New Orleans JAZZED about Engineering Education

Paper ID #16163

# Developing a Professional and Personal Network as a Method for Deepening Lessons in Engineering Leadership

**Mr. Steven W Klosterman, Northeastern University**

Mr. Klosterman is a Director and Professor of the Practice in the Gordon Engineering Leadership Program at Northeastern University.

He has over 25 years of experience in the high technology in computer architecture and systems design at the Digital Equipment Corporation and at startup Stellar Computer. He joined Sun Microsystems in 1990 as a microprocessor designer. At Sun, he led and managed hardware engineering, product design and systems engineering organizations, served as a Director of Engineering in Worldwide Operations and a Product Line Director running a program management organization. Prior to joining Northeastern University, he was Senior Director of Product Management at the Satcon Technology Corporation, a leading maker of commercial solar inverters.

Mr. Klosterman received a BSECE from the University of Cincinnati in 1983, and an SM in Engineering and Management from MIT in 2000 as a fellow in the Systems Design and Management (SDM) Program.

# Developing a Professional and Personal Network as a Method for Deepening Lessons in Engineering Leadership

## 1 Introduction

As a series of assignments in a graduate program run by the Gordon Institute of Engineering Leadership at Northeastern University, students develop and improve their online social media profiles, meet with subject matter experts within their industry, sign up for newsletters, attend events and seminars in their discipline and identify other ways to improve their personal and professional networks.

The objective is to increase awareness of and practice several key skills essential for emerging and successful leaders in the areas of Taking Initiative, Connecting Across Disciplines, Communication and Advocacy, Interpersonal Skills and Inquiry. Assessment, using 360-degree feedback taken before and after participating in the program, indicates average improvement of 6-17% in these skills.

Details on the assignments, designed to introduce the theory and practice of networking, are attached as appendices including how the program builds awareness of the benefits of networking, techniques leading a student to increase the breadth, depth and quality of their connections, and representative, anecdotal comments as reported by participants at the end of the program.

## 2 Program Background

The mission of the Gordon Institute of Engineering Leadership is to "create an elite cadre of engineering leaders with exceptional abilities to lead engineering teams by providing purpose, direction and motivation to influence others to achieve collective goals."

In prior papers[1] an overview of the program was presented including the syllabus and major content. Assessment of industry's need for improvement in engineering leadership, the current impact and consequences of poorly led engineering projects and the global risk to the competitiveness of companies, if not addressed, was presented in 2012[2].

The program addresses assessment, development of and mastery of 14 specific leadership areas illustrated in a polar chart (Figure 1: Leadership Capability Polar Chart), known in the program as the "spider chart".

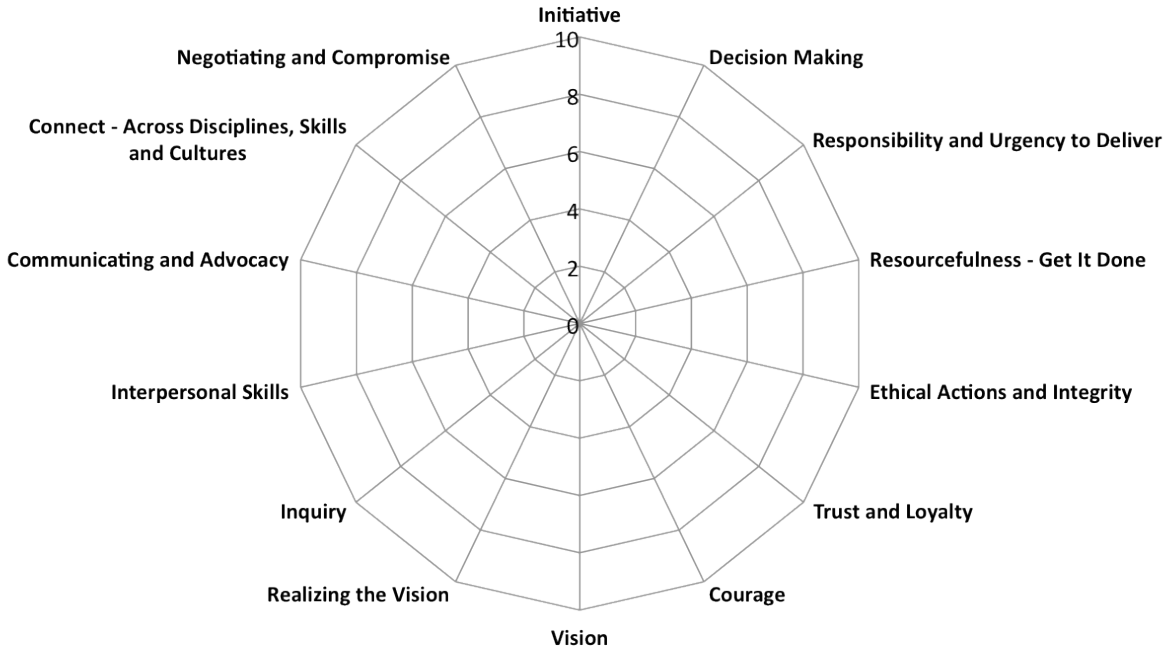


Figure 1: Leadership Capability Polar Chart

The spider chart is also used as the baseline for a 360-degree feedback process to measure the success of students in improving each of these skills.

The exercise described in this paper contributes to the development of five of these capabilities, Taking Initiative, Connecting Across Disciplines, Communication and Advocacy, Interpersonal Skills and Inquiry.

## 3 Program, Student and Cohort Profile

The Gordon Institute of Engineering Leadership (GIEL) was established in 2006 within Northeastern University's College of Engineering (COE) with the objective of increasing leadership skills within the framework of a traditional master degree in engineering. Students, when enrolled in GIEL take two semester long courses in leadership and earn master thesis-equivalent credit through an industry-focused project, called the Challenge Project.

The program enrolls an average of 40 students a year, formed as a cohort. All are either working professionals, or graduate level interns. The cohort has an average age of 27 years and 4.7 years of work experience and an average of 72% male/28% female, 75% US/25% international.

The core course in leadership includes modules and labs to practice and attain mastery in each of the 14 leadership capabilities. Through the Challenge Project, the student's workplace acts as an experiential laboratory to observe and use these capabilities in a real-world setting and through assignments deepen their understanding and appreciation of leadership.

## 4 Research Objective and Methods

The objective of this report is to assess the improvement of skills specifically addressed through a series of assignments and exercises in developing a personal and professional network.

The Leadership Capability Spider Chart was used as a tool for feedback and self-assessment. Entering the program, supervisors and peers rate the student, and the student rates themself on each of the capabilities, on a scale between 0 ("no competency") and 10 ("acknowledged mastery"). Upon completion of the program, this exercise was repeated.

While change and improvement all of the 14 capabilities are collected, this paper concentrates on five specific capabilities, targeted by exercises in the area of "developing a professional network."

## 5 Why networking in an engineering program?

The value of developing a personal network has been a staple in leading business schools for over a generation as a method for building business relationships, sharing ideas and incubating commercial ties[3]. Notably it's been identified a critical skill in entrepreneurship and innovation programs[4]. Yet, when engineering students entering GIEL are polled about networking, even with experience with social networks like Facebook, Twitter, Linkedin, et al, over 50% say they are cautious about actively networking within their companies or industries, due to it seeming insincere, manipulative and/or political in nature.

### 5.1 An essential skill for the technical professional

The results of a Michigan State 2009 survey[5] of major industrial employers identified 12 professional skills deemed essential for success in today's organization by those surveyed. Among them: communicating effectively, acquiring knowledge and navigating across boundaries. Significantly, the survey identified an emerging standard, considered critical for employee success, includes the ability to build and sustain professional relationships. Engineers have additional needs to improve their access to networks because of the relentless need to stay current on technology and the need to effectively work in global, complex, and constantly evolving cross-disciplinary teams.

In 1993, a study of Bell Labs employee development practices[6] (Figure 2: Nine Work Strategies Identified by Bell Labs) identified professional networking as a key element in a model for professional expertise. IBM's T-Shaped individual[7] (Figure 3: T-Shaped Professional as used by IBM), as embraced by the firm IDEO[8] and many others, emphasized not just developing mastery of a discipline, but also both trans-disciplinary knowledge and boundary-crossing competency in maneuvering both the technical and organizational systems in which the individual operates.

A gap exists, however, and most engineering curricula compartmentalize the depth and breadth of knowledge due a bias towards technical content over a systems view[9,10]. Furthermore the increase of technological depth in many disciplines forces a prioritization that de-emphasizes coursework in social sciences. Other methods need to be introduced to bridge this gap.

### 5.2 Techniques for creating connections

Chief amongst the techniques identified as crucial for creating connections that improve the building of systems knowledge, is the nurturing and growing of a professional network. Networking has been long highlighted as an essential skill in finding a job[11,12], but less emphasized as part of an ongoing process of staying current, staying connected and staying relevant in one's areas of knowledge and expertise. Benefits cited include[13]:

1. Gaining solid ground in the current operational state in which the engineer operates, even just within his or her own firm, significantly improves the ability to understand how every part of the organization contributes to the success of the company.
2. The pace of technology advances in every area of engineering increases, integration of these technologies across disciplines becomes more possible, sophisticated, existing technologies rapidly become extinct and new opportunities surface to address emerging markets with innovative solutions not previously possible. The urgency to have regular and trusted information on the state of the art in a field is greater than ever.
3. As the potential for new and unique business models to disrupt current practices, staying on top of and understanding the implications of these trends may be critical to success or even survival.

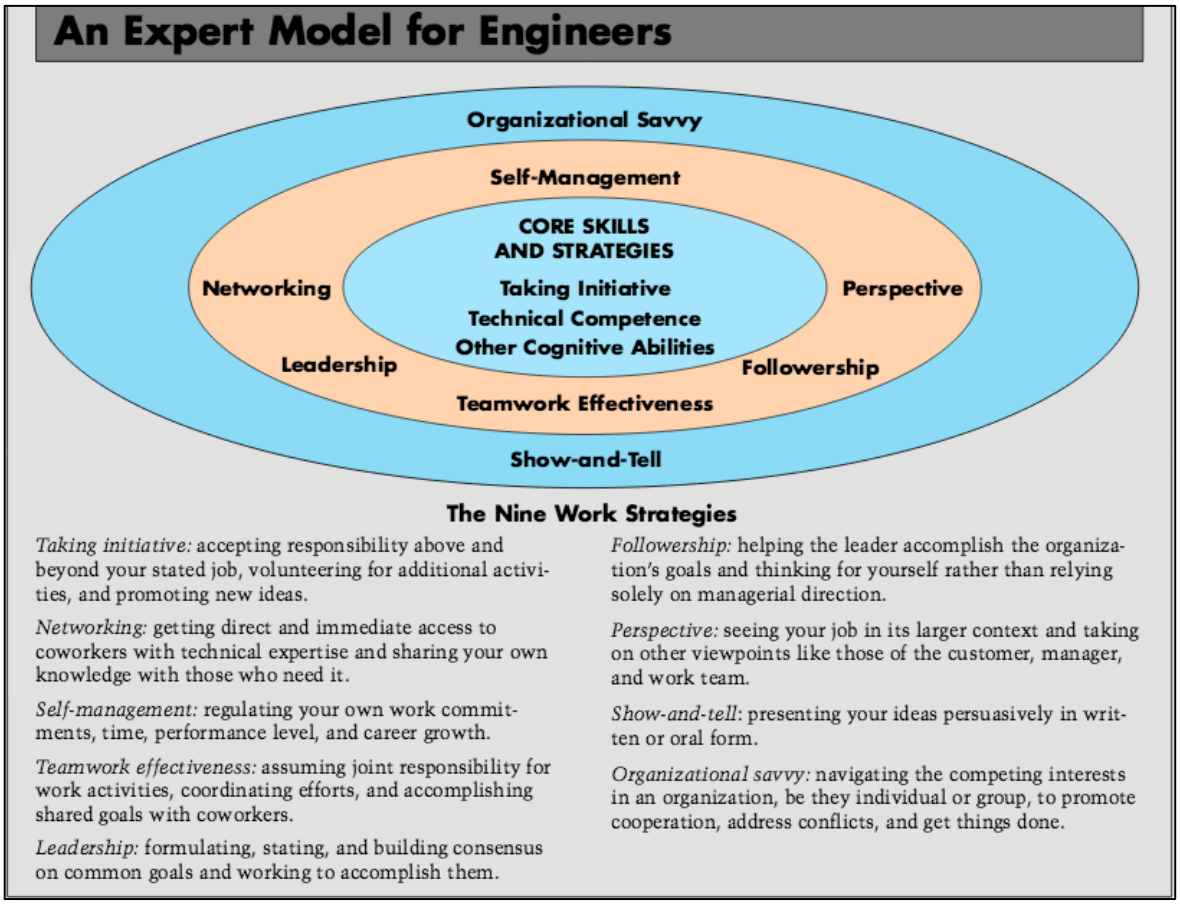


Figure 2: Nine Work Strategies Identified by Bell Labs

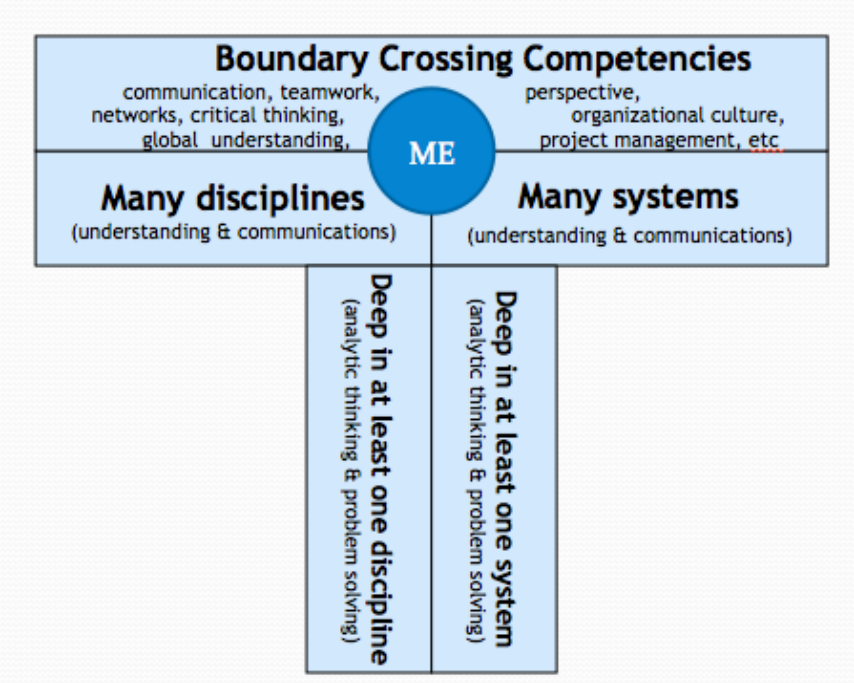


Figure 3: T-Shaped Professional as used by IBM

### 5.3 Engineers and networking

One key for success in building a network is developing the skills in reaching out to someone new, uncomfortable for many engineers. Studies[14,15], using tools such as the Myers-Briggs Type Indicator (MBTI), suggest the typical engineer tending towards a preference for introversion as generalized below[16].

> "I like getting my energy from dealing with the ideas, pictures, memories, and reactions that are inside my head, in my inner world. I often prefer doing things alone or with one or two people I feel comfortable with
> The following statements generally apply to me:
>
> - I am seen as "reflective" or "reserved."
> - I feel comfortable being alone and like things I can do on my own.
> - I prefer to know just a few people well.
> - I sometimes spend too much time reflecting and don't move into action quickly enough.
> - I sometimes forget to check with the outside world to see if my ideas really fit the experience."

This preference can create a blind spot (i.e., why is networking important) and inhibit the motivation to actively develop their network.

## 6 Rating and measurement approach

The specific leadership capabilities targeted in this exercise are:

- **Initiative:** Assess risk and take the initiative, to create a vision and course of action.
- **Inquiry:** Listen to others with intention of genuinely understanding their thoughts and feelings; recognize their ideas may be better than yours.
- **Interpersonal Skills:** Respect needs of individuals and the group; recognition of others' strengths; coaching, gracious professionalism.
- **Communicating and Advocacy:** Clearly able to explain point of view, approach to those with differing backgrounds and cultures; assess extent to which you are understood.
- **Connect – Across Disciplines, Skills and Cultures:** Appreciate, engage, and connect with those who have different perspectives.

Use of the self-assessment and 360-feedback illustrates the approach using a representative "Student A" includes:

- Self-assessment at the start of the program (the 360-feedback at the beginning of the program is not used due to many of the students being relatively new in a relationship and the reviewers noting they did not have enough experience to judge)

- 360-feedback at end of program.
    - Self-assessment redone
    - Feedback from their supervisor (“boss”)
    - Feedback from at least one peer
    - Feedback from subordinate (if appropriate)
- Comparison of the change over time.

Aggregate reports on two cohorts, “Cohort X” and “Cohort Y”, include a summary of these ratings and a comparison of self-assessments made between the start of the program with the end for the entire population of students.

### 6.1 Student A

Student A is representative of the typical participant in the program. Male, 27 years of age, with a BS in mechanical engineering, 5 years of work experience, and working as a full-time intern at a sponsoring company while studying for an MS in mechanical engineering. The student has had some project leadership roles, but no formal training in leadership or management.

### 6.1.1 Self-assessment at start of program

**Engineering Leadership Capabilities Definitions**

| | Score (1-10) |
|---|---|
| **Initiative:** Assess risk and take the initiative to create a vision and course of action. | 5 |
| **Decision-Making:** Make decisions with information at hand, factoring in risk and uncertainty; take alternative action when necessary. | 4 |
| **Responsibility and Urgency to Deliver:** Demonstrate determination to accomplish mission in the face of constrains or obstacles. Commit to absolute responsibility to deliver on time; pursue necessary follow-up. | 4 |
| **Resourcefulness-Get It Done:** Focus on the tasks at hand with passion, discipline, intensity, and flexibility. | 4 |
| **Ethical Actions and Integrity:** Adhere to ethical standards and principals. Have the courage to act ethically and with integrity. | 7 |
| **Trust and Loyalty:** Commit to actions that will instill trust, and to the principal that loyalty to the team yields loyalty to the leader and vision. Work to empower the people around you and make them successful. | 5 |
| **Courage**: Face difficult/high-risk actions head-on. | 4 |
| **Vision:** Create compelling images of the future, identifying what could and should be for new products, systems, and enterprises. | 6 |
| **Realizing the Vision:** Design processes and approaches to move from abstraction to investigation, innovation, and implementation. Lead an organization to plan and deliver a project, exercising solution judgment and critical reasoning. | 5 |
| **Inquiry:** Listen to others in order to genuinely understand their thoughts and feelings. Recognize their ideas may be better than yours. | 8 |
| **Interpersonal Skills:** Respect needs of individuals and the group. Recognize others' strengths; coach, give feedback, both embody and encourage gracious professionalism. | 5 |
| **Communicating and Advocacy:** Be able to clearly explain your point of view or approach to those with differing backgrounds and proactively asses the extent to which you are understood. | 5 |
| **Connect-Across Disciplines, Skills, and Cultures**: Appreciate, engage, and connect with those who have different perspectives. | 7 |
| **Negotiating and Compromise:** Appreciate the need to identify potential disagreement or conflict; negotiate to find mutually acceptable solutions. | 5 |

Figure 4: Self-assessment at start of program-Student A

Student A rated himself on a scale between 0 ("no competency") and 10 ("acknowledged mastery") on each of the capabilities (Figure 4: Self-assessment at start of program-Student A).

### 6.1.2 360-assessment self, supervisor and peer upon completion of program

| Engineering Leadership Capabilities Definitions | Boss | Self | Peer |
|---|---|---|---|
| **Initiative:** Assess risk and take the initiative to create a vision and course of action. | 8 | 9 | 10 |
| **Decision-Making:** Make decisions with information at hand, factoring in risk and uncertainty; take alternative action when necessary. | 8 | 9 | 10 |
| **Responsibility and Urgency to Deliver:** Demonstrate determination to accomplish mission in the face of constrains or obstacles. Commit to absolute responsibility to deliver on time; pursue necessary follow-up. | 10 | 8 | 9 |
| **Resourcefulness-Get It Done:** Focus on the tasks at hand with passion, discipline, intensity, and flexibility. | 9 | 9 | 9 |
| **Ethical Actions and Integrity:** Adhere to ethical standards and principals. Have the courage to act ethically and with integrity. | 9 | 10 | 10 |
| **Trust and Loyalty:** Commit to actions that will instill trust, and to the principal that loyalty to the team yields loyalty to the leader and vision. Work to empower the people around you and make them successful. | 9 | 8 | 10 |
| **Courage**: Face difficult/high-risk actions head-on. | 7 | 9 | 9 |
| **Vision:** Create compelling images of the future, identifying what could and should be for new products, systems, and enterprises. | 7 | 7 | 10 |
| **Realizing the Vision:** Design processes and approaches to move from abstraction to investigation, innovation, and implementation. Lead an organization to plan and deliver a project, exercising solution judgment and critical reasoning. | 6 | 8 | 8 |
| **Inquiry:** Listen to others in order to genuinely understand their thoughts and feelings. Recognize their ideas may be better than yours. | 7 | 7 | 8 |
| **Interpersonal Skills:** Respect needs of individuals and the group. Recognize others' strengths; coach, give feedback, both embody and encourage gracious professionalism. | 8 | 8 | 9 |
| **Communicating and Advocacy:** Be able to clearly explain your point of view or approach to those with differing backgrounds and proactively asses the extent to which you are understood. | 6 | 7 | 9 |
| **Connect-Across Disciplines, Skills, and Cultures**: Appreciate, engage, and connect with those who have different perspectives. | 10 | 9 | 8 |
| **Negotiating and Compromise:** Appreciate the need to identify potential disagreement or conflict; negotiate to find mutually acceptable solutions. | 9 | 7 | 9 |

Figure 5: 360-assessment at end of program-Student A

Upon completion of the coursework portion of the program, the student again rates himself and solicits feedback from his supervisor and a peer on each of the leadership capabilities (Figure 5: 360-assessment at end of program-Student A).

### 6.1.3 Student A Findings

For the purposes of assessing growth, the program currently uses the self-assessed ratings. The boss and peer ratings are used to calibrate the student's perception of themselves relative to others.

| | Before program | At end of program | | | |
|---|---|---|---|---|---|
| **Capability** | **Self** | **Self** | **Boss** | **peer** | **Self-improvement** |
| Initiative | 5 | 9 | 8 | 10 | 80% |
| Inquiry | 8 | 7 | 7 | 8 | -13% |
| Interpersonal skills | 5 | 8 | 8 | 9 | 60% |
| Communicating and Advocacy | 5 | 7 | 6 | 9 | 40% |
| Connect Across Disciplines, Skills and Cultures | 7 | 9 | 10 | 8 | 29% |

Figure 6: Difference between before and after-Student A

For the capabilities specifically targeted with this exercise, the student indicates improvement in four of the skills, a slight decrease in the other. Because these are qualitative some caution should be taken, but coupled with student feedback, is useful as an initial assessment method and baseline for further refinement.

## 6.2 Cohort X

Cohort X participated in the first year in which assessments were done at both the start and end of the program and is representative of a typical cohort in terms of age, gender, and years of experience.

### 6.2.1 Summary of Self-assessment at start of program

| First Name | Last Name | Initiative | Inquiry | Interpersonal Skills | Communicating and Advocacy | Connect- Across Disiplines, Skills, and Cultures |
|---|---|---|---|---|---|---|
| [redacted] | [redacted] | 9 | 7 | 8 | 7 | 7 |
| | | 8 | 8 | 9 | 9 | 8 |
| | | 7 | 7 | 9 | 6 | 8 |
| | | 9 | 8 | 9 | 10 | 7 |
| | | 6 | 8 | 8 | 8 | 8 |
| | | 8 | 9 | 9 | 6 | 7 |
| | | 9 | 9 | 7 | 7 | 9 |
| | | 6 | 7 | 7 | 8 | 6 |
| | | 6 | 7 | 7 | 7 | 5 |
| | | 8 | 4 | 4 | 5 | 6 |
| | | 8 | 8 | 8 | 6 | 8 |
| | | 4 | 8 | 7 | 6 | 7 |
| | | 7 | 10 | 8 | 7 | 8 |
| | | 6 | 6 | 8 | 6 | 8 |
| | | 10 | 5 | 6 | 6 | 4 |
| | | 7 | 7 | 7 | 6 | 7 |
| | | 7 | 6 | 6 | 6 | 6 |
| | | 7 | 8 | 4 | 4 | 4 |
| | | 10 | 7 | 5 | 5 | 5 |
| | | 10 | 9 | 10 | 8 | 7 |
| | | 5 | 5 | 8 | 7 | 6 |
| | | 8 | 4 | 4 | 2 | 4 |
| | | 9 | 7 | 8 | 6 | 7 |
| | | 8 | 8 | 6 | 7 | 6 |
| | | 5 | 6 | 5 | 7 | 6 |
| | | 6 | 8 | 8 | 6 | 9 |
| | | 6 | 5 | 6 | 5 | 6 |
| | | 6 | 9 | 7 | 7 | 10 |
| | | 7 | 7 | 6 | 6 | 5 |
| Average | | 7.3 | 7.1 | 7.0 | 6.4 | 6.7 |

Figure 7: Self-Assessment at start of Program-Cohort X

Each row represents scores reported for an individual student for each of the 5 capabilities of interest and an average computed for the cohort.

### 6.2.2 Summary of Self-assessment at end of program

| First Name | Last Name | Initiative | Inquiry | Interpersonal Skills | Communicating and Advocacy | Connect- Across Disiplines, Skills, and Cultures |
|---|---|---|---|---|---|---|
| [redacted] | | 8 | 9 | 9 | 9 | 9 |
| | | 7 | 7 | 7 | 6 | 8 |
| | | 7 | 9 | 10 | 10 | 10 |
| | | 10 | 4 | 7 | 8 | 7 |
| | | 7 | 7 | 7 | 7 | 7 |
| | | 9 | 9 | 8 | 9 | 9 |
| | | 9 | 7 | 9 | 8 | 8 |
| | | 9 | 8 | 6 | 7 | 7 |
| | | 7 | 9 | 9 | 9 | 8 |
| | | 8 | 8 | 9 | 7 | 9 |
| | | 7 | 9 | 7 | 7 | 6 |
| | | 8 | 9 | 8 | 9 | 8 |
| | | 9 | 10 | 8 | 7 | 9 |
| | | 4 | 7 | 8 | 6 | 8 |
| | | 6 | 8 | 8 | 6 | 7 |
| | | 9 | 9 | 9 | 9 | 9 |
| | | 9 | 7 | 6 | 6 | 6 |
| | | 9 | 9 | 8 | 7 | 8 |
| | | 10 | 10 | 7 | 6 | 6 |
| | | 10 | 10 | 10 | 10 | 8 |
| | | 5 | 5 | 8 | 7 | 6 |
| | | 8 | 4 | 4 | 2 | 4 |
| | | 8 | 8 | 8 | 8 | 8 |
| | | 8 | 8 | 6 | 7 | 6 |
| | | 7.5 | 7 | 7.5 | 8.5 | 7.5 |
| | | 3 | 3 | 7 | 6 | 7 |
| | | 8 | 6 | 7 | 8 | 7 |
| | | 7 | 9 | 9 | 9 | 9 |
| | | 8 | 8 | 9 | 9 | 10 |
| Average | | 7.7 | 7.7 | 7.8 | 7.5 | 7.6 |

Figure 8: Self-Assessment at End of Program – Cohort X

### 6.2.3 Before and after comparison

| First Name | Last Name | Initiative | Inquiry | Interpersonal Skills | Communicating and Advocacy | Connect- Across Disiplines, Skills, and Cultures |
|---|---|---|---|---|---|---|
| [redacted] | [redacted] | -1 | 2 | 1 | 2 | 2 |
| | | -1 | -1 | -2 | -3 | 0 |
| | | 0 | 2 | 1 | 4 | 2 |
| | | 1 | -4 | -2 | -2 | 0 |
| | | 1 | -1 | -1 | -1 | -1 |
| | | 1 | 0 | -1 | 3 | 2 |
| | | 0 | -2 | 2 | 1 | -1 |
| | | 3 | 1 | -1 | -1 | 1 |
| | | 1 | 2 | 2 | 2 | 3 |
| | | 0 | 4 | 5 | 2 | 3 |
| | | -1 | 1 | -1 | 1 | -2 |
| | | 4 | 1 | 1 | 3 | 1 |
| | | 2 | 0 | 0 | 0 | 1 |
| | | -2 | 1 | 0 | 0 | 0 |
| | | -4 | 3 | 2 | 0 | 3 |
| | | 2 | 2 | 2 | 3 | 2 |
| | | 2 | 1 | 0 | 0 | 0 |
| | | 2 | 1 | 4 | 3 | 4 |
| | | 0 | 3 | 2 | 1 | 1 |
| | | 0 | 1 | 0 | 2 | 1 |
| | | 0 | 0 | 0 | 0 | 0 |
| | | 0 | 0 | 0 | 0 | 0 |
| | | -1 | 1 | 0 | 2 | 1 |
| | | 0 | 0 | 0 | 0 | 0 |
| | | 2.5 | 1 | 2.5 | 1.5 | 1.5 |
| | | -3 | -5 | -1 | 0 | -2 |
| | | 2 | 1 | 1 | 3 | 1 |
| | | 1 | 0 | 2 | 2 | -1 |
| | | 1 | 1 | 3 | 3 | 5 |
| Average | | 0.4 | 0.6 | 0.7 | 1.1 | 0.9 |
| % Improvement | | 6% | 8% | 11% | 17% | 14% |

Figure 9: Difference between before and after self-assessment-Cohort X

### 6.2.4 Cohort X Findings

For Cohort X scores indicate average improvement in the 5 capabilities from between 6-17%. This is encouraging and also serves as a useful baseline for comparison with future cohorts. (Note, some report lower scores at the end than at the beginning. When asked students said that

coming into the program they thought they were stronger than they actually were. After studying leadership, and gaining a better appreciation what each skill entails, most indicated that they rated themselves too high at the beginning. This shows the need for future refinement of this assessment method).

## 6.3 Cohort Y

Cohort Y participated in the second year in which assessments were done at both the start and end of the program and is representative of a typical cohort in terms of age, gender, years of experience and degrees.

### 6.3.1 Summary of Self-assessment at start of program

| First Name | Last Name | Initiative | Inquiry | Interpersonal Skills | Communicating and Advocacy | Connect- Across Disiplines, Skills, and Cultures |
|---|---|---|---|---|---|---|
| [redacted] | | 7 | 9 | 8 | 6 | 8 |
| | | 4 | 9 | 8 | 6 | 7 |
| | | 9 | 6 | 7 | 7 | 9 |
| | | 6 | 7 | 8 | 5 | 6 |
| | | 8 | 3 | 8 | 6 | 5 |
| | | 2 | 6 | 6 | 8 | 6 |
| | | 8 | 6 | 6 | 6 | 6 |
| | | 6 | 10 | 7 | 4 | 5 |
| | | 8 | 6 | 8 | 8 | 8 |
| | | 8 | 6 | 8 | 8 | 6 |
| | | 6 | 8 | 5 | 4 | 7 |
| | | 10 | 8 | 8 | 6 | 7 |
| | | 6 | 6 | 6 | 5 | 6 |
| | | 2 | 4 | 2 | 2 | 4 |
| | | 9 | 4 | 6 | 4 | 9 |
| | | 5 | 6 | 4 | 4 | 6 |
| | | 6 | 8 | 8 | 8 | 8 |
| | | 10 | 6 | 8 | 8 | 8 |
| | | 6 | 7 | 9 | 7 | 9 |
| | | 7 | 7 | 8 | 9 | 8 |
| | | 7 | 7 | 8 | 6 | 8 |
| Average | | 6.7 | 6.6 | 7.0 | 6.0 | 7.0 |

Figure 10: Self-assessment at start of program-Cohort Y

### 6.3.2 Summary of Self-assessment at end of program

| First Name | Last Name | Initiative | Inquiry | Interpersona | Communicating and Advocacy | Connect- Across Disiplines, Skills, and Cultures |
|---|---|---|---|---|---|---|
| [redacted] | [redacted] | 8 | 8 | 8 | 5 | 9 |
| | | 7 | 7 | 9 | 5 | 6 |
| | | 9 | 7 | 8 | 7 | 9 |
| | | 8 | 9 | 8 | 9 | 10 |
| | | 9 | 8 | 9 | 8 | 9 |
| | | 9 | 8 | 8 | 9 | 8 |
| | | 8 | 8 | 8 | 7 | 7 |
| | | 7 | 10 | 8 | 7 | 7 |
| | | 10 | 6 | 10 | 9 | 8 |
| | | 5 | 5 | 5 | 4 | 5 |
| | | 7 | 7 | 8 | 6 | 7 |
| | | 7 | 6 | 5 | 5 | 8 |
| | | 6 | 7 | 8 | 7 | 6 |
| | | 9 | 6 | 5 | 6 | 9 |
| | | 8 | 6 | 6 | 7 | 10 |
| | | 5 | 8 | 5 | 5 | 7 |
| | | 8 | 9 | 8 | 8 | 9 |
| | | 9 | 7 | 8 | 8 | 8 |
| | | 4 | 5 | 5 | 2 | 3 |
| | | 10 | 8 | 7 | 7 | 10 |
| | | 9 | 7 | 9 | 8 | 8 |
| Average | | 7.7 | 7.2 | 7.4 | 6.6 | 7.8 |

Figure 11: Self-assessment at end of program-Cohort Y

### 6.3.3 Before and after comparison

| First Name | Last Name | Initiative | Inquiry | Interpersonal Skills | Communicating and Advocacy | Connect- Across Disiplines, Skills, and Cultures |
|---|---|---|---|---|---|---|
| [redacted] | | 1 | -1 | 0 | -1 | 1 |
| | | 3 | -2 | 1 | -1 | -1 |
| | | 0 | 1 | 1 | 0 | 0 |
| | | 2 | 2 | 0 | 4 | 4 |
| | | 1 | 5 | 1 | 2 | 4 |
| | | 7 | 2 | 2 | 1 | 2 |
| | | 0 | 2 | 2 | 1 | 1 |
| | | 1 | 0 | 1 | 3 | 2 |
| | | 2 | 0 | 2 | 1 | 0 |
| | | -3 | -1 | -3 | -4 | -1 |
| | | 1 | -1 | 3 | 2 | 0 |
| | | -3 | -2 | -3 | -1 | 1 |
| | | 0 | 1 | 2 | 2 | 0 |
| | | 7 | 2 | 3 | 4 | 5 |
| | | -1 | 2 | 0 | 3 | 1 |
| | | 0 | 2 | 1 | 1 | 1 |
| | | 2 | 1 | 0 | 0 | 1 |
| | | -1 | 1 | 0 | 0 | 0 |
| | | -2 | -2 | -4 | -5 | -6 |
| | | 3 | 1 | -1 | -2 | 2 |
| | | 2 | 0 | 1 | 2 | 0 |
| Average | | 1.0 | 0.6 | 0.4 | 0.6 | 0.8 |
| % Improvement | | 14% | 9% | 6% | 9% | 10% |

Figure 12: Difference between before and after self-assessment-Cohort Y

### 6.3.4 Cohort Y Findings

For Cohort Y, on average, self-assessment scores indicate improvement in the capabilities from between 6-14%.

## 6.4 Conclusion and summary

The Leadership Capability Spider Chart has been used by GIEL as a tool to assess student development in 14 leadership capabilities. Entering the program, students rank themselves on a scale between 0-10 on each of the capabilities and upon completion of the program, repeat the self-assessment. This is accompanied by 360-feedback from their manager, peers and, if applicable, subordinates.

For the purpose of this paper, looking at a specific set of exercises in the area of "developing a professional network", the assessments provides a before-and-after view on the effectiveness of this approach in developing a student's capability in 5 capabilities.

Results for a representative student and summaries from two representative cohorts indicate improvement in these 5 of the leadership capabilities, ranging from 6-17%. As a first step in measuring the effectiveness of techniques used in the program, this is promising and is helping to establish a framework for more detailed assessments in following cohorts.

The Gordon Institute of Engineering Leadership at Northeastern University is enthusiastic about sharing any of the techniques or approaches with other institutions involved in engineering leadership development. The background material and use of it in structuring this yearlong assignment is an example of a best practice and it is hoped that the description and framework can be of use by other leadership programs.

In summary, as an assignment in a select graduate program in engineering leadership, students are tasked to strategically practice and master the art of professionally networking. Through a series of targeted modules, engineers learn how to initiate a conversation while increasing their breadth and depth of knowledge of different parts of the organization.

The result is increased confidence in building out their network and a richer understanding of how all of the pieces of a company contribute to overall success of the business.

## Appendix A Background: How to develop a network

The objective of the appendices is to provide a roadmap on how the Gordon Institute of Engineering Leadership at Northeastern University teaches networking. Feedback is welcome!

With the emergence of social media that enables one to stay up-to-date and informed on their field, meet-up forums set up to encourage frequent, informal gatherings and online tools, such as LinkedIn/twitter, et al., the ability to reach out, connect with and maintain a professional network continues to improve. Awareness of this ecosystem, actively engaging in reaching out and establishing links, and mastery of the tools available has also been identified as a skill necessary for effective leadership[17]. Both the background theory and techniques for successful networking are covered in an initial reading, class lecture and lab.

Students, the majority of whom are working engineers, are then given a series of specific assignments to go into their company and industry on targeted networking tasks, such as signing up for newsletters, attending a conference and collecting business cards, and scheduling meetings with a representative from marketing, system architecture, supply chain and customer facing activities such as service or sales and, if possible, a real customer. The final task is a contest amongst students to see who can set up a meeting with the highest-ranking person in their organization and interview them on leadership.

## Appendix B Background: Description of the Exercises

The following sections describe the specific modules given out to students, roughly at 4-week intervals.

### B.1 Introduction to Networking

This module is an overview of techniques for developing a networking profile and to improve awareness of existing networks in the student's discipline and industry.

"Intro to Networking

- If you do not have a business card – get one or order one
- If you have a presence on Linkedin, review it and make it professional
- Subscribe to at least one industry trade journal
- Subscribe to a newsfeed in your industry or technology area
- If are not yet a member of a professional association in your field (IEEE, ASME, ASCE, AIChe, etc.) join one and find out if they have a local chapter
- Identify at least one activity (conference, speaker, seminar) occurring in the area in your industry within the next few weeks and attend it"

During weekly class discussions, students are queried on "what's new in your world".

### B.2 Developing and Practicing an Elevator Pitch

This module teaches the students how to tune a quick introduction speech, popularly called an elevator pitch, practice it and test it out:

"For this project:

- Imagine you want to make contact with someone who knows a lot about a field/company that interests you. Develop a 30-second (approx. 40-60 word) script to introduce yourself and explain to the listener why you are interested in talking (or calling) them and what you'd like from her/him. (WRITE your script down). Post the written script to the course folder. You should mention:
    - Your name
    - Your program in college, employer, degree…something to create a visual image
    - Who referred you or how you got the contact's name (i.e., advisor, Alumni Directory, met at a conference, read an article, etc.)
    - State your area of interest and how your background relates to that area. (Example: 'I have a strong background in quantum physics and want to learn how these principles might apply to your industry')

    - Finish with a request for the type of connection you'd like to make.
- Practice your pitch
    - Stand in front of a mirror and practice reading your pitch. Look at your body language and tone of your voice. Are you projecting an image that looks like someone you'd like to get to know
    - Practice your pitch with at least one classmate and get feedback.
    - Students will be picked randomly to 'give their pitch' in front of the class as we continue to meet throughout the semester.
- Identify at least one individual that you do not already know, as someone you think would be interesting to talk to, reach out to them and use your pitch as an effort to schedule a meeting with them (hint: sometimes a invitation for coffee/lunch works wonders!)
- Prepare a summary of things you learned from each of these activities that were new or surprising, list the names of new people you met that are now part of your network and some manner in which you plan to maintain and nurture the relationship. Post what you've learned to the course folder and be prepared to discuss."

**B.3 Trading Business Cards**

This module covers the theater of exchanging information, via business cards. All students are required to get business cards and carry them with them at all times.

"For this project:

- At the beginning of the semester, we covered networking and each of you was tasked to identify opportunities and attend at least one seminar, conference or event in your industry or area. You should also have been practicing your elevator pitch.
- At each opportunity, you should be able to collect business cards.
- As you collect business cards, scan them and post to the course folder along with your networking story. There are unlimited submissions to this folder.
- As noted, throughout the semester, as assignments are handed out, use this as the opportunity to get to know people in your company and organization.
- At the end of the semester, we'll debrief in class and share findings
- Great submissions will be eligible for extra credit points!"

**B.4 Interview on Product Management**

This module is designed to improve the engineer's understanding of customer, market and opportunity, to create an opportunity to meet someone in the organization that is in the chain of taking customer needs and turning them into a product or project proposal and plan:

"For this project:

- Based upon the readings and course discussion on the voice of the customer, determining customer needs, developing a product roadmap and writing specifications for possible projects, prepare a set of interview questions to query someone on how opportunities are found, presented and vetted within your company. These represent the front end of a typical business where selecting the correct projects that best meet a customer's expectation is negotiated.
- Within your company (or a representative company) identify and schedule a meeting with someone responsible for market research, interviewing customers and assessing both the market need and compatibility with your organizations business, capability and competence when proposing new products of projects. Extra points if this includes accompanying someone in a real customer interview or survey. The role could be in marketing, sales, business development or product architecture. Typically in a company there may be a position referred to as product management.
- Main ideas that you should cover:
    - How does the company identify customers/segments and opportunities?
    - What is the method by which these opportunities turn from fuzzy statements or desires into actionable technical requirements?
    - Who evaluates the possible opportunities and selects from them the ones the company chooses to follow?
    - What did you learn that surprised you?
- Write a short whitepaper that summarizes your meeting, your assessment of how your company identifies and selects opportunities that arise. Post what you've learned to the course folder and be prepared to discuss"

**B.5 Interview with a Supply Chain Manager**

This module is designed to improve the engineer's understanding of how their company builds and manages its supply chain, to create an opportunity to meet with someone who does supply chain management.

"For this project:

- Based upon your readings and on the articles, prepare a set of interview questions to query someone on how supply chain management in your firm work, what a map of the supply chain for some key component looks like and to see how your company ranks against the points made in the article.
- Within your company (or a representative company) schedule an interview with someone responsible for understanding and managing the supply chain
- Main ideas that you should cover:

    - What is the company's supply chain strategy?
    - Does the company have a documented supply chain/value stream map? (Research supply chain mapping and value stream mapping on the net for background)
    - Does the company use any type of scorecard to evaluate your supply chain?
    - Where does the financial cost or value exist in the supply chain?
    - What did you learn that surprised you?
- Write a short whitepaper that summarizes your meeting, your assessment of how your company maps and manages supply chains, and either addresses, or does not address, each of the points in the article. Post what you've learned to the course folder and be prepared to discuss"

**B.6 Interview with a Software Engineer**

In employer surveys, a major concern is the lack of understanding by many engineers on how software works, especially now that software exists almost everywhere. This module is designed to improve the engineer's understanding of what happens on both sides of the word of software development. It tends to create the most raucous interactions of the semester. Prior to this assignment a class and workshop on elementary software engineering processes is used to create some context.

"For this project:

- If you self-identify as a software engineer, set up a discussion with someone who is NOT a software engineer and interview them on what they understand about software, software development methods and emerging trends in software. Try to find out if there is gap, and how big, between what they think it is and what you think it is.
    - What do you know about how software impacts you or your products?
    - What do you know about software development in your company?
    - How are software requirements derived in your group?
    - What is something you wish software engineers would understand?
    - What did you learn that surprised you?"
- If you are NOT a software engineer, find someone in your company in either software development or information technology and interview them on the use of software in your company, products, processes, etc.
    - What is software development in your area?
    - Describe how requirements come into your group
    - What is your typical day like?
    - What is something you wish non-software folks would understand?
    - What did you learn that surprised you?

- Write a short whitepaper that summarizes your meeting and be prepared to discuss, post what you've learned to the course folder and be prepared to discuss"

**B.7 Interview with a Service Representative**

The purpose of this module is to gain exposure to the backend customer-facing portion of the organization.

"For this project:

- Locate someone in your company, and or a representative organization, who is in customer or field service. Schedule a meeting with them to discuss how your company approaches field service, then post your report to the course folder and prepare to discuss in class. Be creative and diversity will be rewarded. If you are able to spend a few hours at a customer call center do so (extra credit) and be prepared to discuss.
- Prior to your interview, browse the attached articles to gain some facility in understanding the space of customer service. Most of the articles deal with the "service industry", but touch points with your customers always have some level of human interaction, and the points made are relevant to any industry. Eventually all services begin and end with an exchange with a customer, person to person.
- Broadly, structure your interview to learn more about these areas. You don't need to use these questions, but they may be helpful in framing your ideas:
    - The structure of customer service
        - What is your service strategy?
        - What is the org structure?
        - Where does it report?
    - Is service a cost center or profit center?
    - Quantitative metrics used
        - How is the quality of customer service measured?
        - How is customer service priced? (I.e., think warranties, guarantees, etc)
        - What internal metrics does service use to drive performance and improvement?
    - Human to human side
        - How is the complex side of handling the customer at the human interface handled?
        - How does the company manage customer/field issues?
        - Why type of person makes a good field service representative and why?
    - What did you learn that surprised you?

- Write a short whitepaper that summarizes your meeting and be prepared to discuss, post what you've learned to the course folder and be prepared to discuss"

**B.8 Bagging the Elephant**

The final networking module is designed to overcome the fear of contacting someone important and consists of a contest amongst students to gain access to a senior executive.

"For this project:

- We refer to this assignment as 'bagging the elephant', meaning try to meet a senior (or most senior) member of the organization you report into (or another organization that is of interest to you) that you'd like to learn more about and/or someone of similar stature elsewhere. The purpose of your meeting is:
    - To introduce yourself
    - To have a dialogue with the interviewee on: how did they become a leader, what are their principles of leadership, words of wisdom and advice.
    - Get out of jail reason: It's an assignment for school.
- Use your imagination and discretion. Understand how the politics and procedures within your company work and don't burn bridges, but good leaders will always be open to a short dialogue with anyone in their organization. Prior interviews have included the CEO, VP of a division, CTO, etc.
- Be prepared. Read the bios and understand the history and background of the person you'll be meeting. A question that shows respect and preparation goes a long way.
- Write a short whitepaper that summarizes your meeting and be prepared to discuss, post what you've learned to the course folder and be prepared to discuss"

**Appendix C Outcomes**

In end-of-course surveys, graduates have identified this exercise as one of the most significant out-of-box and eye-opening experiences of the program. The expanding of knowledge within their respective industries and disciplines through networking significantly improved both technical and market awareness of the company's place in their industry. The internal connections within the company improved their understanding of operations, decision-making and corporate priorities and the network connections made can serve as a sustained group of mentors and advisors.

Finally, over 50% of the students were able to connect with a senior executive at the VP level or higher, including several CEO's of Fortune 500 companies. These meetings, where someone "important" takes the time to chat, have been enlightening in making leadership more human to the students. Furthermore, to have such a leader, typically perceived as busy and

unapproachable, take time to meet with them is dramatic validation of how the leader values networking themselves.

## Appendix D Background: Samples from Students

In each exercise students are asked to reflect on what they gained out of it and post their thoughts. Excerpts from papers and examples of the responses presented in class provided the background for rich discussion on all of the networking topics introduced in the program. Students have agreed to have their work published provided names are disguised. The samples are representative of typical submissions:

### D.1 Excerpts from module - "Introduction to Networking"

First assignment on network is to be open to a new way of thinking about it. These excerpts capture typical responses from students in gaining appreciation of networking as a skill:

"I used to be one of those who don't believe in networks. I thought of networking as 'the unpleasant task of trading favors with strangers' or 'insincere or manipulative', at best, 'an elegant way of using people'. After I read this article, I realized how shallow my opinion was. The purpose of networking is more than just to get things done efficiently, it also includes enhancing personal and professional development, providing referrals and figuring out future priority. "

"I cannot reiterate enough that this article has started the change in my perspective on network, it has made me want to be better at it and to practice it. I now understand that it is not a person's personality that makes them efficient at networking; it is the years of practice that makes them successful networkers."

"Operational networking can be done inside your own company, not just outside. It's used to gain trust in one another to accomplish immediate tasks. I always thought of networking as connecting with people outside your company. After reading about operational networking, I realize there is a lot of inter-company networking when getting tasks done. If you need something done by another group, it will be a lot easier if you have some previous connection with them."

### D.2 Excerpts from module – "Developing and Practicing an Elevator Pitch"

Students practice writing and rehearsing an elevator pitch until it comes naturally.

"Hello, my name is <name> and I am pursing a master's in engineering management with a certificate in leadership from the <program> at <university>. Along with my schooling, I am

working full time at <my company> as a mechanical engineer. One of the major aspects of my studies is learning how to become a better leader. I was informed by my professor that you would be a good source for information and I was wondering if you had a minute to talk about what you feel are the important qualities of a leader."

"Hello, my name is <name>. I'm currently enrolled in the <program> at <university> and I'm a mechanical engineer at <my company>. I read an article of yours regarding release mechanisms using differentials in coefficients of thermal expansion. I found your article very interesting and think this is something that could really benefit us at <my company> and would like to hear more details about your experience with them. "

"Hi, my name is <name>, a mechanical engineer at <company>, a worldwide supplier of x-ray inspection equipment. I'm calling today because one of our major design challenges is sealing enclosures, and I'd like to tap your expertise and experience with FIPFG to investigate production solutions across several of our product lines. Would you be willing to meet for coffee?"

**D.3 Excerpts from module - "Trading Business Cards"**

"I attended several events relevant to my current project, collected 43 business cards and connected with everyone at Linkedin, but perhaps the most interesting story is card number 44. I asked for a lyft on Friday night and the driver was one of the leaders at FNE International (http://fneinternational.org/?projects=our-projects). He had been working a lot for that organization for the last 10 years in Nicaragua. He was from New York and he held degrees in business and administration and public health. He was focusing on health services and particularly working on the project 'Semilla' (http://projectsemilla.org/) Since this happened very close to the speech from <guest> CEO, I automatically remembered the story about the <scanner> that the company donated to a devastated area in Haiti and I asked for his card, thinking of connecting him with <a classmate>. Attached is the file with the mails "Gmail - Yesterday's trip - Connection with <company> for portable <scanner>". <My classmate> made the connection and they met at the conference in Chicago. Other people from FNE spoke with <company> representatives in the conference and they found <company>'s scanners much more useful than other ones in the market because of low power requirements. They are in the process of trying to negotiate the loan of a <company> scanner and committed to stay connected."

"Cards are from different events and different people from industry that I've met during last two months. The last card, a manager from Eli Lilly, I met at the AIChE 2014 annual meeting in Atlanta. While in California this fall, I was attending a Stanford open bar reception and everyone was networking and dancing. Our group randomly met another group and, coincidentally, the Eli Lilly manager was in that group. It was a very fun night and we enjoyed reconnecting and talking about last year's AIChE event. I noticed from his badge that he is the manager of small

molecule chemistry in an organization that I am very interested in. We met the day after in one of the talks and afterwards met for lunch and discussed potential career opportunities in his company. We've connected via LinkedIn and plan to stay in touch"

**D.4 Excerpts from module – "Interview on Product Management"**

This is the first of several operational networking assignments, designed to have a student progressive learn more about how their company works while building relationships with organizations they may not always be aware of:

"I got a meeting with <name>, the chief product architect in our division. He owns the overall product technology roadmap, which things to invest in and which not. I always had the impression that his primary job was staying on top of all of the technical stuff within the company and just picking and choosing. However, he spends over half of his time attending conferences, reading journals, meeting with customers, benchmarking the competition and attending standards committees (he is the chair of one of the governing bodies on computer graphic software standards). When possible, he attends our regular project reviews, but his real job is looking 24-36 months ahead and authoring a regular report on 'likely trends' that we need to anticipate and invest in NOW to be ready for. One interesting thing he said it that, usually people say that 'the customer is always right', but when you are in a 'technology push' type of industry, if all you do is give the customer what they're asking for right now, you'll be left in the dust. So, when he meets with customers, and tries to do one a week, it's less asking them what they want and more 'selling them' on what to start preparing for in the near future. In many ways, the customers are looking to us to guide them on what they should invest in as a trusted advisor. As an outcome of this discussion, by the way, I was invited to sit in on a high-level architecture meeting with all of the division heads. It was very interesting!"

**D.5 Excerpt from "Bagging the Elephant**

"The conversation Jeff and I had with Bob (CEO) was one of the best I've experienced at <company>. He clearly embodies many of the leadership qualities and skills we have studied. And he clearly studies them. He didn't happen upon his leadership capabilities. Bob ended our discussion by giving us a bibliography of leadership books he found useful in his career along with a list of quotes. He was searching on his computer for the file saying it must be somewhere under 'bibliography.' 'Oh no. I found it. It was filed under leadership!'"

## 7 References


[1] Pitts, McGonagle, Klosterman and Rappaport (2011), "Inculcating and Fostering Engineering Leadership Skills for Today's Engineers – The Gordon Engineering Leadership Program at Northeastern University", Proceedings of the 2011 ASEE Northeast Section Annual Conference

[2]Pitts, McGonagle, Klosterman (2012), "Addressing the Need to Improve Industry Competitiveness by Providing Continuous Engineering Education in Engineering Leadership", Proceedings of the IACEE World conference on Continuing Engineering Education (WCCEE 2012 Valencia)

[3] Janasz, Forret, "Learning the Art of Networking: A Critical Skill for Enhancing Social Capital and Career Success", Journal of Management Education, October 2008

[4] Dyer, Gregersen, Christensen*, The Innovator's DNA: Mastering the Five Skills of Disruptive Innovators*, HBR Press, 2011

[5] Gardner, "Recruiting Trends, 2009-2010", Collegiate Employment Research Institute, Michigan State University

[6] Kelley, Caplan, "How Bell Labs Creates Star Performers", Harvard Business Review, July, 1993

[7] Donofrio, Spohrer, Zadeh, "Research-Driven Medical Education and Practice: A Case for T-Shaped Professionals", Medical Journal of Australia, Viewpoint, 2009

[8] Hansen, T, "IDEO CEO Tim Brown: T-shaped Stars: The Backbone of IDEO's Collaborative Culture", Chief Executive Magazine, January 21, 2010

[9] Tranquillo, "The T-shaped Engineer: Connecting the STEM to the TOP", ASEE Annual Conference, Atlanta, 2013

[10] Seat, Parsons J., Poppen, "Enabling Engineering Performance Skills: A Program to Teach Communication, Leadership and Teamwork", Journal of Engineering Education, January, 2001

[11] Lucht, *Rights of Passage,* Viceroy Press, 2007

[12] Bolies, *What Color is Your Parachute?,* Ten Speed Press, 2014

[13] Uzzi, Dunlap, "How to Build Your Network, Harvard Business Review, December 2005

[14] Felder, Felder, Dietz, "The Effects of Personality Type of Engineering Student Performance and Attitudes", Journal of Engineering Education, January, 2002

[15] O'Brian, Bernold, Akroyd, "Myers-Briggs Type Indicator and Academic Achievement in Engineering Education", International Journal of Engineering Education, 1998

[16]http://www.myersbriggs.org/my-mbti-personality-type/mbti-basics/extraversion-or-introversion.htm

[17] Ibarra, Hunter, "How Leaders Create and Use Networks", Harvard Business Review, January, 2007