embedded link will be included in the e-mail to enable alumni who choose to participate to easily click on the link and be directed to the Qualtric survey. Alumni will then have the opportunity to respond to the questions included in the survey including both quantitative and qualitative questions.

How long will this take participants to complete?

Approximately 15 minutes to complete the entire survey.

Will follow-ups or reminders be sent?

Yes

If so, explain.
A reminder e-mail will be sent to all alumni with an acknowledgement and thank you to those alumni who have already completed the survey and an encouragement to those that have not to complete the survey. It is anticipated that the survey will be available to alumni for approximately 3 weeks. The reminder will be sent 1 week before the survey is closed.

3. Description of Recruiting Procedures

How will the names and contact information for participants be obtained?
Because of my job responsibilities at BYU I am able to access alumni records through our alumni relations office. All BYU mechanical engineering alumni who have an e-mail listed in the database will be contacted. This will be generated via a query through the BYU alumni relations office. The results of this query will enable us to send an invitation to participate to all identified mechanical engineering alumni.

How will participants be approached about participating in the study?
They will receive an e-mail invitation that includes a brief overview of the research and a link to the Qualtric survey site. The very first page of the online Qualitrics survey is the informed consent document. If they choose to continue with the survey, they are providing their consent to participate in the research. Participants will be encouraged to print the informed consent page for their records.

4. Description of Benefits and Risks

Explain the benefits to participants or to others.
There are no direct benefits to survey participants but knowledge may be gained that might benefit others.

Explain the risks to participants. What will be done to minimize the risks? If there are no known risks, this should be stated.
There are no known risks or discomforts associated with this research.

5. Description of Compensation

Will compensation (including money, gift certificates, extra credit, etc.) be provided to participants?
Yes

If Yes, please describe the amount and type of compensation.
Those survey participants who choose to provide contact information will be eligible for a random drawing to receive one of two BYU Mechanical Engineering Leatherman® multi-tools (Retail value of $46.00) or one of ten Mechanical Engineering T-shirts (Retail value of $9.95).

6. Informed Consent Process

In certain cases for children over the age of 14, such as UNL students who are 17 or 18, waivers of informed consent can be granted.

Would you like to request a waiver of consent?
No

How will informed consent/assent be obtained?

All alumni who choose to participate in the survey will be directed to the first page of the online suvey which includes the informed consent to participate in research and survey document. It clearly states that if they select the arrow keys at the bottom right of the survey that they are providing their informed consent to participate in the survey. Participants will be encouraged to print a copy of the informed consent for their records.

7. Description of How Confidentiality will be Maintained

How will confidentiality of records be maintained?

Any information obtained during this study which could identify survey participants will be kept strictly confidential. The data will be stored in a locked cabinet in the investigator's office and will only be seen by the investigators during the study and for the three years after the study is complete. The information obtained in this study may be published in professional journals or national and international conferences but the data will be reported as aggregate data only.

Will individuals be identified?

No

How long will records be kept?

3 years after the study is complete

Where will records be stored?

The data will be stored in a locked cabinet in the investigator's office and will only be seen by the investigators during the study and for the three years after the study is complete.

Who has access to the records/data?

The principal investigator

How will data be reported?

The information obtained in this study may be published in professional journals or national and international conferences but the data will be reported as aggregate data only.

8. Copies of Questionnaires, Survey, or Testing Instruments

Please list all questionnaires, surveys, and/or assessment instruments/measures used in the project.

* BYU Mechanical Engineering Alumni Survey - Importance of global competence (This includes the informed consent form and will be an online survey administered using Qualtrics)
* Alumni Survey Invitation (this will be an e-mail sent to all BYU Mechanical engineering alumni who have an e-mail registered with the BYU alumni relations office).
* Allumni Survey Invitation Follow-up (this will be an e-mail sent to all BYU Mechanical Engineering alumni who received the first invitation. It will be sent about two weeks after the first invitation and approximately 1 week before the survey is closed)

9. Uploaded Attachments

Alumni Survey Invitation.pdf - 14685 Bytes - application/pdf
Alumni Survey Invitation Follow-up.pdf - 14165 Bytes - application/pdf
ME Survey - Importance of Global Competence Rev01.pdf - 50117 Bytes - application/pdf

Email from PI 040910.pdf - 63878 Bytes - application/pdf

Comments:

PI Comments

URC Comments

ORR Comments

Appendix C: BYU IRB Approval Letter

Institutional Review Board
for Human Subjects

Brigham Young University
A-285 ASB Provo, Utah 84602
(801) 422-3841 / Fax: (801) 422-0620

April 13, 2010

Gregg Warnick
425 CTB

Re: Competencies Considered by Multinational Companies When Hiring Mechanical Engineers to Work in a Global Environment

Dear Gregg Warnick

This is to inform you that Brigham Young University's IRB has approved the above research study.

The approval period is from 4-13-2010 to 4-12-2011. Your study number is E100125. Please be sure to reference this number in any correspondence with the IRB.

Continued approval is conditional upon your compliance with the following requirements.

A copy of the Informed Consent Document, approved as of 4-13-2010 is enclosed. No other consent form should be used.

All protocol amendments and changes to approved research must be submitted to the IRB and not be implemented until approved by the IRB.

The enclosed recruitment advertisement has been approved. Advertisements, letters, Internet postings and any other media for subject recruitment must be submitted to IRB and approved prior to use.

A few months before this date we will send out a continuing review form. There will only be two reminders. Please fill this form out in a timely manner to ensure that there is not a lapse in your approval. If you have any questions, please do not hesitate to call me.

Sincerely,

Lane Fischer, Ph.D., Chair
Sandee M.P. Munoz, Administrator
Institutional Review Board for Human Subjects

Appendix D: UNL IRB Approval Letter

Nebraska UNIVERSITY OF Lincoln

April 13, 2010

Gregg Warnick
Department of Educational Administration
967 E 370 S Santaquin, UT 84655

Larry Dlugosh
Department of Educational Administration
141C TEAC, UNL, 68588-0360

IRB Number: 20100410438 EX
Project ID: 10438
Project Title: Comptencies Considered by Multinational Companies When Hiring Mechanical Engineers to Work in a Global Environment

Dear Gregg:

This letter is to notify you of the final approval of your project by the Institutional Review Board (IRB) for the Protection of Human Subjects. It is the Board's opinion that you have provided adequate safeguards for the rights and welfare of the participants in this study based on the information provided. Your proposal is in compliance with this institution's Federal Wide Assurance 00002258 and the DHHS Regulations for the Protection of Human Subjects (45 CFR 46) and has been classified as Exempt Category 2.

1. Please include your IRB approval number (IRB#20100410438 EX) on the online informed consent document. Please email a copy of the document with the number included to irb@unl.edu for our records. If you need to make changes to the message please submit the revised message to the IRB for review and approval prior to using it.

You are authorized to implement this study as of the Date of Final Approval: 04/13/2010. This approval is Valid Until: 09/30/2010.

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:
* Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
* Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
* Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
* Any breach in confidentiality or compromise in data privacy related to the subject or others; or
* Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

This project should be conducted in full accordance with all applicable sections of the IRB Guidelines and you should notify the IRB immediately of any proposed changes that may affect the exempt status of your research project. You should report any unanticipated problems involving risks to the participants or others to the Board.

If you have any questions, please contact the IRB office at 472-6965.

Sincerely,

Becky R. Freeman

Becky R. Freeman, CIP
for the IRB

Association for the Accreditation of Human Research Protection Programs, Inc. Full Accreditation

Appendix E: Survey Invitation

DEPARTMENT OF MECHANICAL ENGINEERING

April 22, 2010

Dear BYU Mechanical Engineering Alumnus:

BYU's Mechanical Engineering department invites you to participate in an alumni survey. Survey participants who choose to participate and provide contact information will be eligible for a random drawing to receive one of two BYU Mechanical Engineering Leatherman® multi-tools (Retail value of $46.00) or one of ten Mechanical Engineering T-shirts (Retail value of $9.95).

The purpose of this survey is to ***identify if multinational companies consider global competence an important skill in mechanical engineering graduates when making hiring decisions.*** This will include an evaluation of standard hiring technical engineering competencies with a list of global competencies for engineering. This research will provide benchmark information for college and university engineering departments and programs to evaluate their approach in adequately preparing engineers to work in a global environment.

You were invited to participate because you are a BYU Mechanical Engineering alumnus. Participation in this study will require approximately **15 minutes or less** of your time to complete the survey. Questions include general information concerning your education, employment, company, and a comparison of competencies for engineers considered by your company when making hiring decisions for mechanical engineers to be successful working in a global environment.

To begin the survey, please click on the link below:

ME Alumni Survey - Importance of Global Competence?

If you encounter problems with the link above, please go to the following website and you will be directed to the online survey: http://me.byu.edu/content/me-survey

The survey will only be accessible for three weeks so we invite you to take a few minutes now to complete the survey. If you have any questions, please feel free to contact me. We appreciate your efforts in helping us improve the Mechanical Engineering program.

GREGG WARNICK
External Relations Coordinator
Department of Mechanical Engineering

BRIGHAM YOUNG UNIVERSITY
425 CTB
Provo, UT 84602
(801) 422-6322 / Fax: (801) 422-0516 / Cell: (801) 602-6044
E-mail: gregg_warnick@byu.edu
Website: www.me.byu.edu

Appendix F: Survey Invitation Follow-up

DEPARTMENT OF MECHANICAL ENGINEERING

May 3, 2010

Dear BYU Mechanical Engineering Alumnus:

We invited you to participate a couple of weeks ago in a survey to help us ***identify if multinational companies consider global competence an important skill in mechanical engineering graduates when making hiring decisions.*** If you have already completed this survey, we thank you for your timely response and the valuable feedback provided to the mechanical engineering program at BYU.

If you have not yet taken the opportunity to participate in the survey, we invite you to complete this survey now, as it will only be available for approximately one more week. **We particularly need additional survey respondents who work for multinational companies and who are at a manager level or higher to complete the survey.**

As a reminder, survey participants who choose to provide contact information will be eligible for a random drawing to receive one of two BYU Mechanical Engineering Leatherman® multi-tools (Retail value of $46.00) or one of ten Mechanical Engineering T-shirts (Retail value of $9.95).

To begin the survey, please click on the link below or go to the following website and you will be directed to the online survey location: http://me.byu.edu/content/me-survey

ME Alumni Survey - Importance of Global Competence?

If you have any questions, please feel free to contact me. We appreciate your efforts in helping us improve the Mechanical Engineering program.

GREGG WARNICK
External Relations Coordinator
Department of Mechanical Engineering

BRIGHAM YOUNG UNIVERSITY
425 CTB
Provo, UT 84602
(801) 422-6322 / Fax: (801) 422-0516 / Cell: (801) 602-6044
E-mail: gregg_warnick@byu.edu
Website: www.me.byu.edu

Appendix G: Survey Results

1. Please select "Yes" to provide your informed consent to participate in this survey or select "No" if you choose not to participate. To confirm your response, please click on the arrow button at the bottom right.

#	Answer		Response	%
1	Yes		558	99%
2	No		3	1%
	Total		561	100%

Statistic	Value
Mean	1.01
Variance	0.01
Standard Deviation	0.07
Total Responses	561

2. Please indicate the type of mechanical engineering degree(s) you received from Brigham Young University (BYU). If you received more than one degree type from BYU, please select all that are applicable (Due to consolidation of engineering programs - Design Engineering Technology (DET) and Manufacturing Engineering (MFE) graduates are included in the mechanical engineering data).

#	Answer		Response	%
1	BS		500	90%
2	MS		136	25%
3	PhD		14	3%

Statistic	Value
Total Responses	553

3. Please indicate the year that you received your latest degree in mechanical engineering from BYU.

#	Answer		Response	%
1	2010		10	2%
2	2009		44	8%
3	2008		31	6%
4	2007		35	6%
5	2006		25	5%
6	2005		22	4%
7	2004		25	5%
8	2003		20	4%
9	2002		16	3%
10	2001		16	3%
11	2000		17	3%
12	1999		17	3%
13	1998		15	3%
14	1997		16	3%
15	1996		11	2%
16	1995		14	3%
17	1994		14	3%
18	1993		13	2%
19	1992		16	3%
20	1991		8	1%
21	1990		11	2%
22	1989		15	3%
23	1988		7	1%
24	1987		10	2%
25	1986		18	3%
26	1985		13	2%
27	1984		13	2%
28	1983		14	3%
29	1982		6	1%
30	1981		1	0%
31	1980		7	1%
32	1979		7	1%

33	1978		4	1%
34	1977		4	1%
35	1976		5	1%
36	1975		7	1%
37	1974		3	1%
38	1973		6	1%
39	1972		4	1%
40	1971		1	0%
41	1970		4	1%
42	1969		1	0%
43	1968		1	0%
44	1967		1	0%
45	1966		0	0%
46	1965		1	0%
47	1964		1	0%
48	1963		0	0%
49	1962		1	0%
50	1961		0	0%
51	1960		1	0%
52	1959		1	0%
53	1958		0	0%
54	1957		0	0%
55	1956		0	0%
56	1955		0	0%
57	1954		0	0%
58	1953		0	0%
59	1952		0	0%
60	1951		0	0%
61	1950		0	0%
	Total		553	100%

Statistic	Value
Mean	14.95
Variance	124.16
Standard Deviation	11.14
Total Responses	553

4. Which of the following best describes your employment status?

#	Answer		Response	%
1	Employed, working 30 hours or more per week		445	81%
2	Employed part time, working less than 30 hours per week		3	1%
3	Self-employed		22	4%
4	Stay-at-Home Parent		6	1%
5	Not currently employed		11	2%
6	Retired		10	2%
7	Student		55	10%
	Total		552	100%

Statistic	Value
Mean	1.89
Variance	3.84
Standard Deviation	1.96
Total Responses	552

5. The industry that you currently work for is best categorized by which one of the following?

#	Answer		Response	%
1	Aerospace/Aviation		113	24%
2	Automotive		22	5%
4	Construction		8	2%
5	Consulting		19	4%
6	Consumer Products		16	3%
3	Education		18	4%
7	Government/Military		57	12%
8	Manufacturing		50	11%
9	Media / Entertainment		2	0%
10	Medical / Pharmaceutical / Bio-tech		29	6%
11	Petroleum / Energy		49	10%
12	Technology		35	7%
13	Other		51	11%
	Total		469	100%

Other
Legal
Pharmacy/Healthcare
Defense
Legal
Software Development
Semiconductor
Chemical/Environmental
commercial equipment
Engineering Software
Mortgage Lending
Insurance
legal
Automation Distribution
Off-highway
Electric Utility

software development
Nuclear Energy
Computer Science
Chemical
Defense Contractor
Defense Industry
PROCESS CONTROLS
Printing
Nuclear Waste
Manufacturing/Technology
Public Utility
Semiconductor
Sporting Goods
Food
Software Development
Nuclear Energy
Software Development
Public Utility
Energy Conservation
Utility
mining
Industrial controls
Engineering Software
Industrial Equipment
Law
Wholesale distribution
Telecommunications
Traffic Detection
nuclear
HVAC
industrial Equipment
Legal
Chemicals/Plastics
Foundry

Statistic	Value
Mean	6.74
Variance	18.92
Standard Deviation	4.35
Total Responses	469

6. What title most closely matches your current job title?

#	Answer		Response	%
1	CEO / President / Owner		30	6%
2	Vice President		16	3%
3	Director		34	7%
4	Engineering Manager		56	12%
5	Engineering Supervisor		41	9%
6	Engineer		221	47%
7	Other		71	15%
	Total		469	100%

Other
Attorney
Consultant
Scientist
Senior Data Analyst
Marketing Engineer
Video Production group manager
Lean Division Specialist
Associate Attorney
Professor
Technical Marketing Manager
corporate counsel
professor
Faculty
Energy Production Supt
Loan Officer
Pilot

Owner
Branch manager
Program Manager
Software Engineer
Business Development Mgr
Senior Developer
Regional Manager
SALES ENGINEER
Project Manager
Project Manager
Professor
Product Manager
Program Manager
Technical Sales Engineer
Project Engineer
Project Manager
Teacher
Professor
Business Owner
Scientist
Faculty
Associate Professor
Manufacturing Manager
Development Manager
Product Planning and Strategy Analyst
Professor
Program Manager
Database Manager
Integration Specialist
Teacher
Planning & Strategy Analyst
Sr IE
Program Manager
Senior Financial Specialist

Attorney
Airline Pilot
Pricing Manager
Business Analyst
Engineering IT - Senior Manager
Project Leader
Director of Training
No Titles at Gore
Sales Engineer
Partner
Math/German Teacher
Sales Engineer
Continuous Improvement Manager
Lead Engineer
Supplier Development Manager
Global Marketing Director
Plant Manager
Technical Sales

Statistic	Value
Mean	5.47
Variance	3.56
Standard Deviation	1.89
Total Responses	469

7. How many employees (worldwide) does your company employ?

#	Answer		Response	%
1	Less than 50		65	14%
2	50 to 99		21	4%
7	100 to 499		38	8%
3	500 to 999		28	6%
4	1,000 to 4,999		53	11%
5	5,000 to 10,000		55	12%
6	More than 10,000		209	45%
	Total		469	100%

Statistic	Value
Mean	4.69
Variance	3.65
Standard Deviation	1.91
Total Responses	469

8. What is the approximate annual revenue (US $) of your company?

#	Answer		Response	%
1	Less than $10 million		68	17%
2	$10 million to $99 million		46	12%
3	$100 million to $499 million		34	9%
4	$500 million to $1 billion		29	7%
5	Over $1 billion		215	55%
	Total		392	100%

Statistic	Value
Mean	3.71
Variance	2.59
Standard Deviation	1.61
Total Responses	392

9. Does your company conduct business internationally or have at least one operation in a different country?

#	Answer		Response	%
1	Yes		392	84%
0	No		77	16%
	Total		469	100%

Statistic	Value
Mean	0.84
Variance	0.14
Standard Deviation	0.37
Total Responses	469

10. What is the approximate percentage of total company revenues that comes from operations outside of the United States?

#	Answer		Response	%
1	0-20%		97	25%
2	21-40%		58	15%
3	41-60%		67	17%
4	61-80%		52	13%
5	81-100%		12	3%
6	Don't know		104	27%
	Total		390	100%

Statistic	Value
Mean	3.35
Variance	3.69
Standard Deviation	1.92
Total Responses	390

11. Are you directly involved in making hiring decisions for new engineers with your company?

#	Answer		Response	%
1	Y		154	39%
0	N		237	61%
	Total		391	100%

Statistic	Value
Mean	0.39
Variance	0.24
Standard Deviation	0.49
Total Responses	391

12. Please briefly describe how these hiring decisions are made within your company.

- I manage a group of Statisticians at HP. We hire heavily out of India (4 of my staff are in the U.S., 8 are in Bangalore). We hire based on a strong mix of education, experience and international experience.
- Experience, GPA, IQ, personality. The deciding factor is if they are people I would want on my team.
- Employment seekers review posted jobs and submit resumes. HR weeds out the best based on secret squirrel decoder rules and send the top 10% to the manager. As part of the skill team he and his senior engineer will review them and invite the top 5 for an interview. We look for skill set communication ability, willingness
- To be a team player and rate the general competence. The manager makes the final decision.
- Initial screening by HR. Interview w/ VP of R&D. Group interview with R&D Design Engineers. Collective review of candidates by R&D staff for selection. Final decision from VP.
- Human Resources department takes care of the first contact and contracts. The final decision is done by the supervisor that the candidate will report.
- I operate a small LLC which provides consulting engineering to support the Flight Testing of new certification and / or modifications to aircraft. In this small community, I affiliate and / or hire according to Experience in Flight Test. Competency in a foreign language is less a factor, since the language of Flight Test is English. I do value the ability to quickly adapt to challenging engineering projects. When these opportunities arise, those individuals who have solid engineering skills will succeed in the international environment. There are several opportunities for

Flight Test in China which is currently being staffed. It would certainly be helpful to have a Mandarin speaker on our team, but in our meetings in China, we have been able to hire local interpreters to support general discussions. One challenge we have encountered is to hire an interpreter with the appropriate vocabulary skills to address engineering terms.

- Several engineers individually interview each candidate that makes it to interviewing stage. Each engineer provides feedback to the committee that ultimately makes the hire decision.
- Review the resume looking for education and experience, Interview to confirm abilities, tests from human resources
- Ability to solve problems and communicate is evaluated in a 50 minute college campus interview followed by a 4, 1 hour interviews on site. Higher consideration is given to real world experience, analytic ability, and communication (including foreign language ability), than is given to GPA.
- Based on workload and skills needed.
- The hiring committee decides who to interview and then the candidates are interviewed by different attorneys with similar backgrounds. The interviewing attorneys then rate the candidate. The hiring committee then reviews the reviews and decides whether to hire the candidate. This can also involve more than one interview and the candidate may be invited to a summer internship, after which the candidate is further reviewed by those who worked with the candidate and then the hiring committee decides who to hire.
- Initial screening interview on campus. Follow-up phone interview to evaluate further. On-site, full day interview with multiple departments. All interviewers meet to discuss the characteristics of the interviewee and make a recommendation to the hiring manager. Hiring manager extends the offer.
- Prospects interviewed by managers who recommend whether to hire or not hire. Final authorization for professional positions comes from me.
- Starts with recruiting at campus career fairs, resumes are received directly from students, based on short interaction time and resume a few are selected for interviews, based on interviews a few are recommended for on-site visits / interviews. Other interviewers decide if student will receive offer.
- Phone and face-to-face interviews followed by internal discussion.
- We hire the candidate who is best prepared to become competent in multibody dynamics simulation.
- Manager where new employee will be working assembles a group of members of the team that would be working with new employee to do a group interview. In addition, manager might interview one-on-one and previous to this step, there is a phone interview.

- HR prescreens candidates based on position description and requirements from hiring manager. Selected candidates are interviewed by multiple people who would interact with the candidate including managers and peers. Group reviews strengths and weaknesses and hiring manager makes the decision
- There are 2 managers who run our company, and we are not going to hire in foreseeable future
- I make sure they have a technical background and that they have very good English skills.
- Professional experience, creativity, and experience using our products are the 3 main things I look for in an engineer or designer.
- The research and development team meets together with candidates to interview them.
- Hiring decisions are made largely on personality and cultural fit. Our philosophy is that skills can be taught, personalities are harder to change.
- The nine or ten engineering faculty get together and discuss the applicants. We rate them, and invite the top 2 or 3 for interviews. We then get together again, and rate them based on the interviews.
- On need. Supervisors pick their candidates with Management approval.
- Campus screening process; referrals to appropriate divisions; phone screen interview; on-site interviews
- Structured interview process -- behavioral examples that show candidate has critical skills and attributes and has a demonstrated history of strong performance.
- Faculty within the ME department participate in interviews and observe teaching methods. We later meet and discuss our insights into the applicant and make a decision.
- The department has a need for more engineers and we sift through resumes that we have had from job fairs.
- Our interview process is as follows: / 1) We start off by having the candidate take a PI (Predictive Index) survey over the Internet prior to meeting with us. The PI is a personality type survey. / 2) Candidate interviews individually with engineers (Phase 1), and then if the interviews went well, with management (Phase 2) / 3) We interview for technical abilities, interpersonal abilities and type of experience. / 4) After the interviews, we meet as a team to discuss and compare notes from our individual interviews with the candidate and make a decision.
- We go through a process called "select the best" where we match the engineering job duties to the best qualified individual, using interviews, spreadsheets, references and tours.
- We define qualifications based on competency, corporate culture, years of experience, pay scale, and other various skills. We take the candidate that most closely meets the qualifications.

- As a U.S. Air Force Wing Commander, I supervise hiring at my wing. New engineers are vetted by commanders one or two levels of supervision above the new hire's position. Criteria for selection include: military record, degree type, GPA, past duty assignment experience and recommendations from former commanders.
- Positions open due to company growth or from a departure of a current engineer. Typically added when current or anticipated workload exceeds available work hours available. Usually the manager come to me and asks per emission to add another engineer to the staff.
- Hiring decisions are based on relevant work experience and potential growth. Engineer positions are viewed as launching pads operation and marketing management and we want those slots to be filled with high potential employees.
- Interviews and targeted college recruits
- Standard interview process with multiple, cross-functional team members based on the role and capabilities required.
- Resumes screened based on qualifications hiring manager sets up. Hiring manager conducts phone interviews and decides which candidates to bring in for interviews. STAR interview system is used.
- Our company hires only the top engineering students in their class. Relevant skills and experience are critical in the decision making process.
- Engineering managers are responsible for selecting qualified candidates, interviewing, and extending offers.
- Behavioral interviews, Multiple cross functional interviewers, consensus decisions on hires.
- Education, work experience, industry experience, personality fit, strength of references to fit a need based on business forecasts. First and second level manager's interview. Hiring authority approved at General Manager level
- Resumes are submitted by candidates, obtained by searches on the web, or at job fairs. Resumes are pre-screened by HR for general qualifications, including education, experience, as well as salary expectations, submitted in the form of a detailed job application. Acceptable resumes are submitted to hiring managers for consideration. The best candidates are phone interviewed, followed by onsite interviews if successful. Onsite interviews are conducted by 3-7 people - including possible supervisors, peers, manufacturing and HR representatives. The team of interviewers get together to recommend extending an offer. Senior engineering management weekly gathers to review all of the documentation and the recommendations, and then make the final decision to extend an offer as well as establishing the salary, moving allowance, vacation and other benefit levels.
- Resumes are collected via a website and reviewed by the hiring manager. Resumes are reviewed and generally an interview panel is convened.
- Skill set and individual responsibility and personality

- I work for the US Navy in Korea. We hire a couple of engineers every few years at an intermediate to higher level. I direct a hiring board of three people who review resumes and interview most likely candidates.
- Fairly typical posting/resume review/interviewing/background and reference checking.
- Computer scan resumes. Then we review resumes scanned by computer and then select 5 individuals to interview by a panel
- The need for new engineering staff is determined by corporate goals and objectives and if we currently have the resources to meet those goals. We typically try to hire local individuals with relevant experience.
- Resume review followed by interview(s). Decision based on experience, competency, and other factors.
- We hire from a skills, experience and cultural based perspective.
- Engineers assist managers in interviewing candidates. Engineers provide feedback to managers on who to hire.
- Candidate applies on line to HR. Resumes are screened and likely candidates are sent to the hiring managers for further discussion and interview.
- Short resume review, verbal telecon, written evaluation, decision on interview, face to face interview, decision on hire
- Potential employees submit their resumes to HR. After a screening process at HR, the best applicants come in for interviews with HR, engineering managers, and a peer group. The interviewers pass along their interview recommendations and if the decision to proceed is made, the applicant is given an offer.
- Technical competence and an ability to work in a team rank very high on the metrics, often new employees come through existing trusted relationships with peers, peer institutions or schools
- I perform technical interviews to qualify applicants.
- Depending on the position, openings are filled through word of mouth, campus interviews, or a recruiter.
- Current hiring decision are made by upper management in regards to entrance considerations for new college grads for employment, such as grade point average, starting salaries, placements.
- Resumes are reviewed and potential candidates selected by the hiring manager for interview. Interviews with managers or senior personnel from several departments are conducted. Interviewers provide feedback to the hiring manager who decides whether or not to extend offer(s).
- Behavioral interviewing by teams of 5 to 6 managers and peers. Candidates apply online, HR filters candidates per pre-determined criteria, filtered candidates forwarded to hiring manager, hiring manager decides whether to interview, interview

performed, decision made my hiring manager whether to extend offer, HR makes offer

- Standardized sets of questions from competencies associated with a particular job family and job code conducted using a team interview
- We typically look at the following in choosing a candidate for hire: / Resume' / Degree and GPA / Extracurricular involvement / Type of personality / compatibility with current staff / Phone interview / Reference check / Onsite interview including brief test of engineering analytical skills / / Interviews are conducted by the Engineering Manager, Human Resources Manager and President
- Traditional interview process
- Applicants are interviewed, and based upon required skills and personal attitude towards work and views, are hired.
- We conduct interviews, review resumes, look for background in areas relating to assessment of systems performance and writing skills.
- Required minimum criteria are listed and given to HR. HR reviews resumes to make sure the criteria are met. The resumes that meet the criteria are sent to the manager of the department to review. Depending on the position, the manager may select to conduct a phone interview or to bring the candidate in for an in-person interview.
- Committees evaluate, administrators make final decisions. Students are hired by individual professors.
- Through the hiring manager
- First review resumes, then phone screen top candidates, and those making it past that will come to the plant for an all day interview. A meeting is then held to discuss the various candidates and a decision is then made.
- Candidates are selected using various methods including online job search engines, local campus recruiting activities and placement agencies. However, the decision is based almost entirely from the candidate interview process. The Engineering Manager, Vise-President of Manufacturing, and President all have an opportunity to interview the candidates. Final selection is entirely subjective.
- I conduct campus interviews at Purdue University. I select candidates to interview and make recommendations of which should be offered on-site interviews. Those selected for on-site interviews are further screened by technical teams for specific job functions.
- A group of engineers look over resumes and perform interviews of finalists. Discussion about the candidates is made and a joint decision comes of it.
- Candidates are invited for an interview. The engineering staff then votes on which candidate will fit best in our organization.
- Typical interview process. We use a recruiting agency (or several). Hiring managers do the interviewing often with a cross section of other interviews with others in the organization that would be key stake holders to the position.

- We usually hire from an internship with the student during the students senior year. This is of course if the student works out during his/her work.
- HR screens through all candidates for basic qualifications then hiring mgr interviews and hires
- Consideration of applications, interviews
- Application packages are screened to ensure minimum requirements meet, such as education, experience, professional certifications, etc. Packages are forwarded to me to review and select top 3 candidates. Phone interviews are conducted with top candidates by a board that includes senior management, other engineers, and me.
- I review resumes that have been screened by HR. Candidates are interviewed by me and others.
- After screening resumes submitted on-line a group interview (one candidate with several engineering supervisors/managers) is held. Candidates are individually rated on competencies for the open position. A "hire-no hire recommendation is given. Depending on the number of open positions, discussions are held to identify the best candidate.
- Hiring manufacturing engineers to support production. Primary evaluation looks at competency in specific manufacturing area (i.e. machining, fabrication, electro-mechanical, etc). Engineering Manager and I individually interview candidate. Candidate is then interviewed by select group of "peer" engineers.
- We're tiny. So it's pretty simple - there aren't guidelines or policies per se, we just hire people we like.
- Interview Process
- Review of resumes, on site interviews and technical seminar, evaluations by interviewers, decision by senior manager
- Candidates selected from resumes responses to internal and/or external postings for free form phone interviews. A few of these are selected for in house interviews and then a group of interviewers determines the best candidate to whom an offer is made.
- A faculty committee makes recommendations. The faculty votes on the recommendation.
- Interview by staff, those who the candidate will work for and with.
- The resumes are screened and only the best candidates are brought in for an interview. We then have several engineers and managers interview the candidates. They send the evaluations to the hiring manager. The hiring manager then makes the decision.
- Need recognized, manager request approval to hire, application submitted online, HR/Managers take an initial cut, lead engineers and managers place a phone call, candidate is brought in for an in person interview. If skills are applicable the candidate will be hired.
- Hiring manager interviews and decides on candidates.

- Our hiring centers around identifying key traits in people by finding out how they have acted in situations in their past.
- My company is small enough that I seek out the people I want to hire, and make them an offer.
- For new graduates, a cross functional interview panel followed by each functional area selecting candidates that match needs.
- HR filters resumes. Candidates come for interviews. Several interviewers meet with the candidate individually to discuss different aspects of their qualifications. The interviewers come together to discuss the candidate. The interviewers submit a written recommendation on whether or not to hire the candidate.
- It falls under my budget for each year. I have my director make the final interview decisions.
- We have a very methodical hiring process. International experience is a plus but will not get you in the door initially.
- HR screens applications, hiring manager makes short list, interviews are held at three levels and hiring manager decides and upper levels confirm
- 1. Attitude, 2. Ability to think and communicate, 3. Technical ability, 4. Applicable background
- Personal knowledge of the potential employee by myself, my staff, or other association takes top priority. Then by resume and interview
- Most new hires are recommended through current employees. Interviews confirm competence and experience.
- Once a position is approved all candidates must apply through the corporate web site. After an initial screening by the HR department, the hiring manager then reviews the applications to determine who will be called in for interviews. The hiring manager makes the decision to extend an offer within the scope of the opening.
- Look at resume and if they have necessary qualifications or they have the possibility of gaining those we have them come for an interview.
- Global competence is critical.
- Decisions are made based on the specific job duties required and the candidate's qualifications. The decision is typically made by a collective group of the immediate supervisor, engineering manager and engineering executive along with HR.
- Based on our needs and requirements
- Typical of most organizations
- Hiring decisions are made using typical criteria -- relevant experience, education, etc.
- Resume review and fairly informal interview process
- Personal relationships or knowledge of the individual.
- We post job listing then look at resumes and interview candidates.
- Job positions are marketed or posted for review. Sometimes only within the existing company employee base, other times to outside services. May be only Collage hires,

or professional (experienced) hiring. Various web sites and methods used around the world.

- A minimum of three supervisors in disciplines related to the applicants work background interview the applicant and make recommendations to the HR director.
- Must have an engineering degree from a qualified university (in the past this has been a ABET accredited university). Must pass a structured interview process. The structured interview examines various personal attributes like, communication skills, working together skills, technical skills, collaboration skills, problem solving skills, etc. etc. We ask the person being interviewed to provide examples where these types of skills are demonstrated. An assessment is made from the answers given and a hiring decision follows.
- This question is a little unclear. We approve opening a position, and then we have an engineering director who makes hiring recommendations after interviewing candidates and consulting with project managers. New engineering positions are typically in response to immediate or very near-term demands within a project.
- Interviews to determine which applicant seems best suited for the particular job.
- Hiring is based on need and then correlated with the candidates we have available.
- Technical interviews based on the needs of the business followed up with fit assessment based on the culture of the environment.
- Resumes, interviews, and manager decision
- Spanish and English bilingual. International experience. Willing to move. Teamwork.
- Post job internally/externally. Screen resumes. Phone screen with top candidates. Initial face-to-face interview with hiring manager. Follow-on interview with top 2 or 3 candidates with managers of other related organizations.
- Hiring is done through a STARs process evaluating a candidate and their experiences. A group of hiring managers interview and then make a decision about a particular candidate for a particular job.
- I directly hire approximately 10 engineers per year and send resumes for BYD to hire. BYD China hires over 10,000 international candidates per year.
- Competence, education level, ability to work with others, etc
- Interviews, skill sets, motivation, work habits, maturity
- Based on work experience, education, skill sets, references, candidates are selected and interviewed by hiring authorities, HR, others as needed. Candidates are evaluated and selected/passed
- Based upon matching company's needs versus applicants' qualifications
- We look for a culture fit within our company culture, then evaluate them for technical competence, then determine if their interests / desires fit the job they are interviewing for.
- Hiring of degreed engineers from Mechanical, Electrical, and Civil disciplines based on interview at school and follow up site visit and additional interviews. Quantity of hires based on forecasted need. Typically 100-200 per year.

- 1) Business need / 2) Job definition / 3) Job advertisement, referrals, search firm / 4) Resume & application / 5) Phone interview / 6) Face-to-face interviews / 7) Job offer
- We rely heavily upon referrals.
- College relations department determines which Universities we partner with. Team of senior managers visit and review candidates/resumes. Call is made for resume and team of 5 managers down select from 1000's of resume to top 10-20% of candidates. On average 10 candidate resumes are floated to a Line manager with open position to select from. Hiring manager interviews candidate via phone or in person for skills/experience match and either extends offer or request additional resumes. Process is repeated until skill set/experience match is found.
- I interrogate and supply my opinions and findings to the principal owners of the firm.
- Based on need.
- Hiring decisions are made on technical need and financial resources. If the question is how to select a candidate then there are specific requirements. These are generated at the technical group level: technical skills, experience ... The social makeup of the group needs to be considered also. Will the candidate fit in with the group? I am given specific authority to hire who I need. It is my decision. However, I consider the need of the group and the long term impact to the organization.
- Candidates with the best resumes are interviewed on campus, and a select group is then invited to interview at the Company Site, after which offers are extended.
- Hiring decisions are made by the hiring manager, but candidates will go through a series of interviews and the hiring manager receives feedback from everyone that interviews that candidate.
- Department managers get positions approved and filter candidates. When we interview, a cross section team from key functions interview and provide input into hiring decision by the hiring manager
- Open positions are justified based on workload and projected projects. / Hiring managers then work with HR to solicit candidates / Candidates are evaluated for competencies and fit.
- All applicants must apply online. The company will still recruit on campus for screening interviews but the final decisions are made by the hiring managers
- Multiple interviews, thumbs up / thumbs down
- Internet job postings yield resumes that are then "1st order" filtered by HR. Results filtered by hiring manager and final group receives a structured interview by a final review board. Selection then routed back to HR for hiring process.
- Multi Level interviews. Initial screening conducted by HR. 2nd level interview with myself. 3rd level with VP.
- When an opening exists, jobs are posted through Monster, company web site, and job services. Resumes are screened by HR dept. Engineering Manager then further screens and gets approval from me to bring candidates in for interview. After interviews, discussions are held with HR, VP/GM, and Eng. Mgr. on who to hire and offer is made to qualified candidate.

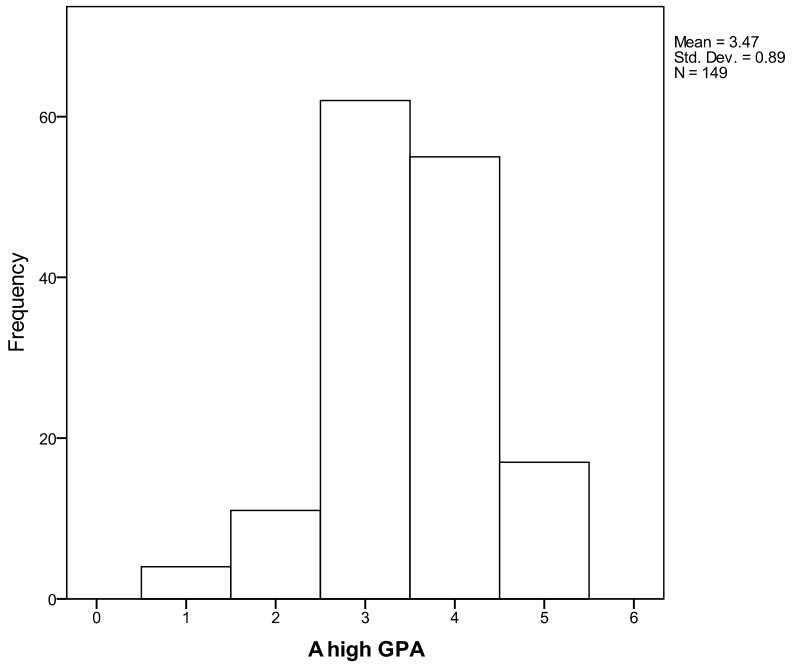
- Need vs. applicant experience.
- Technical Degree / 3.0 GPA / skill sets / security clearance / interviews

Statistic	Value
Total Responses	147

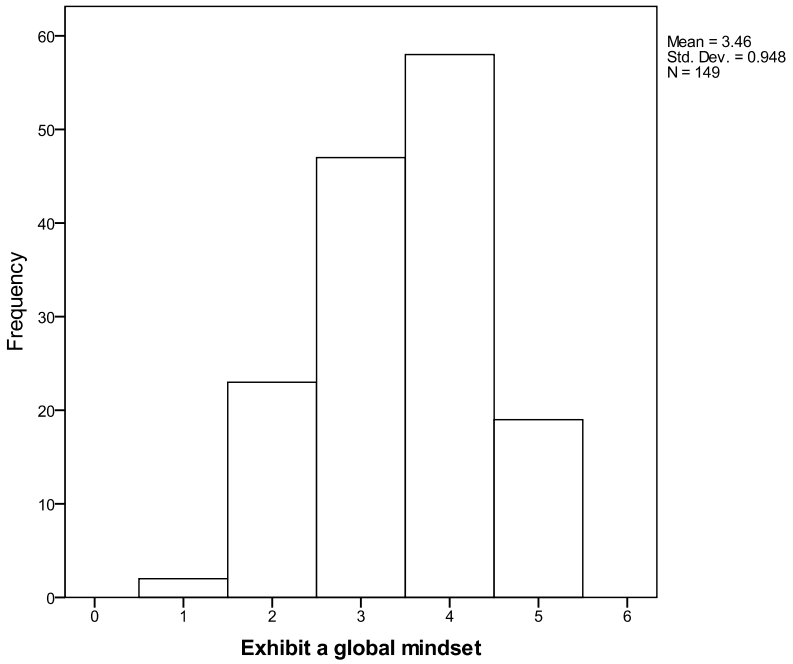
13. How important is it for Mechanical Engineers hired by your company who will either work immediately or eventually in a global environment to have: NOTE: To ensure consistency, please read the definition provided for each competency by placing your mouse cursor over the statement and a pop-up screen will be displayed. To have it reappear, move your cursor away from the statement and then back to the statement. Survey results are provided below for each competency.

#	Question	Unimportant	Of little Importance	Moderately Important	Important	Very Important	Responses
1	a high GPA	4	11	62	55	17	149
2	an ability to exhibit a global mindset	2	23	47	58	19	149
3	an ability to apply knowledge of mathematics, science and engineering.	0	4	7	61	77	149
4	an ability to appreciate and understand different cultures	1	14	48	53	33	149
5	an ability to design and conduct experiments, as well as to analyze and interpret data	0	6	21	45	77	149
6	an ability to demonstrate world and local knowledge	3	29	67	37	13	149
7	an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	1	6	17	59	66	149
8	an ability to communicate cross-culturally	0	14	37	51	47	149
9	an ability to speak more than one language including English	11	46	69	14	9	149
10	an ability to identify, formulate, and solve engineering problems	0	2	6	37	104	149
11	an ability to understand international business, law, and technical elements	5	44	52	39	9	149
12	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	0	5	10	60	74	149
13	an ability to live and work in a transnational engineering environment	3	27	51	41	27	149
14	an ability to work in international teams	5	18	35	49	42	149
15	pertinent applicable work experience	0	10	32	61	46	149

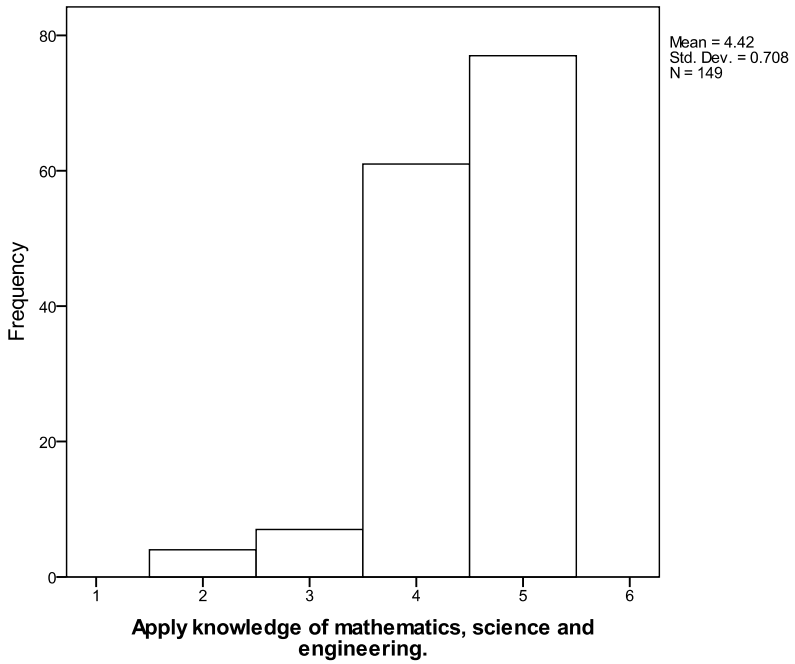
Histogram of survey respondent results for competency 1 “a high GPA” with 149 different responses



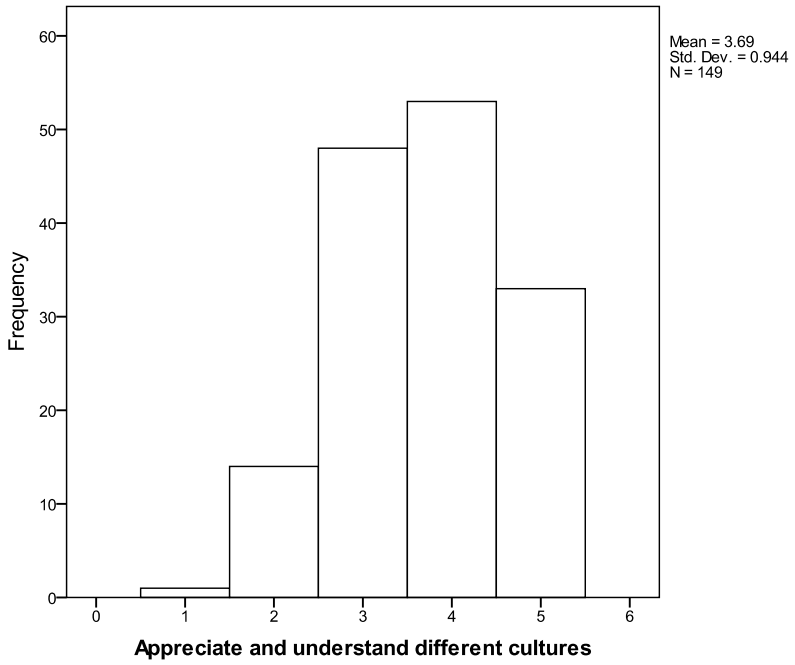
Histogram of survey respondent results for competency 2 “an ability to exhibit a global mindset” with 149 different responses



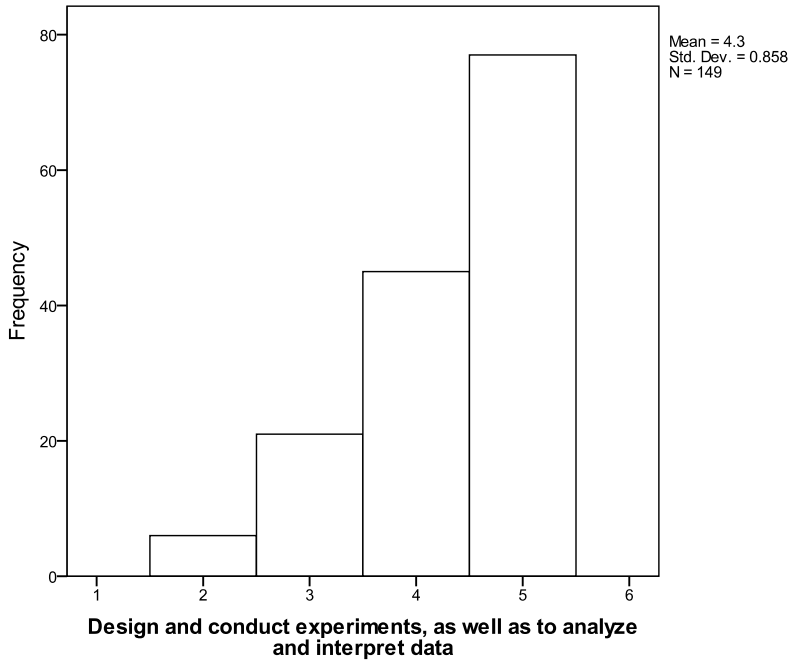
Histogram of survey respondent results for competency 3 “an ability to apply knowledge of mathematics, science, and engineering” with 149 different responses



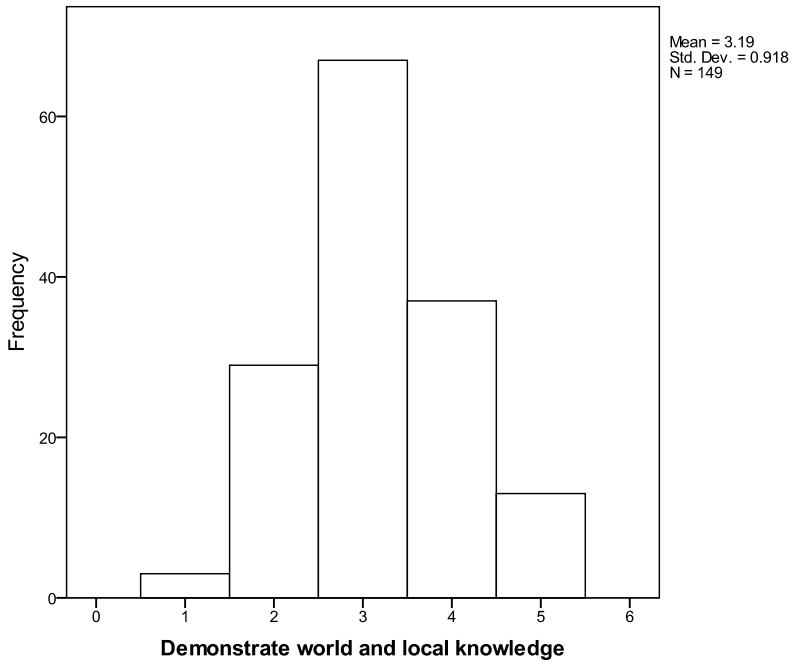
Histogram of survey respondent results for competency 4 “an ability to appreciate and understand different cultures” with 149 different responses



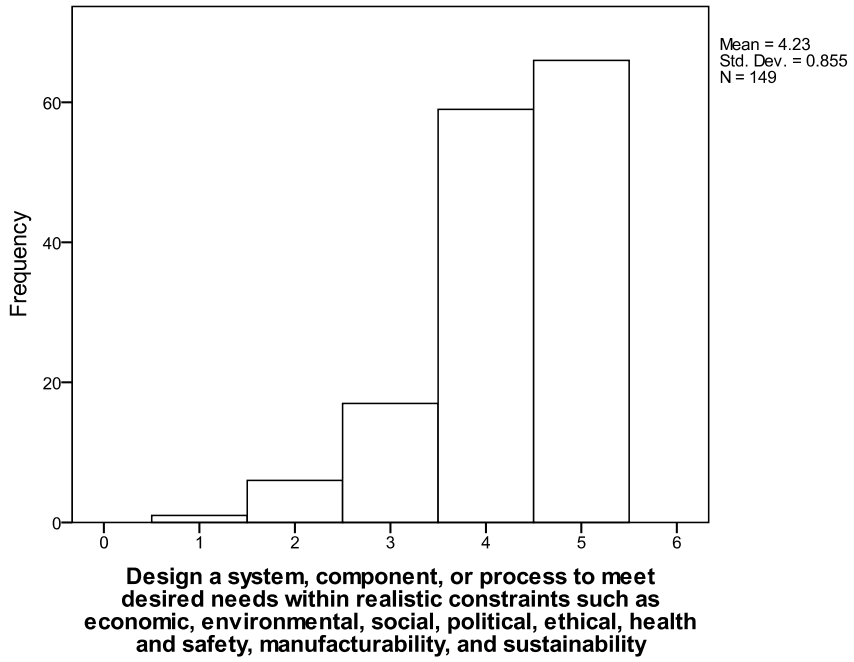
Histogram of survey respondent results for competency 5 “an ability to design and conduct experiments, as well as to analyze and interpret data” with 149 different responses



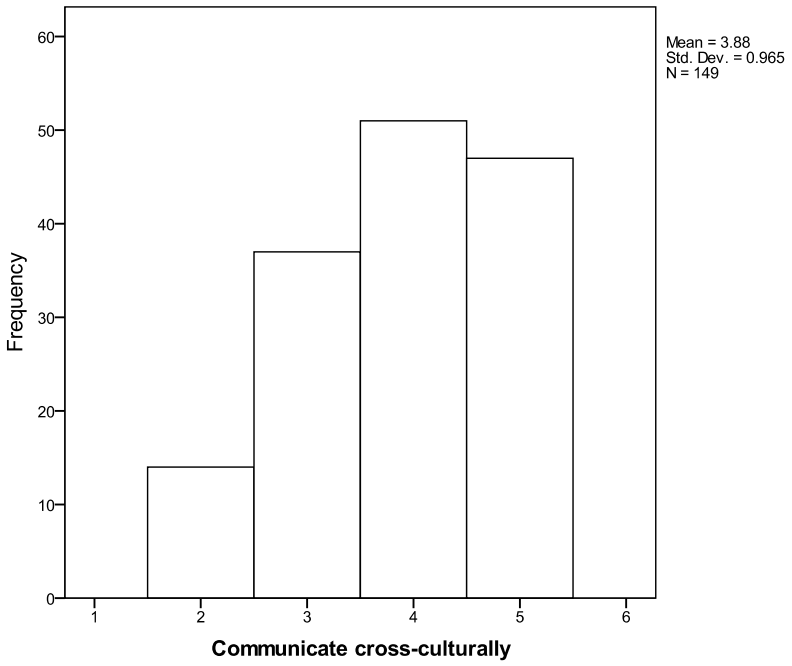
Histogram of survey respondent results for competency 6 “an ability to demonstrate world and local knowledge” with 149 different responses



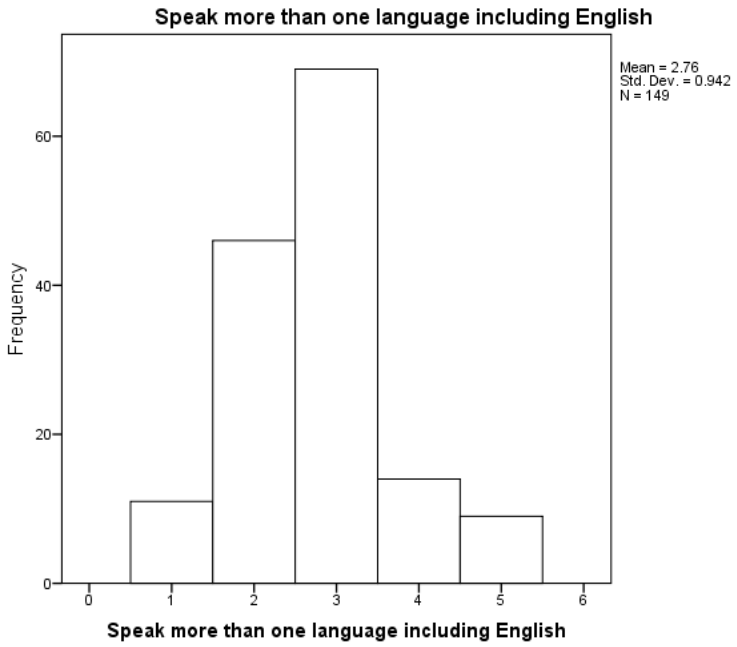
Histogram of survey respondent results for competency 7 “an ability to design a system, component, or process to meet desired needs within realistic constrains such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability” with 149 different responses



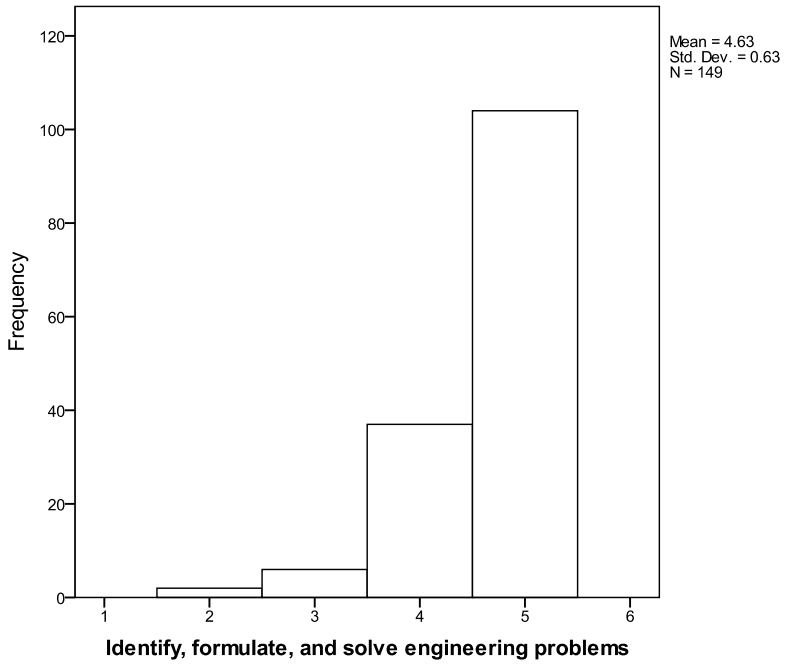
Histogram of survey respondent results for competency 8 “an ability to communicate cross-culturally” with 149 different responses



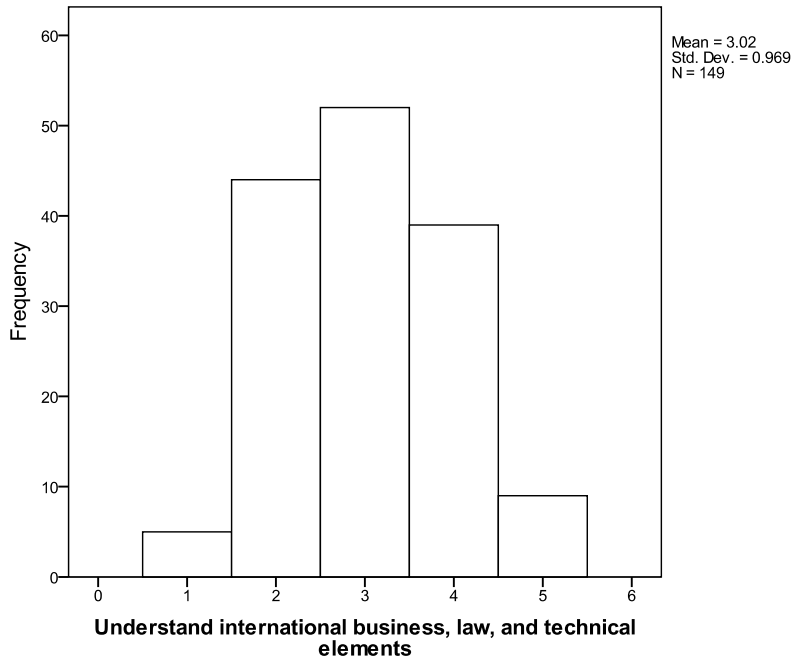
Histogram of survey respondent results for competency 9 “an ability to speak more than one language including English” with 149 different responses



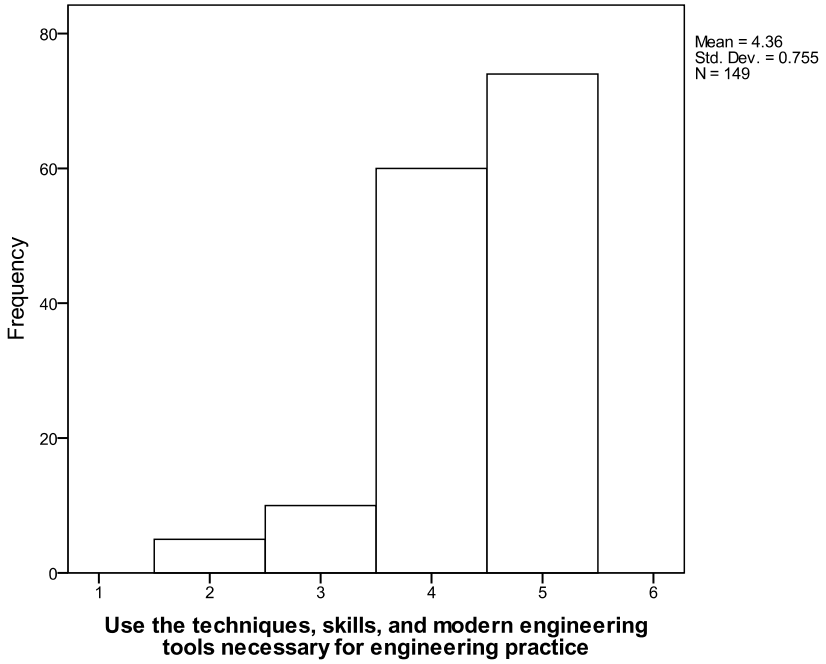
Histogram of survey respondent results for competency 10 “an ability to identify, formulate, and solve engineering problems” with 149 different responses



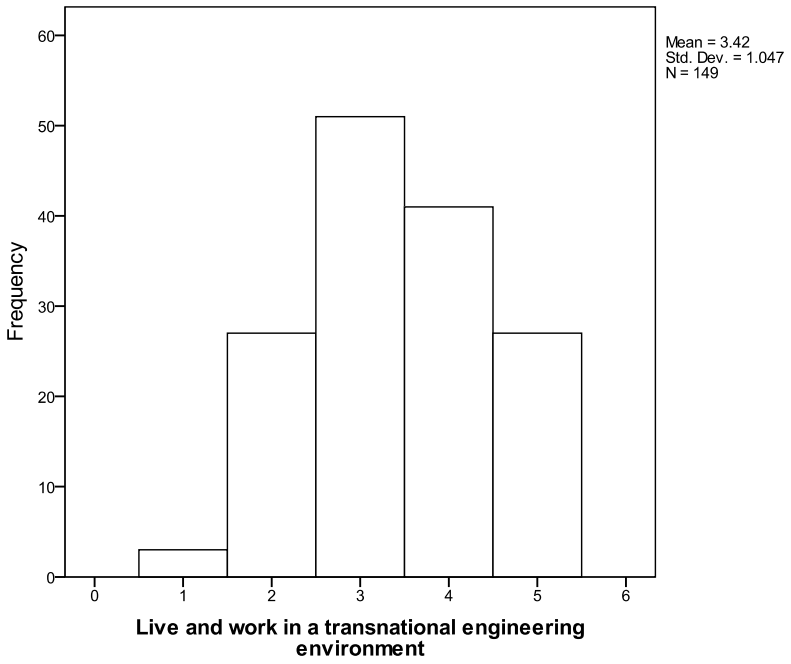
Histogram of survey respondent results for competency 11 “an ability to understand international business, law, and technical elements” with 149 different responses



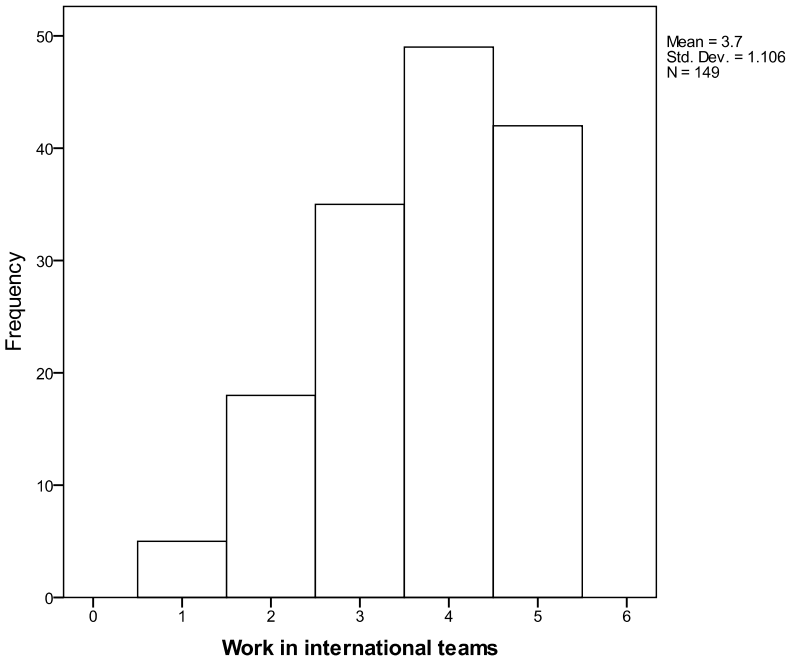
Histogram of survey respondent results for competency 12 “an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice” with 149 different responses



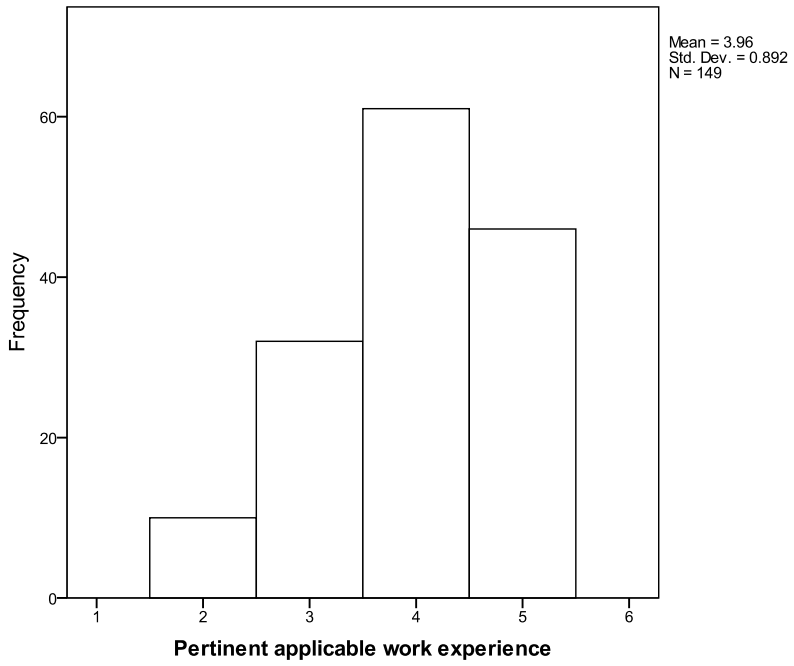
Histogram of survey respondent results for competency 13 “an ability to live and work in a transnational engineering environment” with 149 different responses



Histogram of survey respondent results for competency 14 “an ability to work in international teams” with 149 different responses



Histogram of survey respondent results for competency 15 “pertinent applicable work experience” with 149 different responses



14. Please list any additional competencies your company considers when hiring new Mechanical Engineers to work in a global environment.

Communication & People Skills

- Strong communication skills. Good, clear writer. (In Aerospace, English is the global language). Ability to know when effective communication has actually occurred. General ability to work with others. Willingness to be part of a global team.
- Tolerance for language difficulties, patience, clear communication skills - which are pretty much important regardless of whether the customer is from Orem, Utah or New York City.
- Temperament and communication skills to adapt to working with customers and teams that are internationally diverse.
- Cultural sensitivity and communication skills are key.
- Statistics, problem solving, communications and interpersonal skills.
- How they communicate and interact with others as well as leadership skills are much more important that the technical abilities. We assume that we wouldn't be interviewing a candidate without the requisite technical skills. Additionally, we also feel that we can teach technical skills. It is much more difficult to teach communication skills and the ability to work well with others.
- Written and oral communication skills including public speaking, flexibility/adaptability, attention to detail
- Strong communication and teamwork skills.

- Writing skills are very important. I want written communications that makes sense and show intelligence.
- Excel skills, interpersonal skills, self motivation, passion for something
- My company's needs in the international arena are mostly in the area of managing relationships primarily with China. As such, business skills and native language abilities are more important than engineering skills
- Critical thinking. Ability to present themselves well during a personal interview and to communicate verbally during interview.
- The engineer needs to be able to write at a high level. He needs to have excellent briefing skills. He needs to be able to socially interact with his peers, supervisor and customers. He has to be able to organize and manage the volumes of information that comes across his desk; e-mails, papers, briefings, data, contacts etc. This is usually not taught at the university level but separates the average engineer from a highly influential one. He needs to learn how to listen not just do technical work. He needs some hands on experience; put him on a lathe making a part. He needs to have a tolerance and understanding of other cultures and how to operate and thrive in that culture. He therefore needs to be aware that his way is not the only way. Especially difficult for American born engineers or those who grow up in a small town in Utah. The world doesn't revolve around Provo, Utah or the LDS faith. If the opportunity presents itself don't hesitate to play darts in a pub/bar with your technical group whose members will be from a different background or faith then yours.
- Military standards outside of engineering competence include: physical fitness (run time, push-ups, sit-ups, and waist measurement), communication skills (writing, reading and speaking), integrity (honesty, loyalty, etc.), judgment (ability to balance competing priorities of timeliness and quality) and project management (tracking cost, schedule, performance and risk).
- Are they prone to over stating their abilities?

Teamwork

- Teamwork, process improvement
- There should be no prejudice toward any group or country. Proof that individual can work in a team, especially one with different perspectives of the issues. I must be confident that the individual will make wise decisions pertaining to commitments, safety, integrity, and treatment of others while on company business away from factory locations. Healthy enough to deal with sometimes harsh environments and occasional demanding work schedules.
- Ability to work well as independent thinker/analyst within a diverse team and culture. Diverse defined not only by culture, also geographical, social economical, and geopolitical. That is the world the Aviation industry is operating within today. Also, Engineering not only need to be engineering technically minded but also today require good business economic skills as most decision have risks and opportunities associated in regards to fundamental business decision in association to technical decision.
- Self motivated, Can handle pressure, Important to work along with OEM´s, sales and end users to design new products.

- Engagement. In other words one of the primary skills that indicate someone will be successful is there level of engagement and drive. They must have the necessary technical skills, but this must also be coupled with the right kind of mindset. Do they work solely for a paycheck or do they work for the satisfaction and intrinsic benefits of pride in a job well done
- Open-minded, collaborative, ethical, trustworthy, dependable, professional, diversity.
- Ability to take the initiative, Ability to think creatively (outside the box)
- Work ethic, cultural/personality fit
- Open mindset and willingness to learn and grow.

Capstone / Project or Previous Experience

- We specifically look for candidates who participated in some extra-curricular activity, such as Formula SAE, SAE Mini-Baja, SAE Heavy-Lift, Robotics competitions, or rigorous internship to show that they can apply their school learning on real life technical challenges.
- Project / coop experience highly valued
- Capstone or Internship experience
- Hands-on approach to problem solving.
- Experience, drawing fundamentals, in addition to the above.
- Few if any brand new engineers are placed in global positions right out of school. Stateside pertinent work experience is usually developed first, either in-house or somewhere else.
- Personally I look at the time they have spent in the labs (and what they have done, outside of canned labs), more than the time and what they did in the classroom (If they are coming right out of college.) Working with the government requires U.S. citizenship in most cases, also important are lifestyle and criminal records, etc. They may be required to obtain a security clearance, which is a rather in-depth background check.

Engineering Competence

- Algorithm development, programming competency, computational skills.
- Analytical skills, adaptability to changing environments, the ability to manage time and priorities.
- Lean skills are very important in the working environment. Understanding Lean practices are important to all engineers.
- Rock-solid understanding of US business standards, quality standards, performance standards, manufacturing standards

Ability to Travel

- Ability to travel up to 10-20 percent of the time.
- Flexible to requirements(work times, travel, job functions), enjoyment of diversity and of being at international locations
- Ability to travel.
- Availability for travel. Communication skills. Presentation skills.

English and Foreign Language Skills

- Excellent English.
- While a second language is not required since English is spoken worldwide, a second language can be helpful (French, German and possible Japanese are currently the ones that would of most benefit. Learning on the fly - ability to pick things up quickly. Making decisions even without all information available. Attention to detail
- The advantage of language skills are very dependent on the language spoken and job environment. Right now Mandarin Chinese fluency would be very valuable. Japanese isn't because lack of business interactions and Japanese speak good English. Many mainland Chinese struggle with English.
- Overseas and language or cultural skills are highly sought after. We look for Professional engineering license. We look favorably at advanced degrees if the applicant also has field experience.

Security Clearance

- Must be able to obtain and maintain a security clearance.

Understand Global Markets

- Strong understanding of global markets and what the specific/unique needs of those markets are.

High GPA

- The first thing that is looked at is GPA. Anything above 3.5 GPA has strong considerations. Also high on the consideration is having a master's degree will be looked at very strongly. My experience in recruiting is that, mechanical engineering is very competitive and there are currently large numbers of mechanicals available to hire or select from. So in short, those with the more education and higher GPAs have the best opportunities.

Not Applicable

- With a very small percentage of our work international, this is not a focus generally
- I don't hire mechanical engineers per se. I hire computer science engineers and project managers who deploy hospital computer systems - as opposed software development. My input may not be applicable to your ME survey.
- Our engineers may work with partners internationally, but that is all. We don't have engineers working internationally, so that definitely affects the answers here.
- We have no such requirement.
- Competitive threats.

Statistic	Value
Total Responses	51

15. Please indicate your agreement with the following statements, My company:

#	Question	SD	D	N	A	SA	Responses	Mean
1	is willing to provide the appropriate training / experience for engineers to be successful in a global environment	1	6	37	73	30	147	3.85
2	is successful at providing the appropriate training / experience for engineers to be successful in a global environment	2	10	47	68	20	147	3.64
3	values the efforts of college/university engineering departments/programs to prepare engineers to work in a global environment	0	7	52	69	19	147	3.68
4	considers college/university engineering departments/programs successful at preparing engineers to work in a global environment	3	14	90	31	9	147	3.20

Statistic	is willing to provide the appropriate training / experience for engineers to be successful in a global environment	is successful at providing the appropriate training / experience for engineers to be successful in a global environment	values the efforts of college/university engineering departments/programs to prepare engineers to work in a global environment	considers college/university engineering departments/programs successful at preparing engineers to work in a global environment
Mean	3.85	3.64	3.68	3.20
Variance	0.66	0.73	0.58	0.60
Standard Deviation	0.81	0.85	0.76	0.77
Total Responses	147	147	147	147

16. What can college/university engineering departments do to better prepare engineers for success in a global engineering environment?

Develop Professional Skills

- More business training, communication skills, Leadership/team effectiveness,
- Strong focus on communication skills.
- Teach communication skills and an understanding of all requirements, not just technical to include financial, marketing, operations.
- Focus on communication skills. If an engineer has a good understanding of basic engineering principles and can communicate very well he/she is more valuable than the engineer who has an excellent understanding but cannot communicate that knowledge. Good communication skills are key to success in a global environment.
- Most engineering decisions are economic decisions. Understanding basic finance is good. Also production planning and quality basics.
- Train engineers to be better communicators in all aspects of their education.
- Provide more opportunities to observe, listen, and write customer requirements. Present to program status to customer, oral communication.
- Prepared them to interact with non engineering persons, better communication and verbal skills.
- More Group work, more technical writing, broader internship experiences.
- Lots of diverse teamwork.
- Improve their communication skills. Improve their abilities to write and present their work. More hands-on experience with real problems to solve.
- "Perspective of an issue and communication techniques are the two items that I believe set someone apart. Perspective comes into play when a person's background or environment alters the perceived requirements of a design. As an example. I work for a large Diesel engine manufacturing company. In North America and Europe, labor rates are very high, so a premium is placed on the ability to obtain replacement components (such as a water pump or cylinder head) in a short amount of time. Remanufacturing is of very little interest (basically a throwaway society). In Latin America, there are some countries with huge import duties on replacement parts and also low labor rates. In those countries, the ability to remanufacture is a premium. This difference in perspective and requirement is difficult to solve. Even more so if all of my engineers grew up and lived in small town USA and cannot understand another perspective of the world. Communication is my other issue: Many times, it is not just about changing the language. Google can translate the words. Some cultures and people use language differently. In my experience, North Americans tend to use language to convey facts (i.e. 47% of cylinder heads failed after operating for 1,500 hours at a 20% load factor). There is actually an attempt to remove emotion and conclusions from the communication. Other countries or individuals use language as a way to convey emotion. (There is a high loss of productivity and chance that we may lose the business to our competitors if we are unable to solve our engine issues related to cylinder heads. We need to know where we are with respect to the solution or new design). Many times, these individuals care much more if you understand the issue and sympathize with their struggles before they are willing to work with you on the facts. Other cultures will have tendency to ""save face"". It is much more

important to say ""yes"" (meaning that I have heard you and I feel your desire to arrive at a solution). ""Yes"" doesn't mean ""yes"", in that a statement of fact has been delivered. This can drive you crazy when you have a ""plan of action"" that would be acceptable to a North American audience with dates of commitments. If you use the same methods in other cultures you will be sorely disappointed when you discover that your ""plan"" was merely a desire to do their best."

- Our engineers are sent on typically short trips overseas and sometimes for a few months out of the year to Japan. Basic communication skills and the ability to work in a team atmosphere with various groups including international ones are valuable.
- Teach them to focus on what they can do for the company instead of what the company owes them. Young engineers need to show they are willing to work hard and do what it takes to become a valuable employee. They do not start out that way.
- Universities that focus on improving the intellectual capabilities of candidates are doing them a disservice. The emotional and behavioral capabilities are proving far more important in actual work environments than the IQ measures we once espoused. Prepare them to work as leaders and individual contributors on cross-functional teams spanning time-zones, cultures and faiths. Excellent collaborators and communicators are the candidates that will succeed in tomorrow's work-place.
- Most engineers seem to come out of school afraid of working with international partners, concerned their job will eventually be outsourced. They also typically have a poor understanding of engineering jobs in the context of a business - tend not to see where they fit in to a business as a whole.
- Teach multiple problem solving approaches and make sure they learn risk management as it relates to design uncertainty.
- Instill in graduates a more whole-person perspective. It is not enough to just be a competent engineer. Graduates must also be men and women of honor with physical strength and endurance, moral and physical courage. BYU does a better job at this than virtually any university/academy in the nation.

Foster International Internships / Experience

- Study abroad programs in countries like India and China
- Encourage international internships and work opportunities.
- Internships abroad or foreign exchanges would do far more than any class room exercise.
- This is something that is difficult to teach without putting students in a situation that they're required to do this. For example, a semester of study in Asia would be invaluable, but a class about working with Asian vendors would be of marginal value.
- Provide training in working with international manufacturing companies
- "I don't really know but some ideas (not all of which are practical)
    - internship (or other experience) in foreign country to help recognize that there are cultural differences
    - continue to invite people from various backgrounds to present seminars"
- Don't know how you would train for this as each company is very different. We work on teams with Irish, Danish, and Australians. Is it possible to build a course that would be helpful for this situation? I think it would be difficult. Best training one could give is to actually work on multinational teams.

- Have them enter into hands on projects throughout their collegiate careers as opposed to Capstone during the senior year. Make a real internship a requirement to graduate.
- I'm just getting started with international growth. I seek those with previous international experience. In the future I may consider hiring recent grads, but not yet.
- semester abroad, partner with internationals for intern programs, in BYU's case, promote language abilities
- Many of the elite Engineering departments are enrolling students from non US based schools that bring different thought processes to solving problems. The exchange of information has been found to be very enriching and beneficial to all. Most foreign students come not only with native cultures but experience from many other cultures as well. In US, the data shows they do not venture far from home state let alone outside the country boarders.
- Possibly provide more co-operative work experiences for students with companies, build those relationships with companies to allow or provide more summer time work experiences for students to see how the real world of engineering works when it comes to working in industry.
- Provide research opportunities because they reflect the environment in industry and provide students with realistic engineering experiences.
- Provide them general training in various international standards as they relate to safety in design.
- Virtual teamwork

Teach an Appreciation for other Cultures

- Global experience, foreign language and experience with other cultures
- Teach them about business practices, and courtesies in different cultures. When to shake hands, not shake hands, etc.
- Teach how different cultures approach problem solving, resolution, and every day interrelations differently and the importance of working within that culture rather than expecting others to conform to American culture.
- I don't recall spending any time discussing this topic in my ME BS career. I think having some international faculty, or at least some professors with international experience, to mix things up a bit in the predominantly white male American group of ME professors. I work with engineers from several different cultures, and with a sub-contractor from Japan. It is important in our relations with them to respect their methods of solving problems. I think learning how to work with, how to take the time and how to have the patience to understand engineers with thick accents is important. It sometimes takes pictures, sketches, acting things out, etc.
- Stress the teaming aspects of design and the need for cross cultural communication/understanding. Most new design work is collaborative and will involve often stressful relationships.
- Understand the values and priorities other cultures have and be willing to accept without judgment other cultures and people within those cultures.
- Ensure graduating engineers understand other cultures approach issues/problems differently and those approaches must be respected. Maintaining good relations with outside engineers (especially from customers) is critical.

- The engineer needs to be tolerant of other ways, cultures and beliefs. This is true diversity. Diversity is not about religion, race, or ethnic background. It is about different backgrounds, experience and ideas. The engineer needs to understand there are different ways of doing things and he needs to recognize that fact and use it to his advantage.
- awareness of the facts that US is only a small portion of revenue for lot of businesses so the notion of be American and buy American does not fly very well in my industry. We compete in global market place and interact with cultures all over the world, so teach folks that accepting these facts will make them successful and our companies standing in the world's market place.
- They need to be aware of the various changes in industry, where products are no longer developed and produced at a single geography. It's good for them to have some practical experience in this regard if possible.

Develop Better Engineering Skills

- Teach them to be better engineers (India, China, Germany are putting out better prepared applicants that are willing to work harder)
- Focus more on the engineering and math skills that are universal. It would be impossible to learn enough of the ins and outs of different cultures to really prepare graduates for a global environment, but if they can do the job well in the US and if they are flexible then they can do the same job well anywhere.
- Rock-solid understanding and competence in core engineering subjects (fluids, thermo, heat transfer, machine design, controls and instrumentation, etc)
- I have some concerns about the engineering departments focusing on these soft skills. Perhaps they could facilitate learning experiences in this area, but they should not lose focus on basic engineering and problem solving skills.
- Have the students build things, design with existing components, i.e. good knowledge of McMaster-Carr, etc., not to reinvent the wheel.
- We look for technical competency. It's more of a personal preference if someone is willing and able to work in other countries.
- Provide an emphasis and strong level of competency in product development processes and the tools involved in executing these processes. For example . . . Change Management, Configuration Management, Design Collaboration and the tools that help drive these processes efficiently such as Product Lifecycle Management and Visualization.
- Engineers should be trained to understand the differences in the regulatory environment in which we all are required to operate. In my own field (Flight Test), it is important to have an understanding of the differences in regulatory guidance and methodology. A successful and well trained engineer will be able to navigate the engineering landscape of the country in which he is assigned to work.

Provide Project Work - Capstone

- Have capstone-type projects that involve people from different countries.
- Emphasize actual work situations.
- Too often new graduates seem to have "book knowledge" but are unable to translate this to application. Also too often they flounder in how to research problems when the

issues are not presented "text book style". Teaching students how to solve non canned problems needs to be improved.
- Capstone program should be kept, it helped me a lot.
- I don't see enough applied learning. Theoretical learning only gets an engineer so far in industry. Those that can apply their knowledge to real world situations tend to do well in any engineering task. Building upon that, those that know how to communicate their ideas tend to do much better than those that communicate ineffectively.

Pursue International Collaboration
- Collaborate with other departments globally.
- BYU actually turns out a large number of cross culturally trained engineers. However, it is one of the few universities that do. There is little opportunity for engineers to study abroad due to the compressed and highly rigid course requirements. Engineers in general do not spend a great deal of time socializing due to heavy course load. There is some opportunity to work with engineering students from other countries, though mostly at graduate level. Not sure how that could best be improved.

Promote Foreign Language
- Promote students learning a 2nd language.

Nothing
- I think they are doing well already.
- ??
- My engineering experience with global companies does not require cultural skills to conduct business with them.
- Our particular company does the bulk of business within the U.S. therefore the global viewpoint is of minimal significance at the engineering level.
- In my area specifically, we don't work in a global environment, so take my answers with a grain of salt.
- Teach strategies such as "copy intelligently".
- Difficult for me to answer as my portion of my companies work is in the US. Most of our international hires are experienced engineers. Emphasis in the company with regard to globalization has been more at the leadership level (as opposed to new hires)

Statistic	Value
Total Responses	66

17. Have you worked in a global engineering environment during part of your career?

#	Answer		Response	%
1	Y		318	58%
0	N		226	42%
	Total		544	100%

18. How many different countries have you visited in the context of your career? Note: do not include countries visited only for vacation purposes

#	Answer		Response	%
1	None		62	20%
2	1-3		119	38%
3	4-6		55	17%
4	7-9		35	11%
5	10-12		15	5%
6	13 or more		29	9%
	Total		315	100%

19. Please select all the continents you have visited in the context of your career. Note: do not include continents visited only for vacation purposes

#	Answer		Response	%
1	Africa		32	10%
2	Antarctica		2	1%
3	Asia		157	50%
4	Australia / Oceania (Australia, New Zealand, Polynesia, etc.)		36	11%
5	Europe		178	57%
6	North America		251	80%
7	South America		67	21%

Statistic	Value
Total Responses	315

20. What do you wish you would have known upon completion of college to better prepare you to work successfully in a global engineering environment?

Cultural Appreciation and Understanding

- I wish I had known the important cultural differences between the countries in terms of how they work and how they communicate.
- Europe takes the month of August off for vacation
- How to be respectful in different cultures
- Best preparation at that level is to get to know people from other countries.
- More international etiquette
- A better understanding of cultural differences regarding business and technology
- Maybe a stronger understanding of world history, a clearer understanding of cultural differences.
- International Customs and Communications, International Work Ethics, European Union Works Force
- That saying "Yes" in Asia does not verify agreement or understanding. The hierarchy of power in Asia is more important than the individual.
- Learn some of the does and don'ts of some of the sensitive cultures.
- Learning more of the customs and traditions of other countries
- The difference in how the English language is interpreted as it is spoken by local engineers and customers in different countries. Example: In Japan an answer of yes may mean that yes I hear your question rather than agreement.
- Different business cultures
- How to better approach preparing for entering a new cultural context.
- That it is important to find a way to let people foreign to you know that you respect them and are interested in learning about them not just teaching them.
- Cultural differences and perspectives.
- Asian cultural paradigms, especially in the context of workplace norms.
- Asian business culture overview
- Cultural personalities, such as South Americans tendency to place allot of importance on personal contact and not a lot of importance on being on time.
- Understand better how different cultures function, definitions of right and wrong and what is acceptable.
- The work environment in most countries is very different than the US. Relationships and previous working history are more valuable than knowledge or skill sets. Living and working in other countries is very different from the mission experience as well.
- If you're going to a country you know little of, seek advice from someone who knows the customs. In many countries, it is rude to jump right into business. They expect to build a friendship first.
- That facts are not absolute as to their interpretation. If someone does not interpret the same situation the same as I do, it may not be a problem with intelligence, but more a difference in their point of view. Also, values are not absolute. Some may care about the environment, while others care about power, while others care about families, while others care about a way of life, etc.
- Cultural differences in different nations.

- I would have liked to have a better understanding of the culture and expectations in different countries so that I could be better prepared to communicate with and understand their point of view.
- Cultural considerations for dealing with different people from different cultures. At least language training in one or more countries.
- Simplifying communication so that foreigners can understand it. We use too long of sentences with instructions that may be clear to us, but very hard to interpret by those we are communicating with.
- Cultural differences
- Some basic business culture fundamentals of popular parts of the world. Middle East was an eye-opener for me, Japan... different.
- More understanding of cultural differences and being sensitive to how cultural differences translate in the work environment
- That US is only a small portion of the overall world's market place
- Customs and protocols for other cultures
- How to best communicate with the global community and how to overcome differences in cultures to best promote understanding of the project.
- Knew more about Business Ethics in other countries
- How common it is to work overseas with different cultures.
- Perhaps some exposure to cultural differences affecting work in foreign companies.
- Every company has a different corporate culture. A foreign company like the one I work for also has a different social culture, so it complicates things a little more. In my experience, the most important qualities to have are flexibility and respect for those in authority over you - don't be judgmental of different cultures. I'm not sure that college courses or training can make much of a difference there.
- Cultural differences
- Better understanding of other cultures
- I would like to have known more about the cultural engineering differences between countries.
- I wish I had a better understanding of foreign mind set/culture towards technology and sharing of information. A better understanding of foreign perception of US business and practices (how do other countries view the US).
- Diversity is huge. Learning about yourself and how you react/respond to various stimuli is very important. For example, a person from India constantly interrupts you as you are making a presentation. This angers you and you want to.... You don't understand that interruption in this person’s culture is a sign of respect and shows that he/she is very interested in your subject.
- Social customs of other countries
- International communication strategies - basic etiquette for several key cultures.
- A better understanding of Indian/Hindi customs and lifestyles.
- Known that real Chinese food sucks
- That while working globally is extremely interesting and fun the financial compensation may very well not be worth the extra long hours and time away from home.

- Metric unit system. Cultural differences emphasizing relationships over technical expertise and "to-the-point" negotiation.
- Working in a multicultural team where different ideas are openly shared and explored. We need to learn how to communicate better with others from different back grounds, experiences, and skill sets. Linear thinking is not always best. Also, fundamental business decision knowledge is required today, to assist with the emotional myth that US corporations are moving jobs overseas. By contrast, some work types are worked abroad to save jobs and allow resource for solving tougher problems closer to home.
- That women in Australia are attractive. However, I opted for a Swedish unit so I have no complaints.
- What I need to know to make sure I do not offend in their culture. The book I found was Kiss, Bow or Shake Hands: Doing Business Around The World

International Engineering & Business Understanding

- I would have liked to have had a "survey" course to introduce me to the engineering standards and practices of different countries, and how they contrast to how things are done in the U.S. For example, does "Country X" observe the standards and practices of S.A.E. and other professional standards organizations? If not, what do they use?
- The way people think and do business in different parts of the world
- Variation in engineering standards in various countries - it was well understood that other companies used different mathematical systems, but things like material/alloy names and formulas, fastener standards, production and manufacturing standards - it would have been useful to know a little more about those.
- Overview of differences from USA in business practice and organization of key nations, including policies for employment and taxation, management structures and methods of negotiation.
- How do other engineers in other countries approach engineering decisions
- Be open to working late and early to accommodate various time zones, and become comfortable and efficient with web-meeting and not meeting face-to-face. Learn how to hand off work as time zones transitions (become skilled at updating someone quickly and efficiently on the work you did during the day, and what to do next)
- Some of the business philosophies practiced at other countries that are different than those in the USA.
- A basic class with introduction to European and Asian engineering markets would have been helpful
- How industry works differently in major industrial powers like Japan and China
- Perhaps more about the politics of corporate business.
- How corrupt other societies are and that bribery is common place.
- That outsourcing internationally would be so important to being competitive in the global economy & I would be working with engineers across the globe.
- Better understanding of strengths and weaknesses of other countries from engineering perspective.
- International Codes/Standards, German
- How quickly knowledge of global engineering becomes out-of-date.

- An overview of ITAR and EAR laws and regulations would have been helpful to understand some of the issues of working in a global environment
- What possible global opportunities where available. What companies had global opportunities. This could have affected my initial career decision.
- I wish I understood the great global market for US educated engineers. I wish I knew Arabic. I wish I knew some industrial history of GCC countries.
- Better international standards
- I wish I had understood better the global competitive environment, and how easy it is for goods to flow from one country to another.
- I wish I would have known more about US export control restrictions.
- An overview of business practices & methodologies of different international companies
- Understanding different international standards.
- I would have liked to have had more exposure to industry codes and how they apply (i.e., ASME, API, NACE, ANSI, etc.)
- An intro to system engineering would have been helpful
- An understanding of the capabilities of international suppliers, and how to work with them.
- A better understanding of the business economics of going overseas.
- Supply Chain: many international engineers work in manufacturing and at many times need to have knowledge of how to source materials, components, etc; as well as have some basic concepts of the implications. Better knowledge of McMaster-Carr, Thomasnet, etc. / How do you find what you are looking for?
- Chinese and manufacturing processes
- Electrical standards (i.e. 50 Hz versus 60 Hz)
- Robotics; system controls
- A brief overview of how business is conducted in a number of key engineering countries (i.e. India, Europe (Germany), Mexico, Japan). For example, Indian engineers have a very difficult time making creative engineering decisions because it is very hierarchal. Mexican business is very dependent on relationships, etc.
- A broader background in the history of my field including authors of definitive texts and pivotal papers. A better understanding of leading journals for different fields and the weighted importance of each.
- How the global economy works at least at a macro level. Not sure how this could be done other than through a 100 level business class being added, but in may ways that is just as valuable as any fluids, thermo or heat transfer class.
- More computer technology but in 1974 there wasn't much available anywhere. Had to learn on my own
- Electrical power standards of other countries.
- Spiritual nature of business and engineering
- Former "Engineering" firms are now governed by the politics of non-tech managers and the accounting department aka "bean-counters". It would be nice to fortify our upcoming, untainted, young engineering students how to take back the corporate ship that's currently under siege run by clueless bureaucrats with the short-sighted foresight of Wall street day traders.

- Don't be afraid of competition caused by the globalization of engineering. View it as an advantage.
- I wish I had known better how to analyze problems and solutions.
- What type of an education am I competing with from overseas, and understanding what my strength will be going forward with a changing landscape.
- I entered the work force wanting to work overseas. I wish I had known how challenging it is to obtain an overseas position.
- It would have been good to understand export licensing a little better.
- More knowledge of specific components used for motion control.
- I never realized what calculus was for until 10 years after I graduated. Why can't math teachers realize that they are only teaching words and numbers? They need to tell the students what the heck they are learning.
- The importance of performance, image, and exposure

Business and Communication Skills

- Most engineering words don't show up in standard international dictionaries. Sometimes communication was difficult.
- Though I have not yet been to any other countries I communicate constantly with other attorneys in other countries, especially, China, various parts of Europe, and Canada. I have also worked with attorneys in Mexico, Australia, and India. Communication skills are discussed in school, but most of the focus is on math. English and good communication should be a part of every class.
- General business communication training would have been helpful as a transition to the workforce for both domestic and foreign customers.
- I think the program in general could benefit from some sort of business etiquette course. I think this could be beneficial for international work as well as domestic.
- Economics, global communication skills, human behavior skills
- More business training. I ended up getting my MBA
- I was unprepared for the office politics. I am not sure if it was just the company at which I was working, or if it was general in Japan. Engineers are often inept at office politics.
- I wish I would have had more experience with teleconferencing and overall communication skills. Capstone gave me some experience with this, but more would have been helpful.
- How to manage communication over different time zones. In other words, how to communicate efficiently and effectively when your global colleague is not available during your working day.
- Business classes about working with coworkers in international locations.
- Multinational communication. I've found that when explaining complex concept, and even simple concepts to people whose first language is not English, pictures and diagrams speak much louder than words. In my work, I wish I was more literate in the ability to use tools such as MS PowerPoint to communicate complex things very simply and with a sketch of some sort.
- Communication skills and real life engineering - root cause analysis, how to solve complex problems without necessarily an engineering equation with one correct

answer. How to determine risk (business, engineering, etc) and how to mitigate. More business skills.

- I feel that my BYU education prepared me exceptionally well, as has been proven to me many times in my career. Some additional business training and maybe some interpersonal training may have helped. A language in one of the engineering focused countries (German, Russian, Japanese, etc.) could be considered for some. I have since gotten an MBA and learned some Russian.
- How to navigate a business trip abroad. How best to communicate during a board meeting in an international setting.
- A better understanding of the communication skills needed for successful negotiation.
- My involvement with Dr. Greg Jensen's projects prepared me well for a global engineering environment. Though working in such an environment may be unavoidable in the near future, I have learned from my work experience and in school that advocating or encouraging global engineering does not create a quality, cost effective product. The biggest challenge is communication. However, if our nation's engineering is going global, then students better be ready to deal with the frustration.
- I don't feel that I have been shorted. All of our foreign customers are engineers who speak English reasonably well. Graduate school and training on the job has taught me the importance of communication.
- As a project engineer I wish I had been more fluent in communication written and otherwise. Most of my engineering is "people engineering", getting none technical people to understand what they need.
- Probably it would be useful to understand a little bit about business - basics of what's on an annual report. Making a business case for new products or investments etc. What it means to do due diligence on new technology before acquisitions.
- The importance of communicating effectively through multiple regions and time zones. This could include making communication documents clear for other cultures to understand and collaborate. This communication would include understanding how different cultures communicate ideas and the potential miscommunication with those in North America.
- More political understanding
- Metric/English unit conversions
- Whether it is collaborative engineering between different states or different countries the challenges' are similar: respect for others, and the need for clear and appropriate communication. As distance and language/culture differences grow the importance of clear communication skills grows proportionately.
- How to deal with high level politics of the dishonest and back stabbing sort. My technical expertise and skill was always an asset but uncertainty on how to "fight back" with "local" peer competition was a problem. I achieved VP Engineering rank before retiring, but by changing companies.
- More education on international business principles and corporate culture interaction
- Finance
- Finance and economics
- The types of software tools used in industry.

Nothing More

- N/A - After BYU I went to the U of M for a PhD
- N\A - I felt prepared already.
- I think BYU did a good job at preparing me to work with a global engineering environment. I think the only think that would have been more helpful would be a more diverse school and faculty, but that may not be an option.
- I don't think there was anything additional I would add.
- I think they did a good job. I can't think of any training or classes that could have been provided and weren't, that would have made my employment easier.
- Having done a double major in mechanical engineering and a foreign language, and having done internships at three different multinational engineering companies before graduation, I think I was quite well prepared.
- Better grades
- I can't think of anything in particular that applies globally but not in the U.S.
- To be honest, I can't think of anything. I'm not sure that for the experience I've needed to work globally is something that needs to be taught in school. My mother taught me most of what I've needed to know, i.e., being polite, respectful to others and just how to treat people. Plus, with many of the mechanical engineering students having spent a 2-year mission in foreign countries that is great training for how to conduct oneself internationally.
- I feel that the global work that I did with Dr. Jensen in the ParaCAD group prepared me well for global work in the field.
- Nothing.
- No Comment
- It would have been nice to specialize a little more. Then again, I didn't know what I wanted to do, nor did I know what I needed to know or what specific opportunities might exist in my field.
- I think that serving a mission in a foreign country prepared me better than anything I could have been taught in school to be prepared to work in an international company.
- I was very well prepared.
- Serving a mission taught me the skills I didn't get in the ME program. I served in Croatia, so I did have to work with and learn another culture.
- I was well prepared.
- I think I was well prepared.
- While I have traveled to Mexico, most of my international interactions have been with colleagues in Europe (France and Germany) although I haven't traveled there on business. It might be difficult for a university to do a lot since each situation is almost unique. Being able to work as a team with various backgrounds is needed.
- I thought I was well prepared as I had been to Europe and Asia prior to graduating (not related to school)
- NA
- Can't think of anything
- I was actually pretty well prepared because I served a mission abroad.
- I doubt engineering school could have helped me with this. The problem was that most things I learned were theoretical and very little were practical. I doubt also that

most of the professors understood international business. At least from the time I was at BYU.
- Nothing I can think of.
- So far I feel pretty prepared
- I was very well prepared to work globally after graduation. I would not have changed anything.
- See answer below. BYU did a phenomenal job at preparing me.
- Not sure
- N/A - I had limited involvement with global engineering.
- I feel that I was well prepared for working in a global engineering environment.
- My understanding of the world politics and economy prepared sufficiently for my career.
- Currently cannot think of anything that I have lacked due to my education for working with other countries in engineering items.
- If I could have predicted the future! Jobs - including engineering jobs - are being lost in record numbers to cheap labor markets in Asia and elsewhere. I might have seriously debated going into engineering at all! Many of the engineering jobs that are left are as much business/management as technical.

Language Skills
- Fluent language
- Mandarin
- I wish I had learned Chinese.
- Besides mastering the sound engineering skills I received at BYU, I wished I had developed additional skills in: / 1. Multi-languages - Spanish, Portuguese, German / 2. Business Management
- Languages. Italian and Spanish would have been particular helpful.
- Speak German
- Learning another language and being more familiar with the metric system.
- Fluency in a foreign language.
- Language and culture
- I don't think that the college environment really has much impact on where a person works in the world. Foreign language may help but we work in English around the world.
- A Foreign Language
- Foreign Language
- I would like to have known Spanish.
- Chinese
- Not to drink the water even from public fountains in Paris airport. It would have been helpful if I spoke French, German and Italian.
- A foreign language
- Japanese
- A foreign language (Japanese, German, or Spanish) would be useful
- Chinese
- Speak Mandarin

- A third or fourth language.
- It would be other languages such as Chinese.
- Be able to speak Spanish

International Teamwork and Networking

- How to work with teams that are located around the world rather than having your team at the same work site.
- Some exposure to effective virtual collaboration tools and processes.
- How to develop teamwork in distributed teams. / 2. Successful project management skills. / 3. How to evaluate and work with different personality types.
- How to deal with incompetent people who have decision making power.
- How to communicate effectively with engineering teams on the other side of the world give the cultural and time-difference barriers that exist.
- Networking skills, long-distance (phone, email, videoconference) collaboration and relationship skills
- I wish I would have had more experience with Netmeeting or other tools for sharing and discussing data in groups over long distances.
- Collaboration skills with other facilities and countries.
- Overall, when I entered the work force back in 1987, I felt I was prepared based on my mission experience. Today there are other global communication tools that would be helpful for the graduating engineer to understand and have the skills to use. These include global collaboration tools such as video telecon equipment, WebEx type Internet meeting tools, and audio telecons. The tools themselves are relatively simple to use and yet the effective use of these tools require training in effective communication - especially when language and cultural differences exist. Educating students on effective agenda and presentation of issues, alternatives, pros & cons, documentation of decisions and following up on issues are all things that can help the engineer become a better communicator and leader in global communication and engineering. Education on how to listen and understand is also something that is worth emphasizing.
- How to effectively collaborate on projects via distance communication only. Namely, telephone, email and occasional video conferences,
- Understanding the challenges of creating personal connections on virtual teams spread out across the globe.
- Being able to work in more cross-functional teams from other disciplines. People in accounting, business, marketing, purchasing, documentation.
- You have to communicate with much more detail and patience when working with people overseas.
- How to manage people in the work environment and how to negotiate changes.
- Skills for successfully being a part of an international engineering team and skills for leading and managing engineers in other countries.
- How to find more international job assignments

Project Management Skills

- Management skills are increasingly important to success. A graduate must be able to manage both people (leadership) and things (budgets, time, resources, etc.). They must also be familiar with cultures, not just of foreign countries, but cultures within those countries which are also divers, i.e. government vs. corporate.
- Project management skills.
- We only touched on product development processes in Capstone but in reality, these processes take up >60% of our time as professionals. Lack of a deeper understanding and knowledge for Change and Configuration management best practices, etc. was a significant gap for me. I was competent in the technical aspects of engineering but when it came to the PD processes, I was not as well prepared as I should have been. Globalization has fundamentally altered the way engineering is done. It has globally distributed and in this context, PD processes and PLM tools have become a much more critical competency for successful global product development and collaboration.
- Project management competency or familiarity with PMI (Project Management Institute) principles.
- Project management
- More project Management, CAD, communication, computer programming, and business skills.
- Learning to create and communicate project schedules. Consider both local and global resources available for a particular task.
- Project management and leadership skills.

Real Project Experience and Skills

- More hands on with equipment
- Better application of theory to real world problems.
- More practical exposure to engineer tools
- Comes with experience
- A better understanding of the need to work as a team to complete the project. Every project I am working on relies on a diverse set of skills that need to be controlled to achieve the end result.
- Could there be a global project, a smaller version of Capstone? Does BYU have any partnerships with global universities? Or are you doing this survey to find global companies?

Quality & Statistics

- Quality and Six Sigma and a lot more statistics ... a lot more
- Quality, six sigma, certifications,
- Statistics, MBA
- Statistics. One class is not enough and was not reinforced throughout curriculum. More technical writing with more critical review
- A better understanding of different measurement systems

Internships

- Stronger Internships...preferably international...

- I would have emphasized internships more.
- More global work internship and knowledge of global demands.

Statistic	Value
Total Responses	220

21. Please describe what has best helped you prepare for and obtain success when working in a global engineering environment.

2-year Mission

- Having served a foreign mission.
- Mission to Thailand.
- Previously spent 2 years in another country which helped me understand how to deal with cultural differences.
- LDS mission to a foreign country. A heartfelt understanding that people everywhere are "human" is invaluable.
- I lived in Germany for two years as a missionary. While there, I spent lots of time with not only Germans but people from all over the world.
- Learn my technical specialty well so that I had something to offer. / 2. Getting to know people from other countries, in school, summer work, and on my mission.
- My mission, the only real international experience I had coming out of BYU.
- My missionary experience to Japan was undoubtedly the best thing I could have done to prepare myself. Next was to be outgoing and positive. The technical background really only got me through the door. My skills at typing have been more important to me than any engineering class I've taken.
- Going on a mission helped a lot to understand cultural differences.
- My mission in Asia.
- To be honest, missionary service
- Mission, travel to other countries, reading history/current events, working with people who do not think like I do.
- Portuguese speaking mission
- Serving a mission in Japan
- Probably serving a mission abroad has helped me the most.
- I was hired by an international company (in part) because of bilingual skills acquired during LDS mission service in Europe , as well as technical skills and knowledge acquired in school and on the job . Previous exposure to other cultures helped in my initial assignments with that multinational company.
- mission, & contacts via church with foreigners
- Exposure to different cultures through church mission service and working with citizens of other countries while at BYU.
- Serving a mission in Chile.
- My 2 yr service mission in France.

- Spending 2 years serving a mission in a foreign country
- Speaking a different language and having the opportunity to live in a different country as a missionary.
- Serving a foreign mission
- My mission, and guidance from our people in the various countries I visited.
- Learning to communicate with people. Having served outside the USA on an LDS mission.
- I think more than anything my international experience as a missionary helped me learn to appreciate people from other cultures. I am not sure this is something you can learn in a classroom. I have seen engineers that have had many international experiences and still failed to find a way relate with those of other cultures.
- Learning another language (LDS Missionary experience) also built skills in understanding others who speak English with an accent. Also, I consciously avoid flowery speech when speaking with foreigners to lower the communication barrier.
- My mission to a foreign country
- Training on my German Mission taught me to have greater sensitivity to European ideals but otherwise, a great degree of tolerance, patience and respect for different cultures helps me interact well with foreign customers. Patience and respect for different cultures helps me interact well with foreign customers.
- Serving an LDS mission and learning an appreciation for other cultures and getting a better global picture.
- My Mission and the education I received at BYU
- Foreign mission service
- Mission experience and military deployment experience.
- Foreign mission experience, in that doing so has broadened my understanding of foreigners' differences.
- A foreign mission experience. Knowledge of languages other than English and experience with other cultures. I appreciated having worked with both SAE and metric units in all of the engineering classes offered at BYU.
- Serving a mission to another country where I had to learn the language and the culture.
- Two years spent interacting with a foreign culture on an LDS mission.
- My Mission
- My missionary experience on the Navajo reservation helped me feel comfortable working in Mexico more than anything else.
- Foreign missionary experience, and discussing the concept of looking at things from other peoples' point of view is helpful.
- Missionary service in a foreign language helps me empathize with those I'm trying to communicate with, even if my 2nd language isn't the same as my co-workers.
- Serving an LDS mission and developing good writing skills. Much of the global communication takes place through email.
- Actually my mission experience in France is probably the best thing to help me with understanding that we have cultural differences. / / Technical competence is always appreciated and provides a basis from which one can influence global decisions/discussions

- My missionary experience and my family experience where we lived in a different country.
- More than anything my mission experience to Japan helped me understand another culture and that experience helped me to open my mind to others - realizing that different is only different - not wrong or inferior. It helped me to see that others see things through different lenses based on their culture and experience.
- Mission experience.
- Mission experience, work experience doing it,
- Ability to listen and work through issues even when there is a language barrier, respect for cultural differences, LDS mission to Argentina
- Mission experience
- Mission experience of understanding what is the same with people in a foreign culture, as well as what some of the nuances are.
- Mission companions from other countries. Work with my MBA teams with students from other countries.
- I think my missionary service along with the World Religions class helped me tremendously.
- My mission helped some (served in Costa Rica). Company helped educate us as best they could. The rest was through trial and error.
- My BYU education and my foreign mission.
- Serving a mission for the LDS church. Interviewing for an internship (didn't pan out), but it was helpful to see how business operated overseas during the tour of their campus.
- Serving a mission
- My LDS mission to Portugal.
- A foreign mission; in my case Germany Munich South 1971-73, due to both the language and foreign experience.
- #1. 3 internships before I graduated! / #2. LDS Mission
- My mission for the LDS Church best prepared me for working in a global engineering environment.
- Church service and mission
- LDS missionary service was good preparation. The capstone program was also good.
- Having lived in Taiwan as missionary (opened mind) and learned to speak Mandarin Chinese, coupled with the solid engineering education from BYU
- I am currently working in China. I served a Mandarin Chinese speaking mission in Canada and spent time after my mission in China. The language and cultural experience I have gained through these have done the most to prepare me. Communication skills are the most valuable skills.
- Experiences on the job and quickly learning communication skills. I served a LDS mission in a different country and that was helpful as well.
- Though this has little to do with the education of BYU, serving a mission in a foreign country helped me understand some differences that would be encountered in different cultures, and that others do things differently. Knowing things are done differently helped me in not immediately concluding that what they were doing was wrong.

- Sense of adventure and willingness to jump into a foreign environment. Serving a foreign mission probably helped with that -- but not the language (as most of my global business experience has been in China and I learned German).
- Ability to try and understand their needs and meet what they want/need vs. pushing my understanding onto them. I was an LDS missionary in France, speak French fluently-that experience helped me respect and work with other cultures.

Professional Skills

- I picked up on global business markets.
- Listen first to other's concerns and do not cloud them with your own bias or worldview. Take the concern at face value as something important to them.
- Communication skills and teamwork skills .... technical skills (what 95% of engineering courses are about) are last on the list ....
- Go into business administration, if you have the opportunity. That seems to be the one thing that can't be outsourced - yet.
- I think the greatest things that help are patience and the ability to communicate. So I think working in groups where communication is essential has really helped.
- Ability to communicate ideas and work together as a team/group.
- Leader skills and culture behavior. Technological trends.
- Good communication skills, design review practice, manufacturing practice to see the possible difficulties of actually building CAD modeled designs, working in groups, and pretty much every experience the Capstone class provided to show what engineering was like in the real world.
- The ability to work as a team.
- Writing skills; clear, concise communication skills; mission experience; striving to achieve a high standard of ethics in the workplace; ability to work on projects with undefined requirements and highly ambiguous objectives; ability to lead an work with teams.
- Diversified not a specialist
- I think it is important to be very broad. When I worked in Japan I was one of only a few points of contact between my employer and their American customer, so it was important to have a broad based technical knowledge. When I went to Germany and Spain I was sent because I had very specific expertise on a particular project, but again I was an emissary/ ambassador for the American division and so I again needed to have a breadth of knowledge of the technologies involved in the project. In summary, if a company is going to justify the expense of sending you overseas, you had better be able to take the synoptic view.
- The basic fundamentals have served me best (work hard, follow through, listen, be courteous, tell the truth, have a variety of interests, foster strong personal relationships). These must be taught long before a student reaches university.
- "People skills" - the ability to listen, resolve conflicts, communicate clearly, etc.
- People skills
- Teamwork and communications
- Respectful attitude and helpful personality
- Communication skills

- Learning communication skills and project management techniques that facilitate open communication. Learning how to go into a hostile project environment and diffuse the situation by listening.
- Clear communication skills
- Interpersonal skill is extremely important (not that I have it mastered). Engineering Technical skills and business understanding are also essential. An interest in other countries has also helped.
- Learning to communicate and exchange technical information efficiently via email.
- Communication skills. Project Management skills.
- Engineers are the same in every country I have visited. The only difference has been the language and the cultural differences. The engineering languages such as math and science and physics are the same worldwide. Our company provides cultural training before we visit other countries. (I even learned how to eat spaghetti) The most important thing might be how to get along with people. You seem too interested in what you have called the "global engineering environment". Is this some kind of politically correct term or maybe some term made up by a PhD consultant from the education department? I think you are spending too much time and way too much money on this topic.
- Good technical and writing skills.
- Conversation skills.
- Having good communication skills, written, visual, and verbal. Most importantly, good listening and feedback skills to ensure correct understanding and show genuine interest.
- Communication skills. In my case, as is true with many BYU Alumni, serving a mission and being in an environment where your main focus is to convey a new concept in an "unfriendly" environment certainly helped. Also presentation skills, engineering students need more time presenting and being critiqued. Too often new grads do not have the ability to receive or give constructive criticism.
- Self learning on the mannerisms of the people and making sure I am honest and have integrity
- Flexibility / Knowledge of my strengths and weaknesses; develop the ability to use my team or resources available to solve problems that I could not on my own. / Understanding of the Organization Chart for the company at the different locations.
- Attitude of respect and consideration for others plus a willingness to learn new things. Respect and kindness tear down many barriers to success.
- Ability to communicate in a precise and clear manner.
- the ability to work with people to solve problems. / 2. Innovative design solutions
- Creativity and adaptability - The bottom line is that an engineer that is instilled with the idea that every problem has one right answer, and a pre-determined path to achieving that answer is ill-prepared to work in the real world, and that's magnified by working in a global environment.
- Well defined communication plans. Well defined projects.
- Course on managing remote locations.

Appreciation & Understanding of Other Cultures

- Understanding of different cultures. Appreciation of their contributions.
- Understanding the different culture and religious expectations and norms.
- Getting to know the different cultures and work within them.
- Company sponsored training detailing the various cultural differences in the areas we compete.
- Intercultural experience, appreciating different cultures. A common company culture throughout the organization
- Understanding and respecting the differences in work practices and cultural norms around the world is critical. Different is okay, and even advantageous at times.
- Patience and willingness to learn about other cultures.
- Understanding and respect for other cultures.
- Having been born in a foreign country, I didn't expect everyone to have an American-centric point of view. I was open to people of different cultures and was comfortable interacting with all kinds of people.
- Growing up in a multicultural environment best prepared me to be observant of and sensitive to differences in communication styles, cultural values, and cultural priorities.
- Study basics of culture of other engineers
- It has helped me to know that, even within the same company, engineering teams in different continents tend to develop vastly different methodology, terminology, etc.
- To me it is not that difficult just treat people with respect and understand their culture before you arrive and everything tends to turn out just fine. I don't really feel I need to take a lot of classes to perform such a simple task.
- Understanding of how local cultures need to be considered when conducting operations abroad.
- Interaction with others from different cultures and working together to solve problems.
- Some knowledge of the local customs and language.
- Recognizing that they are smart and that they just don't understand what you are saying even though they say they understand. Need techniques to verify understanding.
- A good understanding of and appreciation for cultural differences.
- Cultural sensitivity and foreign language.
- An understanding of cultural differences and the strength in can bring to a company.
- Understand what they mean when they state their response. For example the Japanese seem like they agree with you, but may think you are crazy. Without understanding their culture there is no way that you could have known that they disagree with you.
- Learning more about how engineering decisions are made in different areas of the world.
- A love of connecting with people and bridging cultural divides.
- Understanding the corporate culture of the people I have worked with and what is important to them has helped in my successes. What is important in the US is not always what is valued by other people or cultures.
- Understanding different cultures work styles and different attitudes toward solving complex problems.

- Understanding foreign perceptions of US citizens and our business practices.
- General understanding of the world was the best preparation.
- Understanding work habits and work processes of various cultures
- I guess some geography courses and cultural courses such as history but most of my international business experience came from working with employees who had experience in those cultures or just interacting with people in those countries. Doing business in Europe for instance is completely different in Japan which is completely different from China and completely different from South America. Experience is the best teacher.

Engineering Fundamentals

- A basic understanding of a wide variety of engineering principles.
- Strong grasp of fundamental physics and engineering. / Good project management skills
- Solid technical background.
- Studied controls, electronics, and robotics
- My experience involved dealing with engineers and the engineering degree gave us common ground.
- Just the standard education.
- Quality of engineering education helped, multicultural environment existing at BYU.
- A good fundamental knowledge of the science behind the engineering and a methodology to "solve" problems
- Sound engineering background and ability to work as a team.
- Mathematical applications - Advanced Engineering Math
- Technical knowledge
- Classes with actual applications and class labs. For example: Material Design, Dynamics, Thermal Dynamics,
- Emphasis on reliability engineering into the design to control long term operating costs.
- A good understanding of thermodynamics and fluid flow has been the best asset in my particular job.
- Patience to listen to what they are trying to say rather than just what was said. Using verbal, body, drawing, and mathematical techniques to communicate. There have been several times where I did not speak the language, but a few drawings and equations communicated enough that we could accomplish the task without words.
- Ability to analyze problems and solve things that were new challenges.
- Not sure -- I had limited involvement with global engineering. However, I did work for a division of Toyota. I found the statistics classes and design for manufacturing classes were helpful since manufacturability and quality were important to Toyota.
- I think the most important thing is having both technical competence and good teamwork skills. I've found that it takes a bit more patience if there are language barriers, but working on global teams isn't much different than working on any other kind of team.
- Technical prowess and depth, and ability to explain technical world to non-technical people. I am a natural leader, and my sensitivity to the "global", non-local groups to

how well they kept up with my new technology presentations and training was a valuable asset.

- An understanding of different expectations, standards and specifications concerning quality, reliability and performance.
- BYU provides a very good foundation for learning. I feel I understand the theory better than most, and know enough to know what knowledge is available. In other words, I have a little wider range of potential tools for tackling problems. For example, most only use existing tools, I could probably go back to my engineering books and make my own little software tool.
- Clear formulation of the problem. Solution offers itself.
- Problem solving capabilities
- Having been put in situations where I needed to provide solutions on my own.
- Team centered work, CAD classes, design classes
- Computer science minor from BYU

Networking

- Talking to peers who had worked with other international firms.
- Experience, mentors, an understanding of CM and ODM business models.
- Talking to other engineers that have been in those countries for some time.
- Spending time learning about the history and background of the countries I work in to better understand the perspectives of the engineers on my teams.
- Create good working relationships with overseas workers, live overseas on a foreign assignment, have a tolerant and open mind when dealing with other cultures.
- Willingness to reach out to international engineering teams for resource needs.
- Periodic teleconference meetings during the hour or two of work day overlap with computer screen sharing and the blogging of activities by the team members.
- Communicating with my peers and senior co-workers.
- Having a mentor to show me the ropes and help me avoid cultural pitfalls was crucial. I don't do much business outside of the US - it's generally the foreign company doing business here. So it's always helpful to do whatever I can to make my supervisors (who are Asian) feel comfortable.
- Working with people who have lived or worked in the countries visited.
- Getting to know and love the people I work with.
- Visiting and interacting with Europeans and Asians.
- Asking questions of experienced people.
- Patience, friendliness, flexible, willingness to listen.
- Ability to socialize with colleagues, and technical training has helped to compensate for lack of business knowledge.
- The value of the knowledge that the craft and long term employees know what they are talking about and to use that knowledge whenever I can.
- Willing to try new task even if uncomfortable.
- I am a passionate soccer fan. Everyone in the world likes soccer, so I am able to talk sports with a very wide range of people.
- Willingness to travel, seek the best solutions and being open to others

- Open and honest mind and heart. Open to exploration of new ideas and problem solving techniques. Honest mind and heart to meaningful dialogue, driving to healthy discussion and eventually leading to data driven decisions.
- Trying to understand what information they need to succeed.
- To read
- Constantly studying new textbooks, in new fields, to broaden my understanding of engineering and business theory and practice.
- Believe it or not, the Internet! / In addition to this, we have partners in other countries or residing in the US that helps us work with customers in Asia, Europe, Canada and South America. We also work with customers in the US that have international operations that we sell to. They know what is required to deal with this and have helped us in this area as well.

Living, Studying, or Working Abroad

- I went to China with the ME and MBA students at the end of my senior year. Visiting the facilities there helped me gain a better understanding of what it meant to work in a global engineering environment.
- Visiting other countries prior to being hired and exposure to world cultural differences through studies/classes.
- The internship through the Kennedy center and the preparation classes associated with it on international business
- Learning a foreign language, living in a foreign country, and working directly with people from different countries while an undergraduate.
- The BYU engineering study abroad program in China.
- First hand working experience in the countries themselves.
- Being from another country and having lived there many years.
- Travel and working with engineers in our local engineering centers. Visiting customers in those locations.
- My time spent working in the orient is was invaluable
- I think that having lived in a different country helped me have a more open mind about what people might expect
- BYU did a very good job at preparing me for a global engineering environment. I took the 2 month course during the summer which included travel to Chinese factories. VERY educational.
- The international emphasis at BYU was helpful. Japanese opened the door at John Deere.
- Prior foreign travel experiences. Frequent email and telephone contact with foreign counterparts. Ability to share CAD files and data via email or FTP. In addition to ability to communicate through electronic means face to face meetings are always useful to develop rapport with the foreign engineering teams.
- I jumped right into global engineering without much preparation. It would have been nice to have travelled overseas prior to my first work trip.
- Enjoying an adventure in a far away land.

Foreign Language

- Learned to speak Spanish and lived outside the U.S.
- Competitive advantage (Spanish) and knowledge of the foreign culture
- Language proficiency and cultural awareness.
- Foreign language skills
- Foreign language
- Foreign Language training
- Being able to speak the language. Having good communication and leadership skills. The ability to see the big picture.
- Learning a language has opened doors and allowed me to understand people on a deeper level than simply talking work. Being willing to try and understand why someone has different priorities than I do. Not being offended if someone does not like my country, my way of life, my familiar forms of government, and the school system within which I was educated. Also important to drop the "holier than thou" or "I'm better than you" attitude. Doesn't matter if this is between cultures or within the hierarchy of a company or plant. Talk respectfully to the "lowest person" at a company as well as "the president". Do not ever give in on your core values. They are not negotiable even across cultures (i.e. corruption, honesty, respect)
- Ability to speak a second language and understand the culture as well as communicate with engineers on a project level without the need for interpreters
- Knowing Spanish
- Language and Communication skills in addition to technical ME knowledge.
- Adaptability is what has helped me the most. I have worked as a Mechanical Engineer, Environmental Engineer, and as a Business Manager/Executive Director for the Navy, working extensively in Korea, and visiting Japan, Italy and the Philippines as part of my job. Having language skills and the ability to work with other cultures has helped. Working among other cultures during high school and college also helped.
- Learn and retain some basic language phrases of the host country. Track the English vocabulary used by your host peers and communicate in a like manner. Do not expect the same level of performance as found in USA domestic locations... could be higher or lower performance depending on location.
- In my case, since I am a Japanese, English skill helped me a lot. Also, it was important to know about customer's culture and accept it. To have success, it was necessary to study about customer, and then sometime you need to change your way of thinking to meet customer's requirement. I think it is communication skill rather than engineering skill.

Capstone

- My capstone project did a pretty good job of helping me understand the problems you encounter when working internationally.
- Capstone was, in my mind, the most important part of my education at BYU. In terms of preparing to work in a global environment . . . my service as a missionary in Korea helped me the most. Missionary service, besides the value of gaining true competence in another language, provided valuable experience in developing patience and communication skills that are critical for a successful global career.

- Working on global collaboration projects in Dr. Jensen's ParaCAD group.
- Working on the PACE Global Engineering project was very helpful in building my understanding of global issues and how to interact with people around the world.
- Capstone and coordinating with other designers in a team environment. Good CAD skills and practice with large assemblies with multiple designers.
- Capstone projects.
- Capstone project. The fact that I was international student at buy gave me the idea of global business. Right now I am working on a foreign country
- CAP stone and the wonderful 291R/391R lecture series which gave us the chance to hear from the corporate voice of typical engineering employees from all walks of life...
- Work on the PACE Formula Car project helped me the most to prepare for global engineering. The end product was not quality engineering. However, the exercise of creating something from conception, to design, to a physical build, while integrating with several teams overseas was an irreplaceable learning experience. After doing similar collaboration with Russian engineers in the aircraft industry, we had very similar challenges. I believe this is largely because global engineering is still in experimental stages for many companies as it was for us students.
- The CAPSTONE program was a big help to me as it gave me a real world project but I could have used more experience with these types of projects.

Global Mindset

- Persistence and willingness to challenge myself constantly.
- Willingness to learn and take risk
- Willing to work where the projects required.
- An open mind.
- Humility. Openness to new approaches and new ideas.
- Lots of hard work!
- Good work ethic (do as much as you can)
- Working hard, offering assistance even when it wasn't your specific job, treating others with respect
- Being straight forward.

Job Experience

- On the job experience and training
- On the job experience
- Working in a consulting firm while continuing my education.
- 25 years employment with an international company,
- The biggest factor has been working at a company with an international presence.
- Experience
- Experience
- Experience

Graduate School

- My MBA

- Post graduate experience and lots of mistakes.
- Getting my MBA helped a lot. Engineering principles are universal, but the MBA expanded my skills to focus on international cultural and business awareness. There is someone out there who can help you accomplish your business and technical goals professionally.

Nothing

- No Comment
- NA
- How corrupt other countries are
- Have not worked much in the global engineering environment
- Other departments took care of global engineering requirements. (so nothing helped me)

Statistic	Value
Total Responses	247

22. Gender

#	Answer		Response	%
0	Male		514	95%
1	Female		25	5%
	Total		539	100%

Statistic	Value
Mean	0.05
Variance	0.04
Standard Deviation	0.21
Total Responses	539

23. Do you speak any foreign languages?

#	Answer		Response	%
0	Yes		381	70.6%
1	No		159	29.4%
	Total		540	100%

24. Language Proficiency: Please list and rate your foreign-language proficiencies (do not include English)

* Elementary = can fulfill basic travel needs and conduct yourself in a polite manner. Able to use questions and answers for simple topics within a limited level of experience

* Limited working = able to satisfy routine social demands and limited work requirements and can handle with confidence most basic social situations; can handle limited work requirements, needing help in handling any complications or difficulties; can get the gist of most conversations on non-technical subjects (i.e. topics which require no specialized knowledge).

* Professional working = able to speak the language with sufficient structural accuracy and vocabulary to participate effectively in most conversations on practical, social, and professional topics; can discuss particular interests and special fields of competence with reasonable ease and has comprehension which is quite complete for a normal rate of speech.

* Native/Fluent = has a speaking proficiency equivalent to that of an educated native speaker; has complete fluency in the language.

#	Question	Elementary	Limited Working	Professional Working	Native / Fluent	Responses
1	2nd Language	29	178	125	49	381
2	3rd Language	46	25	10	4	85
3	4th Language	18	5	3	0	26

Languages Spoken	**2nd**	**3rd**	**4th**	**Total**	**% of Total**	**Top 10 Languages**
Afrikaans	2			2	0.52%	
Albanian	1	1		2	0.52%	
Arabic	1	1	1	3	0.79%	
Bengali		1		1	0.26%	
British Sign Language	1			1	0.26%	
Bulgarian	3	1		4	1.05%	
Cebuano-Visayan	1			1	0.26%	
Croatian	1			1	0.26%	
Czech	2			2	0.52%	
Danish	4			4	1.05%	
Dutch	4	2		6	1.57%	10

Fijian	1			1	0.26%	
Filipino	1			1	0.26%	
Finnish	2			2	0.52%	
French	23	9	5	37	9.71%	5
German	38	7	4	49	12.86%	2
Greek	3			3	0.79%	
Guarani		1		1	0.26%	
Hindi	1	3		4	1.05%	
Italian	10	6	4	20	5.25%	7
Japanese	33	5		38	9.97%	4
Korean	8	1		9	2.36%	9
Korean Sign		2		2	0.52%	
Laotian	1			1	0.26%	
Malagasy	1			1	0.26%	
Maltese		1		1	0.26%	
Mandarin Chinese	13	5	4	22	5.77%	6
Navajo	1			1	0.26%	
Nepali	1			1	0.26%	
Norwegian	4			4	1.05%	
Portuguese	29	11	4	44	11.55%	3
Russian	12	5		17	4.46%	8
Sinhala	1			1	0.26%	
Spanish	164	22	4	190	49.87%	1
Swedish	2			2	0.52%	
Tagalog	5			5	1.31%	
Tahitian		1		1	0.26%	
Thai	5			5	1.31%	
Urdu	1			1	0.26%	
Vietnamese	1			1	0.26%	
Total	**381**	**85**	**26**	**492**		

* 40 different languages (not including English)

25. Personal Contact Information

The personal contact information of survey respondents has been removed for privacy purposes. However a summary of respondents is provided below. Survey Respondents were given a voluntary opportunity to provide personal contact information

and of the 561 respondents that participated in the survey 461 (82.2%) provided their contact information representing 26 states and 3 countries including the United States, Mexico, and Honduras. Respondents represented more than 79 different companies including many large multinational firms such as: Hewlett-Packard, Boeing, 3M, ATK, United Parcel Service, Browning, Intel, Honeywell, Exxon Mobil, Ford Motor Company, ConocoPhillips, Cessna, Adobe Systems, Northrop Grumman, Monsanto, Siemens, Bard Access Systems, Stryker and many others.

Appendix H: Informed Consent and Survey Instrument Flow

Dissertation Survey

INFORMED CONSENT

IC

INFORMED CONSENT TO PARTICIPATE IN RESEARCH AND SURVEY

IRB Approval Number (IRB#20100410438 EX)

Title of Research Project: An Evaluation of Competencies Considered by Multinational Companies When Hiring Mechanical Engineers to Work in a Global Environment

The purpose of this study is to ***identify if multinational companies consider global competence an important skill in mechanical engineering graduates when making hiring decisions.*** This will include an evaluation of standard hiring technical engineering competencies with a list of global competencies for engineering. This research will provide benchmark information for college and university engineering departments and programs to evaluate their approach in adequately preparing engineers to work in a global environment. You were invited to participate because you are a BYU Mechanical Engineering alumnus.

This survey is being conducted by Gregg Warnick (Mechanical Engineering External Relations Coordinator) at Brigham Young University (BYU) and PhD candidate in the Educational Administration department at the University of Nebraska-Lincoln (UNL). We invite you to take part in this research study.

Procedures:

Participation in this study will require approximately 15 minutes or less of your time to complete the survey. Questions include general information concerning your education, employment, company, and a comparison of competencies for engineers considered by your company when making hiring decisions for mechanical engineers to be successful working in a global environment.

Risks or Discomforts:

There are no known risks or discomforts associated with this research.

Benefits

You may not benefit directly as a result of taking part in this study, but knowledge may be gained that might benefit others.

Compensation:

Survey participants who choose to provide contact information will be eligible for a random drawing to receive one of two BYU Mechanical Engineering Leatherman® multi-tools (Retail value of $46.00) or one of ten Mechanical Engineering T-shirts (Retail value of $9.95).

Confidentiality:

Any information obtained during this study which could identify you will be kept strictly confidential. The data will be stored in a locked cabinet in the investigator's office and will only be seen by the investigators during the study and for the three years after the study is complete. The information obtained in this study may be published in professional journals or national and international conferences but the data will be reported as aggregate data only.

Opportunity to Ask Questions:

You may ask any questions concerning this research and have those questions answered before agreeing to participate in or during the study. If you have questions regarding this study you may contact:

- Gregg Warnick, Mechanical Engineering Department External Relations Coordinator. Tel: (801) 422-6322; E-mail: gmw@byu.edu
- Dr. Larry Dlugosh, Educational Administration Department Chair and Professor. Tel: (402) 472-0975; E-mail: ldlugosh1@unl.edu

If you have any questions about being a research participant or to report any concerns about the study, you may contact the UNL Institutional Review Board at (402) 472-6965

Please contact the BYU Institutional Review Board Administrator at (801) 422-1461, A-285 ASB, Campus Drive, Provo, UT 84602, irb@byu.edu if you have additional questions regarding your rights as a research participant.

Freedom to Withdraw:

Participation in this study is voluntary. You may withdraw at any time without penalty or refuse to participate entirely without harming your relationship with the researchers, the University of Nebraska-Lincoln, or Brigham Young University. Leaving the study will not cause a penalty or loss of any benefits to which you are otherwise entitled.

We appreciate your efforts in helping us improve our program. We invite you to **print** a copy of this informed consent page for your records.

1) **Please select "Yes" to provide your informed consent to participate in this survey or select "No" if you choose not to participate.** *To confirm your response, please click on the arrow button at the bottom right.*

Yes ○ No ○

☐ If **No** Is **Selected**, Then Skip To **End of Survey**

EDUCATION

2) **Please indicate the type of Mechanical Engineering degree(s) you received from Brigham Young University (BYU). If you received more than one degree type from BYU, please select all that are applicable** (Due to consolidation of engineering programs - Design Engineering Technology (DET) and Manufacturing Engineering (MFE) graduates are included in the Mechanical Engineering data).

BS ☐ MS ☐ PhD ☐

3) **Please indicate the year that you received your latest degree in Mechanical Engineering from BYU.**

2010

EMPLOYMENT

4) **Which of the following best describes your employment status?**

- Employed, working 30 hours or more per week
- Employed part time, working less than 30 hours per week
- Self-employed
- Stay-at-Home Parent
- Not currently employed
- Retired
- Student

If **Stay-at-Home Parent** Is **Selected**, Then Skip To **End of Block**
If **Not currently employed** Is **Selected**, Then Skip To **End of Block**
If **Retired** Is **Selected**, Then Skip To **End of Block**
If **Student** Is **Selected**, Then Skip To **End of Block**

5) **The industry that you currently work for is best categorized by which one of the following?**

- Aerospace/Aviation
- Automotive
- Construction
- Consulting
- Consumer Products
- Education
- Government/Military
- Manufacturing
- Media / Entertainment
- Medical / Pharmaceutical / Bio-tech
- Petroleum / Energy
- Technology
- Other

6) **What title most closely matches your current job title?**

- CEO / President / Owner
- Vice President
- Director
- Engineering Manager
- Engineering Supervisor
- Engineer
- Other

7) **How many employees (worldwide) does your company employ?**

- Less than 50
- 50 to 99
- 100 to 499
- 500 to 999
- 1,000 to 4,999
- 5,000 to 10,000
- More than 10,000

8) **What is the approximate annual revenue (US $) of your company?**

- Less than $10 million
- $10 million to $99 million
- $100 million to $499 million
- $500 million to $1 billion
- Over $1 billion
- × Don't know

9) **Does your company conduct business internationally or have at least one operation in a different country?**

Yes	No
○	○

If **No** Is **Selected**, Then Skip To **End of Block**

10) **What is the approximate percentage of total company revenues that comes from operations outside of the United States?**

- 0-20%
- 21-40%
- 41-60%
- 61-80%
- 81-100%
- Don't know

11) **Are you directly involved in making hiring decisions for new engineers with your company**

Yes ○ No ○

☐ If **No** Is **Selected**, Then Skip To **End of Block**

12) **Please briefly describe how these hiring decisions are made within your company.**

COMPETENCIES CONSIDERED WHEN HIRING NEW ENGINEERS

13) **How important is it for Mechanical Engineers hired by your company who will either work immediately or eventually in a global environment to have:**

NOTE: *To ensure consistency, please read the definition provided for each competency by placing your mouse cursor over the statement and a pop-up screen will be displayed. To have it reappear, move your cursor away from the statement and then back to the statement.*

	Unimportant	Of little Importance	Moderately Important	Important	Very Important
a high GPA	○	○	○	○	○
an ability to exhibit a global mindset	○	○	○	○	○
an ability to apply knowledge of mathematics, science and engineering.	○	○	○	○	○
an ability to appreciate and understand different cultures	○	○	○	○	○
an ability to design and conduct experiments, as well as to analyze and interpret data	○	○	○	○	○
	Unimportant	Of little Importance	Moderately Important	Important	Very Important
an ability to demonstrate world and local knowledge	○	○	○	○	○
an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	○	○	○	○	○
an ability to communicate cross-culturally	○	○	○	○	○
an ability to speak more than one language including English	○	○	○	○	○
an ability to identify, formulate, and solve engineering problems	○	○	○	○	○
	Unimportant	Of little Importance	Moderately Important	Important	Very Important
an ability to understand international business, law, and technical elements	○	○	○	○	○
an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	○	○	○	○	○
an ability to live and work in a transnational engineering environment	○	○	○	○	○
an ability to work in international teams	○	○	○	○	○
pertinent applicable work experience	○	○	○	○	○

14) **Please list any additional competencies your company considers when hiring new Mechanical Engineers to work in a global environment.**

15) *Please indicate your agreement with the following statements*

My company:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
is willing to provide the appropriate training / experience for engineers to be successful in a global environment	○	○	○	○	○
is successful at providing the appropriate training / experience for engineers to be successful in a global environment	○	○	○	○	○
values the efforts of college/university engineering departments/programs to prepare engineers to work in a global environment	○	○	○	○	○
considers college/university engineering departments/programs successful at preparing engineers to work in a global environment	○	○	○	○	○

16) **What can college/university engineering departments do to better prepare engineers for success in a global engineering environment?**

Global Experience

17) **Have you worked in a global engineering environment during part of your career?**

Yes ○ No ○

☐ If **No** Is **Selected**, Then Skip To **End of Block**

18) **How many different countries have you visited in the context of your career?** *Note: do not include countries visited only for vacation purposes*

- ○ None
- ○ 1-3
- ○ 4-6
- ○ 7-9
- ○ 10-12
- ○ 13 or more

19) **Please select all the continents you have visited in the context of your career.** *Note: do not include continents visited only for vacation purposes*

- ☐ Africa
- ☐ Antarctica
- ☐ Asia
- ☐ Australia / Oceania (Australia, New Zealand, Polynesia, etc.)
- ☐ Europe
- ☐ North America
- ☐ South America

20) **What do you wish you would have known upon completion of college to better prepare you to work successfully in a global engineering environment?**

21) **Please describe what has best helped you prepare for and obtain success when working in a global engineering environment.**

DEMOGRAPHICS

22) **Gender**

Male ○ Female ○

23) **Do you speak any foreign languages?**

Yes ○ No ○

If **No** Is **Selected**, Then Skip To **Thank you for your participation in t...**

24) **Language Proficiency**
Please list and rate your foreign-language proficiencies (do not include English)

* *Elementary* = can fulfill basic travel needs and conduct yourself in a polite manner. Able to use questions and answers for simple topics within a limited level of experience

* *Limited working* = able to satisfy routine social demands and limited work requirements and can handle with confidence most basic social situations; can handle limited work requirements, needing help in handling any complications or difficulties; can get the gist of most conversations on non-technical subjects (i.e. topics which require no specialized knowledge).

* Professional working = able to speak the language with sufficient structural accuracy and vocabulary to participate effectively in most conversations on practical, social, and professional topics; can discuss particular interests and special fields of competence with reasonable ease and has comprehension which is quite complete for a normal rate of speech.

* *Native/Fluent* = has a speaking proficiency equivalent to that of an educated native speaker; has complete fluency in the language.

	Elementary	Limited Working	Professional Working	Native/Fluent
2nd Language	○	○	○	○
3rd Language	○	○	○	○
4th Language _____	○	○	○	○

Lthman

Thank you for your participation in this survey. If you *do not* wish to provide your contact information and do not want to be eligible for the Leatherman® multi-tool or BYU Mechanical Engineering T-shirt please click on the arrow key (bottom right).

If you *would like* to be eligible for a random drawing to win one of two BYU Mechanical Engineering Leatherman® multi-tools (Retail value of $46.00) or one of 10 Mechanical Engineering T-shirts (Retail value of $9.95) please complete the personal contact information below. Once you have completed the personal information, please click on the arrow key (bottom right).

25) **Personal Contact Information**

First Name

Last Name

Employer

Street Address

City

State

Country

Zip Code

E-mail

Phone (e.g. 5552221111)

T-shirt Size (S, M, L, XL, XXL)

Click here to edit form fields

Appendix I: Inferential Statistics Cross-tab Analysis and Results

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Job Title Recoded * A high GPA	149	26.5%	414	73.5%	563	100.0%
Job Title Recoded * Exhibit a global mindset	149	26.5%	414	73.5%	563	100.0%
Job Title Recoded * Apply knowledge of mathematics, science and engineering.	149	26.5%	414	73.5%	563	100.0%
Job Title Recoded * Appreciate and understand different cultures	149	26.5%	414	73.5%	563	100.0%
Job Title Recoded * Design and conduct experiments, as well as to analyze and interpret data	149	26.5%	414	73.5%	563	100.0%
Job Title Recoded * Demonstrate world and local knowledge	149	26.5%	414	73.5%	563	100.0%
Job Title Recoded * Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	149	26.5%	414	73.5%	563	100.0%
Job Title Recoded * Communicate cross-culturally	149	26.5%	414	73.5%	563	100.0%
Job Title Recoded * Speak more than one language including English	149	26.5%	414	73.5%	563	100.0%
Job Title Recoded * Identify, formulate, and solve engineering problems	149	26.5%	414	73.5%	563	100.0%
Job Title Recoded * Understand international business, law, and technical elements	149	26.5%	414	73.5%	563	100.0%
Job Title Recoded * Use the techniques, skills, and modern engineering tools necessary for engineering practice	149	26.5%	414	73.5%	563	100.0%
Job Title Recoded * Live and work in a transnational engineering environment	149	26.5%	414	73.5%	563	100.0%
Job Title Recoded * Work in international teams	149	26.5%	414	73.5%	563	100.0%
Job Title Recoded * Pertinent applicable work experience	149	26.5%	414	73.5%	563	100.0%

Job Title Recoded * A high GPA

Crosstab

			A high GPA			
			Unimportant/Of Little Importance	Moderately Important	Important/Very Important	Total
Job Title Recoded	Sr. Leadership	Count	8	28	19	55
		% within Job Title Recoded	14.5%	50.9%	34.5%	100.0%
		% within A high GPA	53.3%	45.2%	26.4%	36.9%
		% of Total	5.4%	18.8%	12.8%	36.9%
	Manager/Supervisor/Other	Count	4	29	39	72
		% within Job Title Recoded	5.6%	40.3%	54.2%	100.0%
		% within A high GPA	26.7%	46.8%	54.2%	48.3%
		% of Total	2.7%	19.5%	26.2%	48.3%
	Engineer	Count	3	5	14	22
		% within Job Title Recoded	13.6%	22.7%	63.6%	100.0%
		% within A high GPA	20.0%	8.1%	19.4%	14.8%
		% of Total	2.0%	3.4%	9.4%	14.8%
Total		Count	15	62	72	149
		% within Job Title Recoded	10.1%	41.6%	48.3%	100.0%
		% within A high GPA	100.0%	100.0%	100.0%	100.0%
		% of Total	10.1%	41.6%	48.3%	100.0%

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.195	.077	2.537	.011
		Job Title Recoded Dependent	.199	.079	2.537	.011
		A high GPA Dependent	.191	.075	2.537	.011

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	.195	.077	2.537	.011
	Kendall's tau-c	.174	.069	2.537	.011
	Gamma	.319	.124	2.537	.011
N of Valid Cases		149			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Job Title Recoded * Speak more than one language including English

Crosstab

			Speak more than one language including English			
			Unimportant/Of Little Importance	Moderately Important	Important/Very Important	Total
Job Title Recoded	Sr. Leadership	Count	16	29	10	55
		% within Job Title Recoded	29.1%	52.7%	18.2%	100.0%
		% within Speak more than one language including English	28.1%	42.0%	43.5%	36.9%
		% of Total	10.7%	19.5%	6.7%	36.9%
	Manager/Supervisor/Other	Count	30	29	13	72
		% within Job Title Recoded	41.7%	40.3%	18.1%	100.0%
		% within Speak more than one language including English	52.6%	42.0%	56.5%	48.3%
		% of Total	20.1%	19.5%	8.7%	48.3%
	Engineer	Count	11	11	0	22
		% within Job Title Recoded	50.0%	50.0%	.0%	100.0%
		% within Speak more than one language including English	19.3%	15.9%	.0%	14.8%
		% of Total	7.4%	7.4%	.0%	14.8%
Total		Count	57	69	23	149
		% within Job Title Recoded	38.3%	46.3%	15.4%	100.0%
		% within Speak more than one language including English	100.0%	100.0%	100.0%	100.0%
		% of Total	38.3%	46.3%	15.4%	100.0%

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	-.154	.067	-2.274	.023
		Job Title Recoded Dependent	-.154	.067	-2.274	.023
		Speak more than one language including English Dependent	-.155	.068	-2.274	.023

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	-.154	.067	-2.274	.023
	Kendall's tau-c	-.142	.062	-2.274	.023
	Gamma	-.252	.107	-2.274	.023
N of Valid Cases		149			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Number of Employees Worldwide * A high GPA	149	26.5%	414	73.5%	563	100.0%
Number of Employees Worldwide * Exhibit a global mindset	149	26.5%	414	73.5%	563	100.0%
Number of Employees Worldwide * Apply knowledge of mathematics, science and engineering.	149	26.5%	414	73.5%	563	100.0%
Number of Employees Worldwide * Appreciate and understand different cultures	149	26.5%	414	73.5%	563	100.0%
Number of Employees Worldwide * Design and conduct experiments, as well as to analyze and interpret data	149	26.5%	414	73.5%	563	100.0%
Number of Employees Worldwide * Demonstrate world and local knowledge	149	26.5%	414	73.5%	563	100.0%
Number of Employees Worldwide * Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	149	26.5%	414	73.5%	563	100.0%
Number of Employees Worldwide * Communicate cross-culturally	149	26.5%	414	73.5%	563	100.0%
Number of Employees Worldwide * Speak more than one language including English	149	26.5%	414	73.5%	563	100.0%
Number of Employees Worldwide * Identify, formulate, and solve engineering problems	149	26.5%	414	73.5%	563	100.0%
Number of Employees Worldwide * Understand international business, law, and technical elements	149	26.5%	414	73.5%	563	100.0%
Number of Employees Worldwide * Use the techniques, skills, and modern engineering tools necessary for engineering practice	149	26.5%	414	73.5%	563	100.0%
Number of Employees Worldwide * Live and work in a transnational engineering environment	149	26.5%	414	73.5%	563	100.0%
Number of Employees Worldwide * Work in international teams	149	26.5%	414	73.5%	563	100.0%
Number of Employees Worldwide * Pertinent applicable work experience	149	26.5%	414	73.5%	563	100.0%

Number of Employees Worldwide * A high GPA

Crosstab

			A high GPA			
			Unimportant/Of Little Importance	Moderately Important	Important/Very Important	Total
Number of Employees Worldwide	Less than 1,000	Count	9	24	19	52
		% within Number of Employees Worldwide	17.3%	46.2%	36.5%	100.0%
		% within A high GPA	60.0%	38.7%	26.4%	34.9%
		% of Total	6.0%	16.1%	12.8%	34.9%
	1,000 to 10,000	Count	2	15	16	33
		% within Number of Employees Worldwide	6.1%	45.5%	48.5%	100.0%
		% within A high GPA	13.3%	24.2%	22.2%	22.1%
		% of Total	1.3%	10.1%	10.7%	22.1%
	More than 10,000	Count	4	23	37	64
		% within Number of Employees Worldwide	6.3%	35.9%	57.8%	100.0%
		% within A high GPA	26.7%	37.1%	51.4%	43.0%
		% of Total	2.7%	15.4%	24.8%	43.0%
Total		Count	15	62	72	149
		% within Number of Employees Worldwide	10.1%	41.6%	48.3%	100.0%
		% within A high GPA	100.0%	100.0%	100.0%	100.0%
		% of Total	10.1%	41.6%	48.3%	100.0%

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.190	.074	2.557	.011
		Number of Employees Worldwide Dependent	.200	.077	2.557	.011
		A high GPA Dependent	.181	.071	2.557	.011

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	.190	.074	2.557	.011
	Kendall's tau-c	.175	.068	2.557	.011
	Gamma	.305	.115	2.557	.011
N of Valid Cases		149			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Number of Employees Worldwide * Exhibit a global mindset

Crosstab

			Exhibit a global mindset			
			Unimportant/Of Little Importance	Moderately Important	Important/Very Important	Total
Number of Employees Worldwide	Less than 1,000	Count	9	23	20	52
		% within Number of Employees Worldwide	17.3%	44.2%	38.5%	100.0%
		% within Exhibit a global mindset	36.0%	48.9%	26.0%	34.9%
		% of Total	6.0%	15.4%	13.4%	34.9%
	1,000 to 10,000	Count	7	11	15	33
		% within Number of Employees Worldwide	21.2%	33.3%	45.5%	100.0%
		% within Exhibit a global mindset	28.0%	23.4%	19.5%	22.1%
		% of Total	4.7%	7.4%	10.1%	22.1%
	More than 10,000	Count	9	13	42	64
		% within Number of Employees Worldwide	14.1%	20.3%	65.6%	100.0%
		% within Exhibit a global mindset	36.0%	27.7%	54.5%	43.0%
		% of Total	6.0%	8.7%	28.2%	43.0%
Total		Count	25	47	77	149
		% within Number of Employees Worldwide	16.8%	31.5%	51.7%	100.0%
		% within Exhibit a global mindset	100.0%	100.0%	100.0%	100.0%
		% of Total	16.8%	31.5%	51.7%	100.0%

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.186	.072	2.604	.009
		Number of Employees Worldwide Dependent	.192	.075	2.604	.009
		Exhibit a global mindset Dependent	.180	.069	2.604	.009

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	.186	.072	2.604	.009
	Kendall's tau-c	.174	.067	2.604	.009
	Gamma	.288	.108	2.604	.009
N of Valid Cases		149			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Number of Employees Worldwide * Appreciate and understand different cultures

Crosstab

			Appreciate and understand different cultures			
			Unimportant/Of Little Importance	Moderately Important	Important/Very Important	Total
Number of Employees Worldwide	Less than 1,000	Count	7	25	20	52
		% within Number of Employees Worldwide	13.5%	48.1%	38.5%	100.0%
		% within Appreciate and understand different cultures	46.7%	52.1%	23.3%	34.9%
		% of Total	4.7%	16.8%	13.4%	34.9%
	1,000 to 10,000	Count	5	11	17	33
		% within Number of Employees Worldwide	15.2%	33.3%	51.5%	100.0%
		% within Appreciate and understand different cultures	33.3%	22.9%	19.8%	22.1%
		% of Total	3.4%	7.4%	11.4%	22.1%
	More than 10,000	Count	3	12	49	64
		% within Number of Employees Worldwide	4.7%	18.8%	76.6%	100.0%
		% within Appreciate and understand different cultures	20.0%	25.0%	57.0%	43.0%
		% of Total	2.0%	8.1%	32.9%	43.0%
Total		Count	15	48	86	149
		% within Number of Employees Worldwide	10.1%	32.2%	57.7%	100.0%
		% within Appreciate and understand different cultures	100.0%	100.0%	100.0%	100.0%
		% of Total	10.1%	32.2%	57.7%	100.0%

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.302	.068	4.437	.000
		Number of Employees Worldwide Dependent	.327	.074	4.437	.000
		Appreciate and understand different cultures Dependent	.281	.064	4.437	.000

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	.303	.068	4.437	.000
	Kendall's tau-c	.271	.061	4.437	.000
	Gamma	.476	.098	4.437	.000
N of Valid Cases		149			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Number of Employees Worldwide * Understand international business, law, and technical elements

Crosstab

			Understand international business, law, and technical elements			Total
			Unimportant/Of Little Importance	Moderately Important	Important/Very Important	
Number of Employees Worldwide	Less than 1,000	Count	20	18	14	52
		% within Number of Employees Worldwide	38.5%	34.6%	26.9%	100.0%
		% within Understand international business, law, and technical elements	40.8%	34.6%	29.2%	34.9%
		% of Total	13.4%	12.1%	9.4%	34.9%
	1,000 to 10,000	Count	13	11	9	33
		% within Number of Employees Worldwide	39.4%	33.3%	27.3%	100.0%
		% within Understand international business, law, and technical elements	26.5%	21.2%	18.8%	22.1%
		% of Total	8.7%	7.4%	6.0%	22.1%
	More than 10,000	Count	16	23	25	64
		% within Number of Employees Worldwide	25.0%	35.9%	39.1%	100.0%
		% within Understand international business, law, and technical elements	32.7%	44.2%	52.1%	43.0%
		% of Total	10.7%	15.4%	16.8%	43.0%
Total		Count	49	52	48	149
		% within Number of Employees Worldwide	32.9%	34.9%	32.2%	100.0%
		% within Understand international business, law, and technical elements	100.0%	100.0%	100.0%	100.0%
		% of Total	32.9%	34.9%	32.2%	100.0%

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.129	.072	1.802	.072
		Number of Employees Worldwide Dependent	.127	.071	1.802	.072
		Understand international business, law, and technical elements Dependent	.131	.073	1.802	.072

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	.129	.072	1.802	.072
	Kendall's tau-c	.127	.071	1.802	.072
	Gamma	.196	.108	1.802	.072
N of Valid Cases		149			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Number of Employees Worldwide * Live and work in a transnational engineering environment

Crosstab

			Live and work in a transnational engineering environment			
			Unimportant/Of Little Importance	Moderately Important	Important/Very Important	Total
Number of Employees Worldwide	Less than 1,000	Count	17	24	11	52
		% within Number of Employees Worldwide	32.7%	46.2%	21.2%	100.0%
		% within Live and work in a transnational engineering environment	56.7%	47.1%	16.2%	34.9%
		% of Total	11.4%	16.1%	7.4%	34.9%
	1,000 to 10,000	Count	9	7	17	33
		% within Number of Employees Worldwide	27.3%	21.2%	51.5%	100.0%
		% within Live and work in a transnational engineering environment	30.0%	13.7%	25.0%	22.1%
		% of Total	6.0%	4.7%	11.4%	22.1%
	More than 10,000	Count	4	20	40	64
		% within Number of Employees Worldwide	6.3%	31.3%	62.5%	100.0%
		% within Live and work in a transnational engineering environment	13.3%	39.2%	58.8%	43.0%
		% of Total	2.7%	13.4%	26.8%	43.0%
Total		Count	30	51	68	149
		% within Number of Employees Worldwide	20.1%	34.2%	45.6%	100.0%
		% within Live and work in a transnational engineering environment	100.0%	100.0%	100.0%	100.0%
		% of Total	20.1%	34.2%	45.6%	100.0%

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.342	.062	5.532	.000
		Number of Employees Worldwide Dependent	.345	.062	5.532	.000
		Live and work in a transnational engineering environment Dependent	.339	.062	5.532	.000

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	.342	.062	5.532	.000
	Kendall's tau-c	.328	.059	5.532	.000
	Gamma	.505	.083	5.532	.000
N of Valid Cases		149			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Number of Employees Worldwide * Work in international teams

Crosstab

			Work in international teams			
			Unimportant/Of Little Importance	Moderately Important	Important/Very Important	Total
Number of Employees Worldwide	Less than 1,000	Count	10	20	22	52
		% within Number of Employees Worldwide	19.2%	38.5%	42.3%	100.0%
		% within Work in international teams	43.5%	57.1%	24.2%	34.9%
		% of Total	6.7%	13.4%	14.8%	34.9%
	1,000 to 10,000	Count	7	3	23	33
		% within Number of Employees Worldwide	21.2%	9.1%	69.7%	100.0%
		% within Work in international teams	30.4%	8.6%	25.3%	22.1%
		% of Total	4.7%	2.0%	15.4%	22.1%
	More than 10,000	Count	6	12	46	64
		% within Number of Employees Worldwide	9.4%	18.8%	71.9%	100.0%
		% within Work in international teams	26.1%	34.3%	50.5%	43.0%
		% of Total	4.0%	8.1%	30.9%	43.0%
Total		Count	23	35	91	149
		% within Number of Employees Worldwide	15.4%	23.5%	61.1%	100.0%
		% within Work in international teams	100.0%	100.0%	100.0%	100.0%
		% of Total	15.4%	23.5%	61.1%	100.0%

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.220	.069	3.164	.002
		Number of Employees Worldwide Dependent	.239	.076	3.164	.002
		Work in international teams Dependent	.203	.065	3.164	.002

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	.221	.070	3.164	.002
	Kendall's tau-c	.197	.062	3.164	.002
	Gamma	.358	.107	3.164	.002
N of Valid Cases		149			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Revenue_Recoded * A high GPA	149	26.5%	414	73.5%	563	100.0%
Revenue_Recoded * Exhibit a global mindset	149	26.5%	414	73.5%	563	100.0%
Revenue_Recoded * Apply knowledge of mathematics, science and engineering.	149	26.5%	414	73.5%	563	100.0%
Revenue_Recoded * Appreciate and understand different cultures	149	26.5%	414	73.5%	563	100.0%
Revenue_Recoded * Design and conduct experiments, as well as to analyze and interpret data	149	26.5%	414	73.5%	563	100.0%
Revenue_Recoded * Demonstrate world and local knowledge	149	26.5%	414	73.5%	563	100.0%
Revenue_Recoded * Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	149	26.5%	414	73.5%	563	100.0%
Revenue_Recoded * Communicate cross-culturally	149	26.5%	414	73.5%	563	100.0%
Revenue_Recoded * Speak more than one language including English	149	26.5%	414	73.5%	563	100.0%
Revenue_Recoded * Identify, formulate, and solve engineering problems	149	26.5%	414	73.5%	563	100.0%
Revenue_Recoded * Understand international business, law, and technical elements	149	26.5%	414	73.5%	563	100.0%
Revenue_Recoded * Use the techniques, skills, and modern engineering tools necessary for engineering practice	149	26.5%	414	73.5%	563	100.0%
Revenue_Recoded * Live and work in a transnational engineering environment	149	26.5%	414	73.5%	563	100.0%
Revenue_Recoded * Work in international teams	149	26.5%	414	73.5%	563	100.0%
Revenue_Recoded * Pertinent applicable work experience	149	26.5%	414	73.5%	563	100.0%

Revenue_Recoded * A high GPA

Crosstab

			A high GPA			
			Unimportant/Of Little Importance	Moderately Important	Important/Very Important	Total
Revenue_Recoded	Less than $100 million	Count	6	20	17	43
		% within Revenue_Recoded	14.0%	46.5%	39.5%	100.0%
		% within A high GPA	40.0%	32.3%	23.6%	28.9%
		% of Total	4.0%	13.4%	11.4%	28.9%
	$100 million to $1 billion	Count	3	12	10	25
		% within Revenue_Recoded	12.0%	48.0%	40.0%	100.0%
		% within A high GPA	20.0%	19.4%	13.9%	16.8%
		% of Total	2.0%	8.1%	6.7%	16.8%
	Over $1 billion	Count	5	24	40	69
		% within Revenue_Recoded	7.2%	34.8%	58.0%	100.0%
		% within A high GPA	33.3%	38.7%	55.6%	46.3%
		% of Total	3.4%	16.1%	26.8%	46.3%
	Don't know	Count	1	6	5	12
		% within Revenue_Recoded	8.3%	50.0%	41.7%	100.0%
		% within A high GPA	6.7%	9.7%	6.9%	8.1%
		% of Total	.7%	4.0%	3.4%	8.1%
Total		Count	15	62	72	149
		% within Revenue_Recoded	10.1%	41.6%	48.3%	100.0%
		% within A high GPA	100.0%	100.0%	100.0%	100.0%
		% of Total	10.1%	41.6%	48.3%	100.0%

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.121	.073	1.652	.098
		Revenue_Recoded Dependent	.130	.078	1.652	.098
		A high GPA Dependent	.113	.069	1.652	.098

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	.121	.073	1.652	.098
	Kendall's tau-c	.113	.069	1.652	.098
	Gamma	.190	.114	1.652	.098
N of Valid Cases		149			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Revenue_Recoded * Appreciate and understand different cultures

Crosstab

			Appreciate and understand different cultures			
			Unimportant/Of Little Importance	Moderately Important	Important/Very Important	Total
Revenue_Recoded	Less than $100 million	Count	5	21	17	43
		% within Revenue_Recoded	11.6%	48.8%	39.5%	100.0%
		% within Appreciate and understand different cultures	33.3%	43.8%	19.8%	28.9%
		% of Total	3.4%	14.1%	11.4%	28.9%
	$100 million to $1 billion	Count	4	9	12	25
		% within Revenue_Recoded	16.0%	36.0%	48.0%	100.0%
		% within Appreciate and understand different cultures	26.7%	18.8%	14.0%	16.8%
		% of Total	2.7%	6.0%	8.1%	16.8%
	Over $1 billion	Count	2	15	52	69
		% within Revenue_Recoded	2.9%	21.7%	75.4%	100.0%
		% within Appreciate and understand different cultures	13.3%	31.3%	60.5%	46.3%
		% of Total	1.3%	10.1%	34.9%	46.3%
	Don't know	Count	4	3	5	12
		% within Revenue_Recoded	33.3%	25.0%	41.7%	100.0%
		% within Appreciate and understand different cultures	26.7%	6.3%	5.8%	8.1%
		% of Total	2.7%	2.0%	3.4%	8.1%
Total		Count	15	48	86	149
		% within Revenue_Recoded	10.1%	32.2%	57.7%	100.0%
		% within Appreciate and understand different cultures	100.0%	100.0%	100.0%	100.0%
		% of Total	10.1%	32.2%	57.7%	100.0%

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.181	.079	2.325	.020
		Revenue_Recoded Dependent	.200	.087	2.325	.020
		Appreciate and understand different cultures Dependent	.166	.072	2.325	.020

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	.182	.079	2.325	.020
	Kendall's tau-c	.166	.071	2.325	.020
	Gamma	.277	.119	2.325	.020
N of Valid Cases		149			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Revenue_Recoded * Live and work in a transnational engineering environment

Crosstab

			Live and work in a transnational engineering environment			
			Unimportant/Of Little Importance	Moderately Important	Important/Very Important	Total
Revenue_Recoded	Less than $100 million	Count	14	17	12	43
		% within Revenue_Recoded	32.6%	39.5%	27.9%	100.0%
		% within Live and work in a transnational engineering environment	46.7%	33.3%	17.6%	28.9%
		% of Total	9.4%	11.4%	8.1%	28.9%
	$100 million to $1 billion	Count	5	8	12	25
		% within Revenue_Recoded	20.0%	32.0%	48.0%	100.0%
		% within Live and work in a transnational engineering environment	16.7%	15.7%	17.6%	16.8%
		% of Total	3.4%	5.4%	8.1%	16.8%
	Over $1 billion	Count	5	23	41	69
		% within Revenue_Recoded	7.2%	33.3%	59.4%	100.0%
		% within Live and work in a transnational engineering environment	16.7%	45.1%	60.3%	46.3%
		% of Total	3.4%	15.4%	27.5%	46.3%
	Don't know	Count	6	3	3	12
		% within Revenue_Recoded	50.0%	25.0%	25.0%	100.0%
		% within Live and work in a transnational engineering environment	20.0%	5.9%	4.4%	8.1%
		% of Total	4.0%	2.0%	2.0%	8.1%
Total		Count	30	51	68	149
		% within Revenue_Recoded	20.1%	34.2%	45.6%	100.0%
		% within Live and work in a transnational engineering environment	100.0%	100.0%	100.0%	100.0%
		% of Total	20.1%	34.2%	45.6%	100.0%

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.153	.078	1.964	.050
		Revenue_Recoded Dependent	.157	.080	1.964	.050
		Live and work in a transnational engineering environment Dependent	.149	.077	1.964	.050

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	.153	.078	1.964	.050
	Kendall's tau-c	.149	.076	1.964	.050
	Gamma	.224	.114	1.964	.050
N of Valid Cases		149			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Revenue_Recoded * Work in international teams

Crosstab

			Work in international teams			
			Unimportant/Of Little Importance	Moderately Important	Important/Very Important	Total
Revenue_Recoded	Less than $100 million	Count	8	17	18	43
		% within Revenue_Recoded	18.6%	39.5%	41.9%	100.0%
		% within Work in international teams	34.8%	48.6%	19.8%	28.9%
		% of Total	5.4%	11.4%	12.1%	28.9%
	$100 million to $1 billion	Count	4	6	15	25
		% within Revenue_Recoded	16.0%	24.0%	60.0%	100.0%
		% within Work in international teams	17.4%	17.1%	16.5%	16.8%
		% of Total	2.7%	4.0%	10.1%	16.8%
	Over $1 billion	Count	6	10	53	69
		% within Revenue_Recoded	8.7%	14.5%	76.8%	100.0%
		% within Work in international teams	26.1%	28.6%	58.2%	46.3%
		% of Total	4.0%	6.7%	35.6%	46.3%
	Don't know	Count	5	2	5	12
		% within Revenue_Recoded	41.7%	16.7%	41.7%	100.0%
		% within Work in international teams	21.7%	5.7%	5.5%	8.1%
		% of Total	3.4%	1.3%	3.4%	8.1%
Total		Count	23	35	91	149
		% within Revenue_Recoded	15.4%	23.5%	61.1%	100.0%
		% within Work in international teams	100.0%	100.0%	100.0%	100.0%
		% of Total	15.4%	23.5%	61.1%	100.0%

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.149	.079	1.897	.058
		Revenue_Recoded Dependent	.166	.088	1.897	.058
		Work in international teams Dependent	.136	.073	1.897	.058

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Kendall's tau-b	.150	.080	1.897	.058
	Kendall's tau-c	.136	.072	1.897	.058
	Gamma	.231	.121	1.897	.058
N of Valid Cases		149			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.