DISSERTATION APPROVED BY

4/21/2016

Date

Isabelle Cherney, Ph.D., Chair

James R. Martin, Ph.D., Committee Member

Jennifer Moss Breen, Ph.D., Program Director

Gail M. Jensen, Ph.D., Dean

DESIGNING A BETTER EXPERIENCE: A QUALITATIVE INVESTIGATION OF STUDENT ENGINEERING INTERNSHIPS

By

Mohammad R. Paknejad

A DISSERTATION IN PRACTICE

Submitted to the faculty of the Graduate School of Creighton University in Partial Fulfillment of the Requirements for the degree of Doctor of Education in Interdisciplinary Leadership

---

Omaha, NE

April 21, 2016

Abstract

Science, Technology, Engineering and Mathematics (STEM) education play a very important role in preparing students with skills necessary to obtain better jobs, solve real-world challenges, and compete in the global economy. STEM education develops critical thinking and the ability to solve complex problems. Research showed that 8 out of 10 most desired employees were the ones with STEM education like electrical engineering or computer science, yet the United States has fallen in STEM ranking among advanced nations. Additionally, local firms are finding it difficult to recruit the STEM professionals they need be successful in business, and while STEM education is in great demand, lack of desired skills continues to challenge the industry and the new engineering graduates. A review of the literature identified gaps in skills such as technical skills, software skills, soft skills, and organizational culture and attributed these gaps partially to lack of collaboration between the industry and academia. Literature suggested changes to the engineering curriculum to narrow this gap between what students study and what is expected of them when they start a new career. In this qualitative research, the author used a phenomenological approached to answer the research questions. The author interviewed industry experts and inquired about the engineering internship best practices. The research results revealed critical skills which are grouped under four categories or main themes. Industry leaders can develop effective engineering internships based on these themes to prepare the next generation of young women and men to start a new career in engineering, reduce on the job training time, and increase innovation and productivity.

Dedication

This dissertation which represents my highest educational achievement is dedicated to the memory of my parents, Mr. and Mrs. Gholamreza and Parvin Paknejad in honor of their vision, values, guidance, and appreciation for higher education. Their encouragement inspired me to pursue this interdisciplinary doctoral program in leadership at Creighton University to complement my engineering and business experience at CTDI. This education has enabled me to view each day as a gift to serve our organization and our community with a greater sense of purpose.

Acknowledgements

My doctoral journey was filled with excitement, blessings, educational and spiritual growth. The Jesuit education at Creighton has opened my mind to new possibilities, and has opened my heart to let Jesus guide me through life as I strive to fulfill my life's mission. I recognize the blessings that surround me, the opportunities that call for my action, and the people who have helped shape who I have become. For these successes in life I would like to thank the following individuals:

I would like to thank Dr. Isabelle Cherney, my committee chair and my advisor, for her exemplary dedication to this program, for her leadership, guidance, and her influence on my spiritual growth at Creighton. You created a bond among 300 doctoral students with your weekly newsletters and eliminated the word "distant" form distant learning.

I would like to thank Dr. James Martin Jr., my committee member and professor, for his dedication, guidance, and support through many conference calls.

I would like to thank Father Timothy Lannon, S. J., President, and Dean Gail Jensen for their dedication to the university, the news-letters, and for a fantastic educational experience.

I would like to thank Professor Tricia Sharrar, Dr. Peggy Hawkins, Dr. Donna Ehrlich, Dr. Jeff Ehrlich, Dr. Gretchen Oltman, Dr. John Hudson, Dr. Kimberly Grassmeyer, all my professors, Chris Carmichael, and Ed.D. Staff- for the quality of education, individualized attention, and the positive impact each one has had on my education and personal growth. The opportunity to meet and learn from each one of you

has made my Creighton education a richer, more fulfilling, and a more memorable experience.

I would like to thank all my research participants who are leaders in the tech industry, for sharing their views, expertise, experiences, and making this research possible. I greatly value your input and appreciate your time.

I would like to thank Jerry Parsons, Chairman and CEO, and Leo Parsons, President and COO of CTDI for their exemplary leadership, family values, visionary approach, and genuine friendship. The high quality of leadership education at Creighton was a reflection of your leadership in action which I was very familiar with. I am grateful for the countless opportunities that I have had at CTDI and for the lessons that you have taught me over the past 32 years. This leadership education has had a very positive impact on my relationship with our customers and colleagues. These past four and a half years have been great investments in personal development.

I would like to thank my wife Debra, for her love, support, understanding, and encouragements. You have had a positive influence on me and you have been the reason for my success in life ever since we met. Thanks to my sons that I love more than life, Bradley and Evan, for your understanding, encouragement, and support.

I am grateful to my family, brother, sisters, nieces, and nephews who have cheered me enthusiastically. Mina, Minoo, Mahin, Mehry, Mahvash, Azadeh, Azar, Ali, Azita, my cohort, and my friends, you have taught me much and you have all been a great part of my life.

Table of Contents

Abstract iii

Dedication iv

Acknowledgements v

Table of Contents vii

CHAPTER ONE: INTRODUCTION 1

Background of the Problem 1

Introduction and Statement of the Problem 2

Purpose of the Study 3

Research Questions 3

Significance of the Study 3

Aim of the Study 4

Methodology Overview 5

Definition of Relevant Terms 5

Delimitations and Limitations 6

Leader's Role and Responsibility in Relation to the Problem 7

Summary 8

CHAPTER TWO: LITERATURE REVIEW 9

Introduction 9

Engineering and Innovation of new Technologies 9

Engineering and Technical Competence 10
Technical Gaps in Engineering 12
Software and Programing Competence 12
Critical Software Skills 13
Analysis of the Software gap Between Academia and Industry 15
The Role of Soft Skills 17
The Role of Organizational Culture 20
Innovations 21
Mission and Vision 22
Communications and Teamwork 23
Leadership 23
Literature Review Findings (Skill Gaps) 24
Summary 25
CHAPTER THREE: METHODOLOGY 26
Introduction 26
Purpose of the Study 26
Aim of the Study 26
Research Questions 34
Research Design 27
Population and Sample 27
Data Collection Tools 28
The Researcher's Role 29
Data Collection Procedures 30

Data Analysis Plan 31

Validity and Reliability 31

Ethical Considerations 32

Summary 34

CHAPTER FOUR: FINDINGS 36

Introduction 36

Profile of the Research Participants 36

Summary and Presentation of the Findings 39

Q1. Describe the engineering internship program at your company. 39

Key Topic One: Innovation 39

Key Topic Two: Technical 40

Key Topic Three: Communication 41

Key Topic Four: Software 41

Key Topic Five: Diversity 42

Q2. Describe the skills that incoming interns possess. 43

Key Topic One: IP Networking 43

Key Topic Two: Programing 44

Key Topic Three: Soft Skills 45

Key Topic Four: Corporate Strategy 45

Q3. In your company, what skills are most desirable in newly hired full-time engineers? 46

Key Topic One: Software Skills 46

Key Topic Two: Technical Skills 47

Key Topic Three: Soft Skills 47
Key Topic Four: Personal Attributes 48
Q4. What skills do interns usually acquire during your internship program? 48
Key Topic One: Technical Skills 48
Key Topic Two: Soft Skills 49
Key Topic Three: Corporate and Professional Skills 49
Key Topic Four: Software Development Skills 50
Q5. If you could change the internship program at your company, what might you change, if anything? 50
Key Topic One: Longer Internship Programs 51
Key Topic Two: A Well-Structured Program 51
Key Topic Three: Hiring More Interns 52
Summary 54
CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS 55
Introduction 55
Summary of the Study 55
Implementation of Solution Processes and Considerations 56
Roles and Responsibilities of key Players in Implementation 57
Technical Skills 57
Software Skills 59
Soft Skills 60
Corporate Culture 60
Evaluation and Timeline for Implementation and Assessment 61

Convincing Others to Support the Proposed Solution 64

Critical Pieces Needed for Implementation and Assessment 64

Internal and External Implications for the Organization 65

Implications and Considerations for Leaders Implementing Proposed Solution..... 66

Starting an Internship Program 66

Maintaining an Internship Program 67

Measuring and Adjusting an Internship Program 67

Evaluation Cycle 68

Measuring the Success of the Internship Program..... 68

Implications for Action / Recommendations for Further Research 70

References 72

List of Tables

Table 1. Research Participants' Professional Background……37

Table 2. Emerging Themes & Key Topics From the Interviews……..52

Table 3. Summary of Research Findings……..62

CHAPTER ONE: INTRODUCTION

Background of the Problem

Science, Technology, Engineering and Mathematics (STEM) education play a very important role in shaping our future. Science improves our understanding of the world and improves our quality of life and technology encompasses applied scientific knowledge for practical use. Engineering provides innovation, solution to problems like challenges of transportation, global warming, and telecommunication systems, while mathematics holds all three together (Roman, 2012). STEM education prepares students with competencies and skills in the four disciplines that can solve real-world challenges.

A successful STEM education can lead to better job opportunities, regional economic growth, and development of tools necessary to compete in the global economy. Eberle (2010) surveyed the ten most desired employees out of whom eight were found to be the ones with degrees in the STEM fields including computer science, electrical engineering, information sciences, and computer engineering. STEM education develops critical thinkers, increases science literacy, and enables the next generation of innovators. With a solid knowledge in the STEM areas, innovation can lead to new products and processes that sustain our economy (Roman, 2012). Furthermore, research showed that financially rewarding STEM careers grew 17 percent in 2010 as compared to non-STEM careers which grew 9.8 percent with lower financial rewards (Eberle, 2010).

STEM education is on the growth path across genders and ethnicities. Yoder's (2012) research showed a six percent growth in engineering bachelor's degree enrollment for 2011- 2012. Yoder (2012) observed an increase in women's representation at the bachelor's-degree level for the fourth straight year. They earned 18.9% of the degrees

awarded in 2012, up from 17.8% in 2009. Hispanics, who continued a 10-year trend of yearly increases, earned 9 percent of bachelor's degrees, no change for the African American students, and a slight decrease for white students (Yoder, 2012). Based on the enrollment trends, the percentage of women receiving an engineering bachelor's degree is expected to increase slightly over the next few years. Although, this percentage is far below the desired 50% representation for women in STEM fields, it is positive step to increase women's representation in math-intensive fields of science (Ceci & Williams, 2010).

STEM careers help professions build communities and transform nations. These professionals are in charge of solving the complex problems of today's world and its future. STEM careers are clearly what fuels the regional economy, yet local firms are finding it difficult to recruit the STEM professionals they need to continue to be successful in today's changing business environment (www.ed.gov/stem). Government leaders recognize that the United States has fallen in STEM ranks among nations, so the U.S. leaders continue to encourage the next generation of students to understand and embrace the technologies that affect our lives (www.ed.gov/stem).

Introduction and Statement of the Problem

While STEM education is in great demand, the lack of desired skills in new engineering graduates poses a challenge which warranted further exploration to identify key elements of an effective engineering internship to help close the gap between what was taught at universities and what is desired by the industry. Choosing a qualitative approach, the researcher pursued a solution to this important engineering issue while working within the research framework (Creswell, 2014).

The researcher invited eight industry leaders to participate and share their views on current internship programs within their organizations. Each participant answered five specific research questions to help identify and develop the desired skills in engineering students. The results were compared to findings from the literature to identify the desired skills that were in demand in the technology industry.

The findings of this research will help individuals, organizations, and local communities. Through implementations of the findings, engineering graduates will be well prepared to start a career in engineering within a technology or telecommunications industry, reduce the training time, and increase innovations and productivity to help grow the local economy.

Purpose of the Study

The purpose of this qualitative study was to identify skills that were desired in newly hired engineer by technology and telecommunication companies.

Research Question

This research sought to answer two main questions. First, what are the key skills most desirable in newly hired full-time engineers, and second, what are the elements of an engineering internship that would help develop those skills in engineering students.

Significance of the Study

The demand for professionals with STEM education continues to grow (www.ed.gov/stem), yet research showed that large populations of engineering graduates lack the skills that are desirable in the technology or telecommunications industry (Gonzalez, 2015). The gaps in the students' skill-sets are partially attributed to a lack of sufficient collaboration between the industry and academia (Mead, 2009). To close the

gap, new research could identify the skills desired in technology and telecommunications industries and recommend an engineering internship that would effectively develop such skills in engineering students.

This phenomenological research was designed so that research participants who were familiar with the needs of the industry could share best practices for developing desired skills in engineering students and prepare them for their careers. An engineering internship based on the findings of this research would familiarize students with the industry, provide a roadmap to maximize engineering education, and better prepare students for their first jobs.

A review of the literature identified gaps in skills or students' knowledge (Williams, 2011) and linked this deficiency to the absence of collaboration between industry and educational leaders (Aasheim & Williams, 2009). The present study went beyond identifying the gaps and problems, and offered specific solutions and a road map that may guide the engineering students in maximizing their education while in school. While the findings of the present study may help develop more innovative engineers who are well prepared to enter the STEM field and contribute in a more creative and cost effective manner. The findings of the current study could lead to educational policy changes that would impact a larger number of students.

Aim of the Study

The aim of this Dissertation in Practice was to provide a recommendation for an engineering internship that would develop soft and hard skills in students through a customized training program that would be well planned, fully funded, and successfully executed.

This training would allow engineering students to prepare for an entry-level electrical, computer or software engineering position with a technology or telecommunications company.

Methodology Overview

To gain insight into engineering internship best practices, this author designed a qualitative research and conducted a study based on the procedures, protocols, and principals of the phenomenological methodology (Creswell, 2014) in which the researcher interviewed technology industry executives and transcribed the experiences of these industry leaders about the phenomenon or in this case the engineering internship (Moustakas, 1994 as cited in Creswell, 2014).

Through these interviews, the author identified common themes to answer the research questions (Giorgi, 2009; Moustakas, 1994 as cited in Creswell, 2014). This research problem addressed a real-life issue that was confirmed by scholars (Aasheim & Williams, 2009). The research participants included experienced women and men in executive capacity within the technology industry. Research participants had developed, conducted, or enhanced engineering internship programs within their respective organizations in recent years. The interviews were digitally recorded, transcribed, and categorized into four themes. These themes were Technical skills, software skills, soft skills, and organizational culture.

Definition of Relevant Terms

The following terms were defined in the context of this study and used throughout this your dissertation:

High school: An educational institution housing students in grades 9-12.

App Development: Refers to Application development for mobile devices.

Corporate culture: A company's internal work climate. A combination of company's shared values, beliefs, ethical standards, and accepted work practices.

CO-OP: A program similar to engineering internship where the student will have the opportunity to work two full semesters as an intern.

Soft skills: Non-technical skills including presentation, communication, collaboration, interpersonal, leadership, confidence.

Hard Skills: Hardware or technical skills

IP Networking: Internet Protocol Networking using Routers, Switches, and other equipment used for data communication.

IS: Information Systems.

IT: Information Technology.

POC: Proof of Concept

Tech Industry: Technology industry includes companies that are involved with technology, Telecommunications, Data Networking, software and App development.

Readers can use this page for technical descriptions or definition of technical terms in the context of this research.

Delimitations and Limitations

The research participants in this study were senior executives who were familiar with technology and telecommunications industries. The author limited the research participants to those companies who were not a customer or an employee of the company

where he works. This limitation provided unbiased views of external participants and bracketed the internal views or biases on internship programs.

This author aimed to balance the number of female and male participants. Out of the seven females who were asked to participate, only two agreed to participate. This study was limited because of fewer female participants.

Leader's Role and Responsibility in Relation to the Problem

Successful engineering internships start with effective leadership. Developing an internship program that cultivates needed skills in the interns, requires the leader to articulate an appealing vision to the organization that is challenging but achievable, develop a long term strategy for attaining a goal, and link the present to a better future (Robbins & Judge, 2012). Additionally, Effective leaders are all about integrity, service, and excellence as they focus on the concerns and needs of others, (Robbins & Judge, 2012; Johnson, 2012). Leaders acknowledge ethical responsibilities of their role and possible consequence of their decision (Johnson, 2012).

Effective leaders are expected to be champions (Haslam et al., 2011). Leaders should view internships not as a burden, but as an opportunity to act on (Johnson, 2012). Leaders in charge of engineering organizations need to have a higher-level of sensibility, inspire their followers to do things because they want to, and help transform interns' needs to hope and aspiration (Haslam et al., 2011).

Leaders have a sense of mission, are aware of their social environment, achieve social influence, and shape the beliefs and priorities of their followers (Haslam et al., 2011). Finally, Leaders have the capacity to make a personal commitment to support

interns with encouragement and honest coaching. Like Jesuits, leaders would visualize interns' full potential, and commit to unlocking them in their interns (Lowney, 2003).

Summary

In Chapter One, the author provided an overview of STEM technologies, STEM career opportunities, employer's challenges, and engineering students' challenges. The author identified a source of these challenges and described the type of research he conducted to identify the skills most desired by the tech industry and to identify the keys to a successful engineering internship. For this study, five research questions were developed to collect data from the research participants. The author identified the limitations and delimitations of this research, made a case for the importance of this research and the way it would contribute to scholarly knowledge, and concluded with leaders' responsibilities in implementing such programs. In Chapter Two, the researcher will explore the literature to identify skills that are desired by technology companies.

CHAPTER TWO: LITERATURE REVIEW

Introduction

This chapter provides analysis and synthesis of scholarly literature related to engineering, and challenges that engineering graduates come across as they pursue their first jobs. The author started with an overview of the role of engineering and innovation on society. Next he identified the skills that were most critical to student's career as an entry-level engineer based on researching different fields in engineering and science such as Electrical Engineering (EE), Software Engineering (SE), Information Technology (IT), and Information Systems (IS).

Engineering and Innovation of new Technologies

Engineering and innovation of new technologies are vital to economic growth, preservation of the environment, and improvement of health. Government and enterprise leaders recognize the importance of engineering and new technologies to job creation, modernization of the digital infrastructure, and health care (The White House, 2011). Technologies such as high-speed broadband for fast data transmission, internet access, or fourth generation (4G) wireless networks for high speed wireless data and voice communications require a high degree of technical competency, technical excellence, and innovation. These technologies and technical skills are critical to long term prosperity and global competitiveness (The White House, 2011). Prosperity becomes reality when the vision is combined with engineering technological innovations. For example, engineers who are engaged with nanotechnologies design material that have high-performance and efficient molecular structure. The control of these materials could produce new technologies in every field, from electronics and manufacturing to medicine

and the environment (The Nano Tech, 2016). Scientists and researchers agreed that engineers develop new technologies and processes for long-term economic growth. They design products that enable manufacturing to become more productive and flexible. Engineers create new techniques that build complex structures, and use environmentally friendly energy systems to keep the environment clean by using every by-product in the manufacturing to eliminate waste (The Nano Tech, 2016).

Finally, engineers develop tools, drugs, and processes that enable us to fight disease and disabilities. From artificial retinas to computer-aided speech for people with physical disabilities, engineers create devices to overcome obstacles, manufacture drugs to fight cancer, provide solutions to improve overall process efficiency, and lower the cost (www.nanotech.com). These innovations are possible through a high degree of technical proficiency.

Engineering and Technical Competence

Engineering graduates who demonstrate a high degree of technical competency increase their chances of acquiring new jobs. Muller's (2000) showed that over the last two decades, the combination of the telephone and internet access has revolutionized telecommunications in the twenty-first century, and created many new job opportunities. Establishing reliable connections for voice over the internet, optimizing network performance, or choosing the appropriate compression rates requires technology improvement, knowledge of advanced digital signal processing, and engineers with advanced technical skills to make this new paradigm possible. Individuals who can absorb the new technological tools and demonstrate technical competency will have a major impact on productivity and create new job opportunities (Friedman, 2006).

Whether it is engineering, computer science, computer engineering or information technology, engineering students can acquire and exhibit a high degree of technical competence through a well-planned engineering internship.

Technical competency is essential to the future of new engineers and IT professionals. McMurtrey, Downey, Zeltmann, and Friedman (2008) identified technical competence as one of the four critical skill sets for IT professionals and encouraged organizations and educational entities to collaborate and explore innovative ways to pre-train entry level professionals through internships or other partnerships. The researchers recognized the rapid pace of change in technology and encouraged new professionals to benefit all the stakeholders by keeping up with new technologies. Thilmany (2004) agreed with the need for technical competency and argued that those who choose a technical profession do so because they are drawn to certain aspects about the world, such as verifiable results, solving problems, innovation, and creating new products. Engineers must be clear about their professional roles, responsibilities, and impact on the organization where they work. They need to adopt a continuous improvement mindset and exhibit technical excellence (Thilmany, 2004).

Technical competency is essential for new graduates in engineering, computer science, and IT. Engineering is about solving ill-structured problems, contrary to engineering education where the engineering student is expected to solve well defined problems (Bozic, Cizmic, Sumarac-Pavlovic, & Escalas-Tramullas, 2014). Technical skills can be developed through an effective engineering internship, one that provides an understanding of various technologies, application of theory in practice, and prepares students for the workplace (Gonzalez, 2015).

Technical Gaps in Engineering

Engineering internships enable young students to identify and minimize technical gaps. Universities teach students how to think and how to solve problems, but they rarely provide real world experiences, which can lead to an unprepared workforce (Gonzalez, 2015). Internships on the other hand provide real world experience, and allow students to gauge their technical skills, monitor the gap in their knowledge, and prepare to acquire needed skills during their junior and senior years. Gonzalez (2015) argued that companies are realizing more and more that engineering graduates lack adequate technical experience to understand and apply industry design standards. Tadashi Okamura, former Chairman of a Japanese automobile manufacturer said: “Success goes to those with corporate culture that assures the ability to anticipate and meet customer demands” (Thompson, Peteraf, Gamble, Strickland III, 2012, p. 390). It is important for new graduates to look ahead of graduation and anticipate the skills that employers value in successful employees.

Software and Programing Competence

Engineering graduates seeking new employment are challenged by a lack of critical software skills that have resulted from the communication gap between academia and industry. The demand for professionals with software engineering skills continues to grow at an exponential rate in the world of information and communications technologies (Moreno, Sanchez-Segura, Medina-Dominguez, & Carvajal, 2012). The United States Department of Labor forecasts that the demand for software engineers will rise at a much higher rate than other occupations through 2024 (Bureau of Labor Statistics, 2014). The Bureau of Labor Statistics projected that employment of computer and software

engineering and information technology occupations is expected to grow 15 percent from 2014 to 2024. This rate of growth is faster than the average for all other occupations, in part due to cloud computing, data storage, more devices connecting to the Internet, and mobile computing. These new services are expected to create half a million new jobs from 2014 to 2024 with a median annual salary of $79,390, twice the average for all other occupations based on 2014 data. Despite the positive job outlook, new graduates continue to be challenged by a lack of critical software skills (Moreno et al., 2012).

Critical Software Skills

Researchers have conducted several studies to identify the critical skills that engineering graduates need to perform their jobs properly (Gartner, 2005; Lethbridge, 2000). The analysis of Internet job postings has also been instrumental in determining the critical skill requirements of engineering professionals. Researchers worked with various search engines and divided different jobs into several categories in which web development and programming accounted for 51% of the identifiable job skills (Moreno et al., 2012). Additionally, Abraham et al. (2006) worked with several U.S. companies finding that technical skills were desirable in new hires. Pace (2015) studied higher education curricula and the IT industry and discovered similar findings. This study identified several software skills that were critical to the industry and new engineering graduates. Among these highly valued skills, application development, and software development skills were highly in demand. Similarly, Gartner (2005) published a study in which four kinds of knowledge were identified as crucial for people pursuing software and IT related occupations, namely technical knowledge or the knowledge of the way the technology works, its impact, and interaction, with other technologies.

Pace (2015) argued there are more IT jobs than qualified people to fill them. As a result of this growing demand for skilled IT and software developers, educational institutions are expanding their online and campus programs to provide more of the needed software and computer education, leading to summer science camps to encourage high school students to choose STEM careers. Lethbridge (2000) also discovered the shortage of software engineers and indicated that among computer industry workers only 40% have a software- related education. The majority was not educated in key areas of software engineering, such as testing, architecture, and project management. Moreno et al. (2012) argued that most practitioners are merely skilled at programming in a few popular computer languages or at using specific technology products, such as database management, and web development tools. In their view, software engineering-specifics such as design, configuration management or testing were equally important. Other researchers highlighted the relevance of web and emerging Java-related application skills and identified those skills as highest in demand (Kovacs, Davis, Lee, & Han, 2008).

Engineering and IT/IS students who plan to seek employment in the software sector upon graduation should be advised to focus on developing skills in programming languages, systems development methodologies, and increase their knowledge of the IT industry. The learning outcomes that support a higher level of competency in the areas of programming languages, systems development life cycles, and knowledge of the IT industry must remain the primary focus, rather than programs that primarily seek to meet the entry-level needs of non-IT firms (Pace, 2015).

Finally, researchers concluded that mathematics instruction was emphasized more than required by the industry and recommended more attention to technological trends

with emphasis in areas such as project management, system design, software cost estimates, management of software feature package releases, and software reliability (Kitchenham, Budgen, Brereton, & Woodall, 2005 Lethbridge, 2000).

Analysis of the Software gap Between Academia and Industry

There is a noticeable gap between the software skills acquired through engineering or IT programs and the skills required by the IT industry. Several researchers have already highlighted the gap between the industry needs and the current software education (Aasheim & Williams, 2009; Kim, Hsu, & Stern, 2006; Kovacs et al., 2008). Other studies examined whether the core courses provide knowledge that is useful for performing each software task as it applies to application development, architecture, design, and development. They concluded that there was a significant mismatch between software education and industry needs for new graduates to perform the tasks that were expected of them (Moreno et al., 2012).

Aasheim and Williams (2009) examined whether those in academia perceived the importance of various skills for junior IT workers differently than IT managers. They found that IT managers valued issues related to operating systems, hardware concepts, entrepreneurial traits, and leadership skills more than faculty. Kim et al. (2006) also analyzed the content of a curriculum in IS through a sampling of employees at one manufacturing facility. They identified project management as the highest ranked skill and argued that topics like security should receive more emphasis in IS curriculum. Lethbridge (2000) identified the gaps between the knowledge required from a practical viewpoint and the education provided by engineering and IT programs. The research

findings were coherent and they all confirmed the presence of a gap between what is taught in engineering and IT programs and what is required by the industry.

These studies can help identify the areas of importance in the software / IT field and enhance the competencies of recent graduates of software engineering programs to perform the tasks that are expected of these professionals as part of their jobs in industry (Moreno et al., 2012). To fill this gap, it would be necessary to guarantee that the educational programs provide the required knowledge for specific job profiles suggested by industry, and also guarantee that this knowledge is taught in a manner that would enable future professionals to skillfully tackle the challenges that they will encounter during their professional careers (Morino et al., 2012). In addition to the software gap, researchers identified additional critical training related to the business. For example, Kovacs et al. (2008) analyzed the IS curriculum and suggested skills like knowledge of business or problem solving, should be added to the future IS curricula. Furthermore, the knowledge should be taught with examples of practical applications in real world to help students understand its relevance (Moreno et al., 2012).

For the profession to advance, the research suggests the importance of developing software engineering specialization within a broad variety of degree programs. To achieve this educational goal, industry leaders must serve as change agents who motivate the next generation of software engineers and educators (Mead, 2009). Although there are many examples of successful collaborations, they are not as common as expected. Universities and industries have been urged to seek out one another and start a dialogue because this collaboration is critical to keeping the educational programs in line with the industry's needs (Mead, 2009).

The Role of Soft Skills

Soft skills refer to nontechnical skills such as communications skill, presentation skills, ability to work in a team with different personalities or genders, professionalism, and ethical conduct. Regardless of what professional background the individual has, the need to fill the soft skills gap has become very essential to meet company expectations when interacting with their customers. Soft skills are not new concepts to higher education. Accrediting agencies have recommended soft skills for over fifty years (Zhang, 2012). Companies seek candidates who are smart and can present themselves well in front of the customer; therefore, soft skills training have to be an integral part of the undergraduate curriculum (Sharma & Sharma, 2010). Besides communication skills and technical skills, Sharma and Sharma (2010) viewed soft skills as the next important skill to develop, because they help succeed in interviews, group discussions, and in getting the job.

Soft skills are core competencies that if ignored can stall or derail the career of the student (Klaus, 2007). Soft skills encompass personal attributes, ethics, privacy, honesty, integrity, and effective communications with different audiences and teams. A study by Zhang (2012) found that the importance of personal attributes ranked higher than business expertise, core IS knowledge, and proficiency.

Individuals who choose to pursue technical fields such as engineering, IT, or IS may do so because they are drawn to the logical aspect of their work which gives them a sense of solving a problem. The skill sets for undertaking technical tasks are quite different from those expected of managers, consultants, and entrepreneurs. As engineers

move up the career ladder into management, soft skills become critical to be effective and grow within management (Thilmany, 2004).

Schulz (2008) argued that soft skill training continues to be weak in engineering education and IT programs, and agreed with Williams (2011) and Zhang (2012) that both engineering and IT curricula are loaded with technical courses, hampering the career progression of new graduates. Cerri (in Thilmany, 2004) who taught soft skills to engineers who were moving to management role also pointed out the lack of people skills among engineers and feared that the university's main focus and tendency was to teach technical excellence and engineering innovation (Thilmany, 2004).

A study by Surakka (2007) identified interpersonal skills as more important to long-term success in a technical environment than IS/IT cores (Aasheim & Williams, 2009). Future IT professionals nonetheless must optimize effective communication and teamwork (Aasheim & Williams, 2009). There are a number of strategies that can close the soft skills gap. Pace (2015) highlighted Ashford University's initiatives to develop programs aimed at reducing a growing soft skills gap among its student body. This program combined with regional professional networking events where students interacted with professionals in their field, prepared small presentations and acquired corporate exposure would enhance the student's soft skills (Pace, 2015). Additionally, Sharma and Sharma (2010) suggested that faculty such as those in English departments can go beyond improving the language skill of students, and fine tune their soft skills, presentation skills, and help them articulate their attributes in their resumes. Another strategy to help close the soft skills gap would require shifting the focus from passive

learning, where the instructor delivers a lecture and evaluates the student's performance, to an active learning, where the student is fully engaged in the learning (Zhang, 2012).

Managers and entrepreneurs need to exercise their leadership as these skills are vitally important for all engineers, and not just when engineers become managers (Thilmany, 2004). These skills must be encouraged early because a significant number of the graduates may be managing their own companies (Thilmany, 2004). Johnson and Johnson's (1997) teamwork model proposed two basic activities for group members: One was task related and the other involved social activities (Levi & Cadiz, 1998). The theoretical framework of this study recommended technical training with activities, such as preparing and delivering high quality work, attending meetings, participating in meetings, providing ideas, and taking initiatives. At the same time, it recommended soft-skill training with activities like communication, cooperation, conflict resolution, team building, and leadership. (Zhang, 2012)

Researchers agree that the current curricula need to change and be updated regularly to include soft skills training just like grammar, pronunciation, and vocabulary exercises (Sharma & Sharma, 2010). Students do not need to only read about gaining soft-skills, but they need to practice them, and to see them in action (Thilmany, 2004). Soft-skills will fine tune the personality and boost the confidence level of students in the job interview selection process (Sharma & Sharma, 2010).

Sharma and Sharma (2010) argued that soft-skill training would be more advantageous to engineering students than study of literature. They argued that more attention be given to practical aspects of the soft-skills training than theoretical teaching of literature. Students should be trained to perform and speak in different situations with

confidence. The training should include role-plays, debates, group discussions, sessions on etiquettes, body language, and group dynamics (Sharma & Sharma, 2010). Soft skills training would prepare engineering and IT students to demonstrate competence in interpersonal communication, teamwork, and conflict management. Engineering and IT educations should then prepare current students with soft and hard skills to better communicate with end users, to resolve conflicts, and to bring groups with different functional skills together towards a common goal (Zhang, 2012).

Whether the student is studying engineering, IT, or others, Klaus (2007) summed it well. Soft skills are critical for success at work. Mastering these skills takes persistence, mindfulness about self and career, and requires an open mind to feedback. It will not happen overnight, but with hard work, and over time, the payoff can be tremendous.

The Role of Organizational Culture

Thompson et al. (2012) defined corporate culture or a company's internal work climate as a combination of shared values, beliefs, ethical standards, and accepted work practices. Additionally, Thompson et al. (2012) argued that understanding the organizational culture, mission, and corporate strategies is equally important to job satisfaction and career growth as technical and soft-skills.

New graduates need to review the company's culture, community involvement, and success, track records as these practices affect new hires' job satisfaction and professional growth. A company's corporate culture serves as a tool to measure the appropriateness of actions, decisions, behaviors, how its personnel interact, and what behaviors are awarded both financial and symbolic or through job promotions (Thompson et al., 2012). Organizational culture is one of the most important

determinants of sustained organizational performance and innovativeness. To change it, one needs to understand the elements of organizational culture, which include innovative mission, vision, communications, collaboration, and leadership. Understanding organizational culture is important for new graduates because it reflects what the company values, the behavior it rewards in the short and long term, how the management fosters relationships, and how it creates alliances (Dombrowski et al., 2007). A company whose culture is based on growth, productivity, innovation, employee engagement, customer, and community service would be an example of an organization with rich culture (Vilanova & Dettoni, 2011).These types of organizations focus on educating their employees and engaging them in all aspects of the business. On the other hand, organizations whose main motivations are financial profits will have a hard time building company loyalty or a strong foundation for long term success. A discussion of innovation, mission, and vision will follow.

Innovations

Innovation plays a major role in the careers of the new engineering graduates. It creates new jobs, financial growth for the organization, and positively affects the community. Innovation includes product improvement, introduction of new products, new methods, or new markets, which are all important to a company's competitiveness, productivity, profitability, and economic growth (Vilanova & Dettoni, 2011). Companies engage new engineering graduates in innovative strategies in a multitude of ways. For example, some technology companies have developed a culture of innovation where the employees are encouraged to experiment and champion innovations, and in the process, not to be afraid and disagree with their managers in pursuit of their ideas (Sutton, 2001).

In another type of culture, deadlines combined with freedom from other responsibilities and a strong network of expertise allowed the managers to manage innovations. For example, at Samsung, technical employees were authorized to spend 15 percent of their time on discretionary projects. Such a culture promoted creativity and thereby fostered innovation at a workplace (Dombrowski et al., 2007). Once the new graduates realize the role of innovation on the organization, they can pursue their job with a renewed energy and excitement, and communicate their innovative ideas to their managers. Hamel (1999) argued that it is crucial for organizations to promote a culture based on open communication without the restrictions associated with the hierarchy to attract and retain qualified and talented individuals who are keys to innovation.

Mission and Vision

Understanding the company's mission and vision statements is important for new hires because mission and vision guide the organizations in times of peril and prosperity toward the goal of better organizational performance. A unified organization provides incentive to members to share knowledge, learning, and work together for the successful implementation of innovation and growth (Dombrowski et al., 2007). Mission and vision statements bring disparate groups together to focus on organizational objectives and common goals. The lack of common goals may create silos such as a marketing silo or an engineering silo, catering to their own narrow interests, thereby jeopardizing the larger organizational goals and objectives. Understanding the company's mission and vision will provide new engineering graduate a long term view of where the company is headed and what it values, both of which will influence the new hire's long term growth and professional development.

Communications and Teamwork

Communications and teamwork play a crucial role in new engineering graduates' day-to-day responsibilities because engineering design and development projects require a collaborative multidisciplinary approach. In order to improve quality, engineering, interns, and other members of the team need to consider collaboration as an important key to gaining new knowledge in collaborative engineering practices. College graduates need to develop interpersonal skills, communication skills, teamwork, and conflict management (Aasheim & Williams, 2009). To aid in developing such skills in new graduates, universities and colleges are shifting their approaches from passive learning to active learning, switching from class lecture to cooperative learning (Zhang, 2012).

Leadership

In an engineering environment where there is product development, system design, and customer interaction, change is inevitable. Leadership training and understanding leadership principles will prepare new engineering graduates to better manage change. Leadership is about coping with change and the reason leadership has become so important in business is due to the competitiveness and volatility of the business world (HBR, 1998). Effective leaders become excellent strategic thinkers. They continue to learn, gain new knowledge, and anticipate what may occur in the future (Tracy, 2010). Increasing global competition is a major factor driving change and demands on U.S. engineers. U.S. engineers find themselves competing for work with engineers from other countries, who are often paid much less, as much as 80 percent less in some countries (Thilmany, 2004). Engineers who plan to be managers or go into business for themselves, should learn and nurture leadership skills as early as possible in

their careers, preferably in college. Thilmany (2004) believed that creative, entrepreneurial, and leadership skills are something all engineers should have, and encouraged educational institutions to develop a culture of leadership and creativity among students and new graduates. The kinds of jobs engineers are being asked to do and the skills they are expected to have are changing (Katehi, Pearson, & Feder, 2009). To keep pace with the business demands, colleges should be fostering technology, innovation, creativity, and leadership skills in the new students. To succeed in such an environment, engineering graduates not only require analytical skills, system design, and creative thinking, but also a variety of other skills that are often overlooked in engineering education. Communications and leadership, the ability to work in multicultural environments, the flexibility to adapt to change, understanding of the business side of engineering, and a commitment to continuous learning are examples of such skills (Katehi et al., 2009).

Literature Review Findings (Skill Gaps)

Government and industry leaders must promote engineering internship to advance science and engineering. It is conceivable for the government and tech industry leaders to launch a national engineering internship initiative to provide the largest contribution to this effort, with a primary focus on investments in fundamental engineering education.

Aasheim and Williams (2009) studied whether various IT skills were perceived differently by IT managers for entry level IT graduates in comparison to academic and educational environment. They found that IT managers place more importance on issues such as hardware concepts, operating systems, leadership skills or entrepreneurial traits, whereas faculty placed more emphasis on mathematics and basic science instead of web

development and emerging technologies. Researchers recognized the need to ensure that new graduates receive core technical knowledge to do the job as opposed to whether they are capable of performing a task properly. Research findings can be used as critical indicators in developing industry-related school curriculum for colleges and universities. By working closely with industry leaders, universities can develop better curriculums, thus bridging the gap between learning and practical application (Su & Chang, 2014).

Summary

This literature review identified important areas and fields that future engineering graduates need to develop. Each area was analyzed and the benefits it would offer in preparing new engineering graduates were discussed. Researchers addressed gaps in technical skills, software skills, soft skills, and organizational culture among new graduates. They attributed the majority of these gaps to a lack of collaboration between academia and industry. Several new changes were recommended to the engineering curriculum to narrow the gap between what students study and what is expected of them when they start a new career. These findings will be compared to the data from the interviews with research participants to identify the critical skills that would benefit interns. Chapter Three discusses the methodology used to collect and analyze the data.

CHAPTER THREE: METHODOLOGY

Introduction

This chapter describes the qualitative research methodology, research design, and data collection based on the recommended protocols and procedures (Roberts, 2010). The researcher approached this phenomenological study through a series of interviews with executives who were familiar with engineering internship and the technology industry. The researcher focused on the experiences and perspectives of the research participants to gain a comprehensive insight into the engineering internship best practices and answer the research questions.

Purpose of the Study

The purpose of this qualitative study was to identify skills that were desired in newly hired engineer by technology and telecommunication companies.

Aim of the Study

The aim of this Dissertation in Practice was to provide a recommendation for an engineering internship that would develop soft and hard skills in students through a customized training program that would be well planned, fully funded, and successfully executed.

Research Question

This research sought to answer two main questions. First, what are the key skills most desirable in newly hired full-time engineers, and second, what are the elements of an engineering internship that would help develop those skills in engineering students.

Research Design

The researcher designed this qualitative research based on the procedures, protocols, and philosophical principals of the phenomenological methodology (Creswell, 2014). Phenomenological research is defined as an inquiry in which the researcher describes the experiences of participants about the phenomenon or in this case the engineering internship; this description is an accumulation of the experiences of a selected number of individuals who had all experienced the phenomenon (Moustakas, 1994 as cited in Creswell, 2014).

This design methodology required conducting interviews to explore common themes to answer the research questions (Giorgi, 2009; Moustakas, 1994 as cited in Creswell, 2014). The data for this research were collected through a series of interviews with participants who had the knowledge and firsthand experience with developing and conducting successful engineering internship programs. During these interviews, the executives were asked open-ended questions to allow the information and eventually the themes to emerge from the experiences of participants (Creswell, 2014). The information was obtained by recording the interviews with the participants. The researcher then analyzed, interpreted, and categorized the data before the themes emerged.

Population and Sample

With the growth of broadband and the need for technical innovation, this researcher chose to focus on technology companies where there are growth and ample opportunities for hiring new engineering graduates. The population for this study consisted of individuals in technology companies that offered engineering internships. The sample participants included both women and men in executive roles within

technology and telecommunications industry, whom had developed, conducted, or enhanced engineering internship programs within their respective organizations in recent years. All eight participants had over 15 years of work experience each, managing technical professionals.

The participants were composed of three women and five men, selected from a variety of technology companies in different geographical regions, with executive responsibilities within their respected companies, and experience with engineering interns. The participants were all in the position to hire new graduates at a bachelor or masters level in electrical engineering, computer science, and other engineering disciplines. Although 30 percent of the individuals who were invited opted to participate in the interview process, saturation was reached when participants repeatedly identified the same skill sets and themes were identified which will be presented in Chapter Four.

To keep the research results unbiased and unaffected by personal views and experiences, this researcher strategically invited individuals who were not coworkers, employees, or customers. For this study, the participants were a good representation of the technical experts and employers. The researcher was introduced to one participant through his advisor, a professor at Olin College. Through snowball effect, the researcher was introduced to multiple professionals from different organizations and finally four at a job fair.

Data Collection Tools

This researcher conducted a separate telephone interview with each participant, presented unstructured questions, and provided ample time for the participants to share their views. “Unstructured” interviews are most common in qualitative studies where

researchers seek to learn from participants what matters or how processes are understood (Richards & Morse, 2013). The interviews were set up at times that were most convenient to the participants, with no distractions, interruptions, or skewing of the responder's story by the researcher during the interview process (Richards & Morse, 2013). The research questions helped focus the participants on the topic while the researcher assumed the listening stance. All conversations were recorded using a digital recording device. This device was proved to be reliable and ideal as a portable recorder for this study.

The Researcher's Role

In a qualitative research, the inquirer will encounter a variety of issues during the course of the study including ethical, personal, and cultural (Locke, Spirduso, & Silverman, 2013 as cited in Creswell, 2014). With such concerns, researchers are encouraged to identify their biases and personal backgrounds that shape their interpretation during the study (Herr & Anderson, 2015). When choosing a research site or participants for this study, this researcher selected participants from a number of technology companies that hired new engineers. All participants had experience with engineering internship programs but had no previous affiliation with the researcher.

After the Institutional Review Board (IRB) approval was granted, this researcher bracketed previously acquired data, asked the same set of open-ended questions from each participant, and began collecting new data by recording the interviews (Creswell, 2014). In this study, the names of the companies and participants were masked from the data and proper protocols were followed prior, during, and after the interviews as required by IRB. The researcher informed all participants of their rights, provided each participant a copy of the IRB consent form, and emailed a copy of the appropriate

transcribed interview to each participant for her or his approval (Creswell, 2014). To conduct a comprehensive study and produce an outcome that was valuable to engineering students and employers, additional individuals were identified through snowball sampling (Richards & Morse, 2013).

This researcher bracketed his personal experience and focused on the experiences of the research participants (Moustakas, 1994 as cited in Creswell, 2014). Bracketing does not mean forgetting the experience of the researcher, but to prevent the past knowledge to be engaged while a new study is being conducted (Giorgi, 2009 as cited in Creswell, 2014). During this study, the researcher suspended all judgment, captured the views of the participants, and placed the emphasis on exploring new ideas through in-depth interviews (Creswell, 2013). The researcher analyzed the information, grouped the data, reduced and combined the results into themes (Creswell, 2013). These themes focused on identifying what participants had in common as they experienced engineering internship (Creswell, 2012).

Data Collection Procedures

The data collection process started after the Institutional Review Board (IRB) issued a letter of approval to conduct this research. This researcher contacted all participants via email. A copy of the approved IRB consent form, which outlined the participants' rights and the research questions, was sent to each participant along with a request for a personal interview. These interviews were recorded, transcribed, and sent back to the corresponding participant for approval. Prior to the main interview, a small piloting sample of men and women confirmed the recording to be reliable. The recorded interviews were backed up on the researcher's personal computer and transcribed

verbatim by the researcher using a Mac Book and another digital device that had the capability to convert audio to text. All digital contents were saved on a memory device as a second backup and stored in a safe environment in the researcher's office. A few participants made minor changes once they reviewed the transcript of their interview without changing the content. All participants provided approval for the data to be used in this research.

Data Analysis Plan

The researcher analyzed the data systematically. He listened to the recorded audio streams and read the corresponding transcripts one at a time. This process was repeated several times to get a sense of the entire message (Tesch, 1990 as cited in Creswell, 2014). Next the researcher reviewed one transcript at a time, highlighted key messages and asked what the message was about, and made notes and assigned each key message to a sub category. Once this task was completed for all transcripts, the messages and subcategories were entered on an excel spreadsheet. A sequence number and a participant ID were added to each line in separate columns. All messages were then sorted by subcategories to identify four major themes (Roberts, 2010).

Validity and Reliability

Although validation of the findings takes place throughout the research process, Creswell (2014) suggested eight primary strategies that could be used to validate the research findings. This researcher used multiple approaches to validate the accuracy of his research findings.

The transcripts were sent to each participant for external validation. Each participant was given the opportunity to verify the content of the corresponding

transcript, to corroborate, and make any necessary changes that were deemed important by the participants. Some of the participants improved the transcripts and added more clarity to their message by making minor changes to the format or text that was deemed necessary. This validation process confirmed the researcher's ability to assess the accuracy of the recorded information (Creswell, 2014).

Validity of qualitative research is based on whether the findings are accurate from the point of view of the researcher, reader, and the participants (Creswell & Miller, 2000 as cited in Creswell, 2014). The researcher chose member checking to confirm the accuracy of the findings (Creswell, 2014). The participants were asked to share their views on whether the findings were accurate. Finally, this researcher validated the data analysis and theme development through triangulation including committee members, peer examination, and convergence of sources (Creswell, 2014).

This qualitative research validity and reliability was strengthened through the use of direct quotes from the participants, validation of the transcripts by interviewees, and traceability of the data to the recorded interviews. The researcher eliminated obvious mistakes that were made during the transcription and constantly compared the data and codes to prevent drift in the definition of codes (Gibbs, 2007 as cited in Creswell, 2014). The transcripts and recorded interviews were maintained in a password-protected personal computer and were backed up on an external hard drive in an offsite location in a locked cabinet for safety.

Ethical Considerations

Creswell (2014) argued that all researchers must be aware of and anticipate ethical issues throughout the research. This researcher employed ethical practices at the

beginning, throughout the data collection, and at the conclusion of the research. Bryant (2004) encouraged all researchers to guard against bias. This researcher bracketed his personal experience and focused on meeting the standards for objectivity, meaning, the reported findings were based-solely on collected data (Bryant, 2004).

This research and the data collection process started after all IRB requirements were met, the dissertation proposal was accepted, and an approval was granted. Creswell (2014) argued that the researchers have an obligation to respect the rights, values, and desires of the participants. This researcher provided a copy of the consent form to each participant. All necessary steps were taken to inform the participants that the interviews would be recorded; participants' names and the names of their companies would be masked when reporting the findings, and the collected data would be saved in a password protected environment.

Creswell (2012) discouraged a close relationship between the researcher and participants to prevent data collection from being coercive. This researcher selected participants that had no former or current relationship with the researcher or the company where he works. This research was conducted without any changes or alteration to the findings to satisfy any interest groups (Creswell, 2014).

Developing Specific Research Questions

To identify the desired skills and propose an engineering internship that would help develop those skills in new graduates, the research participants were asked the following questions:

- Please describe the engineering internship program at your company.
- Describe the skills that incoming interns possess.
- In your company, what skills are most desirable in newly hired full-time engineers?
- What skills do interns usually acquire during your internship program?
- If you could change the internship program at your company, what might you change, if anything?

Summary

In Chapter Three, the researcher presented the reason a qualitative study was conducted, how the data were gathered, the researcher's role and how the ethical issues were addressed. Through this phenomenological research, the researcher was able to contact industry leaders, set up one-on-one interviews to get their views, perspectives, and their experience with conducting engineering internship. The participants were asked to identify the skills that are desired in new engineering graduates that would make them more desirable for a career with a technology company. The participants had a wealth of wisdom and experience. They shared their knowledge and recommendations with the researcher so that an effective engineering internship program could be identified to help

employers and engineering students. In Chapter Four, the researcher will present the data analysis and the themes that emerged from these interviews.

CHAPTER FOUR: FINDINGS

Introduction

The purpose of this research was to explore the development of an engineering internship that would prepare engineering students for an entry-level electrical, computer or software engineering position with a technology or telecommunications company. The aim of this Dissertation in Practice was to provide a recommendation for an engineering internship that would develop soft and hard skills in students through a customized training program. The researcher conducted individual interviews and asked eight executives from the technology industry the following research questions: 1) Please describe the engineering internship program at your company, 2) describe the skills that incoming interns possess, 3) in your company, what skills are most desirable in newly hired full-time engineers? 4) What skills do interns usually acquire during your internship program? 5) If you could change the internship program at your company, what might you change, if anything?

Profile of the Research Participants

The researcher invited 33 qualified individuals to participate in this research. The participants were selected based on their knowledge and experience in the technology industry, their role and influence on hiring new graduates, and their passion to help young engineers build a solid technical foundation through an effective engineering internship program. Twenty five percent of those invited accepted the invitation and participated in a telephone interview. All eight executives who participated in this research were familiar with engineering internships, had developed internship programs, or had managed engineering interns. The research participants consisted of two women and six

men, each with over 15-25 years of experience in the technology industry. In this dissertation, the eight research participants will be identified as RP1 to RP8. Research participants' backgrounds are listed in Table 1.

Table 1

Research Participants' Professional Background

Research Participants	Gender	Years of Experience	Executive's Expertise
RP1	Female	Over 17 years	Technology, Technical Sales
RP2	Male	Over 25 years	Technology, Engineering
RP3	Male	Over 25 years	Technology, Engineering
RP4	Male	Over 25 years	Technology, Engineering
RP5	Male	Over 25 years	Technology, Human Resources
RP6	Male	Over 20 years	Technology, Engineering

Research Participants	Gender	Years of Experience	Executive's Expertise
RP7	Female	Over 25 years	Technology, Human Resources
RP8	Male	Over 15 years	Technology, Engineering

Summary and Presentation of the Findings

Engineering internships are technical training programs that are developed by senior managers and engineers within a company to introduce engineering students to real engineering projects and responsibilities. The engineering internship programs in this research varied in duration between 12 to 16 weeks, with the number of participants ranging from 30 to 226 interns. Although different interns had different job responsibilities, several key topics emerged out of each interview question with the research participants. At the conclusion of the interviews, these key topics helped identify four main themes that were the foundation for an effective engineering internship. The key topics and themes are tabulated and presented in Table 2. The interviews started with the following question:

Q1. Describe the engineering internship program at your company.

The overall goal of the internship program among the participating companies was to provide engineering training for university graduates and to identify talents for future employment. The research participants worked with key division managers within their companies who funded the internship program to identify projects, mentors, and mapped out a 12 or 16 week training program with specific objectives and expectations. Five key topics emerged out of question one. These key topics were: Innovation, Technical, Communication, Software, and Diversity.

Key Topic One: Innovation

Innovation refers to new product introduction, product improvement, or process improvement that leads to increased productivity and profitability (Vilanova & Dettoni,

2011). The 12-week internship program at RP3's company consisted of 226 interns in 15 locations worldwide. RP3 commented:

> "Our number one objective is to energize and innovate. Our second key objective is to build a pipeline for future employees, establishing relationships with universities and students and the third element is the brand of reputation in the marketplace, while we provide very meaningful projects to the interns."

Key Topic Two: Technical

The internship programs represented in this study were technical in nature and required knowledge of hardware and software. The interns' responsibilities varied depending on the assignments and included software development, hardware engineering, system configuration, proof-of-concept (POC), developing data security solutions, system engineering (SE), and more. These roles and responsibilities gave the interns a better understanding of what to expect as an engineer. RP4 stated:

> "My team offers the SE interns a glimpse into the proof-of-concept and gives them the ability to get some hands-on exposure to the equipment and participate in some customer meetings where we are presenting our solution to the customer."

RP4 further elaborated on how his company developed the interns' technical skills by engaging the interns with the latest technologies and products in the technology lab also known as the "CloudLab."

> "As part of new initiatives, our CloudLab, which is in essence a dynamic self-service laboratory environment provides our systems engineers and our partners

> or customers the various test beds for proof-of-concept testing, demonstration, or training purposes" (RP4).

Key Topic Three: Communication

The research participants communicated with the interns daily, provided mentorship, mapped out the course of the events or specific tasks, and measured the interns' progress over the course of the internship. On the program expectations, RP6 stated:

> "The internship starts with about three to four days orientation more on expectations of them, what their job title is, what their role is, what the company's expectation of them is, and it is effectively to learn."

Open communication, clear expectation, and preparation played a major role in the success of the internship at RP6's company.

Key Topic Four: Software

The majority of the research participants were also responsible for hiring new graduates; therefore, during the internship, the research participants took the time to share their vision and showed the interns how the interns fit into the company's overall goals and mission. RP5's company developed software on a large scale. In many cases these software projects required over 50 software developers to work in teams to complete the project. RP 5 stated:

> "We integrate the interns into our software teams either as a group of interns or as individuals assigned to a team. The interns are typically given a project or work off a backlog. The interns learn at the larger level what we do and how they fit in."

Research participants identified the product knowledge and software development as important engineering responsibilities.

Key Topic Five: Diversity

The company's corporate culture had a major influence on the quality of the internship program. The participating companies were leaders within the industry. Their corporate strategy promoted hiring both female and male interns with a diverse cultural background. In one instance the internship program included six men and six women. Among the women, there were two Asian, two Indian, and two American students. RP1 designed a program that specifically trained women to be systems engineers and described the system engineer's role as the technical advisors to the sales team. Similarly, RP2 was responsible for mentoring several female engineers for roles as sales engineers. These roles required the female interns to be technical, articulate, and knowledgeable about the products and solutions they presented to the customers. RP2 stated:

> "The engineering internship that I led provided the interns the information they needed to experience a day in the life of a field person and the different interaction they would experience with multiple people across the organization including engineering, Middle management, and executives. The engineering internship guided [interns] to be receptive to change, to recognize [growth opportunities], and to understand the requirements for success in the field."

Both RP1 and RP2 recognized the importance of good communication skills for engineers.

In summary, the internship program focused on developing key skills that are important in the day-to-day responsibilities of system engineers. The internship programs

focused on developing interns' technical and software skills, social and presentation skills, and other aspects of the engineering job responsibilities. At the end of the summer each intern prepared and presented a demo or a present a proof-of-concept to the company executives during the "intern show case day," using a poster or a live demo.

Q2. Describe the skills that incoming interns possess.

The engineering internship required varied skill sets among the participating companies. Some companies focused on graduate students working towards their master's degree while others included undergraduate juniors and seniors, but not freshmen. Some research participants were interested in interns who had both networking and programming knowledge and others were mainly interested in software developers and their passion for programing. Four key topics emerged out of question two. These key topics were: Internet Protocol (IP) networking, Programming, Soft Skills, and Corporate Strategy.

Key Topic One: IP Networking

Whether one is a software developer, technical advisor, or a hardware engineer, understanding Internet Protocol (IP) networking is very important and essential for engineers in the field of technology; however, IP networking is generally not part of the engineering curriculum. RP6 noted:

> "Keep in mind a lot of engineering type positions that we have, we're looking to hire people with networking background and we're looking for people who become network engineers, and the reality is there aren't that kind of students available I would realize that we have to hire and invest in training."

Additionally, RP1 added:

> “We focused on typically master’s students, people working on their masters of electrical engineering or some information science or computer science. We looked for people who had some networking background or some telecommunication coursework on the resume but also had some programming experience.”

In his closing comments, RP3 highlighted the need for the knowledge of advanced computer networking.

Key Topic Two: Programing

All participating companies unanimously desired the software development and programming skills. Depending on the assignment, skills in any of the popular languages such as “C “ programming, pearl, python and JavaScript were in demand among interns who would engage in software development or networking assignments.

RP3 stated: “[Interns] would have to have some proficiency in programming ... [also] some knowledge of networking protocols [and] Linux operating system would be important.”

RP5 further shared his company’s need for a specific type of software developers:

> “The kids that have a passion for coding. That is software development. I'm always talking about software. Some other companies may be looking for something different. We're looking for kids who have passion and do the stuff on the side and have a good grasp of solving hard problems.”

Key Topic Three: Soft Skills

Technical knowledge or programing skills were not the only skills that were identified as critical for engineering interns. Soft skills such as communications skills, presentation skills, and collaboration in a team environment were identified as critical for a successful engineering career. RP2 stated:

> "We want the candidates who are presentable, have the right skills, the right soft skills, not just technical skills, articulating in their communications, through email, through presentations, through their body language, and their mind process; sound and efficient at addressing different situations."

RP3 further elaborated on general characteristics of the interns and what the employers would look for in a candidate:

> "You look for self-motivation, you look for collaborative team player type skills, good communication skills both verbal and written, organizational skills, the ability to manage time effectively and work towards a specific outcome."

Key Topic Four: Corporate Strategy

Corporate strategy plays a major role in the internship program. It encompasses communication, diversity, and large array of strategic choices that will benefit the interns, the community and the corporation. Regarding the requirements for the skill sets of the incoming interns RP6 stated:

> "We try to talk to juniors because they are closest to graduation. We are also open to sophomores as well... That's just our strategy... Like I said some have the right skill sets, the others have the potential. You don't need somebody with a networking background because that's something we feel like we are investing

> five weeks to teach them. If we get somebody that is strong, ... [or is] the right type of person. So I would say we are doing a lot based on potential but we also do target students that have networking background [or] certifications... If we leave [the requirements] somewhat open we can take someone with potential and teach them what we need."

This research identified several gaps between engineering interns' academic education and the technology industry's needs for students with knowledge of IP networking, key software skills, and soft skills that are in high demand in this industry.

Q3. In your company, what skills are most desirable in newly hired full-time engineers?

Research participants sought very similar qualities in new hires. Employers were interested in engineers who were passionate about their work, had a desire to succeed, and had leadership qualities. These qualities were grouped into four key topics which were: Software skills, technical skills, soft skills, and personal attributes.

Key Topic One: Software Skills

Software development and automation have become a major part of engineering projects. Through automation, people with software skills can make existing processes more efficient and more cost effective. RP1 stated:

> "We are really pivoting towards hiring people with programming experience who have done scripting and automation programing at work, and that combined with the telecommunication experience for the systems engineering position."

Key Topic Two: Technical Skills

The knowledge of IP networking and fundamentals of telecommunication were delineated several times during the interviews with the research participants; however, the ability to understand the technology was not enough. According to RP4:

> "What we need is technical affinity and expertise, not just the ability to understand technology, but to explain it and truly love working with it."

According to the interviewees, future engineers need to have a passion and willingness to do what is required to succeed.

Key Topic Three: Soft Skills

Soft skills were described in many different ways. For example, the employers were interested in people who could communicate effectively, collaborated in a team environment, and had interpersonal skills. In this study, soft skills refer to written and verbal communications skills, presentation skills, collaboration and interpersonal skills, and the ability to speak up in a group discussion. RP4 highlighted the importance of soft skills especially when working together with customers.

> "The technical piece is important, but equally important in this role because it is part of sales organization are the soft skills…Having … the desire to interact with people… quite frequently you have to act as technical thought leader… command attention.. ,and maintain your presence in front of a very experienced and technical audience."

These skills will encompass leadership skills which all employers welcome and some view as a very critical piece of their required criteria for employment (RP7).

Key Topic Four: Personal Attributes

Employers were interested in people who had an open mind, were tenacious, and were willing to apply extra time and energy to solve hard problems (RP5). Another research participant felt it was important for the intern to be coachable, self-motivated, interested in learning, and have a deep desire to succeed (RP2).

Q4. What skills do interns usually acquire during your internship program?

Research participants focused on providing interns opportunities that would complement intern's education. These opportunities included hands on system configuration, troubleshooting, debugging, understanding customers' needs, and strategies to get beyond corporate bureaucracy. The skills that interns acquired during their internship were grouped into four key topics which were: Technical skills, soft skills, corporate and professional skills, and software development skills.

Key Topic One: Technical Skills

Many interns were taught the basics of IP routing and switching, router's features and functions, and product application (RP1). The interns were provided the opportunity to work with customers' equipment. RP4 indicated:

> "The primary skills that the interns acquire are: hands-on skills specifically hands-on skills with ... equipment. In general, they have limited hands on opportunities within college and there is a lot of text book and reading and testing and they're really looking for a break from that."

Other interns learned about engineering processes, communication technologies, and data analysis. RP8 stated:

> "They certainly get some of the basic knowledge of engineering processes, how we collect data, use data, and what the data means. We use it for planning or making engineering decisions."

RP8 further added that during internship, the interns also get exposed to various Ethernet protocols and data systems.

Key Topic Two: Soft Skills

Out of all research participants, 88% touched on the need for good communication skills. Other important skills included: leadership skills, corporate etiquette, people networking skills, and the skills required to interact with customers. Soft skills were identified among key skills for interns to develop. RP2 stated: "They [interns] also see how their soft-skills are enabling them to grow further or become more mature."

Key Topic Three: Corporate and Professional Skills

All research participants viewed corporate exposure and development of professional skills important to the success of their internship programs. Interns learned how large companies operated and how to complete specific tasks regarding corporate bureaucracy (RP5). Research participants further elaborated about the goal setting, personal development planning, and interacting with senior leadership team. RP7 further added:

> "As we prepare the students for the world, we teach them not to sit in the back of the room, but to have a voice in moderation at the leadership table. We give them the opportunity to stand in front of the senior leadership team and present with confidence."

Key Topic Four: Software Development Skills

Interns' learning experience varied between software automation, software application, software defined networks, and software development on a large scale as some interns worked with larger groups of software developers on the same project. RP5 commented:

> "What I would think, this is one of the things, I believe basically it's software development environment, a much larger scale than they've ever worked on in school or some other intern jobs. You know this is a very large software team on a lot of different products. You have to worry about source code control. You have to worry about your adjustment to the code where they learn a lot about the entire process, the scene of the whole new software development cycle. I think the biggest thing that they see is the scale."

Software development skill has been a critical component of 40% of the internship programs among the participating companies.

Q5. If you could change the internship program at your company, what might you change, if anything?

Research participants believed in innovation, continuous improvement, and each one identified areas for improvement. Four key topics emerged out of question five. These key topics were: Longer internship programs, better tools for tracking interns, well-structured programs, and hiring more interns.

Key Topic One: Longer Internship Programs

Internship programs were typically 12 weeks in the U.S. as opposed to six to twelve months in Europe which were developed in coordination with local universities. Both RP1 and RP7 favored a longer internship program:

> "I would like to see us expand [the internship] to be a four months or five months program as opposed to a three months, and I would do that, so that students would have more depth to know the company, get to know the technology solutions, and maybe do two big projects during the course of their internship instead of just one."

RP7 commented:

> "Let me think, [our internship] is not a perfect program. If I had to change something, I think I would change the length of the internship program. I would make it a six-month program."

Whether internships were extended to four or six month, research participants had a compelling argument that a longer internship program would be more valuable to students and corporations.

Key Topic Two: A Well-Structured Program

RP4 viewed applying the feedback from the previous interns as a major step towards the success of the internship program in his company and attributed this success in large part to the efforts of his counterpart who headed the system engineering internship program. RP4 viewed innovation and continuous improvement as their company's strategy going forward. Finally, RP8 summarized his view on internship programs as valuable opportunities both for the companies and students. RP8 encouraged

the companies to be more deliberate in offering such programs, have a structured internship that is well planned and documented, where expectations were clearly communicated between employers and interns.

Key Topic Three: Hiring More Interns

Besides changes to the internship program, some research participants recommended changes to the current company practices such as hiring more interns with diverse background for full time positions or better marketing strategies to attract new talents when visiting universities (RP6). Both RP3 and RP8 favored converting more interns into full time employees. RP8 identified the following opportunities for improvement:

"[We need to] share expectations both ways, [perform] career evaluation, and offer position to interns after graduation."

Table 2

Emerging Themes and key Topics From the Interviews With Research Participants

Research Participants	Theme 1 Technical Skills	Theme 2 Software Skills	Theme 3 Soft Skills	Theme 4 Culture
Research Participant (RP1)	IP Networking Routers/ Switches Telecomm	Programming, Scripting, Automation	Presentation	Diversity 4-5 month internship
RP2	Technical Interested in technology Field support		Communication, Presentation, Soft skill,	Diversity Coachable, Self-motivated, Hunger to succeed

Research Participants	Theme 1 Technical Skills	Theme 2 Software Skills	Theme 3 Soft Skills	Theme 4 Culture
RP3	Networking Technical skills, Problem solving, Linux	Programming	Communication Presentation, Collaboration	Innovate Energize Build relationships Brand of reputation
RP4	System Configuration POC Hands-on- Exp.		Interpersonal skills	Love working with technology Have passion
RP5		Large scale S/W Development Source code Management	Passionate	Shared Vision Passion Tenacity Expectation
RP6	Networking, Certification Network engineering			Communication Strategy Goal setting Personal growth Preparation Expectations
RP7			Confidence Speak up Presentation	Leadership Corporate exposure 6-month program
RP8	Communication Technologies Safety in Engineering Data Analysis			Communication Documentation Hire interns Be deliberate Share expectation

Summary

Research participants' interviews identified several skill sets that were particularly advantages to the technology and telecommunications industry. These skills were divided into four categories to develop four themes to identify a higher level category of the skills in demand in a professional setting.

Research participants identified important technical skills such as knowledge of IP networking, configuring routers and switches, fundamentals of telecommunications and others as listed in Table 2. Additionally, research participants identified programming and knowledge of software development both for individual software development and in collaboration with other software developers as a key skill in today's technology driven market. Research participants viewed soft skills or the engineer's ability to work in collaborative way, communicate in an effective manner, and exhibit interpersonal skills as a critical skill for career growth and furthering the organization's objectives. Soft skills were in demand along with technical skills. Finally, research participants recognized the knowledge of the corporate culture such as business strategies, vision, diversity, leadership philosophy, expectations, personal development, and passion for one's career as keys to success in an organization.

In Chapter Five, the author analyzed and synthesized the findings from the findings from the literature review with the feedback from the research participants, and presented the evidence as the foundation for an effective engineering internship.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

Introduction

To identify an engineering internship that would equip students with the skills necessary to start a career in technology or telecommunication, the author researched the literature to identify the gap between skills taught at universities, and the skills desired by the industry. Next, the author interviewed eight industry leaders to identify the skills that were most needed by the technology companies. The findings were then analyzed, summarized, and presented as four themes. These themes are presented as the foundation for an effective engineering internship that could best prepare engineering students by developing the skills they need to successfully start their career.

In Chapter Five the author shared how this study has contributed to the literature and further discussed the roles and responsibilities of key players involved with implementation of internship programs, and the implications of such programs on organizations and individuals. In conclusion, the recommendations in this study encourage continuous communications and further interaction between industry and academic leaders to develop critical skills needed by the industry.

Summary of the Study

Research showed that engineering students face many challenges after graduation as they pursue new career opportunities (Morino et al., 2012). These challenges include lack of work experience, lack of people skills, working with and managing teams, interfacing with customers, communications skills, leadership skill, and solving problems

in a business environment. Literature review identified four major skill gaps among new graduates. The gaps identified were technical skills, software skills, soft skills, and lack of familiarity with the organizational culture. Researchers attributed the gaps between the skills acquired and the skills desired in new graduates to lack of sufficient interaction between industry leaders and academia (Lethbridge, 2000; Morino et al., 2012).

Implementation of Solution Processes and Considerations

In this study, the research participants (RP) provided valuable information about the internship programs in their respective organizations and the skills they sought in engineering students. This information was summarized and tabulated in Table 2. Additionally, the literature review identified gaps in education (Aasheim & Williams, 2009) that can be addressed through properly planned engineering internship programs. Additionally, this author used the information from Table 2, recommendations from research participants, and findings from the literature review to offer leaders who are responsible for developing internship programs or enhancing their existing programs a new solution.

To build a strong foundation for an engineering internship, the engineering internship program requires corporate commitment, available resources, and proper planning (RP3). In his organization, the person who led the internship program brought improvements through planning, assigned mentors, available lab resources, and a diverse population of engineers including both genders.

Roles and Responsibilities of key Players in Implementation

The individuals who participated in this research and their implementation teams came from corporate, engineering, IT, sales, and human resources so the internship program could have the support and commitment it needed to be successful. These key individuals approved required funding, selected meaningful projects, assigned mentors, and provided access to workstations, development equipment, proof of concept lab, and software tools (RP3; RP1; RP4). The leadership team developed the mission and vision (RP1) for the internship program that was in line with the corporate culture and objectives of the organization. The research participants recommended an internship that was a minimum of 12 to 16 weeks long, although a longer program in the range of four to five months would allow the interns to work on at least two projects (RP1). During the orientation, mentors familiarized the interns with their projects, company's policies, and program expectations (RP6). Mentors took the initiative to provide training to interns in the following four areas:

Technical Skills

Engineering graduates must possess technical competency. System engineers need to be technically sound, learn to configure products, and demonstrate the products' features to customers (RP2; RP4). To achieve this objective, interns should familiarize themselves with the company's products, how the products operate, how to configure, and simulate the customer's network so they can demonstrate the product's performance. RP4 recommended providing equipment and guidance to interns so they can learn to configure and experiment with the products in a lab environment. Interns further should

learn about the competing products, compare and contrast the performance of similar products, and prepare themselves to provide technical support for the sales team (RP1).

Interns should learn the basics of Internet Protocol (IP) networking and telecommunications (RP1; RP6). Students who have a basic understating of IP networking and telecommunications can engage with senior engineers and actively participate in system configuration and troubleshooting, where as those students who are not familiar with these technologies will have to learn the concepts first before they can be an effective member of the engineering team. To achieve this objective, interns can enroll in network certification classes and work with routers and switches to get familiar with data communication principles, equipment configuration, and data performance measurement equipment. Team activities and hands-on troubleshooting may be one of the most effective and rewarding ways for interns to learn about these products (RP4).

To help interns connect the theory to practice and expand on their technical knowledge, the projects should be technical, challenging but not overwhelming, and offer the interns the opportunity to innovate (RP3). Mentors should continue to provide technical support and guidance so that interns learn new skills, make contributions to the overall project objectives, and develop a sense of accomplishment. The technical projects should incorporate different technologies such as internet protocol (IP) networking, wireless communication (WIFI), system and test equipment configuration, and others as appropriate (RP4). Over the period of 12 to 16 weeks, interns could acquire a more in-depth knowledge of IP networking, wireless communication, software tools, application development, scripting and automation, operating systems, data base management, and others as specified by mentors (RP2; RP5).

Mentors can facilitate events similar to a career day where interns showcase their summer projects and talk about their experience to employees and senior managers (RP3). This might be an effective way to help interns prepare, improve their communication, and presentation skills. During this event, interns have the opportunity to talk about their project to the senior management and company employees before the internship program ends (RP3). These strategies provide the knowledge that industry sought in new engineering graduates. Showcasing the projects teaches interns the knowledge of IP networking, data communication, teamwork, presentation skills, and hand-on troubleshooting. This plan is the first step towards closing the gap in the skills of new graduates (Gonzalez, 2015).

Software Skills

The research participants identified several software skills that would make a new graduate more desirable for employment. RP5 recommended programming in “C” or other popular languages such as C++, C#, Java, and Python. Additionally, writing and automating scripts was identified as valuable (RP1). RP5 valued the ability to develop software as part of a large team of 30 people or more. In such environments, interns would learn how to program on a large scale, work with a team, properly document, and manage the source code. This strategy allows the interns to learn programming and web-based development that accounted for 51% of the identified job skills (Moreno et al., 2012). This plan is the second step towards closing the gap between industry and education received by engineers (Lethbridge, 2000).

Soft Skills

Regardless of the individual's professional background, companies seek candidates with good people skills, leadership skills, and good communications skills. These skills become more critical when individuals interface with external customers. Companies seek candidates who are smart and can present themselves well in front of the customer (RP2). Besides communication skills, Sharma and Sharma (2010) viewed soft skills as the next important skill to develop, because having people skills helps in-group discussions, and in getting the desired job. Soft skill competencies for engineers reflect non-technical skills. Soft skills encompass effective communications and people skills when working with various groups within an organization (Zhang, 2012).

Research participants valued passion, collaboration, communications, and presentation (RP2; RP3; RP5; RP7). To help develop soft skills among the interns, research participants recommended creating networking events (RP4) so that interns could improve their communication skills with professionals in their field. They also expected the interns to prepare a formal presentation at the end of the internship program and present to the senior executives and staff or to the customers (PR2). These opportunities develop the interns' soft skills and help close the gap in their soft skills. Regardless of the student's major, Klaus (2007) viewed soft skills as a critical skill for success at work and encouraged mastering these skills through persistence, mindfulness about self, and an open mind to feedback.

Corporate Culture

Organizational culture is one of the most important determinants of organizational innovation and performance (Thompson et al., 2012). A company's corporate culture

serves as a guide to determine the appropriateness of actions, decisions, interaction, and rewarded behaviors. RP2 valued interns that were coachable, self-motivated, and eager to succeed. RP4 and RP5 valued interns that were passionate about technology, programming, and tenacious about solving challenging problems. Researcher participants valued good communication skills, presentation skills, leadership skills, and gender diversity among the interns (RP2; RP4; RP6; RP7). Interns should be required to develop their communications and leadership skills before they present their solutions to the senior managers and customers (RP3). Interns should identify personal goals, achieve milestones, and develop their professional skills while learning about the corporate culture (RP6). Knowing what is important to the organization and their customers permits the interns to better prepare for their careers and to maximize their education while in school. This was the fourth step towards closing the educational gap. These major recommendations are summarized in Table 3.

Evaluation and Timeline for Implementation and Assessment

An internship that encompasses all four themes can be developed in 12 weeks. This internship program will need the commitment and support of experts in each field. In the technical area, people with product expertise could contribute to the development of case studies that would teach interns how to configure and test products along with related network equipment as the customers use it. Experts in software, soft skill, and corporate culture and leadership strategies can develop similar modules. Each module will provide the interns ample opportunity to expand their skills and get a sense for a professional environment.

This solution can be implemented in two phases. In the first phase, a draft copy of the proposed solution would be used as a guide during the internship and marked up with corrections and improvements. The second phase would have the updated version with lessons learned and ways to improve the experience for the interns. This process will provide the leaders the opportunity to optimize the program and incorporate steps that would lead to a greater experience for the interns.

Table 3

Summary of Research Findings

Recommended Themes	Skill Sets Encompass
Technical Skills	Communication Technologies, Data Analysis, Field Support, Hands-On-Experience Interested in technology, IP Networking, Linux, Network Engineering, Networking Certification, POC, Problem Solving, Routers, Switches, Safety in Engineering, System Configuration, Telecommunication Principles.
Software Skills	Programming in “C” or other Popular Languages Such as C++, C#, Java, and Python. Writing and Automating Scripts, The Ability to Develop Software as Part of a Large Team, Learn how to Program on a Large Scale, Work With a Team, Properly Document, and Manage the Source Code. Learn Programming and Web-Based Development.

Soft Skills	Good People Skills, Leadership Skills, Good Communications Skills. Interface With External Customers. Smart and Able to Present Self Well in Front of the Customer. Soft skill competencies for Engineers Reflects non-Technical Skills. Effective Communications and people Skills, Work Well With Various Groups Within an Organization, Passion, Collaboration, and Presentation , Attend Networking Events, Prepare a Formal Presentation , Present to the Senior Executives and Staff or to the Customers . Mastering These Skills Through Persistence, Mindfulness about Self, Have an Open mind to Feedback.
Organizational Culture	Organizational innovation and performance. the appropriateness of actions, decisions, Interaction, and Rewarded Behaviors. Coachable, Self-Motivated, and Eager to Succeed. Passionate About Technology, Programming, and Tenacious about Solving Challenging Problems. Good Communication Skills, Presentation Skills, Leadership Skills, and Gender Diversity Among the Interns, Develop Their Communications and Leadership Skills, Identify Personal Goals, Achieve Milestones, and Develop Professional Skills While Learning About the Corporate Culture. Knowing What is Important to the Organization and Their Customers

Convincing Others to Support the Proposed Solution

Implementing an internship that covers the gap between education and industry will need the cooperation and support of the leadership team and senior members of the organization. RP1 proposed the idea of developing female engineers for sales engineering positions and asked the senior managers to serve as their mentors. RP1 gained the buy-in from her organization's leadership team prior to the start of the internship program. The organization's leaders and senior managers were fully engaged and committed to the success of the program. The lessons learned from the internship program were used to improve the program during the following years.

RP4 recognized the opportunity to develop similar internship programs for high school students to introduce the students to STEM at a younger age. Furthermore, the senior managers stated that they would like to see a higher number of interns hired at the completion of the internship (RP4). Mentors recognized the benefits of internship to the interns, the organization, and the pipeline for future employees. Organizational leaders had the opportunity to work with the interns and made informed decisions about whom to hire (RP3). Those observations allowed the leaders to best convince their financial leaders in the organization to support the internship program. Sharing success stories, and performing cost and benefit analysis of the internship program allowed the research participants and the mentors to overcome financial obstacles that could have hindered the process (RP1).

Critical Pieces Needed for Implementation and Assessment

There are several critical pieces that contribute to a successful internship program. Individuals who take the lead role in developing an internship program need approved

funding so that they know how many interns the program can support. Once the interns have been identified, program directors need to identify projects, work area, and provide necessary tools, licenses, workstations, and mentors. Murphy (2005), a former United States F15 pilot developed a six step process based on the air force practices called "flawless execution" to train corporations for success. Murphy's (2005) six-step process has been successful in producing desired results. Step one is to set a measurable, achievable objective. Step two is to identify the threats and obstacles to success, both internal and external. Step three is to identify available and required resources to achieve success. This includes training, leadership, people, and systems. Step four is to evaluate lessons learned including the teams' experiences. Step five is to develop a course of action, including who does what, and when. In step six, one has to plan for contingencies. Murphy's (2005) six-steps can help develop a successful internship program. This strategy would help close the gap between industry and academia.

Internal and External Implications for the Organization

Organizational and engineering leaders play a critical role as they develop an engineering internship program. First, leaders produce a higher number of qualified engineering graduates by providing hands-on training through internship programs. Second, they evaluate interns for future employment before they hire the individuals. Finally, they reduce training time and training cost by offering internship opportunities at a much lower cost.

Internship programs may offer engineering students the opportunity to have a clear understanding of the skills that are required in a professional work environment. Exposure to an engineering work environment will plant the seeds of innovation in

engineering students and inspire them to maximize their education as they relate the theoretical knowledge to practical applications.

An internship program speaks to the culture of an organization, commitment of corporate leaders to the community, and development of new graduates as they prepare to start a career in engineering. Engineering internships develop interest among women and men, and motivate more students to pursue and complete an engineering program (Chesler, Ruis, Collier, Swiecki, Arastoopour, & Shaffer, 2015).

Implications and Considerations for Leaders Implementing Proposed Solution

Leaders maintain a balance between the opportunities they provide and the benefits they receive from an internship program. They should offer meaningful work to interns, provide tools, training, and mentoring to develop qualified engineers. Leaders should provide paid internships, and teach the interns the benefits of technical education, a professional work atmosphere, and a corporate culture that is rooted in leadership. In exchange for their investment, they position the organization to hire a new graduate that is trained based on qualities that the company values in new hires.

Starting an Internship Program

Organizational leaders need to start with identifying and sharing the goals, objectives, benefits and the desired outcome of the internship program with the interns at the outset of the program (Belingardi, 2012). Mentors would provide ample support to interns during the program, engage them in real engineering projects, and assign them various roles throughout the program (Ciot & Ciot, 2010). In essence the mentors would provide an individualized and authentic engineering experience in a collaborative environment (Chesler, 2015). The internship experience should promote collaboration,

innovation, and provide opportunities that require engineering solutions. This program should motivate the participants to pursue engineering (Chesler, 2015).

Maintaining an Internship Program

The internship program should provide hands-on troubleshooting opportunities to help the interns understand the technical aspects of their project thoroughly, while improving their problem solving, collaboration, communication, and their overall soft skills (Bozic et al., 2014). This will require the intern to work in a collaborative atmosphere, seek new ideas, work with different people, and present new ideas to solve an engineering problem.

Interns also need to get exposed to other aspects of a professional work environment such as the culture of the company or interdepartmental activities (Jensen, 2013). To maintain an effective engineering internship program, mentors should continue to drive creativity, problem solving, teamwork, organizational skills, and inspire the interns to become computer savvy, inquisitive, and lifelong learners (Jensen, 2013).

Measuring and Adjusting an Internship Program

Engineering mentors need to assess the interns' performance as well as the internship program through benchmarking and rectifying any performance gaps (Behn, 2003). Besides technical and cultural lessons, mentors should teach interns business lessons, analyze innovation successes and failures, review the projects as a group on a weekly basis, and implement course correction as necessary (Adner, 2012).

To improve the program or intern's performance, mentors need to understand how to influence interns so that the outputs can be converted into desired outcomes (Behn,

2003). Mentors should provide interns an opportunity to present a final report at the conclusion of the program and recognize the interns' contributions (Jensen, 2013).

Evaluation Cycle

Research participants evaluated the interns once at the mid-point and once at the completion of the internship program (RP6). The mid program evaluation provided the opportunity for the mentors and interns to review the goals against what was achieved. This one-on-one time also allowed the interns and mentors to schedule specific tasks or modification to the original goals to enhance the intern's learning experience (RP6). In addition to the two evaluation periods, mentors should engage with interns regularly and provide daily communications so that interns' times are spent productively (RP2). Internship programs prepare interns to solve unexpected technical challenges in a creative and a systematic way through hands-on troubleshooting, collaboration, and teamwork. The only challenge that remains with an engineering internship program is the mentors' time commitment (Malloy, 2007).

Measuring the Success of the Internship Program

The success of an engineering internship program could be measured in a number of ways. The interns' motivation during the internship, their perception of the knowledge gained at the completion of the internship program, and the degree to which the program has been able to close the gap between the classroom and the industry are important indicators of the success of the program (Bozic et al., 2014). Internship program's influence on interns' level of accountability, professionalism, and successful placement of the interns after graduation are another measure of the internship success (Ciot, M. G. & Ciot, L. M., 2010). Finally, the interns' transition to the highest level of professional

preparation would indicate the internship program was successful (Ciot, M. G. & Ciot, L. M., 2010). Behn (2003) argued that the real learning is triggered by unexpected results. The internship program could significantly help interns' performance in school, leading to more interviews and job placement after graduation (Ciot, M. G. & Ciot, L. M., 2010).

Summary of the Study

This research sought to develop an engineering internship that was based on the skill sets desired by telecommunication and technology companies. The author selected two female and six male executives who were familiar with engineering internship programs, working with both men and women in the engineering fields. The interviews were transcribed and the findings were summarized and grouped into four major themes. The four themes that represented the desired skill sets were technical, software, soft skill, and culture. Each theme represents many sub-themes that can vary to some degree from company to company, but the principles remained unchanged. For example, an intern can study wireless technology or data networking technology depending on the company and job requirements. The key was to display technical competency and the ability to learn and absorb new technologies, or in other words "be teachable" (RP2).

The findings of this research could be extremely valuable to engineering students because these themes guide and prepare engineering students for a successful career with a technology or telecommunication company. Industry leaders must create learning opportunities and provide hands-on experience for the next generation of engineers. As the senior engineers get closer to retirement, the industry will need to train young and energetic engineers to continue developing a culture of innovation.

In conclusion, the research identified that technical people need to develop their leadership skills, both written and oral communication and presentation skills, the ability to collaborate, negotiate, and work in a team environment. In other words, engineers need to develop their soft skills. This is a very important skill that will complement their technical skills and prepare them for the next level in their careers.

Implications for Action / Recommendations for Further Research

This study makes an empirical contribution to the body of knowledge to help close the gap that exists between engineering education and skills desired in an engineering environment. This study further provides the foundation for an engineering internship that may motivate both female and male engineering students. It is unique because over half of the executives who participated and significantly contributed to the content of this research were personally involved in developing engineering internships at their organizations, and the majority had experience working with both genders.

This study may benefit organizational leaders who are involved in developing engineering internships, educational leaders who are responsible for developing engineering curricula, and engineering students. Additionally, many current engineers can benefit from the findings of this research by conducting a self-assessment and close the gaps that have prevented them from reaching the next level in their careers.

The research findings are based on the experiences and views of leaders of successful telecommunication and technology industries. These findings are summarized into major themes and are well supported by the literature. This study encourages more frequent collaboration between industry and educational institutions to help close the gap in the skill sets of engineering graduates.

Interns should pay close attention to the themes that were identified in this study and develop a certain level of expertise in each area as they prepare for their careers. The key is to be able to articulate competency in each area as they prepare for their job interviews, and to continue further training in each of the areas identified through the themes as they start their careers in an engineering field. Although in an engineering environment the technology and programming tools change every few years, the basic principles that these themes are based on are not technology dependent nor are affected by the organizations regardless what the company's specialties were.

Further research should be performed to measure the impact of the proposed internship on the careers of those who have completed such internship. This study can be conducted with the participations of leaders outside telecommunication or technology industry and results could be compared to identify the themes that are common to all engineering disciplines.

References

Aasheim, C. L. & Williams, S.R., (2009). *Knowledge and skill requirements for entry level Information Technology workers: Do employers in the IT industry vie these differently than employers in other industries*? Retrieved from. http:// www.digitalcommons.georgiasouthern.edu/information-tech-facpubs/1

Abraham, T., Beath, C., Bullen, C., Gallagher, K., Goles, T., Kaiser, K., & Simon, J. (2006). IT workforce trends: Implications for IS programs. *Communications of the Association for Information Systems* 17, 1147–1170.

Adner, R. (2012). *The wide lens: What successful innovators see that others miss*. New York, NY: Portfolio/Penguin

Bozic, M., Cizmic, S., Sumarac-Pavlovic, D., & Escalas-Tramullas, T. (2014). *Problem-based learning in telecommunications: Internship-like course bridging the gap between the classroom and industry*. International journal of electrical engineering education. 51(2), 110-120.

Behn, R. D. (2003). *Why measure performance? Different purposes require different measures*. Public Administration Review 63 (5).

Belingardi, G., Obravodic, J. & Scattina, A. (2012). Student's internship program at Politecnico Di Torino - Automotive engineering course. *Acta technica corvininesis - Bulletin of engineering 5*(1), 129-133.

Bozic, M., Cizmic, S., Sumarac, P.D, Escalas-Tramullas, M., T. (2014). Problem - based learning in telecommunications: Internship-like course bridging the gap between the classroom and industry. International journal of electrical engineering education.

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

Bureau of Labor Statistics (2014). *US Computer and Information Systems Managers*. Department of Labor, Occupational Outlook Handbook, 2014 edition. Retrieved from http://www.bls.gov/ooh/management/computer-and-information systems-managers.htm#tab-1

Ceci, S. J. & Williams, W. M. (2010). *Understanding current causes of women's underrepresentation in science*. Ithaca, NY. Retrieved from http://www.pnas.org content/suppl/2011/02/03/1014871108.DCSupplemental

Chesler, N., Ruis, A., Collier, W., Swiecki, Z., Arastoopour, G., & Shaffer, D.W. (2015). A novel paradigm for engineering education: Virtual internship with individualized mentoring and assessment of engineering thinking. *Journal of Biomechanical Engineering*. Vol 137, Issue 2, (pp 1-7).

Ciot, M. G. & Ciot, L. M. (2010). *Evaluating requirements of internship for students of engineering*. Annals of DAAAM & Proceedings. Retrieved from https:// www.highbeam.com/doc/1G1-246014032.html.

Creswell, J. W. (2012). *Educational research: Planning, conducting and evaluating quantitative and qualitative research* (4th ed.). Boston, MA: Pearson

Creswell, J. W. (2013). *Qualitative inquiry & research design: Choosing among five approaches* (3rd ed.). Thousand Oaks, CA: Sage

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed Methods approaches* (4th ed.). Thousand Oaks, CA: Sage

Dombrowski, C., Kim, J. Y., Desouza, K.C., Braganza, A., Papagari, S., Baloh, P., & Sanjeev, J. (2007). Elements of Innovative Cultures. *Knowledge and Process Management. 14*, 190–202. Retrieved from http://www.interscience.wiley.com.

Eberle, F. (2010). Why STEM education is important. *The Journal of the Illinois Association for Gifted Children.* Retrieved from https://www.isa.org/

Friedman, T. L. (2006). *The world is flat: A brief history of the twenty-first century*. New York: NY. Farrar, Straus, and Giroux.

Gartner (2005). *The IT Professional Outlook: Where Will We Go From Here?* Gartner, Orlando, FL. Retrieved from https://www.gartner.com/doc/485489/it-professional

Gonzalez, C. (2015). Engineering internship: The key to finding a job. *Machine design, 87*(9), 44-51. Retrieved from http://www.machinedesign.com

Hamel, G. (1999). Bringing Silicon Valley inside. *Harvard Business Review* 77(5): 70-84

Haslam, S. A., Reicher, S., & Platow, M. (2011). *The new psychology of leadership identity, influence, and power*. New York, NY: Psychology Press

HBR (1998). *Managing creativity and Innovation: Practical strategies to encourage creativity*. Boston, MA: Harvard Business Press.

Herr, K. & Anderson, G. (2015). *The action research dissertation: A guide for students and faculty* (2nd ed.). Thousand Oaks, CA: Sage

Jensen, R., (2013). *Learning by doing*. TCE: The Chemical Engineer. Retrieved from http://www.icheme.org

Johnson, C. E. (2012). *Meeting the ethical challenges of leadership: Casting light or shadow.* (4th ed). Thousand Oaks, CA: Sage

Johnson, D., & Johnson, R. (1997). *Joining together: Group theory and group skills* (6th ed.). Boston, MA: Allyn and Bacon.

Katehi, L., Pearson, G., & Feder, M. (2009). *Engineering in K-12 education: Understanding the status and improving the prospects*. National Academy Press. Retrieved from http://www.NAP.edu/catalog.php?record_id=12635

Kim, Y., Hsu, J., & Stern, M. (2006). An update on the IS/IT skills gap. *Journal of Information Systems Education, 17*, 395–402.

Kitchenham, B., Budgen, D., Brereton, P., & Woodall, P. (2005). An investigation of software engineering curricula. *Journal of Systems and Software* 74, 325–335

Kovacs, P.J., Davis, G.A., Lee, C.K. & Han, H.J. (2008). Analysis of skills requirement for entry-level programmer/analysis in fortune 500 companies. *Journal of Information Systems Education 19*, 17–27.

Klaus, P. (2007). *The hard truth about soft skills: Workplace lessons smart people wish they'd learned sooner*. New York, NY: Harper Collins.

Lethbridge, T. C. (2000). What knowledge is important to a software professional? *Computer 33*, 44–50.

Levi, D., & Cadiz, D. (1998). *Evaluating teamwork on student projects: The use of behaviorally anchored scales to evaluate student performance*. Retrieved from http://eric.ed.gov/?id=ED424250

Lowney, C. (2003). *Heroic leadership: Best practices from a 450-year-old company that changed the world*. Chicago, IL: Loyola Press.

Malloy, M. A. (2007). *A model for successful engineering internship: Growing our own future engineers*. Hampton, VA: Incose

McMurtrey, M.E., Downey, J.P., Zeltmann, S.M., & Friedman, W.H. (2008). Critical skill sets of entry - level IT professionals: An empirical examination of perceptions from field personnel. *Journal of Information Technology Education.7*.

Mead, N. (2009). Software engineering education: How far we've come and how far we have to go. *The Journal of Systems and Software*, 571-575. Retrieved from http://www.elsevier.com/ locate/js.

Moreno, A. M., Sanchez-Segura, M., Medina-Dominguez, F., & Carvajal, L. (2012). Balancing software engineering education and industrial needs. The Journal of *Systems and Software*. Retrieved from http:// www.elsevier.com/locate/jss /A.M. Moreno et al.

Muller, N. (2000). *IP convergence: The next revolution in telecommunications*. Norwood, MA: Artech House.

Murphy, J. D. (2005). *Flawless execution*. New York, NY: Harper Collins

Pace, A. (2015). *Higher education hones in on the skills gap.* Retrieved from http://www.ASTD.org.

Richards, L. & Morse, J. (2013). *Qualitative methods (3rd ed.).*Thousand Oaks, CA: Sage

Robbins, S. P., & Judge, T. A. (2012). *Essentials of organizational behavior* (11th ed.). Saddle River, N.J: Prentice Hall.

·Roberts, C. (2010). *The dissertation journey*: *A practical and comprehensive guide to planning, writing, and defending your dissertation* (2nd ed.). Thousand Oaks, CA: Sage

Roman, H. (2012). The importance of STEM. *The Journal of the Illinois Association for Gifted Children.* Retrieved from http://www.edisonmuckers.org/the-importance of-stem/

Schulz, B. (2008). The importance of soft skills: Education beyond academic knowledge. *Journal of Language & Communication*, 2 (1), 146-154.

Sharma, G., & Sharma, P. (2010). Importance of soft skills development in 21st century curriculum. *International Journal of Education and Allied Sciences*, *2*, 39-44.

Su, Y.S. & Chang, H.C. (2014). Bridging Photonics and Optoelectronics Curriculum for the Solar Photovoltaic and LED Industries. *International Journal of Photo energy*. http://dx.doi.org.cuhsl.creighton.edu/10.1155/2014/146810

Surakka, S. (2007). *What subjects and skills are important for software developers?* Communications of the ACM, 50, 73-78. Retrieved from http://cacm.acm.org/magazines/2007/1/5746-what-subjects-and-skills-are-important-for-software-developers

Sutton R.I. (2001). The weird rules of creativity. *Harvard Business Review*, 79(8), 94-103. Retrieved from http://www.hbr.org/2001/09/ the-weird-rules-of-creativity/ar

The Nano Tech. (2016). *The Nano Technology 101*. Retrieved from http://www.nano.gov/nanotech-101

The White House. (2011). *The President's views on Technology*. Retrieved from https://www.whitehouse.gov/issues/technology

Thilmany, J. (2004). *Going soft: Good engineers do not necessarily make good managers. but fear not - you can learn to lead*. American Society of Mechanical Engineers, Engineering Management Journal. Retrieved from http://www.ASME.org

Thompson, A., Peteraf, M., Gamble, J., Strickland III, A. (2012). *Crafting and executing strategy* : Concepts and readings.-18e. New York, NY: McGraw-Hill.

Tracy, B. (2010). *How the best leaders lead*. New York, NY: Amacom

Vilanova, M., & Dettoni, P. (2011). Sustainable innovation strategies: Exploring the cases of Danone and interface. Institute for social innovation. Retrieved from http://www.esade.edu/research-webs/esp/socialinnovation

Williams, J. (2011). *Lack of soft skill training is curbing IT career progression*. Retrieved from http://www.computerweekly.com

Yoder, B. (2012). *Engineering by the numbers*. Retrieved from http://www.asee.org/

Zhang, A. (2012). Peer assessment of soft skills and hard skills. *Journal of Information Technology Education*: Research, *11*.