THE EFFECTS OF PARTICIPATION IN COLLEGE CURRICULAR AND COCURRICULAR PROGRAMS ON ENGINEERING ALUMNI PROFESSIONAL LEADERSHIP PRACTICES

DISSERTATION

SUBMITTED TO

The School of Education and Allied Professions

THE UNIVERSITY OF DAYTON

In Partial Fulfillment of the Requirement for

The Degree

Doctor of Philosophy in Educational Leadership

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THE UNIVERSITY OF DAYTON

DAYTON, OHIO

December 2009

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By

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The University of Dayton, 2009

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The purpose of this study was to examine the difference in perceptions toward undergraduate leadership practices of engineering alumni who received their baccalaureate degree between 2000 and 2006. This study examined the effect of cocurricular involvement on concomitant leadership practices of engineering alumni. Because many of these engineers are currently working within the profession, they are expected to use leadership skills honed through collegiate academic and cocurricular activities. This study aimed to measure the engineering program specific learning outcomes against professional expectations. The research design selected for this study is a quantitative causal comparative design (Creswell, 2005).

The Leadership Practices Instrument (LPI) data were analyzed to determine the extent to which the undergraduate college leadership development and workplace leadership practices improved for students between 2000 and 2006. Alumni cocurricular activity involvement was also analyzed to determine the extent to which it affected both college and workplace leadership. Based on the findings, participants who graduated post-2004 perceived they consistently practiced exemplary leadership practices similar to the LPI normative scores in the 5 LPI practices (Model, Inspire, Challenge, Enable, and Encourage) within their engineering classrooms. UD engineers who graduated between 2000 and 2006 had either similar or significantly higher perceptions toward Workplace leadership practices. Undergraduate level of involvement in design competitions enhanced each of the 5 college leadership practices (Model, Inspire, Challenge, Enable, and Encourage) of engineers. High level involvement in design competitions also had a significant positive effect on their Workplace practices (Inspire and Challenge). Gender, graduation years, or engineering major had little or no bearing on the perceived college or workplace leadership practices of UD engineering alumni. Data from this study may be used to inform Schools of Engineering on the curricular and cocurricular opportunities students perceived enhanced their leadership practices and best prepared them to succeed in the engineering workforce.

To My Parents and First Teachers, Raymond and Irene Blyden

ACKNOWLEDGEMENTS

I would like to thank my husband, Charles, for his understanding, patience and support during this wonderful journey. I would like to express my sincere appreciation to the members of my committee, Dr. Darla Twale, Dr. Thomas Lasley, Dr. Molly Schaller, and Dr. Joseph Saliba.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Background

America expects our nation's colleges and universities to graduate students who possess sound leadership and managerial skills and use them once they enter the workplace (Astin & Astin, 2000; Pace, 1979; Smart, Ethington, Riggs, & Thompson, 2002). Professional schools of engineering have accepted that challenge. In 1994, the American Society of Engineering Educators (ASEE) Engineering Deans Council and Corporate Roundtable published the groundbreaking document, *Engineering Education for a Changing World*, highlighting the 12 skills they identified as "professional skills" graduates needed in order to be successful in the engineering profession:

- Team skills (collaborative and active learning);
- communication skills;
- leadership skills;
- a systems perspective;
- an understanding and appreciation of the diversity of students, faculty, and staff;
- an appreciation for different cultures and business practices, and the understanding that the practice of engineering is now global;
- integration of knowledge through the curriculum;
- a multi-disciplinary perspective;
- a commitment to quality, timeliness, and continuous improvement;
- undergraduate research and engineering work experience;

- understanding of the societal, economic and environmental impacts of engineering decisions;
- ethics (ASEE, 1994, pp. 21-22)

Accreditation Board for Engineering and Technology - ABET 2000 Criteria

During the same timeframe, the Accreditation Board for Engineering and Technology (ABET) launched the *ABET EC2000 Criteria*, another effort to restructure engineering education (ABET, 2004). ABET further clarified 11 outcomes requiring all engineering baccalaureate graduates to fulfill their new Criterion 3 labeled, *Program Outcomes and Assessments*. This latest academic reform requires all engineering programs to not only demonstrate undergraduates' technical knowledge of their core programs, but also demonstrate development of professional practices. Students must attain the following outcomes:

- an ability to apply knowledge of mathematics, science, and engineering
- an ability to design and conduct experiments, as well as to analyze and interpret data
- an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability
- an ability to function on multi-disciplinary teams
- an ability to identify, formulate, and solve engineering problems
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

- a recognition of the need for, and an ability to engage in lifelong learning
- a knowledge of contemporary issues
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (ABET, 2004).

Since the late 1990s, the Accreditation Board for Engineering and Technology (ABET) has been the sole governing body responsible for developing standards for our nation's engineering educational programs. With the recent demands on the engineering workforce to perform both technical and managerial roles, employer demands on undergraduate programs have increased. In fact, many engineering educators credit the development of the ASEE Report and ABET 2000 Criteria for leading the changes currently seen in engineering education. Effective 2001, ABET expected all engineering programs to ensure graduates of their program possess a working knowledge of the programs.

Although ABET requires institutions to assess their students' professional practices, ABET offers little guidance on what specific skills adequately fulfill their practices. In fact, operational definitions for each practice may vary depending on the institution (Immekus et al., 2004). Therefore, the engineering community has made multiple attempts to further explain these outcomes for themselves. One such example is the American Society of Civil Engineers' (ASCE, 2004) recent report, *Civil Engineering Body of Knowledge for the 21st Century*. ASCE's offered its membership commentary to clarify and provide structure around the interpretation of each practice.

National Academy of Engineering Recent Reports

In 2004, the National Academy of Engineering (NAE) started another dialogue on the status of engineering education, and identified several challenges it believed were critical to the advancement of engineering in the US. In its report entitled, *The Engineer of 2020: Visions of Engineering in the New Century,* NAE called for reform in engineering education. The committee projected that in order to remain competitive in a world economy, engineers by the year 2020 will need to demonstrate competence in many areas beyond the skills taught in traditional engineering core programs. NAE charged engineering schools with continuing to further strengthen the technical skills while focusing on the development of engineers' non-technical transferrable attributes to prepare professionals for the multiple global problems engineers will face in 2020. They must produce well rounded problem solvers capable of assuming leadership roles toward the advancement of our society.

In their follow-up study, *The Engineer of 2020: Adapting Engineering Education to the New Century,* NAE (2005) offered recommendations to further improve the quality of the undergraduate engineering experience. Once again the committee emphasized the need for engineering educators to develop students' technical competencies, and professional skills as well as their exposure to "interdisciplinary learning" (p. 2). Both NAE reports aligned with many of the same recommendations offered in the aforementioned reports.

Challenges using the ABET framework

Several studies over the years have used the ABET framework to assess engineering students' leadership development. Russell and Stouffer (2005) conducted a quantitative analysis of ABET data submitted by 90 civil engineering programs around the country. At that time, the participating programs represented over 40% of the nation's accredited engineering programs. These data were organized in the same three categories (math and science, general education, and engineering topics) ABET requires during its site visits, with professional skills examined under the engineering category. Within their study specifically, the authors defined professional skills as student abilities within "construction management/administration, civil engineering ethics, leadership and team building, communications and professional development" (p. 121). Engineering students reportedly attributed gains in their professional skills indirectly to engineering courses, to other courses, and to experiences outside of engineering. The authors argued that some engineering programs have not integrated professional skills into their curriculum nor have they offered courses designed to enhance the six areas specified by ABET. Further examination revealed that although ABET requires graduate proficiency in these professional skills, these competencies are given little attention within the engineering curricula and are greatly underrepresented on the Fundamentals of Engineers (FE) licensure exam (Russell & Stouffer).

Statement of the Problem

American schools of engineering constitute one sector of higher education that has been working tirelessly to enhance student leadership competencies since the early 1990s. Engineering professional organizations and industries called upon engineering deans to better address the changes in society by evaluating the quality and content of their programs. Today, after many years of engineering education reform, educators are still engaged in discussions related to the leadership behaviors and practices of engineering graduates. There is no question that engineers have been able to successfully demonstrate their technical competence by completing their prescribed engineering coursework and ultimately passing their certification examinations. However, it is still questionable whether engineers entering the workforce have opportunities to develop the leadership, management and team building skills needed to be successful in the practice of engineering (Bergeron, 2001; Grose, 2004; Rover, 2004; Shuman, Besterfield-Sacre, & McGourty, 2005; Todd, Sorenson, & Magleby, 1993). Unfortunately, because of the rapid growth within the practice of engineering, companies can no longer afford to hire or advance engineers who only possess specialized technical skills (Kumar & Hsiao, 2007). The growing cost of training engineers in leadership best practices has become cost prohibitive to many corporations. It is critical that our American institutions of higher education develop sound strategic plans and missions that build the foundation from which their graduates can compete in this rapidly changing global economy. Engineering educators today must ensure their graduates develop and practice their leadership skills prior to entering the workforce (Kumar & Hsiao, 2007).

Graduates are expected to develop sound leadership skills within their academic and out-of-class college experiences (Astin & Astin, 2000). Despite various institutional efforts over the years, employers are still dissatisfied with the leadership skill of recent graduates. In fact, the shortage of leaders entering the workforce has escalated into a national crisis within the field of engineering, business and other disciplines. In response to industry demands, ABET developed a list of professional practices, mandating every engineering institution to demonstrate that graduates show evidence of proficiency in six outcomes:

- an ability to function on multi-disciplinary teams
- an understanding of professional and ethical responsibility
- an ability to communicate effectively
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- a recognition of the need for, and an ability to engage in lifelong learning
- a knowledge of contemporary issues

Since ABET introduced its professional practice outcomes, engineering programs have attempted to increase opportunities for students to develop these skills during their in class and out of class undergraduate experiences. Lattuca, Terenzini, and Volkwein (2006) surveyed pre-ABET (1994) students and Post-ABET (2004) students of over 40 engineering programs to examine the differences in their undergraduate engineering experience. The researchers found that Post-ABET graduates were more exposed to the professional practices in their engineering programs than Pre-ABET graduates. Based on their findings, implementation of the ABET outcomes has had a positive impact on students' exposure to critical leadership skills during their undergraduate experience. Lattuca et al. (2006) also found employers are now beginning to recognize a difference in new hire skills since the implementation of the new ABET outcomes.

Purpose of the Study

The purpose of this study is to examine the difference in perceptions toward undergraduate leadership practices of engineering alumni who received their baccalaureate degree between 2000 and 2006 from the University of Dayton. This study will also examine the effect of cocurricular involvement on leadership practices of engineering alumni. Because many of these engineers are currently working within the profession, they are expected to use leadership skills honed in college through academic and cocurricular activities. This study aims to align an engineering program's specific learning outcomes with professional expectations. The research design selected for this study is a quantitative causal comparative design (Creswell, 2005).

Significance of the Study

This study was initiated primarily to assess whether alumni who graduated from the UD School of Engineering between 2000 and 2006 had opportunities to develop their leadership skill. It is also the goal of this study to respond to the engineering industry and professional societies' constant call for the assessment of leadership development outcomes within our nation's engineering programs. A major concern of many leading corporations is the inability of ABET and other engineering accreditation bodies to align their priorities with our nation's engineering colleges (Hannon, 2003). Further disturbing is engineering education's failure to learn from experiences of other disciplines to implement changes in their leadership development strategies.

Previous researchers have concluded that professional skills development will enhance engineers' effectiveness and will positively serve engineers in whatever professional track, technical or managerial, they choose within the profession (Russell & Stouffer, 2005). In other words, professional skills are universal and critical to the lifelong development of all students regardless of their major or occupational goals. While the schools of engineering strive to improve the leadership skills of their graduates by making programmatic and course changes (Felder & Brent, 2003), other disciplines are faced with similar problems (Astin & Astin, 2000). The call to shape future business leaders is a national crisis and should be addressed using a framework validated in assessing leadership practices in engineering and other fields. One such example is the Five Practices of Exemplary Leadership Development framework developed by Kouzes and Posner (2007; See Appendix A).

Kouzes and Posner Exemplary Leadership Development Framework

Since 1987, countless researchers have used the five practices of exemplary leadership as one effective framework for advancing and measuring the leadership development of university students and industry professionals (Kouzes & Posner, 2007). The five practices include: (a) model the way, (b) inspire a shared vision, (c) challenge the process, (d) enable others to act, and (e) encourage the heart. In fact, over 200 theses and dissertations have examined leadership skills of students and professionals using this same framework (Kouzes & Posner). Appendix B provides a detailed mapping of Kouzes and Posner's five practices aligned with the six ABET Engineering Criteria Professional Practices and the University of Dayton Marianist Characteristics.

The current study expounds on the original works of Terenzini, Springer, Pascarella and Nora (1995a, 1995b), Lambert, Terenzini, and Lattuca (2006) and Strauss and Terenzini (2007) investigating whether involvement in university environments provide opportunities through both academic and cocurricular involvement for engineering undergraduates to lead during their undergraduate experience. Participants will also have an opportunity to identify how their undergraduate experience influences their current practices.

This research fills the paucity in the literature in two ways. First, it investigates the differences in perceptions toward undergraduate leadership practices of engineering alumni between 2000 and 2006. Second, this study examines what direct effect cocurricular programs can have on their college leadership and post college leadership practices (Pascarella & Terenzini, 2005). Going beyond the development of separate programs for identified leaders, more research is needed on the overall development of the future engineering workforce.

Justification for the Study

This research has several implications in higher education. This study provides insight into leadership outcomes as they relate to student academic and cocurricular involvement among both male and female engineering students. Furthermore, this research investigates the effect of graduates' use of current leadership practices in the workforce that were experienced and honed during their undergraduate engineering program. Data from this study may be used to inform Schools of Engineering on the curricular and cocurricular opportunities students perceived enhanced their leadership practices.

Research Questions

This study evaluates the effects of participation in college programs on engineering alumni's current leadership practices by answering the following four questions:

1. To what extent were UD engineering alumni exposed to leadership practices within their undergraduate programs? To what extent do engineering alumni practice exemplary leadership practices in the workplace? How do their college practices and workplace leadership practices compare to the LPI norm?
2. To what extent were UD engineering alumni involved in cocurricular activities that supported their undergraduate programs?
3. What is the effect of cocurricular involvement on the perception of engineering alumni's college leadership development and workplace leadership practices?
4. How do perceptions of engineering alumni's college leadership development and workplace leadership practices differ by gender, major and graduation year?

Scope of the Study

This study is delimited to alumni who received their baccalaureate degrees between 2000 and 2006 from one of several undergraduate professional engineering programs at the University of Dayton, a midsized Catholic institution in the Midwest. As a matter of convenience, this study was further delimited to those School of Engineering alumni who had current email addresses on record at the University of Dayton Alumni office.

Limitations of the Study

Several limitations are realized in this study. This research is limited to the engineering alumni perceptions of what they recall transpired in their program. Self-rater data do not allow researchers to confirm participants' leadership practices with subordinates, peers or managers. This study's population was also delimited to engineering alumni at one type of institution, a Midwestern Catholic university, making it difficult to generalize the results to engineers who attended public institutions, universities in other regions, or other types of Catholic institutions. However, it may be possible to generalize results to other private and/or religious institutions in similar geographic areas. The time frame from when students graduate from their program to when they reported their perceptions could affect their responses.

Other limitations of the study relate to the instrument administered to measure participants' leadership practices. The instrument is limited to broad leadership practices and neglects to investigate practices specifically related to the field of engineering. Since graduation dates range from 2000 to 2006, participants' dependence on their recollection of college involvement may also influence responses. There is no way to know if their recall is better at remembering either program specific or cocurricular activities.

This study is also limited to an examination of the effects of academic and cocurricular involvement on leadership practices. Consequently, differences based on race and post-college development were not a part of this study. In other words, experiences outside of college could have had an effect on students' leadership practices alone or in combination with curricular and cocurricular activities.

Non probability means of selecting the population should be considered as another limitation. Because the study only consists of the entire population of alumni with email addresses on record, there is a possibility that some alumni who graduated between 2000 and 2006 will be excluded from participation.

Another limitation relates to the level of ABET skills assessed. According to ABET, engineering graduates should be able to demonstrate proficiency in the previously mentioned 11 skills. However, this study is not designed to perform a comprehensive assessment. This study is limited to only examine six non-technical professional skills. See Appendix B for a list of the six ABET Engineering Criteria 2000 professional practices used in this study.

Although the LPI was used to measure student perceptions of their undergraduate experience, it might have been difficult for students to differentiate between their engineering course and other courses taken at the university. Leadership is not the only competence for which the engineering program designed its curriculum. Furthermore, students are expected to view their education holistically such that learning comes from direct as well as indirect means, but this instrument was used to focus on what students received directly from their program rather than as a measure of what they received holistically.

Assumptions

This study is governed by several assumptions. The researcher assumed leadership development is a function of student development university-wide during the undergraduate experience. Learn, lead, and serve is the university motto and brand reinforced in the UD Strategic Plan. Changes implemented at the University of Dayton between 2000 and 2006 are assumed to enhance student leadership development.

Engineers who graduated in 2003 and subsequent years are assumed to have a greater opportunity to develop their leadership skills than earlier graduates because the University of Dayton Engineering program underwent several programmatic changes. Another assumption is that the University of Dayton offers a variety of leadership experiences within its academic and cocurricular programs that appeal to the range of students in all undergraduate programs.

Female alumni were also assumed to have equal opportunities as male alumni to get involved and develop their leadership skills within academic and cocurricular activities. It was also assumed that alumni involved in this study answered questions truthfully and honestly. The Leadership Practices Instrument (LPI) is assumed to accurately assess leadership practices of engineers.

Graduates of the University of Dayton's School of Engineering are assumed to immediately or eventually work in the field of engineering. Therefore, responses are based on their experience as practicing engineers.

While many engineering students graduate with dual engineering majors, alumni are assumed to graduate from one engineering discipline.

Definitions of the Terms

SOE Leadership. SOE leadership refers to the extent to which a student engages in leadership practices within his or her undergraduate engineering courses taught in the School of Engineering.

Engineering programs. Engineering programs, as specified in this study, include the following areas: Chemical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, Mechanical and Aerospace Engineering, and Engineering Technology.

Cocurricular Leadership. Cocurricular leadership consists of four different types of out-of-class activities known to complement the engineering curriculum: (a) internship or cooperative education; (b) study abroad program; (c) student design project beyond classroom requirements; and/or (d) involvement in a student chapter of a professional organization. Because numerous research studies reviewed in this study referred to cocurricular experiences as out-of-class experiences and extracurricular activities, cocurricular will be used interchangeably throughout this dissertation to refer to one of the four activities.

Cooperative Education. Cooperative education is a "structured educational strategy integrating classroom studies with learning through productive work experiences in a field related to student's academic and career goals. It provides progressive experiences in integrating theory and practice" (National Commission for Cooperative Education, n.d.).

Out-of-Class Experiences. Out of class experiences consist of four different activities relevant to engineering education: internship / cooperative education experience; study abroad experiences; participation in design competitions; and involvement in a professional society chapter. This term is used interchangeably with cocurricular activities or cocurriculum.

Extracurricular Experiences. These experiences consist of four different activities relevant to engineering education: internship/ cooperative education experience; study abroad experiences; participation in design competitions; and involvement in a professional society chapter.

Leadership. Leadership is "an observable set of skills and abilities...that can be strengthened, honed, and enhanced, given the motivation and desire, along with practice and feedback, role models, and coaching" (Kouzes & Posner, 2007, pp. 339-340). Leadership is a matter of finding your passion and doing what you most admire. In doing so, leaders will find themselves motivating others to expand their vision. (Kouzes & Posner, p. 346).

Leadership Development. Leadership development is "the expansion of a person's capacity to be effective in leadership roles and processes. Leadership roles and processes are those that enable groups of people to work together in productive and meaningful ways" (McCauley, Moxley, & Van Velsor, 1998).

Leadership Practices. Leadership practice is a composite score of the five LPI scales: Model the way; Inspire the shared vision; Challenge the process; Enable others to act; Encourage the heart (Kouzes & Posner, 2007). See Appendix A for a complete list of Kouzes and Posner's practices and associated commitments.

Professional Skills. ABET recognizes professional skills as leadership, management, teamwork, communication, and knowledge of contemporary issues. For the purpose of this study, six ABET professional skills are mapped with the five leadership practices self reported by alumni of the college of engineering: model the way; inspire the vision; challenge the process; enable others to act; encourage the heart (ABET, 2004; Kouzes & Posner, 2007). See Appendix B for a list of the six ABET professional practices used in this dissertation.

Organization of Study

This study is organized into five chapters. Chapter 1 consists of the introduction of the study including the background, purpose of the study, rationale and theoretical basis for the study, significance of the study, justification for the study, statement of the problem, research questions, scope and limitations of the study, assumptions, definitions of terms, and an overview of the study.

Chapter 2 contains a comprehensive literature review in leadership, student involvement, and women in leadership. Chapter 3 provides the method and procedures of data analysis used in this quantitative study. Chapter 4 offers the findings. Chapter 5 concludes with the discussion, summary, and recommendations for future research.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

Pascarella and Terenzini (2005) in their latest extensive review of the literature on college student development found that college enrollment positively influences students' learning. Much of their cited works have been read as primary sources in order to prepare this much anticipated literature review. The authors found that while significant research has been conducted since 1990 to discover the individual effects of academic and out-of-class experiences on student development, little research has focused on their combined effects (e.g., Kuh, 2001; Pascarella et al., 1996; Springer, Terenzini, Pascarella, & Nora, 1995; Terenzini, Springer, Pascarella & Nora, 1995a, 1995b). This discovery has led to their call for researchers to expand their inquiries to include combinations of academic and other learning experiences that have been found in the literature to enhance student development. In one example, Strauss and Terenzini (2007) expanded the works on Springer, Terenzini, Pascarella and Nora (1995a, 1995b) by investigating the effects of both academic and out-of-class experience on engineering students' analytical and group skills.

College Influence Literature Gaps

Pascarella and Terenzini (2005) stressed that a study focusing on only one aspect of student life may inadequately represent predictors of student outcomes. Of the few studies conducted, researchers have found both academic and out-of-class engagement to make a positive significant individual and joint contribution to student learning: critical thinking (Pascarella et al., 1996; Springer, Terenzini Pascarella, & Nora, 1995; Terenzini, Springer, Pascarella, & Nora, 1995a); undergraduate engineering skills required by ABET (Lattuca, Terenzini, & Volkwein, 2006); and the group and analytical skills development of engineering students (Straus & Terenzini, 2005, 2007). Despite the numerous operational definitions of academic in-class and out-of –class experiences, the review of the research clearly supports the notion that the college student experience is complex and comprises countless experiences that colleges and universities must soon begin to examine (Pascarella & Terenzini, 2005).

Another gap Pascarella and Terenzini (2005) highlighted in their literature review related to the long-term effects of the college experience on student post-college competencies. The authors complained that, besides a few studies, most research they reviewed sought to explain how overall college attendance benefited the lives of alumni in ways pertaining to their happiness, income, health, and civic involvement (e.g., Baum & Payea, 2004; Boesel & Fredland, 1999; Ehrenbreg, 2004; Hartog & Oosterbeek, 1998; Pascarella & Terenzini, 1991, 2005; Perna, 2003, 2005; Rowley & Hurtado, 2003). While there is evidence that academic and out-of-class college experiences positively affect student outcomes, few studies examined the association between engagement in those specific undergraduate experiences and life after college (e.g., Baxter Magolda, 1999; Gurin, 1999; Mentkowski & Associates, 2000; Pearman et al., 1997). The current study aims to address this dearth in the research by examining to what extent engineering programs offered opportunities for their graduates to develop leadership skills useful to the engineering workforce. Pascarella (2006) suggested further research to address this critical paucity in the literature.

Pascarella and Terenzini (2005) also found evidence that peer interactions had the greatest impact on student leadership development. In a recent study on the relationship between college involvement and leadership development, Dugan (2006) noted a lack of many empirical studies utilizing leadership theoretical frameworks. Instead, he found the majority of studies examined college leadership development in a broad sense.

Competency Gaps in Engineering Graduates' Leadership Skills

Evans, Beakley, Crouch, and Yamaguchi (1993) conducted a mixed method study examining the effectiveness of the Arizona State University (ASU) engineering program at preparing students for the workplace. The researchers asked graduates and employers who hire ASU engineering students to rank a list of 10 attributes in terms of their level of importance to new hires and performance of new hires in the workplace. The results revealed that industry leaders and alumni agree on which attributes were most important in the field. Both stakeholders rated problem solving, communication skills, professional ethical skills, open-mindedness and positive attitude, technical skills and math skills the top six important attributes.

Surprising to the researchers, the two highest ranked attributes, problem solving and communication skills, were the attributes alumni reported less prepared to perform upon graduation. There is a concern that faculty emphasis might be placed on developing technical skills while industry requires soft skill development. However, alumni believed their computer skills served them well in the workplace. Industry leaders overwhelmingly agreed that new hires lack sound problem solving and communication skills. However, they perceived graduates were so sure of their computer skills, there may have been overuse of these skills in the field (Evans, Beakley, Crouch, & Yamaguchi, 1993).

Benefield, Trentham, Khodalaski, and Walker (1997), in another effort to assess the quality of their engineering programs, surveyed engineering alumni of Auburn University's College of Engineering Instructional program and the employers who participate in the university cooperative and career placement. The purpose of this study was to determine how well alumni and employers felt the school of engineering prepared graduates for the world of work. Telephone calls were placed to 546 alumni participants who graduated between 1985 and 1994. Over 458 alumni reported high levels of satisfaction with their undergraduate engineering program.

Alumni and industry representatives participating in the study ranked 17 attributes new employees should be able to demonstrate when they enter the workforce. Of the 17 attributes, both groups agreed that the following 16 were critical to new engineers' success (Benefield, Trentham, Khodalaski, & Walker, 1997):

- Ability to learn on their own
- An in-depth technical knowledge of the major engineering discipline
- Excellent writing skills
- Excellent oral presentation skills
- Experience using AutoCAd and other computer software systems to solve problems
- Excellent working in diverse team (gender, cultural, race)
- Ability to work on design projects
- Broad knowledge of engineering principles outside major discipline
- Ability to work in multidisciplinary teams in engineering
- Practical work experience
- Broad liberal arts background
- Co-op experience
- Summer internships
- Ability to work with multidisciplinary team in non–engineering disciplines

- Ability to program in computer languages
- Ability to speak a foreign language

Findings were further confirmed by asking participants to provide additional attributes they thought should be developed by graduates. While many of the responses aligned with the previously noted 16 attributes, most recommendations related to professional skills development. Among their recommendations were interpersonal skills, initiative, GPA, personal flexibility, leadership skills, enthusiasm, and problem-solving skills. In fact, when asked to rank the level of importance placed on four important attributes in engineering (technical knowledge, design experience, practical work experience and personal skill), participants overwhelmingly ranked technical knowledge first and design experience last. This unanticipated result clearly demonstrated how industry's expectations have changed drastically over the years. Today, engineering schools are now accountable for providing opportunities for their students to develop not only sound technical skills but also to sharpen their professional skills in the classroom and other out-of class experiences (Benefield, Trentham, Khodalaski, & Walker, 1997).

Lang, Cruse, McVey and McMasters (1999) conducted a study of aerospace and defense companies' expectations of recent engineering graduates. This research found the industry ranked engineering technical skills and problem-solving skills higher than other attributes. Following the technical demands, they reported a need for graduates to enter the workforce proficient in an awareness of ethical dilemmas, data analysis, teaming, and interpersonal skills. Lang recommended universities use these findings to assess and update engineering programs to meet the needs of our changing global economy.

Bhavnani and Aldridge (2000) described a multidisciplinary research project that assessed an Auburn University course entitled, *Introduction to Team Based Design.* Course developers designed the syllabus to introduce several concepts including project management principles, customer service, group dynamics, teambuilding, quality improvement, and other attributes critical to the success of engineers. Students surveyed reported satisfaction with the course at the end of the term. Many students reported gains in tolerance for diversity, stronger communication between groups, shared leadership, flexibility, and appreciation for team contributions. Bhavnani and Aldridge suggested that replication of this model in the current curricula or in a similar course could bridge the gap between university learning and workplace expectations.

Bjorklund and Colbeck (2001) conducted a qualitative study of 27 engineering national leaders in engineering education (e.g., engineering deans, faculty, and a university president) to gain their perspective on the recent changes in engineering education. Participants were asked to reflect between 1988 and 1998, and identify two substantial changes in engineering education that they believe impacted their role in the field of engineering. Five overarching themes emerged from this study: the inclusion of engineering design in the curriculum; greater attention to effective teaching strategies; advances in information technology; the need to broaden the engineering curriculum to develop a well-rounded engineer; and accountability demands due to ABET 2000. Of the five themes mentioned, the need for broad-based curricula, is of most concern to this research. While leaders realized changes to engineering curricula is and will be a slow process, they also recognized the outcry from both industry and ABET is steadily moving toward strict accountability efforts. These national leaders recommended curricula changes that allowed students to gain knowledge in two different aspects of engineering education. First, they proposed offering students an opportunity to learn about engineering disciplines outside their major coursework. This recommendation is in response to industry demands on the workforce to cross disciplines in many projects. Second, while not traditionally considered important in engineering, leaders recommended incorporating teamwork, communication skills, leadership skills, ethics and other soft skills in the engineering curricula.

Kouzes and Posner's Five Practices of Exemplary Leadership Framework

Since 1987, Kouzes and Posner have conducted extensive research on exemplary leadership characteristics. Kouzes and Posner (2007) regarded leadership as an actual "observable set of skills and abilities that are useful whether one is in the executive suite or on the front line, on Wall Street or Main Street in any campus, community, or corporation" (p. 339). While many believe leaders are born, Kouzes and Posner disagree. They posited that leadership is the responsibility of everyone who personally commits to making a difference within their organization. In fact, leaderships skill can be learned, "strengthened, honed, and enhanced, given the motivation and desire along with practice and feedback, role models and coaching" (p. 340). In their 20 years of research, they found that although institutions express the need for strong leadership skills, corporations rarely made the development of these skills a high priority within their organizations (Kouzes & Posner, 2007). As a result, corporations are now challenging undergraduate programs to develop these critical skills during the undergraduate experience. The five practices of exemplary leadership model will provide a frame for addressing the leadership practices employers expect engineers to develop in their engineering programs and apply in the workplace.

Kouzes and Posner (2007) began their studies by investigating what leadership abilities, behaviors, and practices are needed to propel organizations from ordinary to extraordinary outcomes. Individuals of all levels shared "personal best leadership experiences" (Kouzes & Posner, p. xiii) that they believed made a difference to their organization's success. In turn, Kouzes and Posner developed the Five Practices of Exemplary Leadership framework to account for the best practices of these leaders. After analyzing the "personal-best leadership experiences" of several thousand leaders, five best practices of transformational leaders emerged which include: (a) modeling the way, (b) inspire the shared vision, (c) challenge the process, (d) enable others to act, and (e) encourage the heart. They further expounded on each practice through the development of two specific commitments of leadership that underscored specific leadership behaviors essential of all leaders. Since 1983, many researchers have found this model to be valid and reliable, and comprise characteristics necessary to fully examine transformational leadership practices. The practices and 10 commitments of leadership are discussed further below (See Figure 1).

Model the Way

Exemplary leaders model the way for others by first examining their own personal beliefs (Kouzes & Posner, 2007). They invest time prior to leading others to fully developing their true values, guiding principles and belief systems from which to articulate their goals and increase their creditability within an organization. While self development and identification of core values were important to many leaders, these characteristics alone were insufficient to consider someone an exemplary leader. Exemplary leaders also sought to establish a shared vision by articulating their values to others (Kouzes & Posner, 2007).

Because constituents are always observing leaders for confirmation through daily activities, leaders are cautious to rely on their core values before making any decisions (Kouzes & Posner, 2007). Leaders also recognize the importance of aligning their actions with their stated values. In fact, exemplary leaders send clear messages to their teams reflecting what is really important through four key competencies: how they allocate their time; the language they choose to use when communicating with constituents; how they frame questions of their constituents; and how well and willing they are to solicit feedback from others (Kouzes & Posner). Exemplary leaders are role models willing to make sacrifices time; the language they choose to use when communicating with constituents; how they frame questions of their constituents; and how well and willing they are to solicit feedback

KP Practices	KP Commitments
Model the way	1. Clarify values by finding your voice and affirming shared ideals.
	2. Set the example by aligning actions with shared values
Inspire the shared vision	3. Envision the future by imagining exciting and ennobling possibilities.
	4. Enlist others in a common vision by appealing to shared aspirations.
Challenge the process	5. Search for opportunities by seizing the initiative and by looking outward for innovative ways to improve.
	6. Experiment and take risks by constantly generating small wins and learning from experience.
Enable others to act	7. Foster collaboration by building trust and facilitating relationships.
	8. Strengthen others by increasing self-determination and developing competence.
Encourage the heart	9. Recognize contributions by showing appreciation for individual excellence.
	10. Celebrate the values and victories by creating a spirit of community.

Copied with permission from Kouzes and Posner (2007)

Figure 1. Kouzes and Posner's Practices and Ten Commitments

time; the language they choose to use when communicating with constituents; how they frame questions of their constituents; and how well and willing they are to solicit feedback from others (Kouzes & Posner). Exemplary leaders are role models willing to make sacrifices based on their values and require others to follow their lead (Yukl, 2006). It is more critical to these leaders to transfer their values and encourage others to invest emotionally in the organization's efforts than to gain consensus without commitment.

Bennis and Nanus (1985) argued that ethics is a national concern within all aspects of life. Employees, customers, stockholders and other stakeholders today are all concerned with whether leaders are credible in their dealing with others. With recent attention drawn to leaders abusing their powers, many individuals have become cynical about their leader's ability to lead with integrity. In fact, some researchers (Kouzes & Posner, 2007) assert organizational and leaders' credibility is so critical, in its absence, corporations run the risk of jeopardizing customer loyalty.

Inspire a Shared Vision

People expect their leaders' messages to be inspiring. Exemplary leaders possess the ability to communicate a high spirited message aligning the vision with the personal goal of individuals. Shared vision is an effort by leaders to reveal the underlining reasons for their values and to clear misconceptions. Leaders use this open line of communication as a venue for members to also express their personal beliefs and signify how their values align and support organizational core values. Another benefit to shared values is the ability of constituents to build confidence in their leaders (Kouzes & Posner, 2007).

Bennis and Nanus (1985) in their study of 90 leaders found exemplary leaders emphasized the need for a clear vision to focus the commitment of the leader, management team and followers on a common goal. Most visions demonstrated expectations and goals for all members of the organization to follow. In essence, the vision not only gives direction, but also serves as a means to encourage others to perform. Bennis and Nanus also embraced the idea that leadership has a transactional component that bonds both the leader and follower. Both the leader and follower are critical to successfully accomplishing organizational goals, mission and vision.

Bennis and Nanus (1985) underscored that corporations today are experiencing a "commitment gap" (p. 8). They posited that many organizations lack the necessary leadership dedicated to inspire. Without a vision and values guiding them, how can leaders expect followers to commit to an organization? It was their belief that in order to turn around this dilemma, exemplary leaders must emerge to focus everyone's efforts in one direction. A new vision is only successful when it is openly shared with stakeholders (Yukl, 2006). A leader's ability to clearly communicate to others is essential to the success of others.

Strong belief systems also contribute to exemplary leaders developing positive attitude and commitment to revitalizing the spirits of others. In fact, leaders with a positive attitude create an environment conducive for learning and growth (Kouzes & Posner, 2007). Developing a positive disposition is similar to professional athletes conditioning for a major competition (Maxwell, 1999). Both efforts require daily practice, setting goals, monitoring progress and finally a strong belief in others' ability to achieve a goal. Leaders continually feed their minds with the necessary ideas needed to strengthen them mentally. Exemplary leaders are sometimes characterized as charismatic individuals who are expressive, willing to share their emotions, and authentically appeal to others through speaking from the heart. Their messages are far reaching and spoken with excitement.

Another concern of effective leaders is whether the new vision is credible and plausible to the members of the organization. Yukl (2006) found exemplary leaders aligned the newly developed vision to institutional core competencies. He asserted, "A vision that entails new and difficult types of activities is more credible if the core competencies of the organization and the skills of its members are relevant for these activities" (p. 300). Exemplary leaders afford resources to successfully accomplish the new vision. Despite their knowledge of an organization, these leaders find it advantageous to allow followers to self determine what resources and steps would be necessary to accomplish the vision. In effect, the leader's role is to present large themes that "focus attention on key issues, but not so large as to cause confusion and dissipate energy" (Yukl, p. 275).

Challenge the Process

Exemplary leaders are constantly looking for opportunities to motivate others to achieve the impossible. They never wait for someone to discover deficiencies within their organizations. Taking the initiative sometimes causes individuals to assume enormous levels of risk which could lead to many failed attempts. Kouzes and Posner (2007) asserted that these leaders take the initiative to make changes when needed. By setting this example, they also promote the efforts of individuals at all levels for taking the initiative to implement change. Risk taking must be rewarded and supported. There are several ways exemplary leaders welcome initiative (Kouzes & Posner, 2007): provide training and development opportunities to strengthen their self-efficacy; challenge constituents to identify problems and develop solutions; and challenge the status quo. Moreover, Kouzes and Posner believe that the best way to appeal to people is through their hearts.

Today's businesses are facing changes more rapidly than ever before. Leaders are forced to closely manage high levels of uncertainty and stress while continuing to concentrate on their daily responsibilities. However, exemplary leaders compared to others view stress as a catalyst for new innovation in several ways (Kouzes & Posner, 2007). First, exemplary leaders demonstrate full commitment to change and those expected to implement the change. This is possible by consistently creating an environment that fosters creativity, dedicating resources, and offering rewards. Second, these leaders use change as a way to energize their teams to take risks, challenge the status quo and produce extraordinary results. Teams find themselves stretching their imagination to develop new ideas and explore the impossible. Third, teams were expected to analyze outcomes to determine reasons for both positive and negative outcomes. While leaders expect positive outcomes from change pursuits, they also realize not all changes will lead to successful results. Kouzes and Posner found exemplary leaders used perceived failures as opportunities for continuous team learning.

Enable Others to Act

All leaders embarking on organizational change will face resistance on multiple levels. Although the course may not change, sometimes providing a platform for individuals to share their concerns builds trust and creates a shared vision (Kouzes & Posner, 2007). Honesty is one characteristic exemplary leaders found necessary to establish trust. After 20 years of conducting leadership studies, Kouzes and Posner continued to discover honesty as the most important attribute followers require in their leader before trusting in his or her leadership. Several other researchers agree with Kouzes and Posner's findings, however they used other terms to describe honesty including integrity, character, authentic, ethical, and moral (Bennis & Nanus, 1985; Kouzes & Posner, 2007; Tichy & Devanna, 1986, Yukl, 2006). Exemplary leaders also serve as the moral compass in most organizations (Bennis & Nanus).

Exemplary leaders deliberately set the tone for what is acceptable in the current culture through their actions. Because they know the role they play in the moral lives of their constituents, leaders struggle daily with making the right decision. Kouzes and Posner (2007) referred to this constant struggle as "resolving dissonant internal chords" (p. 346). Bennis and Nanus (1985) summarized their views of trust in the following statement:

> trust, integrity, and positioning are all different faces of a common property of leadership – the ability to integrate those who must act with that which must be done so that it all comes together as a single organism in harmony with itself and its niche in the environment. (p. 186)

Kouzes and Posner speculated that the leader/follower relationship is so very personal; people are more inclined to follow leaders who exhibit characteristics they yearn to acquire. Honest leaders represent someone of conviction and commitment to values and principles.

Another distinct aspect of exemplary leadership is a leader's ability to encourage others to implement the vision. Leaders who inspire and influence others are committed to the vision and goals of the organization. Confidence and optimism are significant to successful leaders. Exemplary leaders serve to empower others by welcoming opportunities to empower their constituents to play an active role in their organization. Kouzes and Posner (2007) found high performing leaders assume the role of mentor and coach. During these types of relationships constituents gain one-on-one access to the leader whose sole role is to assist with the professional development and advancement of others in the company. When asked how to establish coaching relationships exemplary leaders model the types of behavior they would like demonstrated in the organization. They desire to build a higher level of trust than expected in a daily leader-follower relationship.

Although trust is as difficult to define as leadership, researchers agree on its presence and absence within an organization (Bennis & Nanus, 1985). Bennis and Nanus' study revealed that extraordinary leaders were visionaries who aligned every position with their values and vision. Hence, this meant creating an ideal environment for others to predict and place trust in their leadership. The researchers credit these leaders with the ability to build trust by defining the direction they want their organization to go in the face of external and internal distractions. They call this building "organizational integrity" (p. 48). Another respected characteristic of exemplary leaders that builds trust is their ability to remain on course while facing adversity. Bennis and Nanus referred to this trait as "constancy" (p. 52).

Encourage the Heart

Encouragement is a major characteristic of exemplary leaders (Kouzes & Posner, 2007). They view their role as the change agent within the organization. Yukl (2006) agreed that leaders expect all employees to demonstrate competence and confidence within the organization. Therefore, guiding organizational learning is key to their extraordinary outcomes. One way exemplary leaders aid in leadership development is by offering developmental assignments. Within their normal job assignments, employees are given opportunities to lead special projects, identify and solve departmental problems, or introduce innovative ways to improve department effectiveness or efficiency (Yukl). Following each assignment, participants reflect over the experience, skills gained, assignment successes, and project failures (Yukl). At the end of the assignment, coaches or mentors offer each participant direct feedback on their individual and group competencies (Yukl).

Exemplary leaders also afford opportunities for others to work in different divisions to gain a new business perspective (Yukl, 2006). Typically, individuals have little knowledge of the new organizational culture or objectives. Therefore, this method of leadership development challenges employees to stretch their communication skills, team building and group dynamics, and interdependence on others' skill necessary to navigate a new environment. At the end of each assignment, they should return to their original position with fresh ideas, additional resources, a greater understanding of organizational structure, and an appreciation for their original and assigned areas.

Kouzes and Posner (2007) found leaders who spontaneously acknowledge others in the presence of their peers had a positive effect on their organization. In our society, we do not recognize others enough for their contributions in both our personal and professional lives. Acceptable forms for recognition can range from monetary gifts to a simple "Thank You." However, a token of appreciation is much more meaningful when the receiver can see the giver placed a great deal of thought in it (Kouzes & Posner).

Exemplary leaders find out from their constituents what would be the most effective way to reward them. Some organizations chose to implement informal reward systems, while others find it necessary to implement formal programs that also engage employees in the spirit of giving. Leaders do not always have to reward their constituents monetarily (Kouzes & Posner).

Building relationships is another way exemplary leader learned how to meet the needs of their employees. In fact, their success is based on the quality of the leader/follower relationship. Leaders who consistently display a winning attitude tend to be successful (Kouzes & Posner, 2007). Believing in your constituents and setting high expectations for their success is critical. Setting high expectations also means making the necessary resources available for teams to accomplish their goals.

Celebrations are a great way for leaders to connect with others and to recognize behaviors in line with organizational goals, vision, mission and purpose. Celebrations are a way exemplary leaders build community, strengthen morale and encourage social support. One critical component to building community is the leader's personal involvement. Researchers have found that leaders must be involved in all aspects of their organization. This includes celebrating accomplishments of others, mainly because "leadership is a relationship" (Kouzes & Posner, 2007, p. 321).

College Influence on Student Development

According to Astin's (1999) Theory of Involvement, student involvement is defined as the "quantity and quality of the physical and psychological energy that students invest in the college experience" (p. 518). This theory postulates that the time students dedicate to their academic and out-of-class involvement is critical to their college experience and learning. Astin's landmark national study (1993), *What Matters in College*, utilized the Cooperative Institutional Research Program (CIRP) data to not only assess student – student interaction, but also assess student – faculty interaction. This 4-

year longitudinal quantitative national study investigated both academic and personal development outcomes of students who entered college in 1985 as freshmen. Astin asked college students to rate to what extent they enhanced their skills during 4 years of college.

Astin (1993) offered a definition of academic experience based on four categories of student involvement: time spent dedicated to coursework (e.g., attending classes or lab); number of courses taken that emphasized general academic skills (e.g., writing skills, science or scientific inquiry); number of out-of-class student activities (e.g., study abroad programs, college internship); and participation in assessments (took an essay test, took a multiple-choice test). Findings indicated that student development was positively related to the amount of time dedicated to coursework. For example, students who accepted study abroad assignments reported increases in cultural awareness and fluency in foreign languages. Writing courses positively affected writing ability; mathematics courses affected analytical and problem-solving skills; history courses affected writing skills and analytical and problem-solving skills.

The results also suggested that student involvement had positive effects on participants' academic and personal development outcomes (Astin, 1993). Academic development outcomes showed gains in general knowledge, critical thinking ability, analytical and problem-solving skills, and writing ability. The personal development outcomes were many, but only the leadership measure assessing gains in leadership ability, popularity, social self confidence and public speaking ability were of interest to the current study.

Student-student interaction was the strongest influence reported in student development during their 4 years. Strong student-student interactions led to reported gains in leadership development, academic development, problem-solving skills and critical thinking skills (Astin, 1993). Positive peer interactions were also attributed to gains in working on group projects in classes, tutoring other students, participating in intramural sports, being a member of a social fraternity or sorority, being elected to student office, and hours spent in student clubs and organizations (Astin). Involvement in other programs including internship assignments had a positive effect on student academic and personal development (Astin).

Leadership Attributes

Astin (1993) found that active participation in group class projects led to gains in leadership abilities, public speaking skills, analytical and problem-solving skills and job related skills. Student organization participation also had a positive effect on leadership development.

Analytical and Problem-Solving Skills and Job Related Skills

Astin (1993) found that active participation in group class projects, Greek organizations, student organizations and being elected to an office in a student organization led to gains in leadership abilities and interpersonal skills. On the other hand, studying abroad had a negative effect on students' leadership and interpersonal skills.

Selecting a major in an engineering field had a significant positive effect on student development. Engineers reported significant gains in analytical and problem-solving skills and development of job related skills (Astin, 1993). While group class projects contributed to the development of several critical workplace skills including analytical and problem- solving skills, job related skills and knowledge of the field, internship programs had no influence on any of these outcomes.

National Study of Student Learning Framework (NSSL)

Terenzini, Springer, Pascarella and Nora (1995a, 1995b) are noted for conducting the landmark *National Study of Student Learning* (NSSL), the first set of studies to examine the individual and combined effects of academic and out-of-class experiences on student learning. Prior to their studies, very little empirical research combined these independent variables (Pascarella & Terenzini, 1991, 2005). During their NSSL pilot study, the researchers administered the Collegiate Assessment of Academic Proficiency (CAAP), the College Student Experiences Questionnaire (CSEQ) and a demographic sheet to first-year students during the fall of 1991 and spring of 1992 semesters. The CAAP measured five academic constructs – reading comprehension, mathematics, writing, science reasoning, and critical thinking. The CSEQ measured three additional first-year academic constructs and additional out-of-class constructs – course learning, science, relationship with students, campus residence, and topics of conversation, number of non assigned books read and library use. In addition, the research developed a student demographic sheet to collect student pre-college data and family background information. Despite the multiple independent variables included in a multiple regression model initial analysis, many variables not related to the outcomes in question were eliminated in the final analysis.

Academic and Out-of-Class Experiences on Student Intellectual Orientation

Effects on student intellectual orientation. Using the data obtained from 210 first-year students in the NSSL pilot study, Terenzini, Springer, Pascarella and Nora (1995a, 1995b) conducted two studies critical to the current study. The first pilot study (1995b) examined the individual and combined effects of academic (coursework and classroom) and out-of-class experiences on two measures of students' intellectual orientations: interest in academic learning and intrinsic value of learning. Interest in academic learning refers to students' academic enjoyment, willingness to work hard, and enjoyment of a challenge during their freshman year. Intrinsic value of learning refers to the level of importance students place on preparing for a career and getting the best grades.

The independent variable, coursework experiences, in this study measured the number of science and technical or pre-professional courses taken during the freshman year. The second independent variable, classroom experiences, represented the number of hours spent studying per week, teacher effectiveness (first-year math course), course experience and experience with science. Out-of-class experiences measured how students perceived their relationship with other students, living in campus residences, hours/ week socializing, and amount of time conversing with teachers and other students. Controlling for precollege data and scores on the CAAP mathematics and reading measures, this study examined the individual and collective role of coursework, classroom and out-of-class experiences on students' intellectual orientation (Terenzini et al., 1995b).

Terenzini, Springer, Pascarella and Nora (1995a) found classroom experiences made significant contributions to gains in interests in academic learning outcomes. Course learning in the classroom setting and spending time studying had a positive effect on student interests. However, the more time students spent socializing with their friends, the less likely they were to enhance their interest in academic learning. Terenzini, Springer, Pascarella and Nora (1995a) found classroom experiences made significant contributions to changes in the intrinsic value of learning outcomes. On one hand, working with university faculty had a positive effect on students. In addition, encounters with the first-year social science instructor and university library negatively impacted student intrinsic value of learning.

Out-of-class experience contributions were slightly lower than class related experiences in this study (Terenzini et al., 1995a). Yet, courses taken during the freshman year made no contribution to students' first-year outcomes. After examining the independent effects of the independent variables, the researchers also found the three variables jointly contributed to a shared variance of interest in academic learning and intrinsic value of learning.

Academic and Out-of-Class Experiences on Critical Thinking

Effects on student critical thinking. In their second pilot study, Terenzini, Springer, Pascarella and Nora (1995a) examined the role of coursework, classroom and out-of-class experiences on students' critical thinking. In this study, the researchers defined coursework experiences as the measured number of mathematics, sciences and arts and humanities courses taken during the students' first year. Classroom experiences examined students' library experience, weekly study hours, and ratings of their freshman social science course instructor effectiveness. The final variable in question, out-of-class experiences, measured the number of non-assigned books students read and student-student relationships established during their first year.

While the first study controlled for precollege data and scores on the CAAP mathematics and reading scores, the later study only controlled for pre-college data and pre-college critical thinking scores. This study used Pascarella and Terenzini's (1991) comprehensive operational definition of critical thinking:

> identify central issues and assumptions in an argument, recognize important relationships, make correct inferences from data, deduce conclusions from information or data provided, interpret whether conclusions are warranted on the basis of the data given, and evaluate evidence or authority. (p. 118)

The results confirmed classroom academic experiences had a significant positive effect on students' critical thinking after the first year of college (Astin, 1993).The more time students spent studying, the more they increased their critical thinking skills.

Out-of-class experiences also had a significant positive effect on student critical thinking at the end of their second semester. While student relationships with other students had a negative effect, reading books led to significant gains in critical thinking (Astin, 1993; Terenzini, Springer, Yaeger, Pascarella, & Nora, 1994), student-student interactions seemed to have an opposite effect. In fact, in-class experiences accounted for slightly more of students' critical thinking development than their out-of-class experiences. Courses taken during the first year did not seem to influence student critical development at all. Unlike the initial NSSL pilot study, combined effects of the three independent variables were not observed in this study.

Limitations

Both NSSL pilot studies support the hypothesis that there is a significant individual and collective relationship between students' coursework, classroom, and out-of-class experiences on student outcomes. However, these studies were not without several limitations. Terenzini, Springer, Pascarella, and Nora (1995a, 1995b), acknowledged the use of a small sample as one limitation. Both studies used a small sample of freshmen students enrolled in multiple academic disciplines at one institution. Surveys were administered to participants during their first and second semesters of college, which may be an inadequate amount of time to formulate a perception of their institution. In addition, the course, classroom and out-of-class experience variables and learning outcomes were general and not specific to any particular discipline.

Engineering Change Study

In a study using data collected in the Engineering Change Study, Lambert, Terenzini, and Lattuca (2006) investigated the effects of program characteristics, faculty, and student experiences on engineering students' design and analytical skills and group skills. However, only the effects related to student in-class and out-of-class experiences are relevant to the current study. Classroom experiences are defined by three teaching measures: collaborative teaching, interaction and feedback, and clarity and organization. The first measure, collaborative teaching, examines how well professors provide opportunities within the engineering classroom for students to collaborate with their peers. Instead of participating in traditional lecture sessions, students are encouraged by faculty to engage in lengthy peer-discussions, get feedback from others and actively participate in class discussion. Instructor interaction and feedback, the second measure, assessed student-faculty interaction inside the classroom, outside the classroom, and the level of feedback given to students. The third measure, clarity and organization, defined how well instructors clearly explained their material to students (Lambert et al.).

Engineering Group Skills

Lambert et al. (2006) reported that collaborative classrooms and contact with organized instructors who clearly explained assignments had a significant effect on students' group skills, controlling for demographic variables. Actually, an environment fostering student interdependence had the greatest impact on group skill development. Nevertheless, the data did not find faculty interaction and feedback to have any effect on student group skill development. Although in-class experiences had a greater effect on student learning than out-of-class experiences, several out-of-class programs had a significant effect on group skill gains. For example, student involvement in internships programs, design competitions and professional societies made a significant contribution to student group skills gains. Lambert et al. (2006) found that study abroad assignments had no effect on group skills.

Engineering Design & Analytical skills

Developing design and problem-solving skills are also critical in the engineering classroom. Lambert et al. (2006) also found students perceived most in and out-of-class experiences as having a significant effect on how well they developed their design and analytical skills. All aspects of the engineering classroom, including clarity, collaboration and instructor interactions and feedback contributed to how well engineering students solved problems and worked in teams. In addition, internships, design competitions and professional societies accounted for a significant growth in design and analytical skills. Once again, students did not attribute their gains to participation in study abroad programs.

In 2007, Strauss and Terenzini adopted the original framework introduced by Terenzini, Springer, Pascarella, and Nora (1995a, 1995b) to examine both the individual and combined effects of classroom, out-of-classroom and curricular experiences on engineering students' group and analytical skills development (Straus & Terenzini, 2007). Several minor modifications were made to address limitations identified in the original framework. First, the researchers conducted a national study of senior-level participants from 39 engineering programs, instead of collecting data from first-year participants enrolled in various academic disciplines at one institution. This effort improved the external validity and generalizability of the results to other engineering programs. Second, classroom and curricular experiences were combined to include student majors and specific teaching practices found in the literature to enhance learning in engineering education (Cabrera, Colbeck, & Terenzini, 2001; Terenzini, Cabrera, Parente, & Bjorklund, 2001). Third, Strauss and Terenzini selected seven specific out-of-class activities found in the literature to complement the engineering curriculum: employment level; employment status; internship / cooperative experiences; study abroad programs; international travel; design projects/competitions; and student chapters of professional organizations. Fourth, this study measured two critical competencies that the industry expects engineers to master: ability to design and analyze engineering problems and interact in a group setting.

Engineering Design & Analytical Skills

After controlling for pre-college characteristics, Strauss and Terenzini (2007) found clarity and organization, active and collaborative learning, and instructor interaction and feedback significantly contributed to the seniors' engineering design and analytical skills. In fact, they accounted for the most variance in this design and analytical model. Of the six engineering fields, only chemical, computer and industrial made a significant unique contribution. Out-of-class experiences also made a unique significant contribution to engineering seniors' design and analytical skills. Among the out-of-class experiences, internship/cooperative education, participation in engineering design competitions and employment status had a positive significant effect. Participation in study abroad programs did not appear to influence student learning in engineering design and analytical skills.

Engineering Group Skills

Strauss and Terenzini (2007) found classroom experiences contributed less to engineering group skills than design and analytical skills. The unique contribution of classroom clarity and organization and active and collaborative learning were the two classroom experiences with positive significant effects. Chemical, civil and industrial majors contributed significantly to group skills development. Out-of-class experiences also have a positive significant contribution to group skills. Among the out-of-class experiences that significantly contributed to group skills were internship/cooperative education, participation in engineering design competitions, and involvement in student chapters of a professional organization.

Limitations

Although the two dependent variables measured important aspects of the engineering college experience, they are by no means all inclusive. Strauss and Terenzini (2007) limited the engineering classroom experience to only three constructs including instructor ability to clearly explain and organize ideas, students' opportunity to work in an active and collaborative learning environment, and instructor interaction and feedback with students. Considering the unlimited number of in-class experiences engineering students have during their undergraduate years, the researchers recommended future studies examining other in-class experiences. The current study will expand Strauss and Terenzini's work by examining student leadership development in the engineering classroom. Another limitation of this study is the authors' selection of graduating engineering students. Strauss and Terenzini warned their results may not be generalizable to undergraduate students from other disciplines or even engineering graduates.

Academic Experiences and Leadership

In today's global economy, engineers must be capable of transitioning between the role of leader and follower (ABET, 2004; ASCE, 2004) within diverse teams to handle the demand of the workforce. As discussed earlier, engineering programs struggle daily with meeting industry demands to prepare their students for leadership in the workforce. Therefore, engineering educators must explore creative ways to embed meaningful experiences within their curricula or through cocurricular experiences during which engineering students can develop their leadership skills. Several researchers have linked student learning with leadership development in the literature (Brown & Posner, 2001; Terenzini, Cabrera, Colbeck, Parente, & Bjorklund, 2001). According to Yukl (2006), meaningful leadership experiences require three key characteristics: a challenging task; diverse experiences, and useful feedback. A student's ability to learn depends greatly on the professors' willingness to convert their traditional classrooms into a learning organization that encourages forward thinking, team learning, innovation, experimentation and accountability (Yukl).

In one study, Brown and Posner (2001) explored the relationship between management course type and leadership in a recent study of managers engaged in three different learning environments. Managers involved in this study were enrolled in a management course, an evening MBA program or an executive MBA program. The researchers administered the Learning Tactics Inventory (LTI) and Leadership Practices Inventory (LPI) to establish if managers in different learning environments demonstrated learning tactics related to their leadership practices. The LTI measured four learning tactics: action, actively attempting to learn new things; thinking, seeking new knowledge; feeling, in tune with personal feelings; and accessing others, the ability to share ideas with others. The LPI measured five leadership practices: modeling the way, inspiring a shared vision, challenging the process, enabling others to act, and encouraging the heart. Based on the findings, all four learning tactics were significantly related to the five leadership practices. Brown and Posner suggested that an environment linking learning and leadership ensures leadership development in individuals. Students who enrolled in leadership courses or held leadership positions had higher levels of leadership practices scores.

Cocurriculum and Leadership

Kuh (1995) in his article, "The Other Curriculum: Out-of-Class Experiences Associated with Student Learning and Personal Development," examined the relationship between several out-of-class experiences and several personal development outcomes. Out-of-class experiences selected for this study include leadership responsibility, peer interaction, academic activities, faculty contact, work, travel, and institutional ethos. The composite dependent variables are interpersonal competence (self-awareness, social competence, self esteem, and autonomy), practical competence (practical competence, vocational competence), cognitive complexity (reflective judgment and application of knowledge), knowledge and academic skills (knowledge and academic skills), and humanitarianism (altruism and aesthetics).

Study results indicated that out-of-class experiences lead to student development. Although studies have shown most student learning occurs in the classroom, Kuh (1995) found out-of-class experiences provided "real world" situations that encouraged application of concepts learned in the classroom. Students reported peer interaction (21.8%), leadership responsibilities (21.5%), academic activities (17.9%), work (6.5%), and travel (3.7%) as the five out-of-class experiences most responsible for gains in student outcome domains within the study. Several relationships of interest to this study are discussed further.

Leadership Roles – Professional Society

Kuh (1995) also found participants attributed leadership involvement to interpersonal competence (45.1%) and practical competence (24.9%) outcomes. Students in leadership roles reported the highest relationship with practical competence of all other out-of-class relationships. Those students who had opportunities to serve in student government, Greek organizations, or professional organizations were more likely to not only develop their self esteem and confidence, but to also strengthen their decision-making, time management and budgeting skills (Kuh, 1995).

Peer Interaction

Kuh's (1995) findings also showed peer interaction contributed to students' interpersonal competence (55%), cognitive complexity (20.8%), and humanitarianism (30%) gains. However, commuter school participants did not attribute any gains in practical competence, cognitive complexity, and knowledge and academic skills to peer interactions. The positive relationship between peer interaction (51.6%) and interpersonal competence was of the highest reported within the study. Overall, peers of different races benefited from their interaction with peers of different races (Kuh, 1995).

Academic Activities - Competition

Kuh (1995) found academic activities accounted for 42% of knowledge and academic skills gains and 30.3% of interpersonal gains. The highest student gains in knowledge and academic skills were reported by students involved in academic activities. Students who presented at conferences, or presented in competitions related to their major course outside the classroom, reported higher gains in students' sense of purpose. In addition, these experiences usually complemented classroom concepts and offered students other opportunities to hone and demonstrate decision-making, organizational and leadership skills (Kuh, 1995).

Work - Internship/Cooperative Education

Kuh (1995) also found student employment on or off-campus had a positive effect on student interpersonal competence (49.6%) and practical competence (33.4%). When students obtain employment which complements in-class learning or meets their personal needs, they are more likely to develop their leadership skills and become more self directed (Kuh, 1995).

Travel - Study Abroad

Finally, Kuh found only 4% of these study participants attributed spending time overseas to their development. Nevertheless, study abroad programs granted students an opportunity to become more aware of other peoples' cultures and peoples' lives (Kuh, 1995)

Kezar and Moriarty (2000) investigated what academic (curricular), cocurricular and extracurricular activities influence students' leadership ability. Academic involvement referred to student involvement in classroom projects. Cocurricular referred to participation in leadership classes and racial or cultural awareness programs. Extracurricular involvement included student organization participation; volunteer work; and time spent socializing with different groups and elected to lead a student organization. In this study, group projects in class, the only academic experience measured, was a predictor of leadership development only for African American men. On the other hand, Kezar and Moriarty found cocurricular experiences and extracurricular experiences had a positive significant effect on other students' perceptions. Men rated their leadership skills much higher than women. Both male and female students were more likely to perceive an increase in their leadership ability if they reported attending a leadership class during their college career (Kezar & Moriarty).

Cress, Astin, Zimmerman-Oster, and Burkhardt (2001) conducted a quantitative longitudinal study at 10 institutions to determine whether student involvement in leadership programs had an effect on student development between a student's freshman and senior years. Five different leadership and other educational outcomes were examined: civic responsibility; leadership skills; leadership understanding and commitment; multicultural awareness and community awareness; and personal and societal values. The researchers found students who enrolled in leadership development programs reported significantly greater gains in all five academic outcomes than non-participants.

This study also investigated the effects of other college activities, despite student enrollment in leadership programs. Cress et al.'s (2001) results revealed that student involvement in college experiences not categorized as leadership programs, also contributes to gains in leadership abilities.

Volunteer Work

Students engaged in volunteer work and community service individually demonstrated an increase in civic responsibility, leadership skills, leadership understanding and commitment, multicultural awareness and community awareness, and personal and societal values as their volunteering hours increased. Students working with others on assignments in the classroom settings enhanced all outcomes except civic responsibility (Cress et al., 2001).

Internships / Work

Students with internship and work assignments while in college (Astin, 1993) also reported gains. These individuals reported gains in civic responsibility; leadership understanding and commitment; multicultural awareness and community awareness outcomes (Cress et al., 2001). Ingram (2005) also found co-op and internship assignments enable students to develop leadership skills.

Academic and Out-of-Class Experiences and Leadership-SLPI

Several empirical studies have been conducted to assess college students' leadership effectiveness using the Student Leadership Practices Inventory. Adams and Keim (2000) conducted a study of three public mid-western universities investigating leadership practices and effectiveness of male (9) and female (12) Greek student leaders using the Student Leadership Practices Inventory and Leadership Effectiveness Survey. Prior to this research, no study using the SLPI measured the observations of general Greek organization members. Using cluster sampling techniques, four fraternity and four sorority chapters at each institution were selected to participate. Organizations' advisors recruited the 233 convenience sample of chapter presidents, along with five executive council (EC) members and five general members from each chapter. Student leaders were asked to rate their leadership effectiveness on the SLPI-self version and their members rated leaders using the SLPI-Other version on five characteristics: Modeling the way, inspiring a shared vision, challenging the process, Enables others to act, encouraging the heart.

Adams and Keim (2000) conducted a two-way ANOVA to examine the impact of gender and rater position on leaders' effectiveness, as measured by the five subscales of the Student Leadership Practices Inventory. Two subscales, C*hallenging the Process* and E*nabling Others to act* reported statistically significant main effects for gender. Within the *Challenging the Process* subscale, men perceived their fraternity leaders less effective than women perceived their sorority leaders. Similarly, on the *Enabling Others to Act* subscale male leaders were also perceived less effective than female leaders by their organization members. In addition, as reported on the *Inspiring a Shared Vision* subscale, male leader ratings were significantly lower than those of female leaders as reported by both EC members and general members. Overall, female leaders were more effective than male leaders. Arendt (2004) found students involved in official leadership roles or taking leadership courses have higher levels of leadership practice scores.

Bardou, Byrne, Pasternak, Perez, and Rainey (2003) in their comprehensive study investigated the effect of gender on leadership self efficacy, the effect of previous leadership experiences on leadership self efficacy, and the effect of the campus environment on leadership self efficacy. The researchers administered the modified Student Leadership Practices Inventory (SLPI) to 188 of the 532 student leaders of a larger, public, Research I institution in the Midwest. Bardou et al. found that overall, most student leaders exhibited high levels of self efficacy. Female student leaders self reported higher levels of self efficacy than males. More specifically, female leaders reported significantly higher M*odel the Way* self efficacy ratings than male leaders. As the researchers examined the effect of past leadership experiences on student levels of self efficacy, they surprisingly found results that conflicted with previous findings in the literature (Bandura, 1986, 1997; Depp, 1993). It seems leaders' previous leadership experiences self efficacy ratings were not significantly different from those who had no leadership training or experience in the past. Although leaders reported high levels of self efficacy, the *Challenging the Process* leadership practice was the lowest rating reported of all six practices. The researchers discovered that of all the types of organizations, members of activist organizations reported significantly higher levels in *Challenging the Process* self ratings. Of the environmental factors investigated, female leaders were more inclined to report advisor support and encouragement from their organization advisor than the male student leaders.

While investigating effects of gender, previous leadership experiences and institutional environment on leadership self efficacy of student leaders, Bardou et al. (2003) realized a paucity in the literature. They recommended further research to investigate "ways in which organizational type affects leadership self-efficacy and effective leadership behaviors" (p. 46). The researchers also failed to examine the extent to which involvement in curricula and non-curricular programs contribute to the self efficacy and leadership development of students as they matriculate and even as they enter their professions.

Academic and Out-of-Class Experiences and Engineering Leadership-LPI

Although Kouzes and Posner (2007) developed a framework specifically for college students, some researchers have chosen to use the non-student version of the Leadership Practices Inventory in college studies. Baxter (2001) conducted a study to compare the leadership practices of engineering students to non-engineering students serving as ROTC cadets at Texas A&M University using the LPI. The researcher compared the leadership practices of 5^{th}- year students serving as ROTC instructors (n = 17) with engineering students (n = 37) and non-engineering students (n = 22) using the Leadership Practices Inventory (LPI). The findings suggested that engineering cadets tend to have lower leadership practices than non-engineering cadets in other majors. However, the longer students were involved in ROTC, the more likely they were to increase their leadership skills. Fifth-year cadets scored significantly higher on all five LPI practices than both engineering and non-engineering students.

Academic and Cocurriculum Experiences on Post-College Engineering Leadership-LPI

Other researchers have used the LPI to measure college alumni leadership practices. However, instead of using validated leadership frameworks, they developed general questions to assess the effects of college leadership development on alumni's current leadership practices. Skipper (2004) conducted an experimental study examining the leadership practices using the LPI with practicing engineers working at a large construction company. The primary purpose of this study was to compare the leadership practices of successful top performing construction project managers and engineers with a control group of randomly selected project managers. Top performers were defined as project managers who consistently outperformed their colleagues in the areas of quality, safety, cost, communication and client relations, all areas critical to a project manager's success. Using Kouzes and Posner's Leadership Practices Inventory (LPI), the author discovered statistical differences between the top performing project managers and the control group in three of the five leadership practices: model the way, inspiring a shared vision, and challenging the process. Top performers had greater scores than the control group in these areas of leadership.

The second purpose of this study was to determine the differences in job experiences, project management experience, training, and career development leadership influences between both groups. Skipper (2004) found no difference in years of experience, and their initial assignment between the control group and the treatment group. Both groups received comparable hours of project management training and leadership training over a 10-year timeframe. However, there were significant differences found in other experiences. Top performing engineers reported spending more time (80%) involved in leadership-type activities than engineers within the control group (53%). Top performing engineers reported significantly higher total number of years in their project management field than the control group. Actually, they reported higher number of years working as project managers at other companies. Although both groups believed overwhelmingly that there is a need for more formal leadership training, top performers express a significantly greater need for more formal project management training.

Another goal of Skipper's (2004) study was to assess to what extent seven types of career development methods specifically influenced project managers' leadership development and to determine whether top performers' influences differed significantly from the control group. The seven types of influences included observing senior leaders, mentoring/coaching by senior leaders, reading /self study, educational courses during college, educational courses after college, corporate training, and job experiences. Both groups reported job experiences and observing others as the method most often used to develop their leadership skills. Top performers rated mentoring/coaching and reading / self-study significantly higher compared to the control group. While training was important to both groups, it was ranked 5th in the ranking.

Skipper (2004) reported one startling finding worth highlighting related to the influence of formal education on participants' leadership development. Among the seven methods examined, formal education during college and post college education had the least influence on project managers' leadership development. Formal undergraduate education of project managers within this organization ranged from having no undergraduate degrees (n = 4), to those earning bachelors' degrees in engineering (n = 49), non-engineering majors (n = 10), the arts (n = 3), and graduate degree in numerous areas (n = 22). In some cases, several project managers earned multiple bachelors degrees. However, Skipper found no relationship between obtaining an undergraduate or graduate degree and earning the top performer status as a project manager within this corporation. Therefore, the undergraduate degree did not appear to provide engineers an advantage in their project management careers.

Academic and Out-of-Class Experiences on Engineering Leadership Non-LPI

Colbeck, Campbell, and Bjorklund (2000) conducted interviews of students attending Engineering Coalition of Schools for Excellence in Education and Leadership (ECSEL), a coalition of institutions focused on student design and group development from their initial freshman introductory courses to their final senior project course. ECSEL students who either already took or had not taken the first-year design course were asked what in and out-of-class experiences enhanced or limited student interdependence in the engineering design classes.

Classroom Contribution

Colbeck et al.'s (2000) interviews revealed that three characteristics must be present in a group design classroom to ensure an environment of interdependence: real world problems, industry involvement, and size of teams. ECSEL design courses are designed to socialize students into the engineering field. Students assume the role of a practicing engineer and work closely with industry representatives to define, develop and present viable solutions to their identified problems. In turn, industry representatives were expected to provide feedback to students and aid in the development of leadership, communication, problem solving and group skills necessary to be successful in the field of engineering (Colbeck et al.).

Colbeck et al. (2000) found that students credited introductory engineering courses and subsequent higher level engineering classes with their problem solving skills development. While students agreed some engineering classes led to group development, they believed classes lacked an emphasis on communication and group dynamics. Participants also believed they relied heavily on prior learning for team management strategies. Faculty-student interaction was very limited and offered little direction in goals development. In fact, industry representatives appeared to play a greater role in the group class than professors serving as a facilitator.

Work and Cocurricular Involvement

Several out-of-class experiences led to student group development gains including work experiences and cocurricular involvement. Previous work assignments enabled students in their development of team-building skills that ultimately enhanced their experiences in the engineering classroom. In fact, their internship offered insight into the demands and challenges engineers would likely face within the profession. Gains in relationship building, appreciation for differences (cultural, personal) and self confidence were also attributed specifically to engineering internship assignments. Students who participated in professional societies, student organizations and other campus activities reported self analysis, personal development and interpersonal goal growth (Colbeck et al., 2000).

Previous Group Experience

Previous experiences leading groups in previous classes or in other activities influenced students' willingness to assume a leadership role in class. The more competent students were in a particular area, the more likely they were to accept leadership roles in group projects. Working directly with industry leaders, producing status reports, conducting meetings, and presentations also appeared to increase students' self efficacy. Of the many competencies discussed, students identified communications, conflict management and problem management skills as the three competencies participants believed were just as critical to graduates as general technical skills. In fact, they realized how dated technical skills may be due to advancement of technology today (Colbeck et al., 2000).

Wankat, Oreovicz, and Delgass (2000), in response to ABET 2000, conducted a quantitative study to identify to what extent their chemical engineering (ChE) program successfully addressed their ABET professional practice skills. While the university was concerned with adequately fulfilling the ABET requirement, they had intentionally prioritized the skills based on their university goals. The university ranked the ABET professional practices in the following order:

- Communication skills
- Teamwork skills
- Importance of being a life-long learner
- Professional and ethical responsibility
- Broad education to function globally
- A knowledge of contemporary issues (pp. 3-4)

Wankat et al.(2000) focused on six outcomes, which they ranked in order of importance, including written communications, oral communications, engineering ethics, team interactions, leadership skills, and meeting skills. In 1994, the researchers sent surveys to engineers from the 1989 to 1993 graduating classes asking participants to (a) rank the level of importance of each outcome; (b) rank the opportunity to learn each skill; (c) and rank what college program served as the source of the skill. The five college programs examined were chemical engineering seminar, lab, and design course, non chemical engineering courses, co-op or internship, and extracurricular activities.

Chemical engineering graduates ranked their communication (written and oral), and team interactions higher than leadership skills, meeting skills and engineering ethics skills. Based on the priorities set by the university, the researchers were pleased with these results. However, participants rated engineering ethics low. The opportunity to learn each skill also reflected the interests of participants. Graduates thought they had a greater opportunity to learn communication skills (written and oral) and engage in team interaction during their program than leadership skills, engineering ethics and meeting skills. Students once again reported lower ratings on opportunities to develop ethical skills. Although this was an alarming finding, the university was aware of this learning gap. They had already addressed this gap by adding seminars on ethics (Wankat et al., 2000).

Overall, Wankat et al.'s (2000) sources for gaining these skills were relevant to the current study. Graduates learned many of their professional practices from multiple sources during college. Communications (written and oral) were mostly learned in the chemical engineering lab or design course. In addition, involvement in non- chemical engineering courses and subsequent work experiences also contributed to student development of these skills. Knowledge of engineering ethics was gained within the chemical engineering seminar and reinforced during an internship or co-op experience. Team interactions were learned mostly in the chemical engineering lab and design course, work experiences and extracurricular activities. Although leadership and meeting skills are not ABET professional skills, Wankat et al. also considered them critical to the professional development of engineers. Engineering graduates reported learning their leadership skills in both their design course and in their extracurricular programs. Meeting skills were primarily learned in the workplace.

Conceptual Framework for this Study

The conceptual model for this study modifies the original theoretical frameworks of Terenzini, Springer, Pascarella, and Nora (1995a, 1995b) and Strauss and Terenzini (2007). Of the several theories discussed in this literature review, it was evident that the more time students invested in their total college experience, the more they gained academically, personally, and professionally. Additional modifications to the original frameworks allow for the exploration of the individual and collective effects of academic and out-of-class-experiences on engineering alumni's post-college leadership development, while addressing several limitations identified by Strauss and Terenzini in a previous study. The current study will expand Strauss and Terenzini's work by examining leadership development practices that students experienced within the engineering classroom. In addition, the participants consisted of engineering alumni, who graduated between 2000 and 2006 instead of current engineering students (See Figure 2).

This model implies engineering alumni post-college exemplary leadership practices function out of two unique college student experiences: programmatic changes implemented within the formal engineering classroom (Kouzes & Posner, 2007) , and various engineering related out-of-class cocurricular experiences alumni had while pursing their engineering degree (Strauss & Terenzini, 2007).

Appropriateness of the Models

Terenzini, Springer, Pascarella, and Nora's (1995a, 1995b) framework is supported by theory (Astin, 1993; Lambert et al., 2006; Pascarella, 1985; Pascarella & Terenzini, 1991) and proven appropriate to assess academic and out-of-class experiences of engineering students (Strauss & Terenzini, 2007). In this study, program characteristic changes refer to the implementation of the University of Dayton strategic plan entitled *Vision 2005*. In January 2003 the president of the University of Dayton articulated the strategic plan to address the global demands of the 21st century. The vision charged faculty with the task of integrating "learning to leadership and service." As faculty introduced new concepts into the engineering classroom, they challenged students to apply their skills to developing innovative solutions to our many local, national, and international problems.

For the purpose of this study, two types of student involvement will be investigated: academic in-class experiences and out-of-class experiences. Academic in-class experiences refer to five instructional practices alumni experienced in the engineering classroom that contributed to their leadership development. The academic in-class leadership practices consist of the five measures of Kouzes and Posner's five exemplary practices of leadership including model the way, inspire a shared vision, challenge the process, enable others to act, and encourage the heart. Exemplary

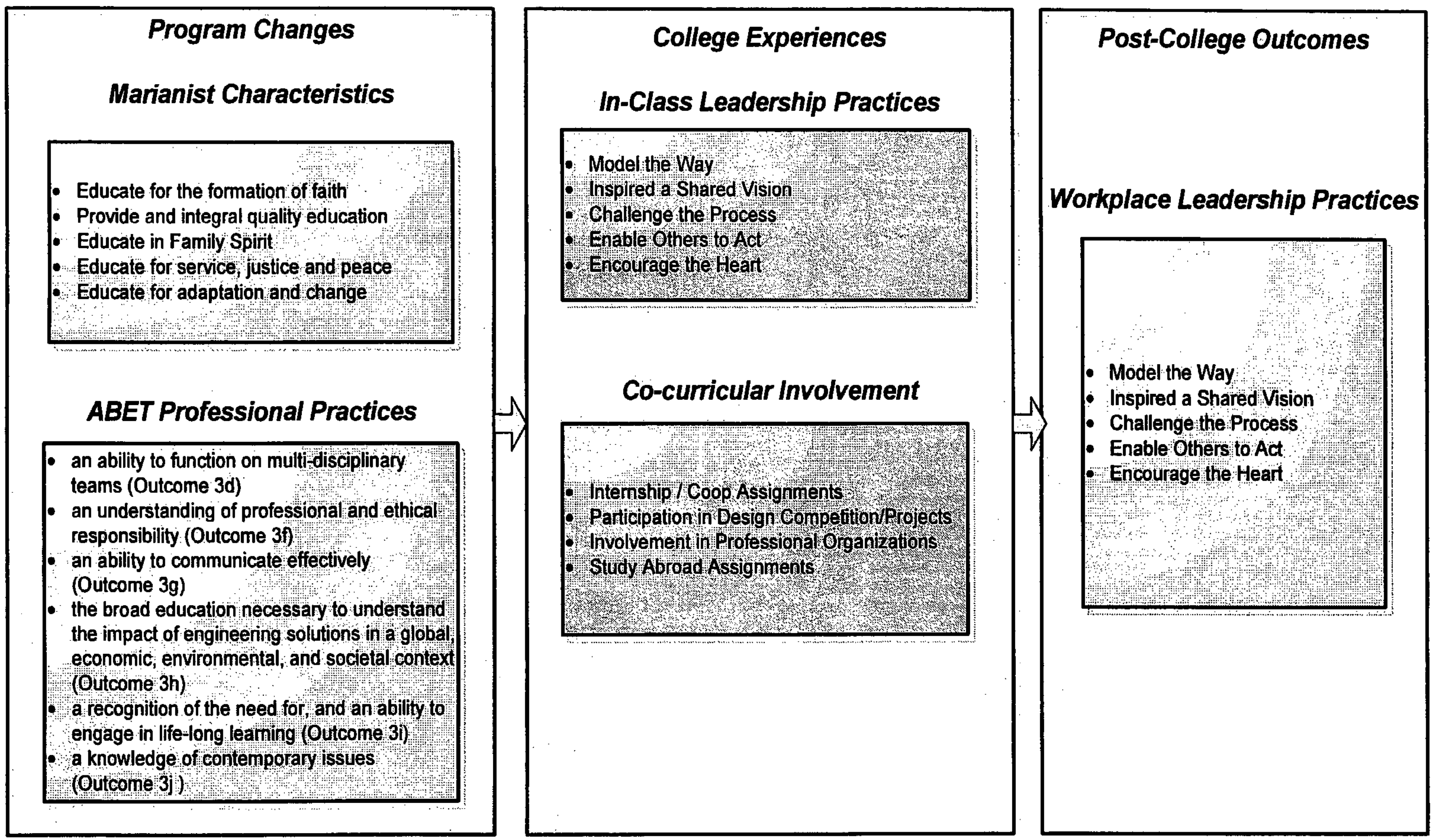

Figure 2. Conceptual Framework for the Study

leadership practices will be measured using the Leadership Practices Inventory (LPI). Of the numerous leadership models reviewed, the Kouzes and Posner's Five Practices of Exemplary Leadership model best represents the six ABET Engineering Professional Practices and the Marianist Characteristics addressed in this dissertation (See Appendix B). The out-of-class experiences included in this study refer to involvement in four co-curricular activities: internship or cooperative education; study abroad programs; design project beyond classroom requirements; and student chapter of a professional organization. Each of the four out-of-class experiences have been found in the literature to support the engineering curricula and to have a significant positive effect on engineering student learning (Lambert, Terenzini, & Lattuca, 2006; Lattuca, Terenzini, & Volkwein, 2006; Strauss & Terenzini, 2007).

Alumni post-college leadership practices will also be measured using the Leadership Practices Inventory (LPI). The Leadership Practices Inventory (LPI) has been proven valid and reliable by universities, corporations and non-profit organizations to investigate the effects of student involvement on leadership development.

CHAPTER III

RESEARCH METHODS

Purpose of the Study

The purpose of this study was to examine the difference in perceptions toward undergraduate leadership practices of engineering alumni who received their baccalaureate degree between 2000 and 2006. This study examined the effect of cocurricular involvement on concomitant leadership practices of engineering alumni. Because many of these engineers are currently working within the profession, they are expected to use leadership skills honed through collegiate academic and cocurricular activities. This study aimed to measure the engineering program specific learning outcomes against professional expectations. The research design selected for this study is a quantitative causal comparative design (Creswell, 2005).

Research Questions

This study evaluated the effects of participation in college programs on engineering alumni's current leadership practices by answering the following four questions:

1. To what extent were UD engineering alumni exposed to exemplary leadership practices within their undergraduate programs? To what extent do engineering alumni practice exemplary leadership practices in the workplace? How do their college practices and workplace leadership practices compare to the LPI norm?
2. What is the effect of cocurricular involvement on the perception of engineering alumni college leadership development and workplace leadership practices?

3. What is the effect of cocurricular involvement on the perception of engineering alumni college leadership development and workplace leadership practices?
4. How do perceptions of engineering alumni college leadership development and workplace leadership practices differ by gender, major and graduation year?

University of Dayton Philosophy on Leadership

The institution selected for this study is the University of Dayton, a mid-sized, Catholic, private university located in the Midwest. As a Marianist institution [supported by the Society of Mary], the University of Dayton was founded on strong traditions of gender equity and equality. Based on the *Characteristics of a Marianist University*, both women and men have opportunities to develop and apply leadership practices during their undergraduate experience. According to the Marianist tradition, a sound undergraduate experience "cultivates both personal and social transformation by creating community, engaging students in learning and enabling each individual to develop as a whole person within the context of commitments to purpose that transcends the personal" (University of Dayton Board of Trustees, 2006b, p. 12). In other words, faculty must be committed to educating all aspects of an individual's life. Each academic unit at the University is expected to uphold the five characteristics of a Marianist university:

- Educate for formation and faith – ensure character and moral development of all students.
- Provide an integral quality education – provide a broad education for students in and outside the classroom that links theory and practice.
- Educate in family spirit – encourage collaboration while developing strong relationships that challenge individuals to expand their knowledge.
- Educate for service, justice and peace – offer equal opportunities for men and women to develop a spirit of work as service to the global society.

- Educate for adaptation and change – develop critical thinkers who use the advancement of technology to enhance the community at large and influence change.

The University of Dayton's mission to grow the undergraduate student into a well rounded servant leader sensitive to world concerns also aligns with the Marianist characteristics. Over the years the institution has implemented several changes that influenced student development within the School of Engineering. Three critical initiatives introduced to the UD community while participants were enrolled at UD (2000-2006) prioritized a new set of goals designed to enhance student leadership development: Accreditation Board for Engineering and Technology Criteria; Vision 2005; and a call to strengthen the Catholic and Marianist traditions. Each initiative is discussed further below.

Accreditation Board for Engineering and Technology - EC2000 Criteria

Beginning in 2001, the Accreditation Board for Engineering and Technology (ABET) required all engineering graduates to demonstrate proficiency in the ABET Criteria Outcomes. The UD School of Engineering was tasked with reviewing each program to ensure students had an opportunity to demonstrate proficiency in the following professional practices. Upon completion of their program, students should have attained the following outcomes:

- an ability to function on multi-disciplinary teams (Outcome 3d)
- an understanding of professional and ethical responsibility (Outcome 3f)
- an ability to communicate effectively (Outcome 3g)

- a broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context (Outcome 3h)
- a recognition of the need for, and an ability to engage in life-long learning (Outcome 3i)
- a knowledge of contemporary issues (Outcome 3j)

Vision 2005 – Integrating Learning, Leadership and Service

As the School of Engineering prepared to meet the ABET standards, the University also underwent major institutional change. The University of Dayton launched its new strategic plan entitled *Vision 2005* to address the global demands of the 21st century. The new vision challenged UD engineering programs to integrate "learning to leadership and service" within each engineering program (Vision 2005, 1993, 1999). While introducing new concepts in the engineering classroom, faculty were also expected to provide opportunities for students to apply their knowledge toward solving actual problems plaguing our local, national, and international communities. *Vision 2005* also required faculty to uphold and model the principles of a Marianist university (University of Dayton, 1999).

A Call to Strengthen the Catholic and Marianist Traditions

Between 1999 and 2002, the president of the University of Dayton engaged the entire community in a conversation about ways to strengthen the Catholic and Marianist traditions. In 2002 a university-wide taskforce released a report entitled, *Conversing: Reflections on the University of Dayton's Catholic and Marianist Character in its 150th Year- A Report from the Task Force on Sesquicentennial Conversation*, presenting several recommendations critical to student leadership development. They recommended each academic unit align their strategic plans with the Catholic and Marianist characteristics. In fact, because the Marianist traditions are at the cornerstone of all major programs on campus, each unit was charged with articulating specifically how their efforts (mission, vision, goals) contributed to the five characteristics of a Marianist university.

The task force also highlighted the need to offer purposeful leadership opportunities to students within their classroom, cocurricular and other university programs. Although UD offered numerous student leadership opportunities on campus, the report underscored how the expansion of these programs would serve a greater number of students and align with the mission to develop service leaders. Encouraging undergraduate student engagement in service learning projects was one pedagogical method suggested by the taskforce to develop the decision-making and problem-solving skills students need to hone in college.

The University of Dayton School of Engineering (UDSOE) Leadership Goals

The University of Dayton's School of Engineering (SOE) focuses on leadership development as a critical learning outcome of undergraduate education. The mission of the School of Engineering also aligns with the tenets and principles of the Marianist faith. Engineering students are taught to view problems not only as technical issues, but as opportunities to "work for service, justice, and peace" (University of Dayton School of Engineering, 2006, p. 3). Based on the mission, vision and goals of the School of Engineering, students are expected to use their technical and leadership skills to contribute individually to the advancement of the UD community and serve others as a transformational change agent (Society of Mary, 1999, p. 6).

The SOE programs recruit and retain students, particularly women and other ethnic groups traditionally excluded from technical disciplines, and provide them with equal access to a solid undergraduate experience (mission). The institution values the development of leadership skills (problem solving, team development, student involvement in professional organizations), while providing occasions for students to implement what they learn in real life situations. Students are encouraged through involvement in their engineering programs, student organizations, professional societies, and other non-academic activities to become transformational leaders in preparation for entering the engineering profession (University of Dayton School of Engineering, 2006).

Assessing the University of Dayton School of Engineering Program

While engineering programs are not required to quantify the extent to which their students are gaining the necessary skills within their engineering programs to be effective leaders in their professions, the University of Dayton continually attempts to enhance the quality of its programs. In response to the aforementioned initiatives introduced to the University, the School of Engineering has reformed its engineering curriculum to provide more opportunities for students to hone their leadership skills in recent years. This study will allow the School of Engineering to identify how students perceive their leadership development during the 2000-2006 timeframe.

Research Design

This research study was conducted using a causal comparative (ex post facto) research design. Causal comparative research examines groups to determine the possible effects of one or more independent variables on one or more dependent variables. In this research, a convenience sample of engineering alumni who graduated between 2000 and 2006 was selected.

Threats to Internal Validity

Using a causal comparative research design poses several threats to internal validity the researcher must address (Wiersma & Jurs, 2005). One threat to the internal validity of a causal comparative study is selection of participants. Use of the entire population is one method used to mitigate this threat. History is another threat to the internal validity of this study. Although several academic and cocurricular variables were identified in this study, the researcher recognized that other independent variables not included in the study could have an effect on engineers' leadership development. For example, engineers may develop leadership skills outside of the university setting during their undergraduate experience. Further, engineers may have furthered their leadership development in the workforce or in a university course. Several corporations today offer their employees opportunities to develop their skill through leadership training, job assignments, executive coaching, and other ways. Nevertheless, this study will not measure these variables.

Threats to External Validity

External validity refers to the ability to generalize study results to other samples, times, or situations (Wiersma & Jurs, 2005). This study lacked external validity in several ways. Although the current study used a convenience sample, the population to which this study can be generalized is engineering students who graduated from the UD engineering program between 2000 and 2006. Leadership development and other professional practices were still given lower levels of attention than technical courses in engineering programs; therefore each program might use different criteria for introducing leadership to its students. Therefore, it was difficult to generalize this one-institution study to other engineering programs. However, the results of this study might be generalizable to other ABET engineering programs similar in size to the University of Dayton. Then again, based on the fact that the goal was to improve the program offerings as they relate to leadership development, generalization is not the real goal.

Participants

Engineers who received their engineering baccalaureate degrees in the nation's schools of engineering made up the population of inquiry. The target population under investigation consisted of engineers who received their engineering baccalaureate degrees between 2000 and 2006 from the University of Dayton. The target population consisted of 1,535 engineering alumni, specifically, 346 (22.54%) female alumni and 1,189

(77.46%) male alumni who graduated from 1 of 7 engineering fields offered by the University: chemical engineering, civil engineering, computer engineering, electrical engineering, engineering management, engineering technology, and mechanical engineering.

While the University had the ability to send mass emails to the entire population, access to individual participants posed a challenge with sample selection. The alumni system did not have the capability to randomly select or contact specific individuals based on undergraduate major, making it difficult to obtain a representative sample of the School of Engineering graduates. Therefore, the resulting population remaining from the target population included 200 female (27.62%) and 524 male (73.38%) alumni who provided email addresses to the alumni office upon their graduation. Based on this system limitation, the researcher elected to use the entire accessible population in this study. This population contained females and males nearly proportional to their representation within the target population. Thus, the accessible population of 724 participants serves as a convenience sample for this study (See Table 1). The Engineering Engagement Instrument will be administered in an online format.

Table 1

Engineering Alumni Participants

UD School of Engineering alumni	Target population (mail)		Accessible population (email)
UD Graduates 2000-2006	1,541	57% of Total	
UD Graduates with Addresses	1,535		724
Female	346 (22.54%)		200 (27.62%)
Male	1,189 (77.46%)		524 (72.38%)

Instrumentation

The researcher developed an Engineering Engagement Instrument (EEI) using the online service SurveyMonkey. The EEI is broken down into four sections. The first section of the EEI is the survey introduction requesting informed consent. Within this section, the researcher will provide detailed information about the purpose and ultimate goals of the study.

The second section of the EEI consisted of Kouzes and Posner's Leadership Practices Inventory- Self (LPI-Self). The purpose of this section is to assess the extent of alumni leadership in five measures specifically within their engineering undergraduate program or courses and the workplace/field in two rows: current job/workplace and undergraduate engineering programs. The five leadership practices are Model the Way, Inspire a Shared Vision, Challenge the Process, Enable Others to Act, and Encourage the Heart. To further clarify the goals of this section, the researcher revised the instructions to remind participants that their responses only reflect their undergraduate engineering program experience and their current workplace practices. The instructions in this section read, *Reflecting on both your current job/workplace and college experiences in questions 1 through 30, please indicate how frequently you practiced the following leadership behaviors.*

The third section of the EEI consisted of four college activities highlighted in the literature review (Lambert, Terenzini, & Lattuca, 2006; Strauss & Terenzini, 2007) which complements concepts taught in the engineering curricula. The four college activities include: (a) internship/ cooperative experiences; (b) study abroad programs; (c) involvement in design projects; and (d) student chapters of professional organizations. The purpose of this section of the instrument is to only assess the extent of leadership engagement during the undergraduate college experience. In the event of a significant difference, the effect size will be calculated to determine the magnitude of the effect.

For each college activity, participants will answer three questions related to their college involvement. The first question of the cocurricular section asks, *Reflecting on your college experience in questions 31 through 34, please indicate how frequently you participated in the following activities.* The second question of the cocurricular section that asks, *Reflecting on both your current job/workplace and college experiences in questions 35 through 38, please indicate how frequently you practiced your leadership skills during the following activities.* Participants can respond to each item, using a 5-point Likert scale: 1 = *Never*, 2 = *Almost Never*, 3 = *Neutral*, 4 = *Almost Always*, 5 = *Always*.

The fourth section of the EEI gathered participants' demographic data which consisted of three variables: gender, graduation year and undergraduate major within engineering. Because current research does not reveal a relationship between engineering leadership engagement and pre-college experiences, the researcher did not include pre-college attributes as part of this study. Another concern is related to the researcher's decision to exclude post college experiences on engineering leadership development. This decision was based on the fact that this study explores experiences of engineers before engineers enter the workforce. Additional leadership development after that timeframe is beyond the control of undergraduate engineering programs. It is due to these reasons that pre-college experiences and post-college experiences are excluded from this research.

The Leadership Practices Instrument (LPI)

The Leadership Practices Instrument (LPI) was developed by Kouzes and Posner (2007) to assess leaders' frequency of engagement in several leadership behaviors. This instrument originated from extensive qualitative research conducted by Kouzes and Posner (2002) on the leadership practices of successful professionals. Based on their interviews, five common themes emerged that were then transformed into the five behaviors of the LPI. Each construct consisted of six items inquiring how frequently participants performed the behavior in their environment. Participants responded to each item, using a 10-point Likert scale: 1 = *Almost Never*, 2 = *Rarely*, 3 = *Seldom*, 4 = *Once in a While*, 5 = *Occasionally*, 6 = *Sometimes*, 7 = *Fairly Often*, 8 = *Usually*, 9 = *Very Frequently* and 10 = *Almost Always.*

Leadership within School of Engineering (SOE) Program

The LPI was selected to measure the leadership behaviors participants observed within the SOE program. In the first section of the LPI, participants were asked, *How frequently did you practice the following leadership behaviors within your engineering program?* Participants selected one of 10 responses discussed above ranging from 1 = *Almost Never* to 10 = *Almost Always*. The SOE Leadership variable consisted of five measures: (a) College Model (i.e., set a personal example of what I expect of others), (b) College Inspire (i.e., talk about future trends that will influence how our work gets done), (c) College Challenge (i.e., seek out challenging opportunities that test my own skills and abilities), (d) College Enable (i.e., develop cooperative relationships among the people), and (e) College Encourage (i.e., praise people for a job well done). Items included in each measure were totaled and transformed into five separate composite scores.

Workplace Leadership Practices

In the second section of the LPI, the researcher asked, *How frequently do you practice the following leadership behaviors?* Participants selected one of 10 responses ranging from 1 = *Almost Never* to 10 = *Almost Always*. The Workplace leadership practices variable also consists of the same five measures: (a) Workplace Model (i.e., set a personal example of what I expect of others), (b) Workplace Inspire (i.e., talk about future trends that will influence how our work gets done), (c) Workplace Challenge (i.e., seek out challenging opportunities that test my own skills and abilities), (d) Workplace Enable (i.e., develop cooperative relationships among the people), and (e) Workplace Encourage (i.e., praise people for a job well done). Items included in each scale will be totaled and transformed into five separate composite scores.

Internal Consistency - Alpha and Test-Retest Reliabilities

This LPI instrument has been used continually since 1987 with consistent reliability scores. The Cronbach Alpha reliabilities reported for each scale for the LPI provided by the authors in 2002 are listed in Table 2. In addition, the research provided the most recent norms for the third edition of the LPI in May 2003 (Table 2). According to the authors, alpha reliability coefficients self-reported for managers in general ranged from .73 to .88. Agriculture Education Department Executive officers reported internal reliabilities on the LPI between .79 and .90 (Spotanski, 1991). For construction project managers, alpha reliabilities reported at .734 (Skipper, 2004). Strong test-retest reliabilities were also reported by the authors. In a study of principals and superintendents, the authors reported reliabilities between .79 and .86 for the five leadership practices (Riley, 1991). In the current study, College reliability scores in this study ranged from .73 to .87; Workplace reliability scores ranged from .63 to .86, with the Enable subscale reporting the lowest alpha score. Table 2 shows the study reliability scores compared to the norm reliability scores.

Table 2

Leadership Practices Instrument Reliability Scores and Scores Compared to the Norm

	Norm		Cronbach reliability scores		
Subscales	*M*	*SD*	Norm	College	Workplace
Model the way	47.02	7.10	.74	0.77*	0.72
Inspire the shared vision	44.35	8.79	.88	0.87	0.86
Challenge the process	46.11	7.22	.79	0.84*	0.79
Enable others to act	49.40	6.42	.73	0.73	0.63
Encourage the heart	47.06	8.19	.76	0.82*	0.80*

Instrument Validity

Validity refers to how well an instrument measures the construct it was designed to measure. Kouzes and Posner (2002) achieved instrument validity using three methods: face validity, concurrent validity, and discriminant validity. Kouzes and Posner (2002) reported high face validity for the LPI. Leaders who attended leadership challenge workshops agreed that the items on the LPI reflect behaviors they carry out on a daily basis. Concurrent validity was also high and related to workgroup performance, team cohesiveness, commitment, satisfaction, and credibility (Kouzes & Posner, 2002). A third method of validity examined was discriminant validity. Several other researchers (Huber, Maas, McCloskey, Goode, & Watson, 2000; Leong, 1995) have also found the LPI to be a valid and reliable instrument through concurrent validity factor analyses and other methods.

Data Collection Methods

During the fall 2008 semester, the researcher conducted a study of engineering alumni who graduated between 2000 and 2006. After completing an Institutional Review Board review, alumni from the School of Engineering were initially contacted via email by the Dean of Engineering informing them of the Engineering Engagement Project and inviting them to participate in a study to assess and improve the experience for engineering students. On the next day, the UD Alumni Office sent out the email containing the URL to the online survey housed on SurveyMonkey. Participants had a total of 2 weeks from the initial mailing to fill out the online survey. Reminder emails followed on the 7th day and 14th day after the initial mailing. Alumni agreeing to participate in the study were asked to dedicate approximately 20 minutes to completing four parts of the Engineering Engagement Instrument: The Leadership Practices Inventory (LPI) measuring leadership in the College program; the Leadership Practices

Inventory (LPI) measuring workplace leadership practices; the Cocurricular Leadership Practices Inventory (CLPI); and demographic information.

Research Questions

This study evaluates the effects of participation in college programs on engineering alumni's current leadership practices by answering the following four questions:

1. To what extent were UD engineering alumni exposed to leadership practices within their undergraduate programs? To what extent do engineering alumni practice exemplary leadership practices in the workplace? How do their college practices and workplace leadership practices compare to the LPI norm?
2. To what extent were UD engineering alumni involved in cocurricular activities that supported their undergraduate programs?
3. What is the effect of cocurricular involvement on the perception of engineering alumni college leadership development and workplace leadership practices?
4. How do perceptions of engineering alumni college leadership development and workplace leadership practices differ by gender, major and graduation year?

Data Analysis

Research Question 1:

To what extent were UD engineering alumni exposed to leadership practices within their undergraduate programs? To what extent do engineering alumni practice exemplary leadership practices in the workplace? Between 2000 and 2002 the University of Dayton implemented numerous changes to enhance student development. For several years the UD School of Engineering invested time and resources aligning its programs, mission, and vision with its institutional mission, Marianist characteristics, and ABET criteria.

Descriptive statistics were conducted to obtain the means and standard deviations for each item on the LPI. The variable consisted of five measures : (a) College Model (i.e., set a personal example of what is expect of others), (b) College Inspire (i.e., talk about future trends that will influence how our work gets done), (c) College Challenge (i.e., seek out challenging opportunities that test my own skills and abilities), (d) College Enable (i.e., develop cooperative relationships among the people), and (e) College Encourage (i.e., praise people for a job well done). Items included in each measure were totaled and transformed into five separate composite scores. Descriptive statistics were also run to obtain the means and standard deviation on each of the five composite scores. Each composite score means range from 6 to 60.

College leadership development. Alumni were first asked to report how frequently they practiced leadership behaviors during courses taught in their college programs using the 30-item Leadership Practices Instrument (LPI). The first continuous dependent variable, college leadership, is comprised of each of the five LPI measures: (a) College Model (i.e., set a personal example of what I expect of others), (b) College Inspire (i.e., talk about future trends that will influence how our work gets done), (c) College Challenge (i.e., seek out challenging opportunities that test my own skills and abilities), (d) College Enable (i.e., develop cooperative relationships among the people), and (e) College Encourage (i.e., praise people for a job well done). Items included in each measure will be totaled and transformed into five separate composite scores. Descriptive statistics will also be run to obtain the means and standard deviation on each of the five composite scores. Each composite score means range from 6 to 60. For each year, a set of one-sample *t* tests will be conducted to compare UD engineering alumni perceptions of their college leadership development scores to the Kouzes and Posner LPI normative means of leaders in general taking the instrument: College Model, College Inspire, College Challenge, College Enable, and College Encourage. The *t* score and level of significance will be presented in tables.

Workplace leadership practices. Alumni are then asked with what frequency they practice the leadership skills learned within college courses in their current workplace. The second continuous dependent variable, workplace leadership, is also measured using each of the five LPI composite scores: Work Model, Work Inspire, Work Challenge, Work Enable, and Work Encourage. These items included in each measure will also be totaled and transformed into five separate composite scores. Each composite score means range from 6 to 60. For each year, a second set of one-sample *t* tests will be conducted to compare UD engineering alumni perceptions of their workplace leadership development scores to the Kouzes and Posner LPI normative means of leaders in general taking the instrument: Workplace Model, Workplace Inspire, Workplace Challenge, Workplace Enable, and Workplace Encourage. The *t* score and level of significance will be presented in tables.

Research Question 2:

To what extent were UD engineering alumni involved in cocurricular activities that supported their undergraduate programs?

Cocurricular involvement. The second research question asked alumni to first indicate how frequently they were involved in four cocurricular activities during college. The cocurricular activities variable consisted of four types of activities found in the literature (Lambert, Terenzini, & Lattuca, 2006; Lattuca, Terenzini, & Volkwein, 2006; Strauss & Terenzini, 2007) that typically provide opportunities for engineering students to develop their leadership skills: Involvement in (a) Internship/ Co-op experiences; (b) Study abroad assignments; (c) Design competitions/projects; and (d) Student chapters of professional organizations were included. Participants can respond to each item, using a 5-point Likert scale: 1 = *Never*, 2 = *Almost Never*, 3 = *Neutral*, 4 = *Almost Always*, 5 = *Always*.

The third continuous dependent variable, cocurricular involvement, is measured using the four types of cocurricular activities: (a) Internship/ Co-op experiences; (b) Study abroad assignments; (c) Involvement in design competitions/projects; and (d) Professional organizations. Each cocurricular activity score means range from 1 to 5. Descriptive statistics will also be run to obtain the means for each of the four scores. For each year, a set of one-sample *t* tests was conducted to determine whether engineering alumni level of participation significantly exceeded the neutral level of 3 for each cocurricular activity: Internship/ Co-op experiences; Study abroad assignments; Involvement in design competitions/projects; and Professional organizations. The *t* score and level of significance will be presented in tables.

Research Question 3:

What is the effect of cocurricular involvement on the perception of engineering alumni college leadership development and workplace leadership practices?

Cocurricular involvement. The third research question asked alumni to first indicate how frequently they were involved in four cocurricular activities during college. The cocurricular activities independent variable consisted of four types of activities found in the literature (Lambert, Terenzini, & Lattuca, 2006; Lattuca, Terenzini, & Volkwein, 2006; Strauss & Terenzini, 2007) that typically provide opportunities for engineering students to develop their leadership skills: Involvement in (a) Internship/ Co-op experiences; (b) Study abroad assignments; (c) Design competitions/projects; and (d) Student chapters of professional organizations were included. Participants can respond to each item, using a 5-point Likert scale: 1 = *Never*, 2 = *Almost Never*, 3 = *Neutral*, 4 = *Almost Always*, 5 = *Always*. Each cocurricular activity score means range from 1 to 5. Descriptive statistics will also be run to obtain the means and standard deviation on each of the four scores. To address the third research question eight separate one-way between groups multivariate analysis of variance (MANOVA) will be conducted using four independent variables in the analysis: (a) Internship/ Co-op experiences; (b) Study abroad assignments; (c) Involvement in design competitions/projects; and (d) Professional organizations.

Use of a one-way MANOVA examined cocurricular involvement differences in each of the following sets of continuous dependent variables: College leadership development (College Model, College Inspire, College Challenge, College Enable, College Encourage); and workplace leadership practices (Work Model, Work Inspire, Work Challenge, Work Enable, and Work Encourage). Each set of dependent variables utilized in the MANOVA are discussed further below.

College leadership development. Alumni were first asked to report how frequently they practiced leadership behaviors during courses taught in their college programs using the 30-item Leadership Practices Instrument (LPI). The first continuous dependent variable, college leadership, is comprised of each of the five LPI measures: (a) College Model, (b) College Inspire, (c) College Challenge, (d) College Enable, and (e) College Encourage. Items included in each measure will be totaled and transformed into five separate composite scores. Items included in each measure will be totaled and transformed into five separate composite scores. Descriptive statistics will also be run to obtain the means and standard deviation on each of the five composite scores. Each composite score means range from 6 to 60. Using the five composite scores, the researcher performed a one-way between groups multivariate analysis of variance (MANOVA) to examine cocurricular involvement differences in leadership engagement within alumni engineering programs. The F score and level of significance are presented in tables. A Bonferonni calculation was run, increasing the study alpha level from .05 to .01 (Pallant, 2005). In the event of a significant difference, the effect size will be calculated to determine the magnitude of the effect.

Workplace leadership practices. Alumni were then asked with what frequency they practice the leadership skills learned within college courses in the workplace. The second continuous dependent variable, workplace leadership, was also measured using each of the five LPI composite scores: Work Model, Work Inspire, Work Challenge, Work Enable, and Work Encourage. These items included in each measure were totaled and transformed into five separate composite scores. Each composite score means ranged from 6 to 60. Using the five composite scores, the researcher performed a one-way between groups multivariate analysis of variance (MANOVA) to examine cocurricular involvement differences in how engineers currently practice the leadership skills learned within their engineering program. The *F* score and level of significance are presented in tables. A Bonferonni was calculated, increasing the study alpha level from .05 to .01 (Pallant, 2005). In the event of a significant difference, the effect size will be calculated to determine the magnitude of the effect.

Research Question 4:

How do perceptions of engineering alumni college leadership development and workplace leadership practices differ by gender, major and graduation year?

To address the third research question, a one-way between groups multivariate analysis of variance (MANOVA) was conducted using three independent variables in the analysis: (a) gender; (b) major, and (c) graduation year.

Gender. The first independent variable, gender, is a categorical variable with two levels: female and male. Males were coded as 1 and females will be coded as 2.

Engineering major. The second categorical independent variable, engineering major, consists of seven levels: chemical engineering, civil engineering, computer engineering, electrical engineering, engineering management, engineering technology, and mechanical engineering.

Graduation years. The third independent variable, graduation years, is another categorical variable with seven levels: 2000, 2001, 2002, 2003, 2004, 2005, and 2006.

Use of a one-way MANOVA examined gender, major and graduation differences in each of the following sets of continuous dependent variables: College leadership development (College Model, College Inspire, College Challenge, College Enable, College Encourage); Workplace leadership practices (Workplace Model, Workplace Inspire, Workplace Challenge, Workplace Enable, and Workplace Encourage.

College leadership development. Alumni were first asked to report how frequently they practiced leadership behaviors during courses taught in their college programs using the 30-item Leadership Practices Instrument (LPI). The first continuous dependent variable, college leadership, is comprised of each of the five LPI measures: (a) College Model, (b) College Inspire, (c) College Challenge, (d) College Enable, and (e) College Encourage. Items included in each measure were totaled and transformed into five separate composite scores. Descriptive statistics were calculated to obtain the means and standard deviation on each of the five composite scores. Each composite score means ranged from 6 to 60. Using the five composite scores, the researcher performed a two-way between groups multivariate analysis of variance (MANOVA) to examine cocurricular involvement differences in leadership engagement within alumni engineering programs. The *F* score and level of significance are presented in tables. A Bonferonni was calculated, increasing the study alpha level from .05 to .01 (Pallant, 2005). In the event of a significant difference, the effect size will be calculated to determine the magnitude of the effect.

Workplace leadership practices. Alumni were then asked with what frequency they practice the leadership skills learned within college courses in their current jobs/workplace. The second continuous dependent variable, workplace leadership, is also measured using each of the five LPI composite scores: Work Model, Work Inspire, Work Challenge, Work Enable, and Work Encourage. These items included in each measure were totaled and transformed into five separate composite scores. Each composite score mean ranged from 6 to 60. Using the five composite scores, the researcher performed a one-way between groups multivariate analysis of variance (MANOVA) to examine program change differences in how engineers currently practice the leadership skills learned within their engineering program. The *F* score and level of significance are presented in tables. A Bonferonni calculation was run, increasing the study alpha level from .05 to .01 (Pallant, 2005). In the event of a significant difference, the effect size will be calculated to determine the magnitude of the effect.

CHAPTER IV

FINDINGS

Purpose of the Study

The purpose of this study was to examine the difference in perceptions toward undergraduate leadership practices of engineering alumni who received their baccalaureate degree between 2000 and 2006. This study also examined the effect of cocurricular involvement on leadership practices of engineering alumni. Because many of these engineers are currently working within the profession, they are expected to use leadership skills honed in college through academic and cocurricular activities. This study aimed to align an engineering program's specific learning outcomes against actual professional experiences. The research design selected for this study was a quantitative, causal comparative design (Creswell, 2005).

Introduction

Analyses conducted during this study are reported in this chapter. First, the participants' demographic variables were examined: gender, graduation year and engineering major. Second, college leadership development, workplace leadership practices and cocurricular leadership development subscales were analyzed to determine the extent to which the undergraduate experience improved for students between 2000 and 2006. Third, alumni cocurricular activity involvement was analyzed to determine the extent to which it affected both college and workplace leadership.

Demographics

The UD Alumni Office sent invitations to engineering alumni who graduated between 2000 and 2006. The UD email delivery system reported that a total of 270 engineering alumni opened the email, of which 216 (80%) actually responded to the survey questions. Before analyzing the data, incomplete surveys or cases identified as outliers were eliminated from the dataset. The final useable sample consisted of 148 engineers, 42 (28%) females and 106 (72%) males. Demographics are presented in Table 3 to Table 5.

Table 3 shows the number of female and male participants were representative of the target population which includes 346 female (22.54%) and 1,189 male (77.46%) alumni who graduated between 2000 and 2007.

Table 3

Gender (n = 148)

Gender	Frequency	Percent
Female	42	28
Male	106	72
Total	148	100

Table 4 shows graduates of each engineering class were equally represented within the study: 2000 (16%), 2001 (18%), 2002 (11%), 2003 (14%), 2004 (18%), 2005 (12%), and 2006 (12%).

Table 4

Graduation year (n = 148)

Year	Frequency	Percent
2000	23	16
2001	26	18
2002	16	11
2003	21	14

(table continues)

Table 4

Graduation year (n = 148)

Year	Frequency	Percent
2004	26	18
2005	18	12
2006	18	12
Total	148	100

Table 5 shows engineering majors were also equally represented: Chemical engineering (17.6%), Civil Engineering (23.0%), Computer / Electrical Engineering (17.6%), Engineering Technology (18.2%), and Mechanical Engineering (23.6%).

Table 5

Engineering Major (n = 148)

Engineering major	Frequency	Percent
Chemical engineering	26	17.6
Civil engineering	34	23.0
Computer / Electrical engineering	26	17.6
Engineering technology	27	18.2
Mechanical engineering	35	23.6
Total	148	100

Research Question 1:

To what extent were UD engineering alumni exposed to exemplary leadership practices within their undergraduate programs? To what extent do engineering alumni practice exemplary leadership practices in the workplace? How do their college practices and workplace leadership practices compare to the LPI norm?

College leadership development

To answer this research question, alumni were first asked to report how frequently they practiced leadership behaviors during courses taught in their college programs using the 30-item Leadership Practices Instrument (LPI). Descriptive statistics were run to obtain the means and standard deviations for each item on the LPI. The variable consisted of five measures : (a) College Model (i.e., set a personal example of what is expected of others), (b) College Inspire (i.e., talk about future trends that will influence how our work gets done), (c) College Challenge (i.e., seek out challenging opportunities that test my own skills and abilities), (d) College Enable (i.e., develop cooperative relationships among the people), and (e) College Encourage (i.e., praise people for a job well done). Items included in each measure were totaled and transformed into five separate composite scores. Descriptive statistics were also run to obtain the means and standard deviation on each of the five composite scores. Each composite score means ranged from 6 to 60.

Comparison of UD Alumni College Leadership to the Kouzes and Posner Norm

For each year, a set of one-sample *t* tests was conducted to compare UD engineering alumni perceptions of their college leadership development scores to the Kouzes and Posner LPI normative means of leaders in general taking the instrument: College Model, College Inspire, College Challenge, College Enable, and College Encourage.

College Enable. Table 6 shows there was no significant difference between the UD engineering alumni and the LPI norm, except during 2004, on their perceptions of the leadership practice of College Enable. This college leadership experience of participants was not perceived differently than the norm. In fact, respondents reported the College Enable practice carried the highest mean score compared to the other four practices for each year, except 2004 when the difference was minimal, suggesting the UD college culture consistently provided students opportunities to collaborate with others and contributing to the personal and professional development of oneself and others.

College Model. Respondents who graduated in 2000 reported College Model scores similar to the LPI norm. However, as shown in Table 6, participants who graduated between 2001 and 2004 consistently reported significantly lower perceptions toward the College Model practice than did the norm. Based on the findings, post-2004 graduates perceived they placed importance heavily on developing sound personal values and core principles, after which they spent time building relationships and sharing their values with others. In other words, post-2004 participants had a significantly higher perception toward College Model practices than participants who took the LPI previously. Results are summarized in Table 6.

College Encourage. Table 6 shows respondents who graduated between 2000 and 2004 scored significantly lower than the LPI norm on the practice of College Encourage. Post-2004 graduates perceived they were more caring and willing to build communities and recognize the roles and contributions of others. In other words, post-2004 graduates had a significantly higher perception of college leadership than participants who graduated between 2000 and 2004. Results are summarized in Table 6.

College Challenge. Between 2000 and 2004, UD engineers reported significantly lower perceptions of the College Challenge practice. Compared to Kouzes and Posner LPI norms, post-2004 graduates' scores were significantly similar. Respondents perceived the classroom experiences provided opportunities to lead which is similar to other leaders taking the LPI.

College Inspire. Of the college leadership practices presented, College Inspire carried the lowest mean score each year, compared to the other four practices. Respondents who graduated between 2000 and 2004 reported significantly lower perceptions toward the College Inspire practice than the Kouzes and Posner norm. Post-2004 graduates perceived themselves to be more engaged in developing and communicating challenging innovative ideas to others and engaging others in turning their ideas into a reality. Table 6 shows the results.

Overall, the results of this question suggest that the UD School of Engineering underwent changes that significantly enhanced the undergraduate experience for students, such that post-2004 alumni perceptions of their undergraduate exemplary leadership practices increased to levels comparable to the LPI norm in all five practices (Model, Inspire, Challenge, Enable and Encourage). Table 6 provides a summary of the college leadership LPI subscales compared to the norm by year.

Workplace leadership practices

Alumni were then asked with what frequency they practice the leadership skills learned within college courses in their current workplace. The second continuous dependent variable, workplace leadership, is also measured using each of the five LPI composite scores: Work Model, Work Inspire, Work Challenge, Work Enable, and Work Encourage. Items included in each measure were totaled and transformed into five separate composite scores. Descriptive statistics were also run to obtain the means and standard deviation on each of the five composite scores. Each composite score means ranged from 6 to 60.

Comparison of UD Alumni Workplace Leadership to the Kouzes and Posner Norm

For each year, a second set of one-sample *t* tests was conducted to compare the Kouzes and Posner LPI normative means of leaders in general taking the instrument to participants' workplace leadership development scores: Work Model, Work Inspire, Work Challenge, Work Enable, and Work Encourage. Table 6 shows engineers' who graduated between 2000 and 2006 reported workplace leadership mean scores either similar to or significantly higher than the normed population in all five Kouzes and Posner leadership practices. These findings suggest that despite their year of graduation, from the University, UD engineering alumni consistently practice within their workplace the exemplary leadership practices learned within their undergraduate programs. Table 6 provides a summary of the workplace leadership LPI subscales compared to the norm by year.

Table 6

Leadership Practices Inventory Subscales Compared to the Norm by Graduation Year

	Norm		Timeframe	2000							2001						
	M	*SD*		*N*	*M*	*SD*	*t*	*df*	*p*		*N*	*M*	*SD*	*t*	*df*	*p*	
Model	47.02	7.10	College	23	45.04	6.39	-1.49	22	.15		26	42.23	8.74	-2.80	25	.01	**
			Workplace	23	50.91	5.99	3.12	22	.01	**	26	49.27	6.35	1.81	25	.08	
Inspire	44.35	8.79	College	23	37.39	7.8	-4.28	22	.00	***	26	34.27	11.29	-4.55	25	.00	***
			Workplace	23	45.96	7.61	1.01	22	.32		26	42.12	10.51	-1.08	25	.29	
Challenge	46.11	7.22	College	23	41.3	7.8	-2.96	22	.01	**	26	38.77	7.95	-4.71	25	.00	***
			Workplace	23	47.7	6.2	1.23	22	.23		26	44.77	7.28	-0.94	25	.36	
Enable	49.40	6.42	College	23	47.65	6.07	-1.38	22	.18		26	47.62	6.34	-1.44	25	.16	
			Workplace	23	51.78	4.49	2.54	22	.02	*	26	52.31	3.72	4.00	25	.00	***
Encourage	47.06	8.19	College	23	42.57	7.72	-2.80	22	.01	**	26	42.12	9.07	-2.78	25	.01	**
			Workplace	23	47.26	8.13	0.12	22	.91		26	47.12	8.3	0.03	25	.97	

Note. $*p < .05$ $**p < .01$ $***p < .001$.

(table continues)

Table 6

Leadership Practices Inventory Subscales Compared to the Norm by Graduation Year

	Norm		Timeframe	2002							2003						
	M	*SD*		*N*	*M*	*SD*	*t*	*df*	*p*		*N*	*M*	*SD*	*t*	*df*	*p*	
Model	47.02	7.10	College	16	41.94	7.66	-2.65	15	.02	*	21	41.33	7.96	-3.28	20	.00	**
			Workplace	16	49.88	4.1	2.79	15	.01	*	21	48.38	5.86	1.06	20	.30	
Inspire	44.35	8.79	College	16	37.44	8.32	-3.32	15	.01	**	21	36.29	10.75	-3.44	20	.00	**
			Workplace	16	45.75	6.32	0.89	15	.39		21	44.48	8.99	0.06	20	.95	
Challenge	46.11	7.22	College	16	40.25	8.87	-2.64	15	.02	*	21	40.14	10.58	-2.59	20	.02	*
			Workplace	16	46.19	6.73	0.05	15	.96		21	45.38	6.69	-0.50	20	.62	
Enable	49.40	6.42	College	16	47.69	5.62	-1.22	15	.24		21	46.48	7.08	-1.89	20	.07	
			Workplace	16	51.38	3.42	2.31	15	.04	*	21	50.71	4.50	1.34	20	.20	
Encourage	47.06	8.19	College	16	42.13	8.08	-2.44	15	.03	*	21	40.33	10.69	-2.88	20	.01	**
			Workplace	16	49.31	4.01	2.25	15	.04	*	21	46	8.80	-0.55	20	.59	

Note. $*p < .05$ $**p < .01$ $***p < .001$.

(table continues)

Table 6

Leadership Practices Inventory Subscales Compared to the Norm by Graduation Year

	Norm		Timeframe	2004							2005						
	M	*SD*		*N*	*M*	*SD*	*t*	*df*	*p*		*N*	*M*	*SD*	*t*	*df*	*p*	
Model	47.02	7.10	College	26	42.81	7.78	-2.76	25	.01	**	18	46.17	8.42	-0.43	17	.67	
			Workplace	26	49.12	4.85	2.20	25	.04	*	18	51.39	5.07	3.66	17	.00	**
Inspire	44.35	8.79	College	26	39.54	10.03	-2.45	25	.02	*	18	42.11	9.93	-0.96	17	.35	
			Workplace	26	46.42	7.97	1.33	25	.20		18	47.5	5.96	2.24	17	.04	*
Challenge	46.11	7.22	College	26	39.65	9.46	-3.48	25	.00	**	18	42.94	9.82	-1.37	17	.19	
			Workplace	26	46.42	7.34	0.22	25	.83		18	48.33	6.19	1.52	17	.15	
Enable	49.40	6.42	College	26	46.65	6.94	-2.02	25	.05	*	18	48.67	6.93	-0.45	17	.66	
			Workplace	26	50.85	4.46	1.65	25	.11		18	52.67	4.07	3.40	17	.00	**
Encourage	47.06	8.19	College	26	43.12	8.29	-2.43	25	.02	*	18	46.56	8.14	-0.26	17	.80	
			Workplace	26	46	6.68	-0.81	25	.43		18	51.11	5.39	3.19	17	.01	**

Note. *p < .05 **p < .01 ***p < .001.

(table continues)

Table 6

Leadership Practices Inventory Subscales Compared to the Norm by Graduation Year

	Norm		Timeframe	2006						
	M	*SD*		*N*	*M*	*SD*	*t*	*df*	*p*	
Model	47.02	7.10	College	18	48.89	4.92	1.61	17	0.13	
			Workplace	18	52.00	4.80	4.40	17	0.00	***
Inspire	44.35	8.79	College	18	43.39	9.10	-0.45	17	0.66	
			Workplace	18	47.11	8.57	1.37	17	0.19	
Challenge	46.11	7.22	College	18	44.89	9.85	-0.53	17	0.61	
			Workplace	18	48.89	7.29	1.62	17	0.12	
Enable	49.40	6.42	College	18	48.67	6.30	-0.49	17	0.63	
			Workplace	18	51.78	5.81	1.74	17	0.10	
Encourage	47.06	8.19	College	18	46.89	7.61	-0.10	17	0.93	
			Workplace	18	48.72	7.10	0.99	17	0.34	

Note. $*p < .05$ $**p < .01$ $***p < .001$.

Research Question 2:

To what extent were UD engineering alumni involved in cocurricular activities that supported their undergraduate programs?

Cocurricular Involvement

The second research question asked alumni to first indicate how frequently they were involved in four cocurricular activities in which they may have engaged during college. The cocurricular activities variable consisted of four types of activities found in the literature (Lambert, Terenzini, & Lattuca, 2006; Lattuca, Terenzini, & Volkwein, 2006; Strauss & Terenzini, 2007) that typically provide opportunities for engineering students to develop their leadership skills: Involvement in (a) Internship/ Co-op experiences; (b) Study abroad assignments; (c) Design competitions/projects; and (d) Student chapters of professional organizations were included. Engineers selected one of five responses ranging from 1 = *Never* to 5 = *Always* for each activity. Leadership opportunities in cocurricular activities varied based on activity type. The frequency of leadership practice for each cocurricular activity is presented in Table 7.

Comparison of UD Alumni Cocurricular Level of Involvement to the Neutral Level of Involvement

For each year, a set of one-sample t tests was conducted to determine whether engineering alumni level of participation significantly exceeded the neutral level of "3" for each cocurricular activity: Internship/ Co-op experiences; Study abroad assignments; Involvement in design competitions/projects; and Professional organizations. Findings suggest that participants who graduated from the UD School of Engineering between 2000 and 2006 reported involvement in cocurricular activities, except study abroad programs, at or beyond the "neutral" level of involvement. Student design competitions/ projects mean scores increased significantly beyond the neutral level during the post-

2004 timeframe from 2001 when the score was $M = 2.50$ to 2005 when the mean score increased to $M = 3.67$. Although internship involvement varied during the 2000-2006 timeframe, participants consistently reported higher levels of internship involvement than other activities during each year. Between 2000 and 2006, internship mean scores ranged from $M = 3.35$ to $M = 3.67$. Involvement in student chapters of professional organizations also remained consistent, but their mean scores were not as high as internships. Professional organization involvement mean scores ranged from $M = 2.86$ to $M = 3.28$. Results are summarized in Table 7.

Table 7

Cocurricular Level of Involvement Compared to the Norm by Graduation Year

	Norm	2000							2001						
	M	*N*	*M*	*SD*	*t*	*df*	*p*		*N*	*M*	*SD*	*t*	*df*	*p*	
Internship / Cooperative experiences	3.0	23	3.35	1.27	1.32	22	.20		26	3.77	0.86	4.54	25	.00	***
Study abroad programs	3.0	23	1.35	0.98	-8.07	22	.00	***	26	1.31	0.74	-11.73	25	.00	***
Involvement in design projects outside the classroom	3.0	23	2.78	1.35	-.77	22	.45		26	2.50	1.27	-2.00	25	.06	
Involvement in student chapters of professional organizations	3.0	23	2.87	1.18	-.53	22	.60		26	3.00	1.50	.000	25	1.00	

Note. *$p < .05$ **$p < .01$ ***$p < .001$.

(table continues)

Table 7

Cocurricular Level of Involvement Compared to the Norm by Graduation Year

	Norm	2002							2003						
	M	*N*	*M*	*SD*	*t*	*df*	*p*		*N*	*M*	*SD*	*t*	*df*	*p*	
Internship / Cooperative experiences	3.0	16	3.63	1.02	2.44	15	.03	*	21	3.52	1.17	2.06	20	.05	*
Study abroad programs	3.0	16	1.25	0.68	-10.25	15	.00	***	21	1.48	1.03	-6.78	20	.00	***
Involvement in design projects outside the classroom	3.0	16	3.13	1.20	.42	15	.68		21	2.90	1.26	-.35	20	.73	
Involvement in student chapters of professional organizations	3.0	16	3.25	1.57	.64	15	.53		21	2.86	1.28	-.51	20	.61	

Note. *$p < .05$ **$p < .01$ ***$p < .001$.

(table continues)

Table 7

Cocurricular Level of Involvement Compared to the Norm by Graduation Year

	Norm	2004							2005						
	M	*N*	*M*	*SD*	*t*	*df*	*p*		*N*	*M*	*SD*	*t*	*df*	*p*	
Internship / Cooperative experiences	3.0	26	3.42	1.30	1.66	25	.11		18	3.67	1.19	2.38	17	.03	*
Study abroad programs	3.0	26	1.23	0.86	-10.46	25	.00	***	18	1.72	1.27	-4.25	17	.01	**
Involvement in design projects outside the classroom	3.0	26	3.00	1.33	.000	25	1.00		18	3.67	1.33	2.14	17	.05	*
Involvement in student chapters of professional organizations	3.0	26	3.15	1.41	.56	25	.58		18	3.28	1.27	.93	17	.37	

Note. *$p < .05$ **$p < .01$ ***$p < .001$.

(*table continues*)

Table 7

Cocurricular Level of Involvement Compared to the Norm by Graduation Year

	Norm	2006						
	M	*N*	*M*	*SD*	*t*	*df*	*p*	
Internship / Cooperative experiences	3.0	18	3.56	1.25	1.90	17	.08	
Study abroad programs	3.0	18	1.94	1.43	-3.12	17	.01	**
Involvement in design projects outside the classroom	3.0	18	3.61	0.70	3.72	17	.00	**
Involvement in student chapters of professional organizations	3.0	18	3.33	1.37	1.03	17	.32	

Note. $*p < .05$ $**p < .01$ $***p < .001$.

Research Question 3:

What is the effect of cocurricular involvement on the perception of engineering alumni college leadership development and workplace leadership practices? To address the third research question, four separate one-way between groups multivariate analyses of variance (MANOVA) were conducted using four independent variables in the analysis: (a) Internship/ Co-op experiences; (b) Study abroad assignments; (c) Involvement in design competitions/projects; and (d) Professional organizations.

Cocurricular Involvement

Finally, alumni were asked with what frequency they were involved in cocurricular activities. The third continuous dependent variable, Cocurricular involvement, was measured using the four types of cocurricular activities: (a) Internship/ Co-op experiences; (b) Study abroad assignments; (c) Involvement in design competitions/projects; and (d) Professional organizations. Each cocurricular activity score means ranged from 1 to 5. The frequency of leadership practice for each cocurricular activity is presented in Table 8.

Table 8

Cocurricular Activities - College Frequency of Leadership Involvement (n = 148)

Cocurricular activities	Never	Almost never	Neutral	Almost always	Always
Internship / cooperative experiences	14	10	30	68	26
Study abroad programs	121	2	16	4	5
Involvement in design projects outside the classroom	28	17	41	46	16
Involvement in student chapters of professional organizations	30	14	42	37	25

Leadership opportunities in cocurricular activities varied based on activity type. The frequency of leadership practice for each cocurricular activity is presented in Table

9. Due to inadequate responses in several categories, the five categories were transformed to create 3 levels of involvement: zero level, low level, and high level. The value of 1 was recoded as zero level involvement; 2 and 3 were recoded as low level involvement; and 4 and 5were recoded as high level involvement. Table 9 shows the frequency distribution for each cocurricular activity by level. All subsequent analyses utilizing cocurricular involvement in this question were conducted using these three levels of cocurricular involvement: zero level, low level, and high level.

Sixty-four percent of engineers reported high level undergraduate involvement in internship programs, more than any other cocurricular activity. Engineers reported similar levels of involvement in design projects/competitions (low level = 58 (39%); high level = 62 (42%) and involvement in student chapters of professional organizations (low level = 56 (38%); high level = 62 (42%)). More than 80% of engineers reported zero level involvement in the study abroad program offered at the University of Dayton. Roughly 20% of the sample was not involved in design projects or student chapters of professional organizations.

Table 9

Cocurricular Activities by Level of Involvement

	Internship level of involvement					
	Zero 1		Low 2-3		High 4-5	
Cocurricular activities	*n*	Percent	*n*	Percent	*n*	Percent
Internship / cooperative experiences	14	9	40	27	94	64
Study abroad programs	121	82	18	12	9	6
Involvement in design projects outside the classroom	28	19	58	39	62	42
Involvement in student chapters of professional organizations	30	20	56	38	62	42

Undergraduate Internship / Cooperative Experience

Effect of Internship Involvement on College Leadership

Engineers reporting a high level undergraduate involvement in internship programs reported the highest college leadership practices mean scores compared to the other two levels, as seen in Table 10. All three groups reported College Enable as their highest mean score (high level M = 48.00, SD = 6.62; low level M = 47.18, SD = 6.57; zero level M = 40.86, SD = 6.69) and College Inspire as their lowest (high level M = 39.65, SD = 10.07; low level M = 36.03.18, SD = 9.40; zero level M = 36.50, SD = 10.67). A one-way (internship level) multivariate analysis of variance (MANOVA) was conducted to investigate the differences between internship involvement levels on the five college leadership practices: College Model, College Inspire, College Challenge, College Enable, and College Encourage. However, MANOVA results did not show significant differences in mean scores by level across the combined college leadership dependent variable, Wilks' Λ = .910, F (10, 282) = 1.36, p = .20, η^2 = .05. In other words, internships had no significant effect on the college leadership development of UD engineering students. Results are summarized in Table 10.

Table 10

College Leadership Practices Means by Internship Level of Involvement

	Internship level of involvement						
	Zero		Low		High		
	n = 14		n = 40		n = 94		
College leadership practices	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*
Model	41.43	7.82	43.45	7.96	44.46	7.74	
Inspire	36.50	10.67	36.03	9.40	39.65	10.07	
Challenge	36.21	8.29	39.95	9.43	42.04	9.03	
Enable	45.64	4.33	47.18	6.57	48.00	6.62	
Encourage	40.86	6.69	41.78	8.68	44.20	8.90	
							1.36

Note. $^{*}p < .05$

Effect of Internship Involvement on Workplace Leadership

Engineers reporting high level undergraduate involvement in internship programs reported the highest workplace leadership practices mean scores. For instance, high level leaders reported a higher Work Model mean scores ($M = 50.38$, $SD = 5.21$) than both zero level ($M = 49.36$, $SD = 5.61$) and low level ($M = 49.43$, $SD = 5.99$) leaders. Another one-way (internship level) multivariate analysis of variance (MANOVA) was conducted to investigate the differences between internship involvement levels on the five workplace leadership practices: Work Model, Work Inspire, Work Challenge, Work Enable, and Work Encourage. However, MANOVA results did not show significant differences in mean scores by level across the combined workplace leadership dependent variable, Wilks' $\Lambda = .910$, $F\,(10, 282) = 1.36, p = .20$, $\eta^2 = .05$, Wilks' $\Lambda = .92$, $F\,(10, 282) = 1.21, p = .29$, $\eta^2 = .04$. Table 11 presents means and standard deviations for each workplace leadership practice by internship leadership level. In other words, internships had no significant effect on the college leadership development of UD engineering students. Results are summarized in Table 11.

Table 11

Workplace Leadership Practices Means by Internship Level of Involvement

	Internship level of involvement						
	Zero		Low		High		
	n = 14		n = 40		n = 94		
Workplace leadership practices	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*
Model	49.36	5.61	49.43	5.99	50.38	5.21	
Inspire	44.79	8.69	44.05	8.72	46.16	8.09	
Challenge	44.36	6.73	45.78	6.90	47.43	6.83	
Enable	51.29	5.04	51.25	3.69	51.83	4.54	
Encourage	44.21	7.92	46.48	8.22	48.74	6.62	
							1.21

Note. $*p < .05$

Study Abroad Experience

Effect of Study Abroad Involvement on College leadership

Engineers reporting high level undergraduate involvement in study abroad programs reported the highest college leadership practices mean scores. For instance, high level participants reported a higher College Enable mean scores (M = 49.11, SD = 8.22) than both zero level (M = 47.53, SD = 6.51) and low level (M = 46.94, SD = 5.01) participants. A one-way (study abroad level) multivariate analysis of variance (MANOVA) was conducted to investigate the differences among study abroad involvement levels on the five college leadership practices: College Model, College Inspire, College Challenge, College Enable, and College Encourage. However, MANOVA results did not show significant differences in mean scores by level across the combined college leadership dependent variable, Wilks' Λ = .96, F (10, 282) = .59, p = .82, multivariate η^2 = .02. Table 12 presents means and standard deviations for each college leadership practice by study abroad involvement level. In other words, study abroad involvement had no significant effect on the college leadership development of UD engineering students. Results are summarized in Table 12.

Table 12

College Leadership Practices Means by Study Abroad Level of Involvement

	Study abroad level of involvement						
	Zero *n* = 121		Low *n* = 18		High *n* = 9		
College leadership practices	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*
Model	43.80	7.98	43.39	6.18	46.22	8.77	
Inspire	37.97	10.24	39.06	6.97	42.44	12.18	
Challenge	40.78	9.19	41.33	7.58	42.11	12.65	
Enable	47.53	6.51	46.94	5.01	49.11	8.22	
Encourage	42.88	8.87	44.22	5.73	45.89	11.42	
							.96

Note. * Indicates significance

Effect of Study Abroad Involvement on Workplace Leadership

Engineers reporting high level undergraduate involvement in study abroad programs reported higher workplace leadership practices mean scores. In this case, high level participants reported a higher College Model mean scores (M = 51.33, SD = 4.53) than both zero level (M = 49.96, SD = 5.77) and low level (M = 46.83) participants. Another one-way (study abroad level) multivariate analysis of variance (MANOVA) was conducted to investigate the differences between study abroad involvement levels on the five workplace leadership practices: Work Model, Work Inspire, Work Challenge, Work Enable, and Work Encourage. However, MANOVA results did not show significant differences in mean scores by level across the combined workplace leadership dependent variable, Wilks' Λ = .96, F (10, 282) = .62, p = .80, η^2 = .02. In other words, study abroad involvement had no significant effect on the college leadership development of UD engineering students. Results are summarized in Table 13.

Table 13

Workplace Leadership Practices Means by Study Abroad Level of Involvement

	Study abroad level of involvement						
	Zero		Low		High		
	n = 121		n = 18		n = 9		
Workplace leadership practices	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*
Model	49.96	5.77	49.83	3.33	51.33	4.53	
Inspire	45.26	8.75	45.50	6.33	48.11	5.25	
Challenge	46.65	7.12	46.33	5.94	47.89	5.60	
Enable	51.78	4.42	50.17	3.75	52.44	4.45	
Encourage	47.50	7.57	47.67	6.52	50.56	4.72	
							.62

Note. * Indicates significance

Design Competitions / Projects

Effect of Design Competition / Projects Involvement on College Leadership

Engineers reporting high level undergraduate involvement in design competition / projects reported the highest college leadership practices mean scores. For instance, high level participants reported a higher College Encourage mean scores (M = 45.95, SD = 7.67) than both zero level (M = 39.75, SD = 9.61) and low level (M = 42.00), SD = 8.56) participants. A one-way (design competition level) multivariate analysis of variance (MANOVA) was conducted to investigate the differences between design competition involvement levels on the five college leadership practices: College Model, College Inspire, College Challenge, College Enable, and College Encourage. Statistically significant differences were found across mean scores in the three levels of design competition involvement on the college leadership dependent variables (Wilks' Λ = .84, F (10, 282) = 2.62, $p < .05$, η^2 = .09). The moderate effect size of .09, suggests 9% of the variance in undergraduate engineering leadership was explained by engineers' level of leadership in design programs.

Analyses of variance were conducted on each dependent variable as a follow-up test to the MANOVA using the Bonferoni method. This procedure adjusted the alpha level from .05 to .01. Significance in undergraduate engineering leadership was found at the univariate level for College Model (F (2,145) = 8.44, $p < .01$, η^2 = .01(College Inspire (F (2,145)=8.77, $p < .01$, η^2 = .11); College Challenge (F (2,145)=10.66, $p <$ .01, η^2 = .13); College Enable (F (2, 145)=6.42, $p < .01$, η^2 = .08) and College Encourage (F (2,145)= 6.24, $p < .01$, η^2 = .08. Results are summarized in Table 14.

A subsequent Tukey post hoc analysis to the univariate ANOVA for all dependent variables was conducted to determine mean differences using the adjusted alpha level of .01. While Table 14 indicates differences in mean scores between the various levels of involvement, not all differences were significant. Results revealed high level participants' mean scores were significantly higher in the College Model, College Inspire, College Challenge, College Enable, and College Encourage leadership practice than zero level participants. In addition, results show participants with any level of involvement in design competitions reported significantly higher mean scores in the practice of College Challenge than zero level leaders. Table 14 presents means, standard deviations and significant mean differences for each college leadership practice by design competition involvement level.

Table 14

College leadership Practices Means by Design Competition Level of Involvement

	Design competition level of involvement						
	Zero		Low		High		
	n = 28		n = 58		n = 62		
College leadership practices	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*
Model	39.36	9.21	43.55	7.08	46.27	6.87	
					H>Z**		
Inspire	32.50	10.27	37.84	9.97	41.52	8.75	
					H>Z**		
Challenge	34.61	9.39	41.05	8.49	43.66	8.43	
			L>Z**		H>Z**		
Enable	44.39	6.95	47.14	6.21	49.37	5.84	
					H>Z**		
Encourage	39.75	9.61	42.00	8.56	45.95	7.67	
					H>Z**		
							2.62*

Note. *p < .05 **p < .01; Z = zero; L = low; H = high

Effect of Design Competitions / Project Involvement on Workplace Leadership

Engineers indicating high level undergraduate involvement in design competitions / projects reported the highest college leadership practices mean scores. For example, high level participants reported higher Work Enable mean scores (M = 52.61, SD = 4.01) than both zero level (M = 51.07, SD = 4.21) and low level (M = 50.83, SD = 4.63) participants. A one-way (design competition level) multivariate analysis of variance (MANOVA) was conducted to investigate the differences between design competition involvement levels on the five workplace leadership practices: Work Model, Work Inspire, Work Challenge, Work Enable, and Work Encourage. Statistically significant differences were found across the three levels of design competition involvement on the workplace leadership dependent variables, Wilks' $\Lambda = .85$, $F\,(10, 282) = 2.43, p < .05$, $\eta^2 = .08$. The moderate effect size of .08, suggests 8% of the variance in workplace engineering leadership was explained by engineers' level of involvement in design programs.

Analyses of variance were conducted on each dependent variable as a follow-up test to the MANOVA using the Bonferoni method. This procedure adjusted the alpha level from .05 to .01. Significance in undergraduate engineering leadership was found at the univariate level only for Work Inspire ($F\,(2,145)=8.77, p < .01,\ \eta^2 = .11$) and Work Challenge ($F\,(2,145)=10.66, p < .01,\ \eta^2 = .13$). Results are summarized in Table 15.

A subsequent Tukey post hoc analysis to the univariate ANOVA for all dependent variables was conducted to determine mean differences using the adjusted alpha level of .01. Univariate ANOVA results revealed high level participants' Work Inspire leadership practices mean scores were significantly higher in the Work Inspire leadership practice than zero level participants. In fact, high level participants reported higher Work Challenge mean scores than both zero level and low level participants. These results clearly show that highly involved students are more likely to develop critical workplace skills than non-participants or low-level involved participants. In other words, design competition level of involvement had a significant effect on the workplace leadership development of UD engineering students. Results are summarized in Table 15.

Table 15

Workplace Leadership Practices Means by Design Competition Level of Involvement

	Design competition level of involvement						
	Zero		Low		High		
	n = 28		*n* = 58		*n* = 62		
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*
Workplace leadership practices							
Model	48.75	4.90	49.29	5.99	51.29	4.96	
Inspire	42.39	8.63	44.02	8.56	48.19	7.15	
					H>Z**		
Challenge	43.21	7.12	45.34	7.01	49.52	5.49	
			H>L**		H>Z**		
Enable	51.07	4.21	50.83	4.63	52.61	4.01	
Encourage	45.43	8.11	46.95	7.29	49.44	6.63	
							2.43*

Note. *$p < .05$ **$p < .01$; Z = zero; L = low; H = high.

Professional Organizations

Effect of Professional Organization Involvement on College Leadership

Engineers indicating high level undergraduate involvement in professional organizations reported the highest college leadership practices mean scores. For example, high level participants reported a higher College Encourage mean scores (*M* = 44.69, *SD* = 8.65) than both zero level (*M* = 41.23, *SD* = 9.54) and low level (*M* = 42.68, *SD* = 8.16) participants. A one-way (professional organization level) multivariate analysis of variance (MANOVA) was conducted to investigate the differences between professional organization involvement levels on the five college leadership practices: College Model, College Inspire, College Challenge, College Enable, and College Encourage. However, MANOVA results did not show significant differences in mean scores by level across the combined college leadership dependent variable (Wilks' Λ = .89, F (10, 282) = 1.78, p =

.07, η^2 = .06). In other words, professional organization involvement had no significant effect on the college leadership development of UD engineering students. Results are summarized in Table 16.

Table 16

College leadership Practices Means by Professional Organization Level of Involvement

	Professional organization level of involvement						
	Zero		Low		High		
	n = 30		n = 56		n = 62		
College leadership practices	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*
Model	41.50	7.95	43.13	7.52	45.76	7.68	
Inspire	33.87	10.19	39.04	9.65	39.95	9.80	
Challenge	37.10	10.22	41.52	7.95	42.24	9.36	
Enable	46.33	6.09	47.50	5.99	48.19	6.96	
Encourage	41.23	9.54	42.68	8.16	44.69	8.65	
							1.78

Note. * Indicates significance

Effect of Professional Organization Involvement on Workplace Leadership

Another one-way (professional organization level) multivariate analysis of variance (MANOVA) was conducted to investigate the differences between undergraduate professional organization involvement levels on the five workplace leadership practices: Work Model, Work Inspire, Work Challenge, Work Enable, and Work Encourage. However, MANOVA results did not show significant differences in mean scores by level across the combined workplace leadership dependent variable (Wilks' Λ = .89, F (10, 282) = 1.76, p = .07, η^2 = .06). In other words, professional organization involvement had no significant effect on the workplace leadership development of UD engineering students. Results are summarized in Table 17.

Table 17

Workplace Leadership Practices Means by Professional Organization Level of Involvement

	Professional organization level of involvement						
	Zero		Low		High		
	n = 30		n = 56		n = 62		
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*
Workplace leadership practices							
Model	49.87	5.14	49.20	5.79	50.85	5.24	
Inspire	43.00	9.97	46.02	7.61	46.15	7.96	
Challenge	44.10	8.27	47.77	5.96	46.97	6.70	
Enable	51.17	3.64	51.48	4.67	51.97	4.42	
Encourage	47.17	8.09	47.32	7.32	48.31	6.98	
							1.76

Note. * Indicates significance

Research Question 4:

How do perceptions of engineering alumni college leadership development and workplace leadership practices differ by gender, major and graduation year?

To address the fourth research question, a one-way between groups multivariate analysis of variance (MANOVA) was conducted using three independent variables in the analysis: (a) gender, (b) major, and (c) graduation year.

Gender

Effect of Gender on College Leadership

Female engineers reported higher mean scores on each college leadership practice as compared to males. Males and females both reported College Enable as their highest mean score (female M = 48.52, SD = 6.31; male M = 47.17, SD = 6.46) and College Inspire as their lowest (female M = 38.83, SD = 9.60; male M = 38.19, SD = 10.23

A one-way (gender) multivariate analysis of variance (MANOVA) was conducted to investigate participant perceptions toward their college leadership development: College Model, College Inspire, College Challenge, College Enable, and College Encourage. However, MANOVA results did not show a significant main effect for college leadership development, (Wilks' Λ = .96, F (5, 142) =1.08, p = .38, η^2 = .04). In other words, gender had no significant effect on the college leadership development of UD engineering students. Results are summarized in Table 18.

Table 18

College Leadership Practices Means by Gender

	Gender				
	Female n = 42		Male n = 106		
	M	*SD*	*M*	*SD*	*F*
College leadership practices					
Model	45.26	7.71	43.36	7.82	
Inspire	38.83	9.60	38.19	10.23	
Challenge	41.38	9.53	40.75	9.09	
Enable	48.52	6.31	47.17	6.46	
Encourage	43.60	8.95	43.08	8.65	
					1.08

Note. *p < .05 **p < .01

Effect of Gender on Workplace Leadership

Both male and female engineers reported Work Enable as their highest mean score (female M = 51.55, SD = 4.87; male M = 51.65, SD = 4.11) and Work Inspire as their lowest mean score (female M = 44.79, SD = 8.87; male M = 45.73, SD = 8.11). Female engineers' scores on the practices of Work Model (female M = 50.21, SD = 6.03; male M = 49.95, SD = 5.23) and Work Encourage (female M = 48.17, SD = 7.58 male M = 47.52, SD = 7.23) were slightly higher than males' scores; whereas, males scored slightly higher on Work Inspire (female M = 45.73, SD = 8.11; male M = 44.79, SD = 8.87), Work Challenge (female M = 46.05, SD = 7.22); male M = 46.94, SD = 6.75), and Work Enable (female M = 51.55, SD = 4.97; male M = 51.65, SD = 4.11).

A one-way (gender) multivariate analysis of variance (MANOVA) was conducted to investigate participant perceptions toward their workplace leadership practices: Work Model, Work Inspire, Work Challenge, Work Enable, and Work Encourage. However, MANOVA results did not show a significant main effect for workplace leadership practices, (Wilks' Λ = .98, F (5,142) = .59, p = .71, η^2 = .02). In other words, gender had no significant effect on the workplace leadership practices of UD engineering students. Results are summarized in Table 19.

Table 19

Workplace Leadership Practices Means by Gender

	Gender				
	Female n = 42		Male n = 106		
Workplace leadership practices	M	SD	M	SD	F
Model	50.21	6.03	49.95	5.23	
Inspire	44.79	8.87	45.73	8.11	
Challenge	46.05	7.22	46.94	6.75	
Enable	51.55	4.97	51.65	4.11	
Encourage	48.17	7.58	47.52	7.23	
					.59

Note. *p < .05 **p < .01

Major

Effect of Engineering Major on College Leadership

Engineers in all five majors reported College Enable as their highest mean score (M = 48.09, SD = 6.42) and College Inspire as their lowest (M = 35.85, SD = 10.25). A one-way (engineering major) multivariate analysis of variance (MANOVA) was conducted to investigate participant perceptions toward their college leadership development: College Model, College Inspire, College Challenge, College Enable, and College Encourage.

However, MANOVA results did not show a significant main effect for college leadership development, (Wilks' Λ = .88, F (20, 462) = .89, p = .60, η^2 = .03). In other words, engineering major had no significant effect on the workplace leadership practices of UD engineering students. Results are summarized in Table 20.

Table 20

College Leadership Practices Means by Engineering Major

	Engineering major										
	Chemical n = 26		Civil n = 34		Computer - Electrical n = 26		Engineering Technology n = 27		Mechanical n = 35		
College leadership practices	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*
Model	44.58	6.79	42.56	8.53	43.62	7.21	43.85	9.16	44.94	7.32	
Inspire	37.62	9.20	35.85	10.25	38.81	9.58	39.74	11.29	40.00	9.71	
Challenge	40.58	8.09	38.59	9.73	41.65	7.80	42.63	10.05	41.60	9.70	
Enable	47.12	5.31	46.76	6.82	47.88	5.49	47.96	7.93	48.09	6.42	
Encourage	43.35	7.94	40.47	8.56	44.85	8.26	42.74	9.98	45.00	8.42	
											.89

Note. *p < .05 **p < .01

Effect of Engineering Major on Workplace Leadership

Engineers of the Engineering Technology and Computer / Electrical programs reported higher mean scores on each workplace leadership practice compared to the other engineering majors. Engineers in all five majors reported Work Enable as their highest mean score (M = 53.30, SD = 4.80) and Work Inspire as their lowest (M = 47.93, SD = 7.15).

A one-way (engineering major) multivariate analysis of variance (MANOVA) was conducted to investigate participant perceptions toward their workplace leadership practices: Work Model, Work Inspire, Work Challenge, Work Enable, and Work Encourage. The MANOVA results did show significant differences in mean scores by major across the combined workplace leadership practice dependent variable (Wilks' Λ = .79, F (20, 462) =1.66, $p < .05$, $\eta^2 = .06$).

Analyses of variance for perceptions toward college leadership development were then conducted on each dependent variable as a follow-up test to the MANOVA using the Bonferoni method. This procedure adjusted the alpha level from .05 to .01 to control for a Type 1 error. However, the follow-up ANOVA did not indicate a significant difference in major at the univariate level. In other words, engineering major had no significant effect on the workplace leadership practices of UD engineering students. Results are summarized in Table 21.

Table 21

Workplace Leadership Practices Means by Engineering Major

	Engineering major										
	Chemical n = 26		Civil n = 34		Computer - Electrical n = 26		Engineering Technology n = 27		Mechanical n = 35		
Workplace leadership practices	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*
Model	50.19	5.44	49.06	6.60	51.38	4.52	51.63	4.40	48.60	5.30	
Inspire	43.69	7.73	43.65	9.05	46.69	7.73	47.93	7.15	45.71	8.98	
Challenge	45.58	6.72	44.06	7.65	48.50	5.61	49.48	5.81	46.57	6.98	
Enable	51.27	4.73	50.91	4.62	51.92	3.25	53.30	4.80	51.06	4.03	
Encourage	46.73	6.89	45.59	8.59	50.65	5.05	48.37	6.70	47.77	7.70	
											1.66

Note. *p < .05 **p < .01

Graduation Year

Effect of Graduation Year on College Leadership

Engineers who graduated between 2005 and 2006 reported higher mean scores ($M = 48.67$ and $M = 48.89$ respectively) on each workplace leadership practice compared to graduates of earlier year categories. Engineers in all 7 years reported College Enable as their highest mean score ($M = 48.67$, $SD = 6.93$) and College Inspire as their lowest ($M = 34.27$, $SD = 11.29$).

A one-way (graduation year) multivariate analysis of variance (MANOVA) was conducted to investigate participants' perceptions toward their college leadership development: College Model, College Inspire, College Challenge, College Enable, and College Encourage. The MANOVA results did show significant differences in mean scores by major across the combined college leadership development dependent variable (Wilks' $\Lambda = .74$, $F\,(30,550) = 1.47$, $p < .05$, $\eta^2 = .06$).

Analyses of variance for perceptions toward college leadership development were then conducted on each dependent variable as a follow-up test to the MANOVA using the Bonferoni method. This procedure adjusted the alpha level from .05 to .01 to control for a Type 1 error. However, the follow-up ANOVA did not indicate a significant difference in major at the univariate level. In other words engineering major had no significant effect on the college leadership development of UD engineering students. Results are summarized in Table 22.

Table 22

College Leadership Practices Means by Graduation Year

College leadership practices	Graduation year														
	2000		2001		2002		2003		2004		2005		2006		
	n = 23		*n* = 26		*n* = 16		*n* = 21		*n* = 26		*n* = 18		*n* = 18		
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*
Model	45.04	6.39	42.23	8.74	41.94	7.66	41.33	7.963	42.81	7.78	46.17	8.42	48.89	4.92	
Inspire	37.39	7.80	34.27	11.29	37.44	8.32	36.29	10.75	39.54	10.03	42.11	9.93	43.39	9.10	
Challenge	41.30	7.80	38.77	7.95	40.25	8.87	40.14	10.58	39.65	9.46	42.94	9.82	44.89	9.85	
Enable	47.65	6.07	47.62	6.34	47.69	5.62	46.48	7.08	46.65	6.94	48.67	6.93	48.67	6.30	
Encourage	42.57	7.72	42.12	9.07	42.13	8.08	40.33	10.69	43.12	8.29	46.56	8.14	46.89	7.61	
															1.47

Note. $*p < .05$ $**p < .01$

Effect of Graduation Year on Workplace Leadership

Engineers in all 7-year categories reported Work Enable as their highest mean score (M = 52.31, SD = 3.72) and Work Inspire as their lowest (M = 42.12, SD = 10.51).

A one-way (graduation year) multivariate analysis of variance (MANOVA) was conducted to investigate participants' perceptions toward their workplace leadership practices: Work Model, Work Inspire, Work Challenge, Work Enable, and Work Encourage. However, MANOVA results did not show a significant main effect for workplace leadership practices, (Wilks' $\Lambda = .78$, $F(30,550) = 1.20$, $p = .22$, $\eta^2 = .05$). In other words, graduation year had no significant effect on the workplace leadership practices of UD engineering students. Results are summarized in Table 23.

Table 23

Workplace Leadership Practices Means by Graduation Year

Workplace leadership practices	Graduation year														
	2000 $n = 23$		2001 $n = 26$		2002 $n = 16$		2003 $n = 21$		2004 $n = 26$		2005 $n = 18$		2006 $n = 18$		
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*
Model	50.91	5.99	49.27	6.35	49.88	4.10	48.38	5.86	49.12	4.85	51.39	5.07	52.00	4.80	
Inspire	45.96	7.61	42.12	10.51	45.75	6.32	44.48	8.99	46.42	7.97	47.50	5.96	47.11	8.57	
Challenge	47.70	6.20	44.77	7.28	46.19	6.73	45.38	6.69	46.42	7.34	48.33	6.19	48.89	7.29	
Enable	51.78	4.49	52.31	3.72	51.38	3.42	50.71	4.50	50.85	4.46	52.67	4.07	51.78	5.81	
Encourage	47.26	8.13	47.12	8.30	49.31	4.01	46.00	8.80	46.00	6.68	51.11	5.39	48.72	7.10	
															1.20

Note. *$p < .05$ **$p < .01$

Summary of Findings

This study examined the difference in alumni perceptions toward undergraduate leadership practices and current leadership practices by answering four research questions. A summary of the findings for each question is provided below.

Research Question 1:

To what extent were UD engineering alumni exposed to leadership practices within their undergraduate programs? To what extent do engineering alumni practice exemplary leadership practices in the workplace? How do their college practices and workplace leadership practices compare to the LPI norm?

Participants who graduated post-2004 perceived they consistently practiced exemplary leadership practices similar to the LPI norm in the five LPI practices within their engineering classrooms. Based on these findings, UD post-2004 graduates perceived themselves to be exemplary leaders more so than did pre-2004 alumni.

Compared to the LPI norm, UD engineers who graduated between 2000 and 2006 had either similar or significantly higher perceptions toward workplace leadership practices.

Research Question 2:

To what extent were UD engineering alumni involved in cocurricular activities during their undergraduate experience?

Participants who graduated from the UD School of Engineering between 2000 and 2006 reported involvement in cocurricular activities, except study abroad programs, at or beyond the "neutral" level of involvement. Based on the findings, participants who graduated post-2004 had more opportunities to get involved in cocurricular programs through design competitions/projects.

Research Question 3:

What is the effect of cocurricular involvement on the perception of engineering alumni college leadership development and workplace leadership practices?

Results showed there was a significant main effect for level of involvement in design competitions for both the college and workplace leadership practices. Results revealed high level design competition respondents reported mean scores significantly higher than zero level participants for the practices of College Model, College Inspire, and College Enable and Encourage. Results also showed both low level and high level involvement in design competitions respondents reported significantly higher mean scores in the practice of College Challenge than did zero level leaders.

The results also showed that high level undergraduate involvement in design competitions had a significant positive effect on participants' workplace leadership skills in the practices of Work Inspire and Work Challenge.

Research Question 4:

How do perceptions of engineering alumni college leadership development and workplace leadership practices differ by gender, major, and graduation year?

Results did not show a significant main effect for gender and college or workplace leadership development. Results did not show a significant main effect for college or workplace leadership development and major. Results did not show a significant main effect for graduation year and college and workplace leadership practices.

CHAPTER V

DISCUSSION

Purpose of the Study

The purpose of this study was to examine the difference in perceptions toward undergraduate leadership practices of engineering alumni who received their baccalaureate degree from UD between 2000 and 2006. This study also examined the effect of cocurricular involvement on concomitant leadership practices of these engineering alumni. Because many of these engineers currently work within the profession, they are expected to use leadership skills honed in college through academic and cocurricular activities. This study results show UD engineering programs' specific learning outcomes align with professional expectations. The research design selected for this study is a quantitative causal comparative design (Creswell, 2005).

The current study expounds on the original works of Terenzini, Springer, Pascarella and Nora (1995a, 1995b), Lambert, Terenzini, and Lattuca (2006) and Strauss and Terenzini (2007) investigating whether involvement in university environments provide opportunities for engineering undergraduates to hone their leadership skills during their undergraduate experience. Participants also had an opportunity to identify how their undergraduate experience influences their current workplace practices. This chapter reviews the analysis and findings of the four research questions examined in this study. Implications and recommendations for future studies are also included.

RECOMMENDATIONS

Effect of Design Competition / Projects Level of Involvement on Leadership

This study examines students' perceptions of the effect of cocurricular activities on engineering leadership. Based on the findings of this study, undergraduate level of involvement in design competitions enhances each of the five college leadership practices (Model, Inspire, Challenge, Enable, and Encourage) of engineers. High level involvement in design competitions has a significant positive effect on their workplace Inspire and Challenge practices.

Despite the fact that over 80% of participants reported involvement in internships, professional organizations or design competitions, undergraduate involvement in design competition is the only cocurricular activity that has a significant effect on the perceived college leadership of UD engineering alumni. This finding is consistent with Lambert et al. (2006) and Strauss and Terenzini (2007) who found involvement in design competitions enhances students' engineering group skills and engineering design and analytical skills. This finding also supports Kuh (1995), who found students who present their research at program specific conferences are more likely to develop organizational, leadership and decision-making skills. Compared to other types of cocurricular activities, academic activities (which include design competitions and presentations) accounted for 42% of student knowledge and academic gains and 30% of interpersonal gains (Kuh). These findings imply that students perceive that engineering design competitions at UD offer them diverse leadership opportunities that are not available in the other three cocurricular activities examined in this study.

Participants of design competitions are usually upper-level students who have mastery in a specific area and have developed the ability to integrate learning from all of their classes. Project sponsors engage students to solve a particular engineering problem, giving a set of criteria from which students operate. Design teams manage their project timeline, cost, quality and requirements, consulting with a sponsor autonomously.

Perhaps design students perceive an increase in leadership development because of their ability to articulate engineering concepts, lead a design team, work independently from their university faculty, practice in a field of engineering, and transfer technical and professional skills to the profession. Overall, students engaged in design competitions are more active in their own learning and develop numerous skills critical to their cognitive, academic, and interpersonal competence (Kuh, 1995). Design projects have been so successful at UD, post-2006 course offerings expanded to provide upperclass students similar experiential learning opportunities in the classroom. Assignments in these classes provide opportunities for engineering students to collaborate with students from other disciplines as they develop solutions to problems presented by local corporations. Because findings show design competitions and projects contribute to students' leadership development of upperclass students, perhaps UD could consider offering a design seminar for first-year and second-year students. This recommendation will further support the SOE mission to integrate leadership development into each engineering program. Student learning could be enhanced in four unique ways. First, students will build on their experiences each year by engaging in relevant hands-on activities. Second, freshman and sophomore students will have an opportunity to develop a sense of identity with the profession and apply their technical skills prior to their capstone experience. Third, students will also engage in projects that hone their leadership, problem-solving, presentation, and communication skills that are critical to the engineering profession. Fourth, participating in design projects appropriate for students' level of expertise could also enhance students' self concept and professional socialization process earlier in their careers (Pascarella & Terenzini, 2005).

Effect of Internships on Leadership

Although participants consistently report higher levels of internship involvement than any other cocurricular activity during each timeframe, findings show undergraduate involvement in internships and co-ops do not enhance college or workplace leadership practices of UD engineering alumni. This finding differs from the recent findings of Lambert et al. (2006) and Strauss and Terenzini (2007) who found engineering interns attributed their gains in group skills and design and analytical skills to their internship experiences. The current findings also contradict Kuh's work (1995) which found students who worked report gains in their decision-making, time management and specific skills related to their anticipated post-college careers. Several researchers also found students engaged in internship or work assignments report gains in leadership understanding and commitment, civic responsibility, and community awareness (Astin, 1993; Cress et al., 2001; Ingram, 2005; Kuh, 1995).

While working as an intern may allow students to develop their technical skills, the current findings indicate that UD engineering students may have fewer opportunities to enhance their leadership skills during their co-op / internship experience. Research suggests that involvement in internship programs provides opportunities for socialization into the engineering profession and for student development of critical engineering skills including relationship building, team building and self confidence (Colbeck et al., 2000) but among these students the perception of leadership as a result of internships is not apparent.

In its most recent strategic plan, the UD School of Engineering demonstrated its commitment to developing its students and faculty experientially for the changing technological demands. In its effort to "seek out the resources to guide a co-operative education experience that is more integrated with the core courses" (UDSOE Strategic Plan, 2006), UD's School of Engineering may find it beneficial to schedule regular site visits in order to determine the extent to which co-op experiences are valuable to its technical, leadership or professional development. Faculty or staff may need to reevaluate industry sites and expectations for students in order to render those experiences of higher quality. Because UD students can register for co-op credit during their sophomore year, it is important to set expectations based on students' skills, length of assignments and number of assignments. Perhaps the School of Engineering might consider collaborating with the Dean's Advisory Board to clearly define a broad range of leadership experiences employed in each engineering discipline for industry partners to emphasize. Because the Board is comprised of industry leaders and alumni, they would be capable of determining the appropriate level of leadership experiences suitable for students based on the length of time students have been engaged in co-op and internship experiences. Although the field of engineering typically requires engineers to demonstrate high levels of competence prior to assuming leadership responsibilities, it is still possible for employers to develop small scale experiences for students to begin to model sound leadership practices.

Effect of Study Abroad Involvement on Leadership

Findings of this study suggest that undergraduate study abroad involvement is not significant to college or workplace leadership practices of engineers. Based on the findings, undergraduate involvement in study abroad programs does not improve the student's perceived college or workplace leadership practices of engineers. These findings are consistent with the findings of Lambert et al. (2006) and Strauss and Terenzini (2007) who found study abroad involvement to have no effect on student group skills and design and analytical skills development. While few studies examine the effects of study abroad involvement on student leadership, Kuh (1995) found traveling abroad offers students the unique opportunity to develop an appreciation for the arts and develop cultural awareness but this study, like others, does not necessarily address enhancing leadership development, especially in the engineering field.

According to the director of the UD International Education department (Amy Anderson, personal communication, October 8, 2008), study abroad programs were not very popular with earlier graduates of UD engineering programs. This might explain why over 80% of engineers reported no involvement in the study abroad programs between 2000 and 2006. In its 2006 Strategic Plan, UD named *International Engagement* as one of its five strategic initiatives. This initiative commits to "advancing the international and intercultural citizenship and engagement" (University of Dayton Board of Trustees, 2006b). In other words, all departments, including the School of Engineering, must now focus on developing a sound international education experience for their students. It also supports the Marianists' goal to use education to influence the global world.

The role of a Marianist university is to ensure that through exposure to different cultures and worlds, members of the community will develop an appreciation for the contributions of others. In 2003, the School of Engineering partnered with Shanghai Normal University to begin offering its students an opportunity to collaborate with UD students and take upper level classes in the United States. This was another attempt to offer a broad education to its students. If students shy away from study abroad programs because of financial constraints or travel apprehensions, faculty, staff, and administrators might consider virtual contact with international industry partners and other international SOE university programs in order to permit students to work with international peers and partner on pressing, first, second, and third world problems.

Effect of Professional Organizations on Leadership

Although students who graduated between 2000 and 2006 were more engaged in professional organizations than design competitions, they reported fewer opportunities to lead during professional organization activities. Based on the findings, undergraduate involvement in professional organizations does not improve the college or workplace leadership practices of UD engineering alumni. These findings contradict recent researchers who found that involvement in professional organizations developed undergraduates' engineering group skills (Lambert et al., 2006) and engineering design and analytical skills (Lambert, Strauss, & Terenzini, 2007). Colbeck et al. (2000) in a qualitative study of engineering students also found that students who engage in professional organization business have high levels of self-awareness and interpersonal goal growth. The current study findings also contradict Kuh's work (1995) which found student leaders in professional societies report gains in their interpersonal skills, self-esteem, and self-confidence. Although the literature shows engineering students have been found to develop critical technical skills during their involvement in professional organizations, the current findings show no evidence of leadership skills development.

Several factors may influence why no significant differences emerge. First, many engineering students may participate as members of the organization without assuming a leadership position or assuming a leadership role. Second, while many students might have a strong desire to increase their level of participation, many may be restricted due to their heavy course schedule, campus involvement, financial constraints, or work obligations. Third, many students are unable to align their professional organization activities with their long-term occupational goals so their involvement, if any, may be sporadic or ill directed toward ultimate career aspirations. Because from other studies successful outcomes have emerged, the SOE Dean's Advisory Board may want to carefully guide students to professional opportunities that align with their goals. After this is attempted, further study to compare the results of these graduates with subsequent cohorts is suggested.

Faculty advisors might also want to ensure that proposed engineering programs are relevant, current, and address multiple leadership practices needed in industry. In support of another SOE initiative to "increase strong learning and mentoring communities focused on teamwork and leadership development" (University of Dayton School of Engineering, 2006), faculty advisors might want to collaborate with Career Services, local companies and the student leaders of professional engineering organizations on campus in the development of a leadership program that works, taking into consideration each engineering major. Practicing engineers will have an opportunity to discuss current leadership issues and engage students in the development of problem-solving strategies to resolve real problems plaguing the industry. Faculty would also have an opportunity to introduce students to the world of research by involving them in current projects or research projects with the engineering community. Sheparding students to professional meetings and conferences exposes students to additional leadership opportunities not available in other cocurricular endeavors, but again the emphasis should be aligned with student career goals.

Effect of Gender, Graduation Year and Engineering Major on Leadership

Findings in this study show that student perceptions of exposure to curricular and cocurricular activities are not related to gender, graduation years, or engineering major. Based on the findings, gender, graduation years, or engineering major has little or no bearing on the perceived college or workplace leadership practices of UD engineering alumni. Male and female engineers report similar perceived leadership development through college and into the workplace. In fact, the finding of no significant gender difference contradicts other LPI studies conducted by Kouzes and Posner (2007). Kouzes and Posner found that while males and females do not differ on the Model, Inspire, Challenge, and Enable practices, females score significantly higher on the Encourage the Heart practice. In the current study, mean scores for males and females are similar. Despite national discussions about improving conditions for women in engineering, findings show UD provides an environment that students perceive offers female *and* male engineering students similar opportunities to lead in their classroom and during cocurricular activities.

The Marianist tradition intentionally "transcends the personal" (University of Dayton Board of Trustees, 2006b, p. 12). In other words, UD strives to provide opportunities for all students to develop all aspects of life. In fact, since the implementation of Vision 2005, the UD School of Engineering continues to align its goals with the Marianist traditions and UD Mission. As a result, students of all engineering programs report similar leadership development opportunities within their engineering classrooms. In terms of graduation year, students who graduated from 2000 to 2006 report similar opportunities to lead within the engineering classroom. One might suggest that UD's commitment to upholding its Catholic and Marianist characteristics undergirds the educational process in engineering.

IMPLICATIONS

Kouzes and Posner Leadership Development

The Five Practices of Exemplary Leadership framework is used in this study to assess the leadership practices of UD engineering alumni who graduated between 2000 and 2006 because this framework has been proven valid and reliable in industry and academe for over 20 years. Over the years engineering educators have been under pressure to develop both the technical and non-technical skills of their students. While studies show evidence that most engineering students practice their technical skills in college, researchers continue to question whether the engineering curriculum offers adequate opportunities to practice their non- technical skills (Bergeron, 2001; Grose, 2004; Rover, 2004; Shuman et al., 2005; Todd et al., 1993). This concern was reiterated recently by the National Academy of Engineering (2004, 2005) which identified the need for engineering programs to assess how well their programs enhance the non-technical attributes of their students. They identified skills including "strong analytical skills, creativity, ingenuity, professionalism, and leadership" (NAE, 2004, p. 5) as critical to the success of our nation's engineering future workforce. The NAE further warned that in order for engineering graduates to be successful in this global economy they must be able to "understand the principles of leadership and be able to practice them in growing proportions as their careers advance" (NAE, 2005, p. 56). The findings of this study suggest, contrary to concerns expressed in recent reports, engineering students not only understand leadership principles, but also have opportunities to practice exemplary leadership practices through both their curricular and cocurricular programs offered at the University of Dayton. Furthermore, UD alumni actively engage in the leadership practices in the workplace that they honed during college.

As the University of Dayton prepared to enter the 21st century, numerous institutional initiatives were underway that benefitted engineering students. Between 2000 and 2002, the UD School of Engineering integrated its institutional strategic planning efforts with its Accreditation Board for Engineering and Technology (ABET) self-evaluations in an effort to improve the quality of its programs as shown in Table 24. First, in a personal effort to preserve its Marianist traditions, UD embarked on a quest to gather critical data to identify gaps and influence future programmatic changes. Second, in preparation for its 2004 ABET accreditation review, the School of Engineering used the earlier data gathered to identify and implement changes specifically to enhance course offerings relative to the ABET standards and outcomes. Several programmatic changes were implemented in the School of Engineering to enhance the undergraduate leadership experience, affirming the Marianist tradition to "connect learning, leading and serving" (University of Dayton Board of Trustees, 2006a, p. 4). In fact, because the UD School of Engineering modified their program based on institutional goals, it is expected that any subsequent change introduced to the School of Engineering through ABET, for instance, would support critical components of the program. It is the assumption of this study that changes implemented between 2000 and 2002 enhanced students' perceived leadership development.

Compared to the norm, students who graduated after the changes (2005-2006) report significantly higher levels of college leadership engagement (Model, Inspire, Challenge, Enable, Encourage) within the engineering classroom implying that the changes implemented enhanced the quality of the UD engineering program. Although perceptions of classroom leadership practices varied for early graduates (2000-2004), findings show student involvement in design competitions complemented their college leadership experience during that timeframe. Recent graduates (2005-2006), on the other hand, consistently practiced their leadership skills both during their classroom and design competition experiences.

Table 24

Kouzes and Posner Practices Aligned with ABET Professional Practices and UD Marianist Characteristics

Kouzes and Posner Practices	ABET professional practices						UD Marianist characteristics				
	3d	3f	3g	3h	3i	3j	Educate for formation and faith	Provide an integral quality education	Educate in family spirit	Educate for service, justice and peace	Develop for adaptation and change
Model	X	X	X						X		
Inspire			X						X		
Challenge			X	X	X	X		X		X	X
Enable	X	X	X		X		X		X		
Encourage	X	X	X				X		X		

Note. ABET Professional Practices: 3d = an ability to function on multi-disciplinary teams; 3f = an understanding of professional and ethical responsibility; 3g = an ability to communicate effectively; 3h = the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context; 3i = a recognition of the need for, and an ability to engage in lifelong learning; 3j = a knowledge of contemporary issues.

Although students at the University of Dayton are equally involved in internship/co-op programs as they are in design competition, students overwhelmingly perceive design competition involvement enhances their leadership skills. As mentioned in the most recent strategic plan, the SOE built a new Innovation Center learning space designed to foster student-faculty and peer interaction in an environment that encourages innovation. All members of the UD engineering community now have access to the latest technology in a design simulation and product realization center, a conference and multimedia center, and a collaborative learning studio.

The Innovation Center is also used to develop corporate partnerships. For example, the SOE has recently integrated design projects into the curricula through the development of new multidisciplinary design courses, granting students experiential learning opportunities comparable to many industry driven internship programs. Students serve as consultants with industry partners in the development of solutions to real problems plaguing the professions. Interaction with industry leaders might also provide additional student-faculty interaction, industry mentoring, and alumni interaction opportunities for socialization into the field.

ABET Professional Development

The ABET professional practices in this study are aligned with the Kouzes and Posner (2007) leadership practices to also examine the effects of classroom and cocurricular involvement on each ABET outcome (See Table 24). Several findings had significant implications to the School of Engineering that are discussed in this section. The findings show that in the engineering classroom, students consistently engage in the Enable practice more than the other four practices. Compared to the norm, participants during each year, except 2004, report similar exposure to the leadership practice of Enable. The Enable practice relates directly to four of the six ABET practices including: the ability to function on multidisciplinary teams; the understanding of professional and ethical responsibility; the ability to communicate effectively, and the ability to recognize the need for, and an ability to engage in, lifelong learning. Only students engaged in the Challenge practice had an opportunity to develop the remaining two ABET practices: the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context; and a knowledge of contemporary issues.

In this study, findings indicate that while both early graduates and recent graduates acquired a broad range of leadership skills, the source of the leadership experiences is different. Early graduates (2000-2003) developed teaming, ethical training, communications, and appreciation for lifelong learning in the engineering classroom. They further developed these same skills through their involvement in design competitions and projects. However, their awareness of the impact of engineering solutions on society and their knowledge of contemporary issues developed through their involvement in design activities. Recent graduates (post-2004) acquire all six ABET professional practices in the engineering classroom and during design activities. Nevertheless, these findings show that regardless of when participants graduated from the UD School of Engineering between 2000 and 2006, they had similar opportunities to develop the six required ABET Professional Practices. The results of this study have significant implications for the School of Engineering achieving the six ABET Professional Practices that are discussed further below.

Multidisciplinary teams. Engineering programs are required by ABET to graduate students who can lead multidisciplinary teams and understand group development. Based on the Enable findings of this study, it was revealed that UD alumni perceive their undergraduate experience provides opportunities for students to build community inside and outside the School of Engineering. For instance, the development of multidisciplinary design courses is one way UD promotes innovation and generates new ideas through collaboration. In the new design clinic courses students of any engineering program learn to develop their group skills and develop shared goals in a group comprised of members with different perspectives of the problem. Kouzes and Posner (2007) assert that exemplary leaders realize that "the success of one depends on the success of the other" (p. 233).

According to the data on post-2004 participants, students perceive the UD environment offers opportunities to enhance the practice of Encourage. The Encourage practice refers to students' ability to recognize and support the professional and personal development of their peers. This finding shows post-2004 graduates perceive greater opportunities to encourage peers, celebrate their accomplishments and recognize others for their contributions in the classroom than earlier graduates (Kouzes & Posner, 2007). Participants working in groups are more likely to offer regular positive feedback to their peers on how their contributions influence the team.

Aligned with the Marianist value for personal growth, the School of Engineering has recently introduced several initiatives to celebrate student achievement and recognize the accomplishment of the entire community (See Table 24). As noted in the SOE Strategic Plan (2008), the School of Engineering focuses on introducing "a culture that celebrates technical excellence [and] encourages the sharing of new developments with colleagues in industry and academia, and that rewards significant achievement" (p. 7). Both student and faculty accomplishments are highlighted in campus media such as the *Engineering Magazine* and other university-wide publications. Funding and support are now available for students who choose to present their research at national conferences and publish their research in engineering journals. Kouzes and Posner (2007) consider celebrations as necessary rituals that build self-esteem, empowering others and reinforcing desired behaviors. In recent years, many faculty require their students to present the design projects at the university-wide Brother Joseph Stander Symposium. The Symposium is an annual celebration of excellence that showcases students' work in poster sessions, hands-on activities and other types of presentations with the university community.

The School of Engineering has also been recently working with the School of Arts and Sciences to develop a culture that connects engineering students with non-engineering students in another effort to expose students to diverse views to real industrial problems. These types of initiative are supported by the SOE to emphasize the importance of partnering "across campus for improved understanding of the vital interdependencies, opportunities, and challenges faced by humankind in an increasingly technological society" (University of Dayton Board of Trustees, 2006b, p. 3). Engineering faculty might also consider collaborating with faculty outside in the Schools of Education and Business as well in an expanded development of course assignments that deal with real industry problems and engineering related innovations that call forth leadership opportunity. For instance, the new doctorate in physical therapy program might offer students an opportunity to collaborate on practical apparatus to assist people with treatable physical abnormalities. Perhaps engaging engineering student professional organizations in these collaborative initiatives might strengthen students' cocurricular leadership development. In terms of the study abroad programs, additional international programs are recently being developed to enhance the leadership experiences of students.

Understanding professional and ethical responsibility. Each engineering discipline is governed by an engineering code of ethics. The ABET engineering criteria call for each engineering program to integrate its engineering code of ethics into the curriculum. According to Kouzes and Posner's (2007) Enable practice, exemplary leaders concentrate on building the trust of others and defining the acceptable cultural norms in any organization. However, building trust requires one to act ethically and to exhibit a "strong character and solid integrity" (p. 30). Based on the findings, engineering alumni believe they treated each other with dignity and respect, implying the UD classroom culture consistently supports an ethically sound environment for students.

The UD School of Engineering, concerned with first-year students gaining a full understanding of their professional ethical and professional responsibilities, recently implemented changes to the freshman experience courses to now include these topics (i.e., ethics, leadership). Students are now ushered into the profession through involvement in small projects that offer opportunities to work in teams which apply classroom theory to real world design projects. Each course assignment is structured to help students increase their knowledge of the different aspects of the profession. These experiences help students develop shared values, engage in professional and ethical rituals, learn common terms, and enhance their pride in their personal contribution to the field (University of Dayton School of Engineering, 2006).

Communications. ABET calls for all graduates to demonstrate an ability to communicate effectively. Most engineering courses offered at UD require students to effectively problem solve in cooperative teams and share their findings, both through oral and written communications at the end of each course. Findings show UD engineering students perceive they learned critical skills including how to make decisions, listen to divergent views, and support the decisions of others throughout their classroom experiences (Kouzes & Posner, 2007). These findings imply that the UD SOE culture offers opportunities for students to share their technical knowledge and openly express their views. At the end of each project, students are usually required to present their findings.

Lifelong learning. ABET also calls upon engineering programs to develop self-directed learners. Kouzes and Posner (2007) found exemplary leaders consistently seek out knowledge and openly share it with others in the community. UD alumni report their undergraduate experience enhanced their ability to assess skills and develop competence with their peers. According to the Kouzes and Posner framework, participants in this study consistently demonstrate their ability to assess team strengths and weaknesses and then assume responsibility for coaching peers to an acceptable level of competence. Student involvement in these practices contributes to the necessary technical and professional skills needed to remain competitive within their profession (Kouzes & Posner). For example, UD upperclass students have an opportunity to influence the academic development of first-year students during mandatory freshman study sessions. First-year engineering students are required to attend academic weekly study hall sessions, led primarily by juniors and seniors, where students are tutored in math and science. Upperclass students offer freshman tutorial assistance in calculus, physics and technical classes. They also serve as mentors and role models during this most critical time of a student's college transition. Assuming these roles is a huge opportunity for juniors and seniors to hone both their technical and leadership skills while serving other members of the UD community.

Contemporary issues and global / societal impact. ABET outcomes indicate that by the time engineering students graduate from college, they should have an understanding of how engineering influences society. According to Kouzes and Posner (2007), the practice of Challenge relates to students' ability to take the initiative to create an environment that fosters innovation and creativity. Based on the findings, UD alumni involved in design competitions perceive their engineering program encouraged them to look beyond the boundary of SOE to seek out solutions that enhance the quality of life for others. Students are willing to take risks, make mistakes and continue to be active learners with the hope that each mistake will serve as a learning opportunity.

One popular engineering course that immerses students in global and societal issues today is the Engineers in Technical, Humanitarian Opportunities of Service Learning (ETHOS) program. Students work in teams to design, develop and implement solutions to global concerns. In 2008, a small team of UD engineering students traveled to Cameroon, West Africa. During the previous academic year, UD students led the planning and development of a water filtration system project for a village servicing over 300 residents. They invest time communicating with others to determine the impact of their project and actions on others in the community. This process is what Marianists call the practice of social analysis, which holds individuals responsible for assessing the impact of their design solutions to technical problems. Marianists concern themselves with the extent to which solutions enhance the quality of life for others. Their ability to clearly identify the village's needs, enlist others in the SOE to support their ideas and remain sensitive to the cultural needs of the village is an excellent example of how UD is developing leaders to influence changes in the profession. ETHOS students have opportunities to experience all aspects of a design process while fully immersed in the African culture. Other service learning programs are available to students who express a passion for social justice and global learning.

Implications for Engineering Education

This study provides a systematic approach to assessing student leadership development outcomes for continuous improvement purposes. Because this research was conducted at a Catholic university in the Midwest, it may be difficult to generalize these results to engineers who graduate from public engineering programs and those in the West, South, or Northeast. However, other private and/or religious institutions within a similar geographic area might benefit from knowing that there is a methodical approach to aligning an institution's mission and guiding principles with its academic programs resulting in students achieving program ABET outcomes. Additionally, these universities might also consider incorporating design experiential opportunities within the engineering classroom to compensate for possible limitations of cocurricular programs.

Implications for Industry

This study also has implications for the engineering industry. UD Engineering alumni perceive their undergraduate experience prepared them for the workforce. Engineering interns and co-ops reported similar leadership experiences as those students who had no work experience during college. Engineering employers may need to reexamine their co-op and internship programs to ensure they offer intentional leadership opportunities that contribute to the professional practices of engineers. The SOE Dean's Advisory Board might begin to develop guidelines for partnering corporations to follow when students accept internship assignments. Now that it is apparent that design competitions are most effective with UD students, perhaps industry partners can develop design projects that will allow further leadership development of their interns or co-ops.

RECOMMENDATIONS FOR FURTHER STUDY

Further studies might be conducted to explore if and what other on-campus cocurricular and extracurricular programs offered alumni leadership development opportunities. In fact, other studies should be conducted to determine what other extra-curricular activities at the University might have contributed to the leadership development of engineers such as residence hall, Greek affiliation, clubs, or athletics.

While this study provides insight into the perceptions of engineering alumni who graduated between 2000 and 2006, it would be interesting to replicate this study for alumni who graduated beyond 2006. The analysis of data using graduates from subsequent years might determine if perceptions of leadership development at UD remain consistent over time following the program initiatives of 2004.

Although the School of Engineering was selected for this study, other academic units at UD implemented programmatic changes as a result of the institutional changes and standards imposed by their accreditation boards. Other populations including the School of Education, School of Business, School of Arts and Sciences and the Law School, should be studied to assess whether their alumni perceptions align with those of engineering alumni. In other words, to what extent are all students compared to the SOE perceiving leadership development practices commensurate with their School's specific curricular and cocurricular activities? It is important to determine to what extent these are driven by the accrediting agencies or the ethos, mission, and vision set forth in the Marianist characteristics. It may be important to note if other Schools align their curriculum and cocurriculum to their accreditation expectations in an effort to graduate exemplary leaders. The results suggest that further studies should be conducted with current graduate and undergraduate engineering students to examine at what stage of the undergraduate experience they develop their leadership skills (pre-college, freshman, sophomores, junior, senior, graduate level, professional practice).

Longitudinal studies of engineering students, beginning in their freshman year, will provide awareness of when, what, and how students' perceptions of their leadership development change over time. Incoming engineering students with strong pre-college leadership experiences may also influence their college leadership experience. This type of study will also assist with determining the effects of cocurricular activities in different phases of students' undergraduate experience. This would give the SOE more data on which to base the best times for involving students in each of the four cocurricular areas in order to make them as effective as possible.

Having students and their employers take the instrument at graduation and follow-up with the workplace LPI several years later may increase internal validity of the results. Results from this study could be compared with subsequent replications to test validity and whether the time frame between test administrations compromised the results found here. Further research is also needed to examine the types of leadership activities and roles alumni are assuming on their jobs and how these contribute to their perceived workplace leadership development.

Further qualitative studies should be conducted to determine what students gain or do not gain from their involvement in professional organizations, internships, and study abroad activities to determine how they can be more effective in developing leadership skills and opportunities that can be extended to a wider audience of engineering students.

The University of Dayton is a residential institution, where over 90% of its students live on campus. Replication should be conducted at other types of institutions to compare with the information gleaned here to determine whether residential populations have greater opportunities to lead than non-residential students. Additional studies should be conducted to determine to what extent the implementation of the new Innovation Center and any newly established industry partnerships contribute to student innovation, technical development in the engineering classroom, and in what ways it contributes to perceived leadership practice.

The results of this study indicate that through curricular and cocurricular programs offered in the School of Engineering, students are gaining exposure to the exemplary leadership practices (Model, Inspire, Challenge, Enable, Encourage). This study fills a gap in the literature identified by Pascarella and Terenzini (2005) in two ways. First, instead of only examining one aspect of college life, this research examines the effects of classroom and out-of-class experiences on college leadership development of undergraduates. Second, it fills the gap in the research related to the long-term effects of the college experience on students' post-college life. In both instances, results address the extent to which engineering programs at the University of Dayton between 2000 and 2006 offered opportunities for their graduates to develop leadership skills useful to the engineering workforce.

Between 2000 and 2002, the School of Engineering in an effort to improve the quality of its programs made a commitment to align its School's strategic plan, mission, vision and any systematic changes with the institution's strategic plan and Marianist characteristics. As a result, course offerings are enhanced to ensure that leadership development is an integral part of the entire curriculum. This study supports the fact that engineering students are utilizing opportunities provided to everyone in the School of Engineering to develop their leadership skills in college and hone them in the workplace. Alignment of the strategic plan and the Marianist ethos with ABET practices as well as paying attention to industry changes and technological and educational innovations, the SOE is poised to enhance leadership development.

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APPENDIX A

APPENDIX A

Kouzes and Posner Practices and Commitments

KP Practices	KP Commitments
Model the way	1. Clarify values by finding your voice and affirming shared ideals. 2. Set the example by aligning actions with shared values
Inspire the shared vision	3. Envision the future by imagining exciting and ennobling possibilities. 4. Enlist others in a common vision by appealing to shared aspirations.
Challenge the process	5. Search for opportunities by seizing the initiative and by looking outward for innovative ways to improve. 6. Experiment and take risks by constantly generating small wins and learning from experience.
Enable others to act	7. Foster collaboration by building trust and facilitating relationships. 8. Strengthen others by increasing self-determination and developing competence.
Encourage the heart	9. Recognize contributions by showing appreciation for individual excellence. 10. Celebrate the values and victories by creating a spirit of community.

Copied with permission from Kouzes and Posner (2007)

APPENDIX B

APPENDIX B

ABET Professional Practices Mapped with Kouzes and Posner Practices

Table 18

Kouzes and Posner Practices	ABET Professional Practices						UD Marianist Characteristics				
	3d	3f	3g	3h	3i	3j	Educate for formation and faith	Provide an integral quality education	Educate in family spirit	Educate for service, justice and peace	Develop for adaptation and change
Model	X	X	X						X		
Inspire			X						X		
Challenge			X	X	X	X		X		X	X
Enable	X	X	X		X		X		X		
Encourage	X	X	X				X		X		

Note. ABET Professional Practices: 3d = an ability to function on multi-disciplinary teams; 3f = an understanding of professional and ethical responsibility; 3g = an ability to communicate effectively; 3h = the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context; 3i = a recognition of the need for, and an ability to engage in life-long learning; 3j = a knowledge of contemporary issues.

APPENDIX C

APPENDIX C

ABET 11 Engineering Criteria 2000 Practices

Students must attain the following outcomes:

3.a	an ability to apply knowledge of mathematics, science, and engineering
3.b	an ability to design and conduct experiments, as well as to analyze and interpret data
3.c	an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability
3.d	an ability to function on multi-disciplinary teams *
3.e	an ability to identify, formulate, and solve engineering problems
3.f	an understanding of professional and ethical responsibility *
3.g	an ability to communicate effectively *
3.h	the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context *
3.i	a recognition of the need for, and an ability to engage in lifelong learning *
3.j	a knowledge of contemporary issues *
3.k	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

* indicates ABET Engineering Criteria 2000 Professional Practices Used in the Study

APPENDIX D

APPENDIX D

Engineering Engagement Instrument

Section I: Informed Consent Form

Purpose of Research: The purpose of this study is to examine the effect college involvement activities have on concomitant leadership practices and perceptions of engineering alumni who received their baccalaureate degrees from the University of Dayton between 2000 and 2006.

Procedure: We will ask you several questions related to your experience as a student and practicing engineering professional, Your input is critical to understanding how students develop their professional leadership skills before entering the workforce..

Alternative Procedures: No alternative procedures exist in this research project.

Anticipated Risks and / or Discomfort: The researcher will ask you to answer several questions during this research project. Fatigue may occur from sitting during the interview. Fatigue will be minimized by allowing you to take periodic breaks to walk around and stretch.

Benefits to the Participant or others: By participating in this research, you will assist the School of Engineering with assessing their undergraduate programs. If you have any questions about this research, please feel free to ask during the study.

Confidentiality: No records of your participation in this research will be disclosed to others. Your data will be pooled with data from other research participants and only summary results will be made public. Your name will not be revealed in any document resulting from this research. Your data will be kept confidential and you will be assigned a pseudonym. Your name or other identification will not be recorded with the data.

Contact Person for Questions or Problems: If a research-related injury occurs, or if you have questions about the research, contact Patricia Y. Blyden, CH Hall Room 207, (614) 229-3307. Questions about the rights of the subject should be addressed to Jon Nieberding., Chair of the Committee for the Protection of Human Subjects, Kettering Labs Room 542, +0104, 229-4053.

Consent to Participate: I have voluntarily decided to participate in this research project. The investigator named above has adequately answered all questions that I have about this research, the procedures involved, and my participation. I understand that the investigator named above, or one of her assistants, will be available to answer any questions about experimental procedures throughout this research. I also understand that I may refuse to participate or voluntarily terminate my participation in this research at any time without penalty or loss of benefits to which I am entitled. The investigator may also terminate my participation in this research if she feels this to be in my best interest. In addition, I certify that I am 18 (eighteen) years of age or older.

Clicking "Next" below indicates that you understand these instructions and agree to participate in this survey. If you'd like to leave the survey at any time, just click "Exit this survey". Your answers will be saved.

____ ________

Signature of Investigator Date

Section II: Academic Leadership Practices Instrument

LPI-Self Leadership Practices Inventory

By James M. Kouzes and Barry Z. Posner

Reflecting on both your current job/workplace and experience in your undergraduate engineering program in questions 1 through 30, please indicate how frequently you practiced the following leadership behaviors.

For each item please mark the number that best matches how frequently you engage in the following behaviors in your current job/workplace and during your engineering program.

1= Almost Never	6= Sometimes
2 = Rarely	7= Fairly Often
3= Seldom	8= Usually
4= Once in a While	9 = Very Frequently
5= Occasionally	10 = Almost Always

1. I set a personal example of what I expect of others.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

2. I talk about future trends that will influence how our work gets done.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

3. I seek out challenging opportunities that test my own skills and abilities.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

4. I develop cooperative relationships among the people I work with.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

5. I praise people for a job well done.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

6. I spend time and energy making certain that the people I work with adhere to the principles and standards we have agreed on.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

7. I describe a compelling image of what our future could be like.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

8. I challenge people to try out new and innovative ways to do their work.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

9. I actively listen to diverse points of view.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

10. I make it a point to let people know about my confidence in their abilities.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

11. I follow through on the promises and commitments that I make.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

12. I appeal to others to share an exciting dream of the future.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my	○	○	○	○	○	○	○	○	○	○

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
engineering program:										

13. I search outside the formal boundaries of my organization for innovative ways to improve what we do.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:										
In my engineering program:										

14. I treat others with dignity and respect.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:										
In my engineering program:										

15. I make sure that people are creatively rewarded for their contributions to the success of our projects.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:										
In my engineering program:										

16. I ask for feedback on how my actions affect other people's performance.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:										
In my engineering program:										

17. I show others how their long-term interests can be realized by enlisting in a common vision.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:										
In my engineering program:										

18. I ask "What can we learn?" when things don't go as expected.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:										
In my engineering program:										

19. I support the decisions that people make on their own.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:										
In my engineering program:										

20. I publicly recognize people who exemplify commitment to shared values.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:										
In my engineering program:										

21. I build consensus around a common set of values for running our organization.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:										
In my										

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
engineering program:										

22. I paint the "big picture" of what we aspire to accomplish.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

23. I make certain that we set achievable goals, make concrete plans, and establish measurable milestones for the projects and programs that we work on.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

24. I give people a great deal of freedom and choice in deciding how to do their work.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

25. I find ways to celebrate accomplishments.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

26. I am clear about my philosophy of leadership.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

27. I speak with genuine conviction about the higher meaning and purpose of our work.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

28. I experiment and take risks, even when there is a chance of failure.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

29. I ensure that people grow in their jobs by learning new skills and developing themselves.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my engineering program:	○	○	○	○	○	○	○	○	○	○

30. I give the members of the team lots of appreciation and support for their contributions.

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
Today on my job:	○	○	○	○	○	○	○	○	○	○
In my	○	○	○	○	○	○	○	○	○	○

	1 Almost Never	2	3	4	5	6	7	8	9	10 Almost Always
engineering program:										

Section III: Cocurricular Leadership Practices Instrument

By Patricia Y. Blyden

"Most leadership programs seek to empower students to enhance their self efficacy as leaders and understand how they can make a difference, whether as positional leaders or active participants in group or community process. Leadership development involves self-awareness and understanding of others, values, and diverse perspectives, organizations, and change. Leadership also requires competence in establishing purpose, working collaboratively, and managing conflict."

(Council for the Advancement of Standards in Higher Education. "CAS Professional Standard for Higher Education" 2003.)

Reflecting on your college experience in questions 31 through 34, please indicate how frequently you participated in the following activities.

31. Reflecting on your COLLEGE EXPERIENCE, please indicate how frequently you PARTICIPATED in the following activities:

	Never	Almost Never	Neutral	Almost Always	Always
Internship / Cooperative experiences	○	○	○	○	○
Study abroad programs	○	○	○	○	○
Involvement in design projects outside the classroom	○	○	○	○	○
Involvement in Student Chapters of Professional organizations.	○	○	○	○	○

32. Reflecting on your COLLEGE EXPERIENCE, please indicate how frequently you PRACTICED your leadership skills during the following activities:

	Never	Almost Never	Neutral	Almost Always	Always
Internship / Cooperative experiences	○	○	○	○	○
Study abroad programs	○	○	○	○	○
Involvement in design projects outside the classroom	○	○	○	○	○
Involvement in Student Chapters of Professional organizations.	○	○	○	○	○

33. Please indicate how frequently you PRACTICE the leadership skills you learned during the following activities on your CURRENT JOB:

	Never	Almost Never	Neutral	Almost Always	Always
Internship / Cooperative experiences	○	○	○	○	○
Study abroad programs	○	○	○	○	○
Involvement in design projects outside the classroom	○	○	○	○	○
Involvement in Student Chapters of Professional organizations.	○	○	○	○	○

Section IV: Demographic Information

34. Gender

	Female	Male
Gender	◌	◌

35. Graduation Year

	2000	2001	2002	2003	2004	2005	2006
Graduation Year	◌	◌	◌	◌	◌	◌	◌

**36. Reflecting on your entire work career since graduation, please indicate how many years you have actually worked in a field directly or indirectly related to engineering.
(Please exclude any time spent unemployed or working in non-engineering related positions)**

	0	1	2	3	4	5	6	7	8
Since graduation, I spent _____ years practicing engineering.	◌	◌	◌	◌	◌	◌	◌	◌	◌

37. Undergraduate Major

- ◌ Undergraduate Major Chemical and Mechanical Engineering
- ◌ Civil Environmental Engineering Mechanics
- ◌ Electro Optics Engineering
- ◌ Engineering Management
- ◌ Engineering Technology
- ◌ Mechanical and Aerospace Engineering
- ◌ Other (please specify) ____________

Thanks for you participation!

APPENDIX E

APPENDIX E

Study Codebook of Variables

Academic and Workplace Leadership Experiences Continuous: 1= Almost Never, 2 = Rarely, 3= Seldom, 4= Once in a While, 5= Occasionally, 6= Sometimes, 7= Fairly Often, 8= Usually, 9 = Very Frequently, 10 = Almost Always	
Description of Variable	SPSS Variable
Q1	Q1 SOE
Q1 Workplace	Q1 Workplace
Q2	Q2 SOE
Q2 Workplace	Q2 Workplace
Q3	Q3 SOE
Q3 Workplace	Q3 Workplace
Q4	Q4 SOE
Q4 Workplace	Q4 Workplace
Q5	Q5 SOE
Q5 Workplace	Q5 Workplace
Q6	Q6 SOE
Q6 Workplace	Q6 Workplace
Q7	Q7 SOE
Q7 Workplace	Q7 Workplace
Q8	Q8 SOE
Q8 Workplace	Q8 Workplace
Q9	Q9 SOE
Q9 Workplace	Q9 Workplace
Q10	Q10 SOE
Q10 Workplace	Q10 Workplace

Q11	Q11 SOE
Q11 Workplace	Q11 Workplace
Q12	Q12 SOE
Q12 Workplace	Q12 Workplace
Q13	Q13 SOE
Q13 Workplace	Q13 Workplace
Q14	Q14 SOE
Q14 Workplace	Q14 Workplace
Q15	Q15 SOE
Q15 Workplace	Q15 Workplace
Q16	Q16 SOE
Q16 Workplace	Q16 Workplace
Q17	Q17 SOE
Q17 Workplace	Q17 Workplace
Q18	Q18 SOE
Q18 Workplace	Q18 Workplace
Q19	Q19 SOE
Q19 Workplace	Q19 Workplace
Q20	Q20 SOE
Q20 Workplace	Q20 Workplace
Q21	Q21 SOE
Q21 Workplace	Q21 Workplace
Q22	Q22 SOE
Q22 Workplace	Q22 Workplace
Q23	Q23 SOE
Q23 Workplace	Q23 Workplace
Q24	Q24 SOE
Q24 Workplace	Q24 Workplace
Q25	Q25 SOE

Q25 Workplace	Q25 Workplace
Q26	Q26 SOE
Q26 Workplace	Q26 Workplace
Q27	Q27 SOE
Q27 Workplace	Q27 Workplace
Q28	Q28 SOE
Q28 Workplace	Q28 Workplace
Q29	Q29 SOE
Q29 Workplace	Q29 Workplace
Q30	Q30 SOE
Q30 Workplace	Q30 Workplace

Calculated Academic Experiences (RQ1) **Leadership Skills Practiced in SOE**	
College Model Total (M)	Add items Q1, Q6, Q11, Q16, Q21, Q26 Continuous: Range 6 to 60 Norm: 47.02
College Inspire Total (M)	Add items Q2, Q7, Q12, Q17, Q22, Q27 Continuous: Range 6 to 60 Norm: 44.34 Q2, Q7, Q12, Q17, Q22, Q27,
College Challenge Total (M)	Add items Q3, Q8, Q13, Q18, Q23, Q28 Continuous: Range 6 to 60 Norm: 46.11
College Enable Total (M)	Add items Q4, Q9, Q14, Q19, Q24, Q29 Continuous: 6 to 60 Norm: 49.40
College Encourage Total (M)	Add items Q5, Q10, Q15, Q20, Q25, Q30 Continuous: 6 to 60 Norm: 47.06

Calculated Workplace Academic Experiences (RQ 1) Leadership Skills Practiced in Workplace	
Workplace Model Total (M)	Add items Q1 Workplace, Q6 Workplace, Q11 Workplace, Q16 Workplace, Q21 Workplace, Q26 Workplace Continuous: Range 6 to 60 Norm: 47.02
Workplace Inspire Total (M)	Add items Q2 Workplace, Q7 Workplace, Q12 Workplace, Q17 Workplace, Q22 Workplace, Q27 Workplace Continuous: Range 6 to 60 Norm: 44.34
Workplace Challenge Total (M)	Add items Q3 Workplace, Q8 Workplace, Q13 Workplace, Q18 Workplace, Q23 Workplace, Q28 Workplace Continuous: Range 6 to 60 Norm: 46.11
Workplace Enable Total (M)	Add items Q4 Workplace, Q9 Workplace, Q14 Workplace, Q19 Workplace, Q24 Workplace, Q29 Workplace Continuous: Range 6 to 60 Norm: 49.40
Workplace Encourage Total (M)	Add items Q5 Workplace, Q10 Workplace, Q15 Workplace, Q20 Workplace, Q25 Workplace, Q30 Workplace Continuous: Range 6 to 60 Norm: 47.06

College Cocurricular Experiences (RQ 2) Cocurricular Leadership Skills Practiced in College Continuous: 1= Never, 2= Almost Never, 3 = Neutral, 4 = Almost Always, 5 = Always	
Description of Variable	SPSS Variable
College Internship/Coop	College_Intern Continuous: Range 1 to 5 Norm: 3
College Study Abroad	College_Abroad Continuous: Range 1 to 5 Norm: 3
College Engineering Design Projects/Competitions	College_Design Continuous: Range 1 to 5 Norm: 3
College Professional Organization	College_Proforg Continuous: Range 1 to 5 Norm: 3

College Cocurricular Experiences (RQ 3) Cocurricular Leadership Skills Practiced in College MANOVA Independent Variables Continuous: 1= Never, 2= Almost Never, 3 = Neutral, 4 = Almost Always, 5 = Always	
Description of Variable	SPSS Variable
College Internship/Coop	College_Intern Continuous: Range 1 to 5
College Study Abroad	College_Abroad Continuous: Range 1 to 5
College Engineering Design Projects/Competitions	College_Design Continuous: Range 1 to 5
College Professional Organization	College_Proforg Continuous: Range 1 to 5

Calculated Academic Experiences (RQ 3) Leadership Skills Practiced in College MANOVA Dependent Variables	
Description of Variables	SPSS Variable
College Model Total (M)	Add items Q1, Q6, Q11, Q16, Q21, Q26 Continuous: Range 6 to 60 Norm: 47.02
College Inspire Total (M)	Add items Q2, Q7, Q12, Q17, Q22, Q27 Continuous: Range 6 to 60 Norm: 44.34
College Challenge Total (M)	Add items Q3, Q8, Q13, Q18, Q23, Q28 Continuous: Range 6 to 60 Norm: 46.11
College Enable Total (M)	Add items Q4, Q9, Q14, Q19, Q24, Q29 Continuous: 6 to 60 Norm: 49.40
College Encourage Total (M)	Add items Q5, Q10, Q15, Q20, Q25, Q30 Continuous: 6 to 60 Norm: 47.06

Calculated Workplace Academic Experiences (RQ 3) Leadership Skills Practiced in Workplace MANOVA Dependent Variables	
Description of Variable	SPSS Variable
Workplace Model Total (M)	Add items Q1 Workplace, Q6 Workplace, Q11 Workplace, Q16 Workplace, Q21 Workplace, Q26 Workplace Continuous: Range 6 to 60 Norm: 47.02
Workplace Inspire Total (M)	Add items Q2 Workplace, Q7 Workplace, Q12 Workplace, Q17 Workplace, Q22 Workplace, Q27 Workplace Continuous: Range 6 to 60 Norm: 44.34
Workplace Challenge Total (M)	Add items Q3 Workplace, Q8 Workplace, Q13 Workplace, Q18 Workplace, Q23 Workplace, Q28 Workplace Continuous: Range 6 to 60 Norm: 46.11
Workplace Enable Total (M)	Add items Q4 Workplace, Q9 Workplace, Q14 Workplace, Q19 Workplace, Q24 Workplace, Q29 Workplace Continuous: Range 6 to 60 Norm: 49.40
Workplace Encourage Total (M)	Add items Q5 Workplace, Q10 Workplace, Q15 Workplace, Q20 Workplace, Q25 Workplace, Q30 Workplace Continuous: Range 6 to 60 Norm: 47.06

Demographic Information (RQ 4) MANOVA Independent Variables	
Description of Variables	SPSS Variable
Gender	Dichotomous: 1 = Male, 2= Female
Graduation Date	Grad_Date Seven-point ordinal scale: 1 = 2000, 2 = 2001, 3 = 2002, 4 = 2003, 5 = 2004, 6 = 2005, 7 = 2006
Undergraduate Major	Undergrad_Major Seven-point nominal scale: 1 = Chemical Engineering, 2 = Civil Engineering, 3 = Computer Engineering, 4 = Electrical Engineering, 5 = Engineering Management, 6 = Engineering Technology, 7=Mechanical Engineering

Calculated Academic Experiences (RQ 4) Leadership Skills Practiced in College MANOVA Dependent Variables	
Description of Variables	SPSS Variable
College Model Total (M)	Add items Q1, Q6, Q11, Q16, Q21, Q26 Continuous: Range 6 to 60 Norm: 47.02
College Inspire Total (M)	Add items Q2, Q7, Q12, Q17, Q22, Q27 Continuous: Range 6 to 60 Norm: 44.34
College Challenge Total (M)	Add items Q3, Q8, Q13, Q18, Q23, Q28 Continuous: Range 6 to 60 Norm: 46.11
College Enable Total (M)	Add items Q4, Q9, Q14, Q19, Q24, Q29 Continuous: 6 to 60 Norm: 49.40
College Encourage Total (M)	Add items Q5, Q10, Q15, Q20, Q25, Q30 Continuous: 6 to 60 Norm: 47.06

Calculated Workplace Academic Experiences (RQ 4) Leadership Skills Practiced in Workplace MANOVA Dependent Variables	
Description of Variable	SPSS Variable
Workplace Model Total (M)	Add items Q1 Workplace, Q6 Workplace, Q11 Workplace, Q16 Workplace, Q21 Workplace, Q26 Workplace Continuous: Range 6 to 60 Norm: 47.02
Workplace Inspire Total (M)	Add items Q2 Workplace, Q7 Workplace, Q12 Workplace, Q17 Workplace, Q22 Workplace, Q27 Workplace Continuous: Range 6 to 60 Norm: 44.34
Workplace Challenge Total (M)	Add items Q3 Workplace, Q8 Workplace, Q13 Workplace, Q18 Workplace, Q23 Workplace, Q28 Workplace Continuous: Range 6 to 60 Norm: 46.11
Workplace Enable Total (M)	Add items Q4 Workplace, Q9 Workplace, Q14 Workplace, Q19 Workplace, Q24 Workplace, Q29 Workplace Continuous: Range 6 to 60 Norm: 49.40
Workplace Encourage Total (M)	Add items Q5 Workplace, Q10 Workplace, Q15 Workplace, Q20 Workplace, Q25 Workplace, Q30 Workplace Continuous: Range 6 to 60 Norm: 47.06

APPENDIX F

APPENDIX F

Rankings of College and Workplace Leadership Practices Compared to the Norm

Rankings of College and Workplace Leadership Practices Inventory Subscales Compared to the Norm by Graduation Year
2000
1. College Enable (t (22) = -1.38, *p=.18, M*=47.65, *SD*=6.07)
2. College Model (t (22) = -1.49, *p=.15, M*=45.04, *SD*=6.39)
3. College Encourage (t (22) = -2.79, *p<.05, M*=42.57, *SD*=7.72)
4. College Challenge (t (22) = -2.96, *p<.01, M*=41.30, *SD*=7.80)
5. College Inspire (t (22) = -4.28, *p<.001, M*=37.39, *SD*=7.80)
1. Work Enable (t (22) = 2.54, *p<.05, M*=51.78, *SD*=4.49)
2. Work Model (t (22) = 3.12, *p<.01, M*=50.91, *SD*=5.99)
3. Work Challenge (t (22) = 1.23, *p=.23, M*=47.70, *SD*=6.20)
4. Work Encourage (t (22) = 0.12, *p=.12, M*=47.26, *SD*=8.13)
5. Work Inspire (t (22) = 1.01, *p=.32, M*=45.96, *SD*=7.61)
2001
1. College Enable (t (25) = -1.44, *p=.16, M*=47.62, *SD*=6.34)
2. College Model (t (25) = -2.79, *p<.01, M*=42.23, *SD*=8.74)
3. College Encourage (t (25) = -2.78, *p<.01, M*=42.12, *SD*=9.07)
4. College Challenge (t (25) = -4.71, *p<.001, M*=38.77, *SD*=7.95)
5. College Inspire (t (25) = -4.55, *p<.001, M*=34.27, *SD*=11.29)
1. Work Enable (t (25) = 3.99, *p<.001, M*=52.31, *SD*=3.72)
2. Work Model (t (25) = 1.81, *p=.08, M*=49.27, *SD*=6.35)
3. Work Encourage (t (25) = 0.03, *p=.97, M*=47.12, *SD*=8.30)
4. Work Challenge (t (25) = -0.94, *p=.36, M*=44.77, *SD*=7.28)
5. Work Inspire (t (25) = -1.08, *p=.29, M*=42.12, *SD*=10.51)
2002
1. College Enable (t (15) = -1.22, *p=.24, M*=47.69, *SD*=5.62)
2. College Encourage (t (15) = -2.44, *p<.05, M*=42.13, *SD*=8.08)
3. College Model (t (15) = -2.65, *p<.05, M*=41.94, *SD*=7.66)
4. College Challenge (t (15) = -2.64, *p<.05, M*=40.25, *SD*=8.87)
5. College Inspire (t (15) = -3.32, *p<.01, M*=37.44, *SD*=8.32)
1. Work Enable (t (15) = 2.31, *p<.05, M*=51.38, *SD*=3.42)

Rankings of College and Workplace Leadership Practices Inventory Subscales Compared to the Norm by Graduation Year
2. Work Model (t (15) = 2.79, *p<.05, M*=49.88, *SD*=4.10)
3. Work Encourage (t (15) = 2.25, *p<.05, M*=49.31, *SD*=4.01)
4. Work Challenge (t (15) = 0.05, *p=.96, M*=46.19, *SD*=6.73)
5. Work Inspire (t (15) = 0.89, *p=.39, M*=45.75, *SD*=6.32)
2003
1. College Enable (t (20) = -1.89, *p=.07, M*=46.48, *SD*=7.08)
2. College Model (t (20) = -3.28, *p<.01, M*=41.33, *SD*=7.96)
3. College Encourage (t (20) = -2.88, *p<.01, M*=40.33, *SD*=10.69)
4. College Challenge (t (20) = -2.59, *p<.05, M*=40.14, *SD*=10.58)
5. College Inspire (t (20) = -3.44, *p<.01, M*=36.29, *SD*=10.75)
1. Work Enable (t (20) = 1.34, *p=.20, M*=50.71, *SD*=4.50)
2. Work Model (t (20) = 1.06, *p=.30, M*=48.38, *SD*=5.86)
3. Work Encourage (t (20) = -0.55, *p=.59, M*=46.00, *SD*=8.80)
4. Work Challenge (t (20) = -0.50, *p=.62, M*=45.38, *SD*=6.69)
5. Work Inspire (t (20) = 0.06, *p=.95, M*=44.48, *SD*=8.99)
2004
1. College Enable (t (25) = -2.02, *p<.05, M*=46.65, *SD*=6.94)
2. College Encourage (t (25) = -2.43, *p<.05, M*=43.12, *SD*=8.29)
3. College Model (t (25) = -2.76, *p<.05, M*=42.81, *SD*=7.78)
4. College Challenge (t (25) = -3.48, *p<.01, M*=39.65, *SD*=9.46)
5. College Inspire (t (25) = -2.45, *p<.05, M*=39.54, *SD*=10.03)
1. Work Enable (t (25) = 1.65, *p=.11, M*=50.85, *SD*=4.46)
2. Work Model (t (25) = 2.20, *p<.05, M*=49.12, *SD*=4.85)
3. Work Challenge (t (25) = 0.22, *p=.83, M*=46.42, *SD*=7.34)
4. Work Inspire (t (25) = 1.33, *p=.19, M*=46.42, *SD*=7.97)
5. Work Encourage (t (25)= -0.81, p=.43, M=46.00, SD=6.68)
2005

Rankings of College and Workplace Leadership Practices Inventory Subscales Compared to the Norm by Graduation Year
1. College Enable (t (17) = -0.45, *p=.66, M*=48.67, *SD*=6.93)
2. College Encourage (t (17) = -0.26, *p=.80, M*=46.56, *SD*=8.14)
3. College Model (t (17) = -0.43, *p=.67, M*=46.17, *SD*=8.42)
4. College Challenge (t (17) = -1.37, *p=.19, M*=42.94, *SD*=9.82)
5. College Inspire (t (17) = -0.96, *p=.35, M*=42.11, *SD*=9.93)
1. Work Enable (t (17) = 3.40, *p<.01, M*=52.67, *SD*=4.07)
2. Work Model (t (17) = 3.66, *p<.01, M*=51.39, *SD*=5.07)
3. Work Encourage (t (17) = 3.19, *p<.01, M*=51.11, *SD*=5.39)
4. Work Challenge (t (17) = 1.52, *p=.15, M*=48.33, *SD*=6.19)
5. Work Inspire (t (17) = 2.24, *p<.05, M*=47.50, *SD*=5.96)
2006
1. College Model (t (17) = 1.61, *p=.13, M*=48.89, *SD*=4.92)
2. College Enable (t (17) = -0.49, *p=.68, M*=48.67, *SD*=6.30)
3. College Encourage (t (17) = -0.10, *p=.93, M*=46.89, *SD*=7.61)
4. College Challenge (t (17) = -0.53, *p=.61, M*=44.89, *SD*=9.85)
5. College Inspire (t (17) = -0.45, *p=.66, M*=43.39, *SD*=9.10)
1. Work Enable (t (17) = 1.74, *p=.10, M*=51.78, *SD*=5.81)
2. Work Model (t (17) = 4.40, *p<.001, M*=52.00, *SD*=4.80)
3. Work Challenge (t (17) = 1.62, *p=.12, M*=48.89, *SD*=7.29)
4. Work Encourage (t (17), 0.99, *p=.34, M*=48.72, *SD*=7.10)
5. Work Inspire (t (17) = 1.37, *p=.19, M*=47.11, *SD*=8.57)

APPENDIX G

APPENDIX G

Rankings of College and Workplace Leadership Practices Compared to the Neutral Involvement

Rankings of College and Workplace Leadership Practices Inventory Subscales Compared to the Neutral Involvement (Involvement=3) by Graduation Year
2000
1. Internships (t (22) = 1.32, *p*=.20, *M* =3.35, *SD* = 1.27)
2. Professional Organization (t (22) = -0.53, *p*=.60, *M* =2.87, *SD* = 1.18)
3. Design Competition (t (22) = -0.77, *p*=.45, *M* = 2.78, *SD* = 1.35)
4. Study abroad (t (22) = -8.07, *p<.001, M* = 1.35, *SD* = 0.98)
2001
1. Internships (t (25) = 4.55, *p<.001, M* = 3.77, *SD* = 0.86)
2. Professional Organization (t (25) = 0.00, *p*=1.0, *M* = 3.00, *SD* = 1.50)
3. Design Competition (t (25) = -2.00, *p*=.06, *M* = 2.50, *SD* = 1.27)
4. Study abroad (t (25) = -11.73, *p<.001, M* = 1.31, *SD* = 0.74)
2002
1. Internships (t (15) = 2.44, *p<.05, M* = 3.63, *SD* = 1.02)
2. Professional Organization (t (15) = 0.64, *p*=.53, *M* = 3.25, *SD* = 1.57)
3. Design Competition (t (15) = 0.42, *p=.69, M* = 3.13, *SD* = 1.20)
4. Study abroad (t (15) = -10.25, *p<.001, M* = 1.25, *SD* = 0.68)
2003
1. Internships (t (20) = 2.06, *p*=.05, *M* = 3.52, *SD* = 1.17)
2. Design Competition (t (20) = -0.35, *p*=.73, *M* = 2.90, *SD* = 1.26)
3. Study Abroad (t (20) = -0.51, *p*=.61, *M* = 2.86, *SD* = 1.28)
4. Study Abroad (t (20) = -6.78, *p<.001, M* = 1.48, *SD* = 1.03)
2004
1. Internships (t (25) = 1.66, *p=.11, M* = 3.42, *SD* = 1.30)
2. Professional Organization (t (25) = 0.56, *p*=.58, *M* = 3.15, *SD* = 1.41)
3. Design Competition (t (25) = 0.00, *p*=1.00, *M* = 3.00, *SD* = 1.33)
4. Study abroad (t (25) = -10.46, *p<.001, M* = 1.23, *SD* = 0.86)
2005
1. Design Competition (t (17) = 2.14, *p<.05, M* = 3.67, *SD* = 1.33)
1. Internships (t (17) = 2.38, *p<.05, M* = 3.67, *SD* = 1.19)
2. Professional Organization (t (17) = 0.93, *p*=.38, *M* = 3.28, *SD* = 1.27)
3. Study abroad (t (17) = -4.25, *p<.001, M* = 1.72, *SD* = 1.27)

Rankings of College and Workplace Leadership Practices Inventory Subscales Compared to the Neutral Involvement (Involvement=3) by Graduation Year
2006
1. Design Competition (t (17) = 3.72, *p<.01, M* = 3.61, *SD* = 0.70)
2. Internships (t (17) = 1.89, p=.08, *M* = 3.56, *SD* = 1.25)
3. Study abroad (t (17) = -3.12, *p<.01, M* = 1.94, *SD* = 1.43)
4. Professional Organization (t (17) = 1.03, *p=.32, M* = 3.33, *SD* = 1.37)

APPENDIX H

UDRI
UNIVERSITY of DAYTON
RESEARCH
INSTITUTE

8 February 2008

Ms. Patricia Blyden
University of Dayton
Department of Educational Leadership
Dayton, OH

SUBJECT: "Learning to Lead: Examining the Role of Universities, Corporations and Community in the Leadership Development of College Students and Practicing Professionals"

Dear Ms. Blyden:

The Institutional Review Board for the Protection of Human Subjects in Research has reviewed the subject proposal. The proposed research protocol is exempt from human subject regulations as described in 45 CFR 46.101(b)(2). The procedures you have designed to protect participant confidentiality and to secure informed consent are adequate and conform to accepted ethical standards for this type of research.

Therefore, you have approval to proceed with the study. The Committee expects that the appropriate subject protection measures will be followed, as outlined in your proposal.

Please inform the Committee of any ethical issues that may arise in your study. Please feel free to contact me should you encounter other issues relevant to the protection of human subjects. Good luck with your research.

Sincerely,

Jon Nieberding
IRB Chair

INSTITUTIONAL REVIEW BOARD FOR THE PROTECTION OF HUMAN SUBJECTS IN RESEARCH

UD Research Institute
Kettering Labs, Rm. 542
300 College Park
Dayton, OH 45469-0104
(937) 229-2919
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APPENDIX I

KOUZES POSNER INTERNATIONAL
15419 Banyan Lane
Monte Sereno, California 95030 USA
FAX: (408) 354-9170

November 28, 2008

Mr. Patricia Blyden
5216 Kornwal Drive
Columbus, Ohio 43232

Dear Patricia:

Thank you for your request to use the Leadership Practices Inventory (LPI) in your dissertation. We are willing to allow you to *reproduce* the instrument in written form as outlined in your request, at no charge, with the following understandings:

(1) That the LPI is used only for research purposes and is not sold or used in conjunction with any compensated management development activities;
(2) That copyright of the LPI, or any derivation of the instrument, is retained by the authors, and that the following copyright statement is included on all copies of the instrument: "Copyright © 2003 James M. Kouzes and Barry Z. Posner. All rights reserved. Used with permission.";
(3) That one (1) **electronic** copy of your dissertation and one (1) copy of **all** papers, reports, articles, and the like which make use of the LPI data be sent **promptly** to our attention; and,
(4) That you agree to allow us to include an abstract of your study and any other published papers utilizing the LPI on our various websites.

If the terms outlined above are acceptable, would you indicate so by signing one (1) copy of this letter and returning it to us. Best wishes for every success with your research project.

Cordially,

Barry Z. Posner, Ph.D.
Managing Partner

I understand and agree to abide by these conditions:

(Signed) Patricia Y. Blyden Date: Nov. 28, 2008