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Promoting Licensure on College Campuses

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This project report is submitted in partial fulfillment of the degree requirements of Worcester Polytechnic Institute. The views and opinions expressed herein are those of the authors and do not necessarily reflect the positions or opinions of the NSPE or Worcester Polytechnic Institute.

This report is the product of an education program and is intended to serve as partial documentation for the evaluation of academic achievement. The reader should not construe the report as a working document.

ABSTRACT

The goal of this project, commissioned by the National Society of Professional Engineers, was to devise a plan to market licensure and the FE exam to engineering students on campuses nationwide. To reach this objective, the project team conducted sixty-two interviews with engineering faculty. The data collected from these interviews provides the NSPE with a comprehensive plan to fulfill the project goals. This plan includes on-campus presentations by guest speakers, using visual aids, to promote licensure and the FE exam.

AUTHORSHIP PAGE

The Interdisciplinary Qualifying Project (IQP) team wrote the entire report together except for the Results and Analysis, Conclusions, and Recommendations sections of the report. Daniel O'Brien is responsible for the Results and Analysis section of the IQP. Timothy Duong is responsible for the Conclusions section of the report. Lastly, Ryan Walsh is responsible for writing the Recommendations section of the IQP.

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1.0 EXECUTIVE SUMMARY

A decline in membership, stemming from a drop in the overall number of college students pursuing licensure upon graduation, prompted the NSPE to investigate ways to address this problem. The NSPE sponsored a project with a team of students at Worcester Polytechnic Institute to research ways of better promoting licensure to students on college campuses. The secondary objective included obtaining the total percentage of students taking the FE exam and the total percentage of engineering college faculty registered as PEs.

The team conducted semi-standardized interviews, contacted state licensing boards, and spoke with individual engineering departments. A questionnaire was developed, pre-tested, and then used as an instrument to obtain the percentage of licensed faculty at each college and suggestions as to how the NSPE could better promote licensure and the FE exam to senior engineering students. The percentage of students who took the FE exam was obtained by contacting state licensing boards and individual engineering departments.

The schools selected for interviews were determined using a random sampling method from a list of 312 ABET accredited engineering colleges. The team determined the number of schools that should be interviewed to attain a ninety-five percent accuracy rate.

The team then analyzed the data gathered from the interviews and state boards. The analysis consisted of putting both the quantitative and qualitative data into two spreadsheets constructed using Microsoft Excel. The first spreadsheet contained the

percentage of licensed faculty, the percentage of students taking the FE exam, and the programming each university uses to promote the FE exam. The second spreadsheet contained suggestions made by engineering faculty as to how licensure can be better marketed at engineering campuses.

These spreadsheets were carefully reviewed by the project team to find correlations between the percentage of students taking the FE exam and the university programs used to promote licensure. Universities with a review course and a high percentage of licensed faculty members had the most success in getting engineering students to take the FE exam.

The team also looked at the suggestions made by the interviewees and identified the most common ideas. These suggestions included a guest speaker, an information session, informational brochures, and a review course sponsored by the NSPE. Upon further analysis the project team realized that a guest speaker could conduct an information session on college campuses at which informational brochures are distributed. In this case, the majority of the interviewees' suggestions are accounted for.

The inaccuracies the team discovered in the data, and the fact that some necessary data was unavailable, indicates that an essential part of the success of a licensure campaign is a systematic and thorough data collection process.

The primary recommendation from the project team is that the NSPE should sponsor guest speakers who would travel to universities to educate and motivate college students to pursue licensure and to take the FE exam. The guest speaker would use visual aides such as an MS Powerpoint presentation and the promotional video currently under development at the NSPE. This video is aimed at educating students about the

advantages of becoming a professional engineer. Students would also have an opportunity to ask the speaker questions about licensure and the process of becoming a professional engineer.

With respect to long-term goals the project team was also able to provide some recommendations vital to the future of the NSPE. Perhaps the most important recommendation for the future of promoting licensure on college campuses includes encouraging more college engineering faculty to become licensed. Data obtained from this project shows that universities with more faculty licensed as PEs also have more students who take the FE exam. Faculty members are the most important tools in promoting the FE exam because their insights can be influential to students. Furthermore, their support is of no cost to the NSPE.

2.0 INTRODUCTION

The objective of this project is to help the National Society of Professional Engineers (NSPE) promote engineering licensure and the Fundamentals of Engineering (FE) Exam to students graduating from engineering universities. The NSPE represents individual engineering professionals and licensed professional engineers (PEs) across all engineering disciplines and strives to enhance the image of the engineer. The society also provides invaluable networking with other PEs across the country. However, an engineer can only become a licensed member of the NSPE if they have a PE license. A special student membership is offered to full-time students in ABET accredited engineering universities (NSPE, 1999).

The National Council of Examiners for Engineering and Surveying (NCEES) is the organization responsible for licensing professional engineers. Engineers can receive their PE license by passing two exams administered on a state-by-state level by the NCEES.

The first exam, known as the Fundamentals of Engineering (FE) Exam, can be taken by students enrolled in or who have graduated from an ABET accredited engineering university. According to the NCEES, "It is a pass or fail exam that is taken by approximately 50,000 people a year, most of whom are recent college graduates or seniors within one year of graduating" (LeFevre, 1999). While specific questions may be different in each state, the general engineering fundamentals remain the same. Once engineers pass the FE exam they become Engineering Interns or EIs (NCEES, 1999). At this point they are not professional engineers but are on their way towards licensure.

Likewise, they also have the option of joining the NSPE as Engineers in Training (EIT) at this time (NSPE, 1999).

The second exam, known as the Principles of Engineering (PE) Exam, can only be taken after the FE exam is passed. In addition, most states require the engineer to gain four years of worthwhile experience before taking the PE exam. The PE exam differs from the FE exam in that it is focused on a particular engineering field instead of a broad range of fields (NCEES, 1999).

Once both exams are passed and the engineer receives a PE license, he or she has the option of joining the NSPE as a licensed member. Since the exam deals with a broad range of engineering fundamentals, the NSPE recommends that it be taken during the senior year of college or immediately after graduation. Unfortunately, there are no facts to prove that engineers are more likely to pass the FE exam if they take it during or immediately after college. However, most engineers would agree that general engineering fundamentals are still "fresh" in their minds during college as opposed to six years down the road (NSPE, 1999). According to Smith, "The greater the passage of time since college graduation, the greater their (engineers) chances of failing the exam" (Smith, 1999).

Ernest T. Smerdon, President of the American Society for Engineering Education suggests, "A major problem for engineering as a recognized profession is that only about one-fifth (20%) of working U.S. engineers are licensed professional engineers (P.E.)" (Smerdon, 1999). This percentage is extremely low when compared with other professions such as teaching, nursing, and even automobile mechanics who are required

to get professional licenses. Other societies such as the American Bar Association enjoy a licensure rate of 50% of all lawyers nationally (ABA, 1999).

Even worse, the number of engineers taking the FE exam from 1993 through 1998 has dropped considerably. For example, the number of mechanical engineers taking the exam was down nearly 60% from 13,455 in 1993 to 5,576 in 1998. Furthermore, in civil engineering, which accounts for the highest percentage of enrollment in the FE exam, numbers have dropped by 60% over the last five years. In fact, every engineering discipline has seen a decline in the number of candidates taking the FE Exam from 1993 through 1998. The downturn will soon affect the number of engineers taking the PE exam as a four year waiting period is generally required between taking the two exams (Smith, 1999).

Likewise, membership in the NSPE has also dropped over the years. The NSPE has lost over 15,000 members from 1991 through 1999. Since the majority of the members are PE's the decline is directly related to the decline in the number of engineers getting their PE license.

Part of the reason for the low percentage of engineers becoming licensed as PE's is the fact that there is no need for a license when performing engineering work in industry. Only engineers who consult directly with the public are required to be licensed. This law, upheld in most states, is known as industrial exemption. Therefore, unless an engineer is working outside of industry, that engineer does not need to get licensed. Professions such as teaching, nursing, and law, do not have similar "exemption laws" and this, coupled with the fact that these professions also deal primarily with the public, accounts for part of the reason the percentage of licensed professionals in these fields

exceeds that in engineering. Unfortunately, the low numbers of engineers taking the FE exam contribute to more than just industrial exemption.

Many college students are uneducated about the process of becoming a licensed PE. This accounts for part of the reason that the already low numbers of enrollment in the FE exam have dropped considerably over the years. According to the American Society for Engineering Education (ASEE), "Many students have shown little interest in achieving engineering intern (EI) status, and thus show little interest in passing the examination (FE)." The ASEE suggests that, "Many of these students have been given little or no advice about the licensing process" (ASEE, 1999).

As a result, the NSPE is actively searching for ways to increase membership in their society. The goal of this project will focus on promoting licensure on university campuses. Although the NSPE does not administer the FE exam, it believes that if it can increase the number of students taking the exam on campus, then more people will join the society with hopes of enhancing the image of their profession as a whole.

The project will include researching how licensure is perceived and promoted at engineering universities, including the total percentage of faculty members and deans who are licensed. Furthermore, the project will also examine the percentage of engineering students taking the FE Exam. This data will give the NSPE an estimate of how many students are taking the FE exam during college.

In order to find out how many faculty members have taken the exam and how many students take the exam each year, engineering college faculty need to be contacted and asked to disclose the information. Each engineering school keeps records on the number of professionally licensed faculty members and the number of students taking the

FE exam each year. The number of students taking the FE exam will be obtained by contacting the NCEES. If this statistical information cannot be attained from the NCEES then state licensing boards can provide the information.

In addition, the NSPE would like to know how engineering college faculty perceive licensure and how well they think the FE exam is promoted on their campus. The society would also like to know what universities do to promote the exam to their students. After the necessary data is collected and analyzed, the final goal of the project will be to develop a comprehensive plan that will help the NSPE promote licensure on college campuses.

To get this data, a series of individual interviews will be carried out with faculty of engineering colleges. The goal of the interviewing is to first ask faculty what their school is doing to promote licensure and secondly, what NSPE could do to increase licensure by college graduates. The results and recommendations to be given to the NSPE will be based on the data obtained from the interviews.

The results and recommendations of this project will be presented to the NSPE in the form of a written report and an oral presentation. These tools will help the NSPE to figure out why only a small percentage of engineers take the FE exam and offer suggestions as to how the agency can increase the total percentage of engineers licensed as PEs.

The objective of this project will be to increase the number of students taking the FE Exam as opposed to the PE as well. Additional time will be needed to research information and sources regarding reasons engineers decide not to pursue licensure further down their careers. Researching this problem is another whole project in itself.

Keeping in mind the project objective is to increase percentage of license engineers out there, the starting point that will help NSPE increase the number of licensed PEs is to actually educate, and encourage students to take the FE Exam, which is the first step in becoming licensed.

In summary, the objective of this project is to propose methods the NSPE can use to better educate college students on the advantages of becoming a licensed Professional Engineer. This will include telling students about the advantages enjoyed by PE's as well as the path students need to take if they wish to pursue licensure. In addition to educating students, the team recognizes the importance of motivating students to take the FE exam, which is the next step towards licensure after college.

3.0 LITERATURE REVIEW

Since this project deals with conducting extensive research for the NSPE that can lead to important findings for the agency, a thorough knowledge of the subject matter must be completed before the project team begins collecting data. The background research conducted not only builds a solid foundation for the project but also ensures that no one else has already done what the team hopes to accomplish.

3.1 The National Society of Professional Engineers

Founded in 1934, the National Society of Professional Engineers (NSPE) is the only engineering society that represents individual engineering professionals and licensed professional engineers (PEs) across all engineering disciplines. The primary function of the society is to promote engineering licensure and ethics while at the same time enhancing the engineering image.

The society also advocates and protects the PEs' legal rights at the national and state levels, publishes news in engineering, provides continuing education opportunities, and much more. There are many advantages to becoming a member of the NSPE. They offer employment benefits such as job and resume placement services along with useful information about salaries. NSPE also offers discounted travel rates and long term health care coverage. Nevertheless, promoting engineering licensure continues to be the most important goal of the society for the simple reason that without members, the society will cease to exist (NSPE, 1999).

Today, the NSPE serves some 60,000 members and the public through 54 state and territorial societies and more than 500 chapters. Membership in this prestigious society is open to Licensed PEs, Engineers In Training (EITs), graduates of Accreditation Board for Engineering and Technology (ABET) accredited engineering programs, and graduates of four-year non-ABET engineering programs. Graduates of ABET-accredited engineering technology programs, Land Surveyors licensed to practice in any state or U.S. territory and Land Surveyors in Training, and students in engineering programs or ABET-accredited engineering technology programs can also attain membership in this prestigious society. All memberships are individual; there are no company memberships (NSPE, 1999).

3.2 Sustaining University Program

The Sustaining University Program (SUP) sponsored by the Professional Engineers in Education (PEE) Division of the National Society of Professional Engineers (NSPE) provides an opportunity for ABET-accredited colleges and universities to actively pursue initiatives directed toward the enhancement of engineering education. In addition, a secondary purpose of the program is to educate college students about the NSPE. The program gives engineering students the opportunity to work with the NSPE before they graduate. In 1998, approximately 150 colleges and universities participated in this program (NSPE, 1999).

3.3 NSPE Practice Divisions

Once engineers pass the PE exam and become Professional Engineers, they have the option to become members in one of the NSPE's Practice Divisions. These divisions all parallel a particular engineering discipline and are better adapted to fit the specific needs of a PE. A member has the option to join any or all of the following practice divisions (NSPE, 1999).

3.3.1 Professional Engineers in Construction (PEC)

PEC represents engineers in the construction industry. The organization has active projects to develop better contract documents and helps members in such areas as design/build and construction management contracting, legislation and government affairs, building safety, arbitration, privatization, and engineering licensure. PEC coordinates activities with AGC, ABC, MCAA, NECA, and other construction groups. The PEC section in *Engineering Times* keeps members informed of PEC activities and developments in the industry (NSPE, 1999).

3.3.2 Professional Engineers in Education (PEE)

The PEE serves engineers whose goal is to satisfy the educational needs of the engineering profession. Activities include the Sustaining University Program (SUP), in which some 160 engineering colleges participate. Quarterly, the PEE section in

Engineering Times covers matters of importance to engineering educators and students (NSPE, 1999). For example, an article in the August/September 1999 edition cites that salary levels for engineering educators at all faculty levels are increasing substantially (*Engineering Times,* 1999).

3.3.3 Professional Engineers in Government (PEG)

PEG is dedicated to meeting the needs of all engineers employed in local, state, or federal government. PEs can stay abreast of current legislative and regulatory developments through the PEG section in *Engineering Times* (NSPE, 1999).

3.3.4 Professional Engineers in Industry (PEI)

PEI works to help engineers in industry faced with the needs created by more uncertain career patterns, frequent job changes, and the pressures of ever increasing worldwide competition. Its Industry Relations Program seeks better communications with top management. Members keep abreast of new developments through the PEI section in *Engineering Times* (NSPE, 1999). Articles are focused on new trends in the engineering industry and issues that directly affect PEI's.

3.3.5 Professional Engineers in Private Practice (PEPP)

In the PEPP, PEs focus on the professional concerns of engineers providing construction design services to the public and private sectors. PEPP's monthly section in *Engineering Times* reports on salaries, liability, practice management, markets, legislation, professional development, and other significant issues. Members gain access to standard forms of agreement, general conditions, bid bonds, and other documents; publications; video tapes; and more (NSPE, 1999).

3.4 NSPE State Societies

PEs keep closely in touch with the NSPE-affiliated societies located in their state. These societies, located in all 50 states, work closely with the state governments and the NSPE to protect and ensure the success of PEs. The state societies also keep PEs updated with job opportunities available in each state. Most societies have annual meetings, dinners, seminars, and workshops all aimed at discussing engineering issues.

The state societies do not work exclusively with Professional Engineers. In fact, a large amount of work goes into collaborating with local universities to conduct college prep courses aimed at preparing a candidate for the PE exam. These courses are refresher courses for candidates who have been away from academia as a result of working in their professions (NSPE, 1999).

3.5 State Licensure Boards

In every state there exists a State Board of Examiners for Engineers and Surveyors. These boards are responsible for the administration and regulation of the professions of engineering and land surveying in each individual state (NYSED, 1999). The boards review applications, administer examinations, license qualified applicants, and regulate the professional practice of the licensees throughout the states. The boards also investigate complaints, and those requiring further action are scheduled for a hearing before the boards (NCBELS, 1999).

3.6 The National Council of Examiners for Engineering and Surveying (NCEES)

In 1920, The National Council of Examiners for Engineering and Surveying (NCEES) was created out of a need to coordinate information between state boards of licensure. The NCEES serves as a verifying agency for the professional engineer or land surveyor who is seeking multiple-jurisdiction licensure and who meets the requirement of holding current licensure with at least one licensing board. Therefore, the NCEES decides whether or not engineers licensed in one state can practice in another.

Over the years, the council has grown to also oversee the state boards and work with them to administer the FE and PE exam to engineers and license those who pass as professional engineers. In addition, the NCEES develops and scores the FE and PE examinations and reports the results to licensing boards.

The Fundamentals of Engineering (FE) Exam is a general engineering science exam to be completed by engineers of all disciplines. The exam can be taken during college or after graduation. The first half contains questions common to all examinees. For the second half, candidates can take either a general engineering fundamentals exam or one that is aimed at their specific discipline including mechanical, civil, electrical, industrial, or chemical engineering.

The second exam, known as the Principles of Engineering (PE) Exam, is specific to the candidate's engineering field. This exam is generally taken four years after the FE exam. PE exams are offered in the fields of civil, mechanical, electrical, chemical, environmental, structural, agricultural, manufacturing, control, metallurgical, fire protection, mining, nuclear, petroleum, and industrial engineering. An exam is also offered to land surveyors. Most states require four years of responsible engineering practice in a specific discipline before taking the PE exam. Other states may choose to waive the written exam on the basis of education and experience (NSPE, 1999).

To better promote licensure, the NCEES offers a special opportunity for recent college graduates aimed at starting the licensure process immediately after college when engineering ideas are still firmly implanted in the candidate's mind. Engineers graduating from college need not wait four years to begin the process for licensure. The NCEES currently allows college graduates to take the FE exam and become Engineers In Training (EITs) provided they pass. In most states, the EITs still need to gain four years experience before they can take the second exam known as the Principles of Engineering (PE) exam (NSPE, 1999).

3.7 Licensure Benefits

Perhaps the largest advantage of becoming a Professional Engineer (PE) lies in the fact that a PE license allows you to perform engineering consulting with the general public (NSPE, 1999).

Professional engineers have many advantages that other engineers do not. Licensed engineers have the ability to prepare, sign, seal, or submit any engineering plans for approval by a public committee. Only licensed engineers are allowed to offer their services to the public. In other words, if an engineer wishes to work on his or her own he or she must be licensed through the NCEES (NCEES, 1999). In order to work as a consultant or a practitioner, a PE license is not only recommended but also required. Most engineering positions in federal government agencies also require licensed engineers. Many states are beginning to require licensed workers to teach engineering in their school systems. The need for licensed engineers is growing in the military as well as in modern construction projects. The National Society of Professional Engineers is working to produce competent licensed engineers in order to insure safety (NSPE, 1999). On the other hand, certain engineering disciplines are more likely than others to have the need for PEs. For example, civil engineers often work directly with the public when building structures or constructing roads. Although being a licensed PE offers many advantages, the largest reason behind licensure lies in the fact that it allows engineers to work with the general public. For this reason, the civil engineering field has the highest percentage of PEs.

3.8 Becoming a Professional Engineer

Like lawyers who have passed the bar exam, professional engineers have fulfilled the education and experience requirements and passed the exams that, under state licensure laws, permit them to offer engineering services directly to the public. PEs take legal responsibility for their engineering designs and are bound by a code of ethics to protect the public health and safety. To promote membership, both the NCEES and NSPE highlight the benefits that can be gained from becoming a PE. However, in order to become a PE, an engineer must fulfill certain criteria (NSPE, 1999).

In order to gain licensure from the NCEES and become a professional engineer, there are several qualifications an individual must attain. Although these qualifications may vary from state to state, and are exclusively under the control of the individual state legislatures, they follow a general format (NSPE, 1999).

First of all, the candidate must be enrolled in or have a BS degree from an ABET accredited engineering institution. Second, the candidate must pass the FE exam. If the candidate passes this exam, four years of worthwhile engineering experience must be gained before taking the PE exam. Once the PE exam is passed, the engineer will have earned his or her PE license in the state where the exam was taken.

3.9 Licensure in Other Professions

There are many professional associations and professions that have similar goals and standards as the National Society of Professional Engineers. However, these standards are contoured to their particular organization. Some of these societies operate in the fields of nursing, teaching, and law practice.

3.9.1 Nursing

To be a registered nurse (RN) requires licensure in each state. The National Council of State Boards of Nursing met and initiated the creation of a program to permit interstate licensure. In December of 1997, they signed a system that would allow RNs to practice in one state even though they were licensed in another (Ventura, 1999). Nurses would obtain a license in one state and could operate in other states providing his or her license did not have any restrictions and that he or she followed the laws of the state in which she was practicing. A system like this would require a national database containing licensure and disciplinary records of every nurse in the United States. Many nurses worry the price of licensure will increase to support this system, however the need for multiple inter-state exams and the corresponding fees will be eliminated (Ventura, 1999).

This system is similar to the NCEES in that both allow practice in other states. However, although the PE and FE exams are relatively similar in every state, there are

minor discrepancies between certain states. As a result, passing the PE exam in one state does not guarantee that a PE can practice in every state. This is contrary to the nursing exam proposed by The National Council of State Boards of Nursing, which allows for practice in any state upon passing the test.

3.9.2 American Bar Association

The American Bar Association (ABA) was founded on August 21, 1878 by 100 lawyers from 21 states. At the time, the legal profession barely existed and lawyers were generally sole practitioners who trained under a system of apprenticeship. There was no national code of ethics or organization to serve as a forum for discussion of the increasingly intricate issues involved in legal practice (ABA, 1999).

Today, the mission of the association is "To be the national representative of the legal profession, serving the public and the profession by promoting justice, professional excellence, and respect for the law" (ABA, 1999).

The ABA's system of registering lawyers in their society by administering the Bar Exam is similar to the way the NCEES licenses engineers through the FE and PE exams. In order to become a member of the ABA, a lawyer needs to take and pass the Bar Exam. This exam can be taken right after graduation from law school or at any time in a lawyer's career. The exam itself is administered on a state level. Exams vary from state to state but generally contain the same questions about law. Once the candidate passes the exam, he or she is free to practice law in the state where the exam was taken, but may

or may not be able to practice in other states. Again, this is determined by the individual states (ABA,1999).

Like the NSPE, the ABA has a chapter in every state. Although each chapter shares the same mission and goal under the ABA, they have small differences that contour to their particular state. For this reason, a lawyer registered by the Bar Association in one state may not always be able to practice in another state (ABA, 1999). The NSPE faces a similar problem.

3.10 Engineering Education Problems

Recently, the National Society of Professional Engineers surveyed about 1,000 engineering employers to determine whether or not engineering graduates will meet the basic needs of their hiring company. Over one third of the people in the study felt that college graduates they hired do not meet the basic needs of their company. Approximately 80% placed teamwork as a high priority. However only 1 in 4 engineering graduates were well trained in this area. Many companies felt these students had poor communication skills and needed more practical experience (Dahir, 1993).

In the 1998 Harris Poll, 17 professions were rated and 34% of people held engineers in great prestige and 37% held them in considerable prestige. Engineers managed to be ranked sixth only behind scientists, doctors, policemen, ministers, and teachers (Sylar, 1999). NSPE is trying to determine why engineers are still concerned about enhancing their image. Another study conducted by the Harris Poll stated that 60% of Americans do not understand or feel well informed about the engineering profession.

Also, many people do not realize the importance of engineering in terms of health and safety issues. The National Society of Professional Engineers is developing projects to give people a better understanding of engineering and its benefits (Sylar, 1999).

Russell Kehl suggests that engineers can only advance their careers if they are able to keep up with technological advances. Currently, 19 states require engineers to continue education to remain licensed in what is known as Continuing Professional Competency (NCEES, 1999). Kehl gives three reasons engineers should remain licensed: to keep up to date with technology; legal liability reasons; and to maintain an overall respect as a professional (Kehl, 1996).

3.11 Attempts to Correct Engineering Education Problems

In order to standardize educational goals for engineering institutions, some universities have suggested is requiring all engineering students to take the Fundamentals of Engineering (FE) exam in the last semester of their senior year (Mazurek, 1995). The National Council of Examiners for Engineering and Surveying (NCEES) gathered a team to consider rewriting the FE exam so it would better evaluate the effectiveness of the programs of engineering institutions (Mazurek, 1995).

Recently, the Coast Guard Academy administered a quality action team (QAT) to investigate the cadet pass rate and general knowledge of the FE exam. The people surveyed in the study included their staff, cadets, and recent graduates. The QAT determined that most of the professors in the academy had not even mentioned the FE exam to any of the students. More importantly, they determined that the FE exam is not a

priority to students because it is not a requirement for graduation, therefore giving other class activities much higher priority (Mazurek, 1995).

Some smaller companies have voiced concerns that larger companies can continue professional development among their employees much more easily. They fear that continued licensure increases in large companies could eventually put them out of business. However, mandatory licensure for all practicing engineers is also suggested as a way to ensure efficiency (Kehl, 1996).

3.12 Interviewing

The following sections discuss different processes to obtain qualitative data. It is important to understand these processes in order to be able to gather accurate data in an efficient manner. Furthermore, the project team used these processes extensively to collect data for the project. Two types of research that will be defined in detail are interviewing and focus group sessions.

Interviewing is defined simply as conversation with a purpose to gather information (Berg, 1998, p. 57). Consideration to conduct an interview for a case study will not be possible without thinking about different interview structures that could be used in the research being done. Two major categories of interviewing are standardized and semi-standardized interview structures (Berg, 1998, p. 60).

3.12.1 Standardized Interview

A standardized interview involves having a set of prepared questions that an interviewer must ask an interviewee to answer. The rationale is to offer each participant approximately the same stimulus so that responses to the questions, ideally, will be comparable (Berg, 1998, p. 60). Researchers using this method assume that the questions scheduled will elicit data, which will benefit the research study being conducted. The purpose of standardized interviews is to ask a set of pre-determined questions that will extract data thoughts, opinions, and attitudes of a subject concerning study-related issues (Berg, 1998, p. 60).

3.12.2 Semi-Standardized Interview

A semi-standardized interview involves implementing a number of pre-determined questions and working in topics that will bring about rapport, which can lead to useful information provided by a participant. Questions are typically asked of each interviewee in a systematic and consistent order, but the interviewer is allowed freedom to digress. In other words, the interviewers are permitted (in fact expected) to probe far beyond the answers to their prepared and standardized questions (Berg, 1998, p. 61). If questions are to be standardized, they must be formulated in words familiar to the people being interviewed (Berg, 1998, p. 61). Therefore, questions that are used in a semi-

standardized interview should demonstrate that people understand the topic in different ways.

3.12.3 Creating the Proper Interview

To determine the interview schedule, an interviewer must think about the subject of the questions he or she plans to ask and answers that could be expected. Breaking the overall topic into several related questions is done in a way that provides unity to the interview (Rubin & Rubin, 1995, p. 146). Once this decision is made, creating questions and a possible interview schedule will follow.

The wording of questions and phrasing depends on whom one is asking, educational level, language barrier, and many other characteristics. There are four types or styles of questions that must be included in a questionnaire. These include essential questions, extra questions, throw-away questions, and probing questions (Berg, 1998, pg. 65).

Essential questions deal with the main reason behind a research study. Essential questions are geared to gather specific information from each subject that participates in the study. Extra questions are those questions roughly equivalent to certain essential ones but worded slightly different. These questions are meant to verify responses given by participants to check consistency of responses. Throw-away questions are queries that get asked but will not help the study at hand. Probing questions on the hand provide interviewers with a way to draw out more complete stories from subjects (Berg, 1998, pg.

67). This technique is used to get more information when a response is unclear or incomplete (Frey & Oishi, 1995, pg. 27).

Carefully worded questions are an extremely important concept that must be considered because an interviewer tries to motivate respondents for complete and honest answers. An interviewer will not get complete answers if a participant does not understand what is being asked (Berg, 1998, pg. 67).

3.12.4 Problems in Interviewing

An interviewer can run into problems during the question formulation stage for interviews. The three major problems often encountered are effectively worded questions, double-barreled questions, and overly complex questions. Effectively worded questions arouse emotional response, usually negative (Berg, 1998, pg. 69). These questions are not meant to be antagonistic, but reactions that result from them can prevent certain subjects to be brought up. An interviewer can stop such an occurrence by asking questions that tend to neutralize or normalize the affect (sensitivity) of the question (Berg, 1998, pg. 69).

The double-barreled question expects a subject to respond to two issues asked in a single question. The problem with double-barreled questions is that a participant may try to answer the question asked, but rarely does an interviewee answer both questions completely. In order to avoid this, the interviewer should separate the two questions for the interviewee. Finally, there is the problem of asking complicated questions that some individuals may not comprehend, and therefore will not answer such questions

completely. Interviewers should keep questions brief and concise, which allows clear responses and more effective analysis of answers (Berg, 1998, pg. 70).

Types of questions that are asked in an interview can have a significant impact on the results collected. Normally an interviewer will start off with non-threatening questions that develop rapport (Berg, 1998, pg. 70). This will allow the interviewer to work in more complex and sensitive questions relating to the study being conducted. A careful pre-test of the interview procedure can help researchers determine whether an approach will produce results that one expects and desires for the study. Careful pre-testing of the instrument, although time consuming in itself, can save time and lower cost in the long run (Berg, 1998, pg. 71).

There are several keys to conducting a successful interview and one is to make the interviewee feel comfortable in his or her environment. This will allow the interviewee to speak freely about his or her knowledge on the study being conducted (Kvale, 1996, pg. 125). An interviewer should never begin an interview cold where a subject is not yet comfortable enough to answer any questions. One must remember to spend several minutes chatting and making small talk with the subject (Berg, 1998, pg. 87). Also the interviewer should remember the objective for holding this particular interview. The objective is to gather information for an ongoing research study. Try to keep the subject on track, and if you are working with an interview schedule, always have a copy of it in front of oneself—even though the questions are memorized (Berg, 1998, pg. 87). Memorizing questions is good but being able to present them in a natural way is even more important. An interviewer should relax and be natural as if questions that are asked just popped into one's head (Berg, 1998, pg. 87).

One should be attentive and have interest in what the interviewee is actually saying. Attentiveness shows respect to the interviewee and reinsures that he or she will contribute toward research work. If an interviewer does not show interest the interviewee will be turned off and could possibly not provide useful information towards the research at hand (Berg, 1998, pg. 87).

Proper attire should be worn as well when conducting interviews depending on who one is interviewing. Business attire is usually the most appropriate but there are occasions where one can dress casually. An interviewer must always be aware of their appearance and how others perceive them. No one wants to be interviewed by someone who looks unprofessional or like they just woke up.

Monosyllabic answers will not offer any data that can benefit a research study, and the interviewer must be attentive enough to recognize when an interviewee begins to give yes-and-no answers. An interviewer should probe more questions when this occurs to elicit more information about a subject. Doing simple things, for example pausing or having a puzzled facial expression, could possibly bring on more useful information.

3.13 Focus Groups

A focus group is a discussion where more than one person is being interviewed. The group of no more than seven people is led by a moderator whose objective is to learn more about a particular topic of interest to the group and the researcher. The moderator gets information by drawing it out from the participants through a pre-arranged set of

questions and allowing participants to speak freely about the topic under investigation (Berg, 1994, pg. 100).

Focus groups also provide a means for collecting qualitative data in settings and situations that require pertinent data in a short amount of time or where a one-shot collection is necessary. In addition, focus groups can be effective when a certain group of interest to a researcher is only available for a limited amount of time. In many cases, focus group interviews serve the same purpose as surveys. In this case, focus groups are popular because they are usually less time consuming and expensive (Berg, 1994, pg. 101).

If administered properly, focus group interviews can be extremely dynamic. Discussion is stimulated by interactions between members of the group when one group member reacts to comments made by another. The moderator should only have to push the group in the right direction to get the desired data without having dominated the discussion. This method of group dynamics allows the members to draw information out of each other in a collective brainstorm. As a result, a large number of ideas, issues, topics, and answers to a problem can be generated in one meeting. The amount of data gathered is generally far more than what could be obtained from a one-on-one interview (Berg, 1994, pg. 106).

3.13.1 The Role of the Moderator in Focus Groups

The interviewer in the focus group is the moderator. It is important that the moderator has respect for the participants and shows a positive regard to all their

responses. In doing this the moderator will hold the interest of the participants and ensure the productivity of the session. It is important that the moderator guides the session and does not share his or her own personal views or shape the discussion in any way. A good moderator is able to hold back personal opinions even when he or she does not agree with the responses of the participants (Krueger, 1998, Vol. 4, pp. 3-8).

In the period of time before the focus group session, the moderator must complete a few preparation tasks. It is vital that he or she be mentally alert and free of any anxieties and distractions because moderating requires diligent listening and concentration to keep the discussion on the desired topic. Similar to an interview, the moderator will have a short questionnaire used to guide the discussion and make sure all the participants continue to discuss issues pertinent to the goal of the session. The moderator must be familiar with the questionnaire and be clear on the purpose of the study (Krueger, 1998, Vol. 4, pp. 9-10).

Aside from being mentally prepared, the moderator must create a suitable environment for the session to take place. Upon arrival in the room the moderator has a short period of time to determine whether or not the room is suitable. He or she should check the temperature, the lighting, the placement of electrical outlets, the background noise, and the number of chairs and the size of the tables (Krueger, 1998, Vol. 4, pp. 11-14).

Once the room is deemed suitable for the session, a table is set up for registration, another for refreshments, and one for the discussion. The registration table is placed right next to the door through which the participants will enter. The refreshment table is set up along a wall. The discussion table should be in the center of the room with chairs placed

around the perimeter. If possible, the moderator should be the only person facing the door to prevent the participants from getting distracted. There should also be an assistant moderator present sitting directly across from the moderator. This person should be silent throughout the session, however he or she should be recording the content of the session either by hand or a tape recorder (Krueger, 1998, Vol. 4, pp. 15-17).

As the participants arrive for the session, the moderator registers each person individually by gathering information such as their name, age, education level, occupation, and annual income. He or she should also begin to make small talk with the participants to develop a rapport and make them feel as comfortable as possible. Once everyone is present and seated at the discussion table, the moderator introduces the participants to each other (Krueger, 1998, Vol. 4, pp. 21-23).

The reactions of the moderator are to be short and positive. They should be no more than saying "yes" or "uh-huh" and a simple head nod. After a response it is a good idea to allow a short pause to let the participants ponder the information and possibly give their thoughts on the subject. Many of the responses are short answers without explanation. It is the moderator's job to ask probing questions and attempt to have the participants offer reasoning for their feelings on the particular issue (Krueger, 1998, Vol. 4, pp. 24-28).

Once the moderator has obtained the desired information, he or she must end the session. This can be done by providing a summary of the discussion and asking the participants if they feel anything was left unsaid. When all the participants have left the room, the moderator and the assistant should sit down and discuss the session and debrief each other. Some of the things they should discuss are the major themes of the session,

how these differed from what was expected, how these differed from other focus group sessions. Furthermore, they should ask each other if there were any unexpected findings and what should be included in the report. This is the first opportunity for the two to compare note and decide if they agree on answers to the above questions. If they cannot agree that the job was done well, the moderator and the assistant need to review the tape (Krueger, 1998, Vol. 4, pp. 31-35).

3.13.2 Focus Group Questions

Once the problem of a focus group is clarified between participants and its sponsor, brainstorming of questions should begin. The questions that are formulated by the group should be carefully placed sequentially, and the phrasing should be straightforward so that the intended audience can understand. Focus groups are intended to be a social experience and conversational questions are essential to create and maintain an informal environment (Krueger, 1998, Vol. 3, p. 3).

The types of questions that should be asked are opening, introductory, transition, key, and ending. Opening questions are designed to be answered quickly and to make people feel comfortable by identifying characteristics that participants have in common (Krueger, 1998, Vol. 3, p. 23). The introductory questions will introduce the topic of discussion and allow participants to reflect on their connection with the topic. Once the participants are allowed to reflect, transition questions should be asked so the topic can be seen in a broader scope. Transition questions serve as the logical link between the introductory questions and the key questions because participants at this point understand

their connection with the topic of investigation (Krueger, 1998, Vol. 3, p. 25). This allows the key questions to follow, in turn driving the study of a focus group. The moderator needs to allow sufficient time for a full discussion of these questions, and probing additional questions will be needed as well to elicit sufficient data. Ending questions should then be used to conclude the session allowing the participants to reflect on answers that were given, and permit additional thoughts that the group may have about the topic (Krueger, 1998, Vol. 3, p. 26).

One should remember to avoid asking "why" questions during the focus group session. "Why" questions imply a rational answer developed by thought and reflection (Krueger, 1998, Vol. 3, p. 33). Questions should also be kept simple and clear so the participants of a focus group can understand what is being asked. If a question is too complicated there can be multiple interpretations provided. Giving examples should be avoided as well because it can limit other dimensions from emerging about a topic. If examples are given, give them as probes after participants have already given their insights (Krueger, 1998, Vol. 3, p. 35).

In conclusion, focus group questions should be both aimed at gathering worthwhile information while at the same time providing a social experience intended to keep the audience feeling comfortable. The wording and order of these questions should be well thought out as they are the most important tools for the interviewer in a focus group.

4.0 METHODOLOGY

The primary objective of this project is to gather information from selected engineering schools that will focus on effective marketing techniques of licensure and the Fundamentals of Engineering Exam. A secondary goal is to obtain the percentages of students taking the FE exam as well as the percentage of licensed faculty at these particular schools. These percentages should confirm that licensure numbers are down and help determine which universities are doing a good job in promoting licensure.

In order to accomplish our primary objective, we conducted interviews with faculty at engineering universities. The initial goal was to interview deans of engineering schools as they were the premier representatives of the university. However, often times the dean was unfamiliar with licensure, the FE exam, and its promotion at the institution. In these cases, another faculty member who was more familiar with the subject or was in charge of a review course for the exam was interviewed. The goal of the interviews was to determine the percentage of licensed faculty members in the school's engineering department, how licensure is promoted by the university and the NSPE, and ways the NSPE can effectively market licensure on college campuses.

The process of obtaining the percentages of students taking the FE exam has two parts. First, the state licensure boards are contacted to obtain the number of students who have taken the exam at a particular university. Next, the engineering departments at the universities are contacted to determine the number of students who have received bachelor's degrees from the engineering college. Once both sets of data have been

collected a percentage is calculated by dividing the number of students taking the exam by the number of students having received bachelor's degrees.

Unfortunately, all of our objectives may not be reached using just interviews. Therefore, a sufficient backup method must be in place should the interviews fail to meet both the primary and secondary objectives of the project. To gain more insight on how licensure is perceived and promoted on college campuses, we can conduct focus groups of faculty and focus groups of students.

An email survey of engineering students was considered, however the response rate of this type of survey is quite low. The idea was to conduct an email survey of student groups and organizations such as ASCE and ASME to gain their perceptions of licensure and methods the NSPE could use to better promote the FE exam to senior engineering students. A similar project was conducted at the NSPE in the past and the response rate of the students was unsatisfactory. In addition, the researchers do not have the option of probing the interviewee to gather additional information on interesting topics.

4.1 Interviewing

The interviews for this project are with the dean or faculty member who is considered the school's expert on licensure and the FE exam and their promotion. The interviewees are from the engineering departments of the selected universities. The goal is to interview only deans but in many cases the deans are not as familiar with the subject as one of their faculty members. Some of these faculty members are well drilled in

fields of licensure and the FE Exam in the sense that they deal directly with the state licensing boards and the FE exam. In general these people work towards goals similar to those of the NSPE. Often times an engineering school does not have a dean, but it does have a director of the engineering department. In these cases, the director is interviewed in place of the dean. Regardless of the circumstances, the initial contact is made with the dean.

In contacting the faculty of engineering universities, a secretary usually answers the phone. Secretaries act as gatekeepers who screen information for the faculty participants in our research project. A research bargain may be needed to convince the secretary to let us speak with the interviewers (Berg, 1998, 131). In our case, the bargain may include giving incentives to the secretary to relay to the faculty that will assure them that their input could potentially help more students to take an interest in licensure. In many instances, the simple act of being polite to the secretary will suffice. During the telephone calls the project and its objectives are explained and incentives are offered in order to convince the faculty to agree to a telephone interview at a later date. The incentive given in this project is that our research could potentially help promote licensure and the FE exam on their campus.

The goal of the telephone interview with college faculty is two-fold. The primary objective of the interview is to obtain qualitative data from the faculty which indicates how licensure and the FE exam is perceived and promoted on their campus as well as effective ways to promote licensure. A secondary objective will be to obtain the quantitative data, the percentage of faculty licensed as PEs.

The telephone interviews follow a semi-standardized format. A semi-standardized interview involves the implementation of a number of pre-determined questions. These questions are typically asked of each interviewee in a consistent order. However, the interviewers are allowed freedom to digress and probe far beyond the answers to their pre-determined questions if they get onto a subject that could provide worthwhile information (Berg, 1998, 61). This is important because many of the interviewees give responses that are not expected and a semi-standardized interview allows the interviewer to gather a broader range of qualitative data.

Different engineering school faculty perceive licensure and the promotion of the FE exam in different ways. Hence, the semi-standardized interview fits the specific needs of this project in that the pre-determined questions allow all the qualitative data to be collected. At the same time the interview collects some of the quantitative data, the percentage of licensed faculty in the engineering department.

Determining the types and order of the questions to ask throughout the interview is very important. Since the semi-standardized interviews being conducted serve as a means of gathering quantitative and qualitative data, a funnel design must be used. A funnel design is a system of arranging interview questions to ensure that the maximum amount of qualitative data can be gathered from the interview. A typical interview using the funnel design system starts with broad, open-ended questions followed by domain questions and concludes with specific questions. The specific questions are directly connected to the goal of the study.

The first two questions are broad and focus on developing rapport with the interviewee. At the same time these questions are aimed at obtaining as much

quantitative data as possible. Specifically, the questions focus on getting at the percentages of faculty who are licensed PEs and whether or not the interviewee is a PE. Since broad questions do not put the interviewee in a situation in which he or she is at risk, the collected data should be accurate (See Appendix B).

The next two questions become more difficult for the interviewee to answer. These are domain questions that determine how the interviewee feels about licensure. The questionnaire tries to determine if the interviewee feels the FE exam is an accurate assessment tool and if his or her school requires students to take it in order to graduate (See Appendix B).

The remaining questions are specific questions. They are aimed at the primary goal of the project, the promotion of licensure to senior engineering students and particular ways the NSPE can do this. The interviewees may be tentative when answering these questions because they do not want to make their colleges look bad or insult the NSPE. For example, if their engineering school is doing nothing to promote the FE exam, the interviewee might not desire to tell the interviewer because it may give the school a bad image. The goal of the preceding questions is to make the interviewees comfortable so they can accurately answer the final questions (See Appendix B).

The behavioral questions in the questionnaire were purposely kept open ended and vague, with the assumption that the nature of the questions would allow the group to go off on a tangent if the subject matter was valuable and worthwhile to the project.

At the beginning of every interview, the interviewees are briefed on the confidentiality of the issue. The interview team will not publish any information without the permission of the dean.

4.1.1 Pre-Testing the Questionnaire

After the questionnaire is written, interviews are conducted with three particular groups; the researchers, college deans, and the NSPE staff and members. The questionnaire is then re-written to eliminate any of the errors that occurred in the interviews and to ensure that all goals are met. Once the questionnaire is perfected, the total design method is implemented so that each interview is successful and meets the objectives set by the project team.

The total design method takes the instrument, in this case the questionnaire, and tests its effectiveness on participants sharing relevant qualities with the participants in the study. If the questionnaire does not obtain data consistently directed at the goal of the project, the weaknesses must be identified and the questionnaire re-written. For example, if the participant pre-testing the questionnaire thinks it is not meeting the interview objectives, he will notify the project team. At this point, the team will proceed to change the questionnaire to fit the participant's advice. The questionnaire will then be pre-tested on a different participant. This cycle is repeated until the questionnaire consistently produces data pertaining to the goal of the project.

The interview is not efficient without a questionnaire for the interviewers to use as a guideline. Please consult Appendix B for a specific list of questions that were asked during the interviews.

4.2 Focus Groups

If interviews with deans of engineering universities did not obtain sufficient qualitative data, the team's backup plan was to conduct focus groups at George Washington University, Howard University, University of the District of Columbia, and Catholic University. Focus groups offer an alternative to gathering qualitative data if the attitudinal and behavioral section of the interviews are not able to do so. Since, this type of interview must be conducted in person, the actual focus group would need to include faculty members and students from engineering schools in the Washington D.C. area.

Focus groups offer a simple yet effective alternative to interviews. They are relatively easy to set up, and carry out. Furthermore, the data collected can yield valuable results. However, a project team at our agency has conducted focus groups in the past and the NSPE feels they are not effective because only engineering schools from a small area of the country are represented. Since our initial methodology was successfully implemented, it was not necessary to implement focus groups.

4.3 Sampling Methods

The frame of the project includes deans or faculty experts on licensure and the FE Exam from universities with engineering programs. It is important that only deans or faculty members from Accreditation Board of Engineering and Technology (ABET)–accredited engineering universities be interviewed and asked to provide data on the

percentage of faculty licensed as PEs and the number of students from their school taking the FE exam. Students who did not graduate from ABET–accredited engineering schools are not eligible to take the FE exam. There are more than 300 ABET–accredited engineering schools in the United States (ABET, 1999).

Since it would be impossible to interview someone from every school, a sampling method must be used to determine how many deans should be interviewed in order to obtain an accuracy level of 5% or less. Although the error level appears rather high, it must be taken into consideration that the number of ABET-accredited engineering universities is extremely large.

Salant and Dillman (1994) have composed a chart on the required sample size for desired sampling errors. The chart uses the population size and the desired sampling error to give the reader an exact number of people that need to be interviewed to obtain valid data.

Figure 3.1 **Sample size for the 95 percent confidence level**

	∀3% sampling error		±5% sampling error		±10% sampling error	
Population size	50/50 split	80/20 split	50/50 split	80/20 split	50/50 split	80/20 split
100	92	87	80	71	49	38
250	203	183	152	124	70	49
500	341	289	217	165	81	55
750	441	358	254	185	85	57
1,000	516	406	278	198	88	58
2,500	748	537	333	224	93	60
5,000	880	601	357	234	94	61
10,000	964	639	370	240	95	61
25,000	1,023	665	378	234	96	61
50,000	1,045	674	381	245	96	61
100,000	1,056	678	383	245	96	61
1,000,000	1,066	682	384	246	96	61
100,000,000	1,067	683	384	246	96	61

Singh and Chaudhary (1986) offer another method to determine sample size. They give two equations to determine the proper size.

Equation 1

$$n_0 = t^2 \times P\frac{(1-P)}{\epsilon^2}$$

Equation 2

$$n_1 = \frac{n_0}{1+(n_0-1)/N}$$

P = the population proportion or the percentage of the population having this particular characteristic.

For our case, we have determined that approximately 90% of the deans or faculty members agree that the NSPE can do a better job promoting licensure. Therefore, the population proportion is equal to 0.9.

t= 1.96 the normal variate (Singh & Chaudhary, 1986)

ϵ = Marginal permissible error. It was indicated earlier that the sampling error be less than 5%. In other words, there is 95% confidence in the data. Given the desired error, $\epsilon = 0.05$.

N = Number of units in the particular population, in this case, the 312 ABET – Accredited engineering schools.

Using the two equations, the number of deans or faculty members we need to interview to obtain 5% accuracy or 95% confidence level is 58. When compared to the chart of sampling errors by Salant and Dillman, this number is very similar.

Now that a specific number of schools has been determined, the process of random sampling begins. A list of the ABET– Accredited engineering universities was

obtained from the Professional Engineers in Education (PEE) division of the NSPE. This list was available through the Sustaining University Program (SUP), which is headed by the NSPE, and includes the universities supporting this program and the prospective supporters as well as each dean's or faculty member's contact information.

In order to keep the process random, a number from one to five is randomly chosen. The list of ABET– Accredited engineering schools is numbered from 1 to 312. Using the randomly chosen number as a starting point, every fifth college on the list is selected until the end of the list was reached. The actual number of institutions selected was 63. Although this number is larger than 58 schools, it is beneficial because data from a small number of schools will not be attainable. As long as data from 58 colleges from the drawn sample is complete, the desired accuracy is upheld (Singh & Chaudhary, 1986).

4.4 Collecting the Quantitative Data

To find the percentage of students taking the FE exam, the project team observed data from the last two academic years. This improved the validity of the research and at the same time was not too difficult a task. Determining the percentages of senior engineering students taking the FE exam was a two-fold process. First, the state licensure and examination boards were contacted to determine the number of students that took the FE exam in the last two academic years at the specific universities from the sampling procedure.

Most of the state boards have this information categorized by the individual schools in their state. The data was needed from the following examination dates; October 1997, April 1998, October 1998, and April 1999. The numbers from the October 1997 and April 1998 examinations was added to give the total number of students who took the exam for the 1997 to 1998 academic year. The same procedure was used to determine the number of students taking the exam for the 1998 to 1999 academic year. If the state boards do not have the information needed, the particular engineering universities in the state were contacted to get the information.

The second part of obtaining the percentage of students taking the FE exam at engineering universities included determining the number of senior engineering students at each college. The easiest way to get these numbers was to call the engineering department at the university and ask for the numbers of bachelor degrees they awarded to engineering students in each of the last two academic years. This assures that the number of engineering students being used to calculate the percentage is accurate. Some of the colleges have the information readily available and others have to transfer the call to another department that keeps the records of graduating engineering students.
Since seniors are usually the students who took the exam, a percentage was calculated for each academic year, 1997 to 1998 and 1998 to 1999. The percentage was found by dividing the number of students who took the exam by the total number of engineering graduates from the university. This number was multiplied by 100 to obtain the percentage. Because a percentage was found for two years, an average had to be taken.

Unfortunately, the project team encountered a problem with the collection of the student percentages at the selected engineering universities. Problems arose in several areas. First of all, several state boards who help the NCEES administer the FE exam were unable to provide the total number students taking the exam at universities in their state. The boards claimed that they either did not have the data or they had forwarded it to the universities. When the universities were contacted, often times they would state that the data was never received from the state boards.

Furthermore, certain engineering schools refused to hand over the data on the number of students from their university over to the project team. These colleges stated confidentiality as the reason for their refusal to supply the data. Other institutions complained that the data was inaccurate and should not be used because their tally of the number of the students taking the exam differed from the number given to them by the state board.

In fact, both state boards and engineering schools complained that the number of students taking the FE exam at particular universities was inaccurate because many students failed to fill out the "oval" indicating the university they attend or attended before graduation.

Consequently, the project team was forced to find a solution to the data collection problem because at that point, it would be impossible to get data from all 58 selected universities. The solution to the problem was to take another random sample of 15 engineering schools. This would ensure data was taken from 58 universities as required to keep the accuracy level of the data at 5% or less.

In order to take the second random sample of 15 schools, the project team started with the original frame of 312 schools. Next, the universities already selected were taken off the list. Then any schools in states with state boards that could not give proper data were taken off the list. These were the same states that could not supply student data for the first sample of 63 schools. This left 76 universities from which to draw a sample. We began by drawing a number between one and five. Then, starting with that number, every fifth school could be selected until there are no more schools remaining on the list.

Once the fifteen schools were selected, they were then consulted for interviews and student data in the exact same manner as the original 63 universities. State boards for these universities were also contacted for student taking the FE Exam. The second sample allowed for a 5% accuracy to be maintained so that the project team could meet their desired goals for the project. Therefore, although the project teams data collection techniques may be 5% accurate, the data collect may be inaccurate according to both state boards and universities. These inaccuracies will be discussed in more detail in the "*Results*" section.

4.5 Collecting Qualitative Data

The project team decided on the methods by which the qualitative data from the interviews was collected and developed the instrument that was used to do so. The next step included determining how the data would be collected using each particular method.

To ensure that accurate data was collected when conducting interviews, three people participated. One person actually conducted the interviews while two other

research assistants wrote down information from the dean or faculty member. Once the interview was complete the two assistants compared notes to make sure all of the data had been recorded accurately. The data from all of the interviews was written on an interview data sheet which includes the time, date, interviewee, interviewer, and the questions in the questionnaire.

4.6 Organizing the Data

The amount of data from the faculty and student percentages as well as interviews was rather large so an organizational method was needed. A spreadsheet was created using Microsoft Excel. The spreadsheet contains the name of the university, the state it is in, the name of the interviewee, and their status at the college. Also included are the numbers of students from the university who took the exam in the last two years, the number of students who received an engineering degree in the last two years, the percentage of students taking the FE exam, and the percentage of licensed faculty. Lastly, the spreadsheet includes whether or not the state board has been contacted, whether or not the student data and interviews are complete, the time of the interview, and the date. All of the information in the spreadsheet is specific to the university and alphabetized by the state.

In short, this spreadsheet includes all of the quantitative data (number of students taking the FE Exam and the percentage of faculty licensed as PEs) as well as a list of the interview dates and times. The qualitative data included on the interview data sheets was excluded from the spreadsheet due to the large amount of space that would be required to

organize this information. The project team felt that the data sheets were a very effective way of organizing the qualitative data from each university.

5.0 ANALYSIS & RESULTS

After the interviews were completed and the percentages obtained, the project group began to determine the results of their research. Before results could be reported to the NSPE, the interview data had to be organized. Once the data was organized, the project team was able to analyze the information and come up with some concrete results.

Analysis is the process by which the researcher expands and extends data beyond a descriptive account (Coffey, 1996, p. 108). Hence, the major objective of the quantitative analysis was to support the fact that the number of students taking the FE exam across the country is low and that a problem exists with the way that licensure is perceived and promoted on engineering college campuses across the country.

More importantly, the suggestions from the interviewees were used to determine how the NSPE could work to efficiently promote licensure on college campuses. In doing this, the project team hoped to find an effective marketing technique to better educate students on the benefits of becoming licensed. Ideally, this would play a direct role in increasing the number of students taking the FE exam.

The interviews conducted at the various engineering universities gave the NSPE an estimate of the total percentage of faculty members and deans who are licensed. Contacting state licensure boards and engineering universities yielded the total percentage of engineering students taking the FE exam.

The project team hoped to use the quantitative data to support the fact that the total number of engineering students taking the FE exam is low and that there is a direct correlation between this data and the percentage of licensed faculty. In addition, the data

should support a correlation between the percentage of students who took the FE exam and the efforts of the university to promote licensure. The team found several university programs that are effective in promoting licensure to senior engineering students. However, before a complete analysis was performed, the percentage of licensed faculty appeared to have the greatest influence on the number of students taking the FE exam.

The qualitative data was harder to organize and analyze than quantitative data. Since some of the data is opinionated and some factual, the first step was to separate the facts from the opinions. In this case, the facts included everything the universities are currently doing to promote licensure and the FE exam. The opinionated information included everything that engineering faculty think could help the NSPE better educate college students.

The information gathered from conducting interviews cannot be accurately analyzed until the data is condensed and made systematically comparable. The data was condensed by applying an objective coding scheme to the qualitative data through the process of content analysis (Berg, 1998, p. 223).

Content analysis uses a raw count or quantitative method to analyze qualitative data. The raw count includes words, themes, characters, paragraphs, items, and concepts. In the case of this project, the team performed a count of themes and concepts. The qualitative data was counted for common themes and concepts until all the interview information has been reviewed. The project team searched for themes and concepts that were related to the promotion of licensure on college campuses as well as solutions to this problem. This ensured that the proper data was used to make conclusions as well as recommendations (Berg, 1998, p. 223-226).

Once the facts and opinions were listed and catalogued then they were relatively easy to analyze. The easiest way to organize this data was by placing it in two spreadsheets created using Microsoft Excel. One spreadsheet included all of the facts gained from the interviews. This consists of everything the universities are currently doing to promote licensure and the FE exam. The other spreadsheet contained all of the opinions offered by the faculty. This included their suggestions on how the NSPE could better market licensure and the FE exam.

Both of the spreadsheets listed the universities in alphabetical order by name. Across the top row of the sheet containing the factual data were programs conducted by each university that are used to promote licensure and the FE exam. All of the programs sponsored by the universities were listed in this row. These programs include review courses, information sessions, guest speakers, brochures, etc. Below every program, an 'X' was made next to each university that conducted that particular program to promote licensure and the FE exam.

The percentage of licensed faculty as well as the percentage of students who took the FE exam in the last two years was also included. The project team hoped this would show a direct correlation between high percentages of students taking the exam and a high percentage of faculty licensed as PEs as well as a considerable effort from the university to promote licensure and the FE exam (See Table I in Appendix C).

Listed across the top of the second spreadsheet were common themes and ideas from interviewees about how licensure can be promoted more efficiently. Again an 'X' indicated whether or not a particular university's interviewee mentioned the idea. Once completed the spreadsheet enabled us to find useful trends that could aid in making

suggestions to the NSPE as to how a successful marketing scheme for licensure and the FE exam can be developed (See Table III in Appendix C).

After a complete analysis of both the quantitative and qualitative data, several valuable results were attained. These results allowed the project team to become aware of the programs that universities are currently undertaking to promote licensure and the FE exam to their students. The results of the data showed a wide variety of programs used by these universities.

In addition, the data has shown that certain programs are more popular than others. The percentage of students taking the FE exam at these universities reflects the impact these programs have on engineering students. This allowed the project team to see which programs are more successful than others. The results enabled the team to put together a plan to be presented to the NSPE on how to better market licensure and the FE exam to college students.

Furthermore, the suggestions from faculty at the selected universities also helped the project team decide which programs would be successful in promoting licensure and the FE exam to students. Many suggestions about how the NSPE could increase licensure awareness on college campuses were similar. These results have enabled the project team to take advantage of the suggestions from the faculty and actually use their ideas when making recommendations to the NSPE.

In addition, the results from the research have helped the project team identify areas aside from college campuses where the NSPE could seek to increase the number of engineers who choose to get a PE license.

5.1 University Programming

The spreadsheet containing the university programming was examined carefully to find common programs used to promote licensure and the FE exam to engineering students. Percentages of these programs used by engineering colleges were calculated. The project team also reviewed the spreadsheet to determine if there was any correlation between certain programs and the percentage of licensed faculty and students taking the FE exam.

The most common program that engineering universities conduct is a review course. Interviewees from 71% of the interviewed schools said that their college holds a review course to prepare the students for the FE exam. The majority of these courses are taught by professors on campus and are open to students and people in the area of the college who want assistance in preparing for the exam (See Table I in Appendix C and Figure 4.1).

Another popular method of promoting licensure and the FE exam is through state and student chapters of the NSPE. 33% of the schools in the frame have an active student or state board chapter. These chapters are responsible for setting up and running the review course at the university as well as making students aware of licensure and its benefits. They also advertise the date and time of the FE exam (See Table I in Appendix C and Figure 4.1).

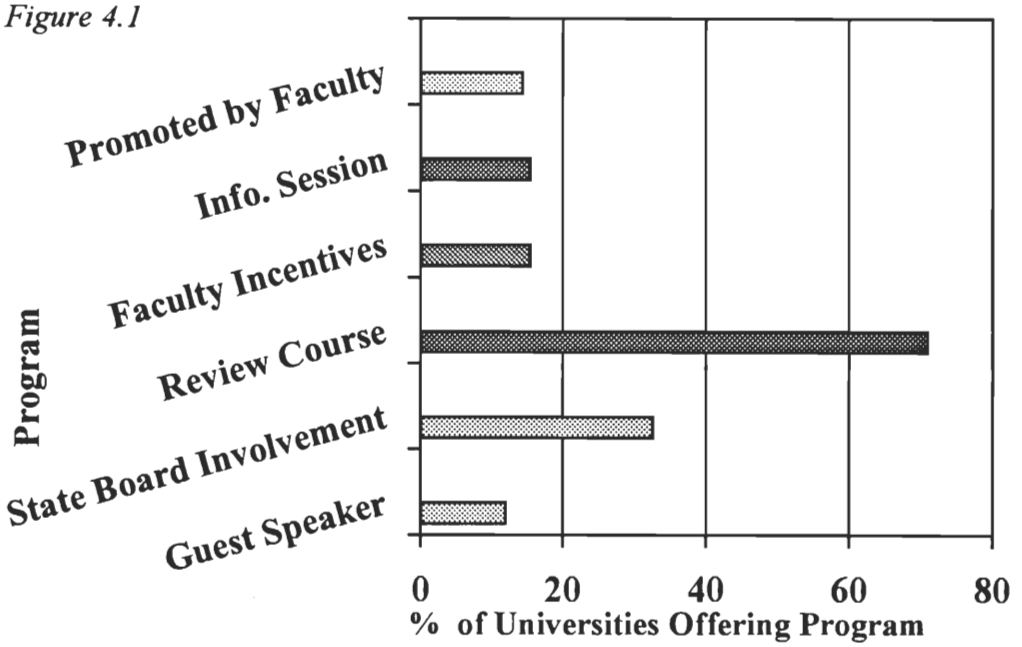
Over 15% of the interviewees said that their university offers an informational session for its engineering students. These sessions explain the licensure process, the benefits of licensure, and where and when the students can take the FE exam. The same

percentage of schools (15.5%) offer incentives to their faculty to become licensed professional engineers. Many deans will not consider their faculty members for tenure unless they are PEs. All of these schools said they would fund the cost of the exam as well as any preparation material needed. The idea is that licensed faculty promote licensure to their students so increasing the number of professors who are PEs will indirectly increase the number of students who take the FE exam (See Table I in Appendix C and Figure 4.1).

Licensure is promoted by faculty members on 14% of the engineering colleges interviewed by the project team. On these campuses professors inform students about licensure and what it may hold for their future as engineers (See Table I in Appendix C and Figure 4.1).

Currently, 12% of the colleges in the sample have a guest speaker either from industry or their state chapter of the NSPE come and speak to their engineering students. The speaker talks about the licensure process, its benefits, and most importantly how

Figure 4.1



licensure has helped him or her throughout his or her career as an engineer (See Table I in Appendix C and Figure 4.1).

There were many other programs that were mentioned by the interviewees, however the percentage of universities with these programs in place was not large enough to formally mention in this section of the report. Many of these programs may be effective and will be considered when making conclusions and recommendations to the NSPE. For this reason, a spreadsheet has been created to keep track of these programs and the percentage of universities who use them (See Table II in Appendix C).

5.2 Inaccuracy in Results

Once the percentages of the programs used at universities to promote licensure were calculated and put into the proper tables, the project team had to determine if there was any correlation between particular programs and the percentage of students taking the FE exam. To do this, the percentage of students taking the FE exam from the universities that have the popular programs was calculated. Then the percentage of the students taking the FE exam was calculated for the schools that did not have that particular program. Ideally, this would give the project team a good idea of which programs are successful and which are not. However, in doing this many problems were encountered.

First of all, in contacting state licensure boards the project team realized that a great deal of the data concerning the number of engineering students taking the FE exam was not available. The problem was more complicated than anticipated. Before a student begins taking the FE exam, the proctor for the exam is supposed to have the examinees

fill out a box indicating the college from which they graduated or the college they presently attend. Many students do not fill in this box and at the same time people who have already graduated may fill in this box. As a result, the number of students from particular universities who took the FE exam is not always available and when it is, the numbers are often inaccurate. The solution to this problem was to contact the engineering universities to obtain the data. Upon contacting the universities it became evident that many of the colleges depended on the state licensure boards to get these numbers.

The next problem in searching for a correlation between the number of students who took the FE exam and the university programming used to promote licensure was that only one of the mentioned programs is currently being conducted by the majority of the schools that were interviewed. As a result, conclusions cannot be drawn on which programs best promote licensure and the FE exam to engineering students on college campuses.

Since 71% of the interviewees stated that their university holds a review course, a calculation of the percentage of students who took the FE exam can be taken for those schools and compared to the percentage of students who took the exam at schools without a review course. The project team found 51% of students took the exam at schools with a review course and only 40% took the exam at schools without a review course.

The only other correlation found was with the percentage of licensed faculty. At universities with more than 50% licensed engineering faculty, approximately 66% of the students took the FE exam. At the colleges with less than 50% of licensed engineering faculty, only 39% of the students took the exam. Of course, some of the colleges with

less than 50% of licensed engineering faculty have a higher percentage of students who took the exam than at the schools with more than 50% of licensed faculty. However, in general more students tend to take to take the exam when more than 50% of their engineering faculty are licensed.

One of the objectives of the spreadsheet containing the programming engineering universities use to promote licensure was to prove that the percentage of students taking the FE exam was low. The team found that 46.7% of engineering students took the FE exam in the last two academic years. This number is higher than expected but it is important to consider that the data concerning the number of students who have taken the FE exam is not necessarily accurate. This is because many of the state licensure boards that administer the exam do not keep records according to school and if they do keep records of the exam according to the school there is no guarantee that the numbers are accurate. As mentioned earlier, the records may not be accurate because the examinees are not required to indicate which college they attend or attended.

Furthermore, the exam is not offered at every engineering university. In general, more students take the exam if it is offered at their university as opposed to some other location in the state. This causes the data concerning the number of engineering students who took the FE exam at a particular school to be biased in the sense that the FE exam is more convenient for students who can take it at their college.

Another possible explanation for the higher than expeceted percentage of students taking the FE exam could be that there is a good number of students who take the exam, however, the number of these students who pass and continue to pursue a PE license could drop significantly. In other words, many engineers might take the FE exam but

never continue on the road to licensure and take the PE exam. It is certain the number of licensed professional engineers has decreased, but it is not certain that the number of people taking the FE exam has also decreased.

As a result of this confusion, additional research was conducted to determine whether or not the number of engineering students taking the FE exam was in fact decreasing. Over the past five years, the number of students taking the FE exam in the field of mechanical engineering has dropped by 60 percent, from 13,455 in 1993 to 5,576 in 1998. In chemical engineering the number of students taking the exam dropped by 45 percent, in civil engineering by 60 percent, and in electrical engineering by 65 percent (Smith, 1999). These numbers support the fact that the number of people taking the FE exam has dropped considerably and that our project to determine a better way to market licensure is worthwhile.

5.3 Suggestions

The project team constructed the next spreadsheet using Microsoft Excel to organize the list of universities and the suggestions made by their respective interviewees. The suggestions deal with methods the NSPE can use to increase the number of engineering students taking the FE exam. Those suggestions that were the most common were listed across the top of the spreadsheet and the colleges were listed down the side. If the interviewee from a particular college made a suggestion that was listed, an 'X' was placed in that box. Some of the suggestions were made by only one or

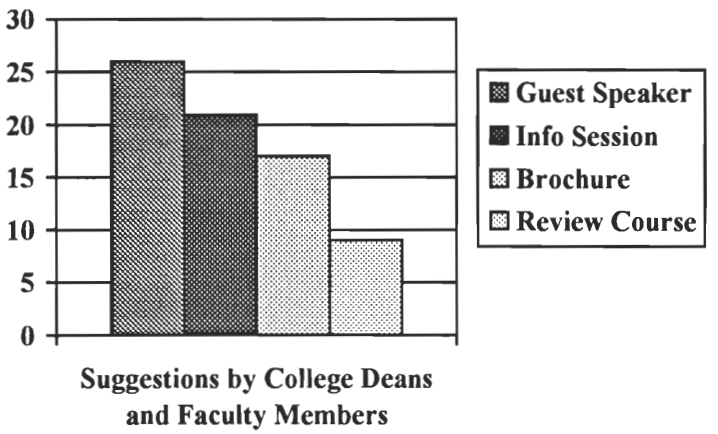
two of the interviewees and although these will not be brought up in great detail at this point, they will be considered when making recommendations to the NSPE.

As a result of the interviews, the most common suggestions about how the NSPE can better promote licensure and the FE exam are: a guest speaker from the NSPE; a licensure information session; informational brochures; and a review course for the FE exam. All of these suggestions would take place on engineering college campuses.

The idea of a guest speaker was suggested by 15 of 58 (26%) of the interviewees. The guest speaker would either be a representative from the NSPE or a licensed professional engineer from industry who has found licensure to be valuable throughout his/her career. The speaker would educate the students on what licensure is, how to become licensed, the importance of licensure, the benefits of licensure, how licensure has helped them, and what the students should expect to encounter in the FE exam (See Table III in Appendix C and Figure 4.2).

21% of the interviewees suggested an information session on campus be held to inform the students of licensure and the FE exam. Similar to a guest speaker, the

Figure 4.2



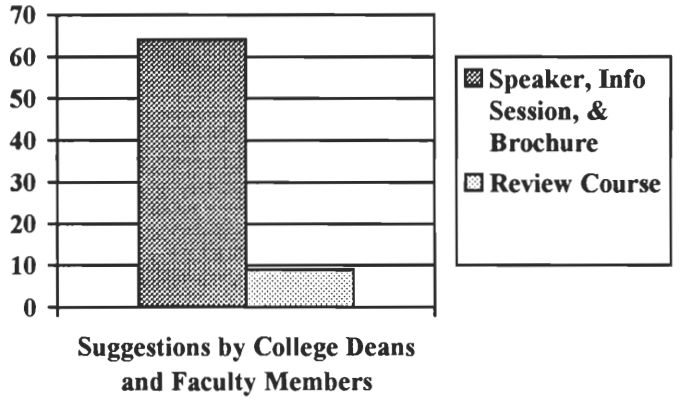
information session would define licensure, the FE and PE exams, the benefits of licensure, and most importantly when and where the FE exam will be held. Many interviewees felt the students are not aware of the date and time of the FE exams in their area, therefore they do not end up taking the exam (See Table III in Appendix C and Figure 4.2).

Another suggestion made by 17% of the interviewees was for the NSPE to print and distribute informational brochures to engineering students. The brochure would be distributed to engineering students of all education levels. According to the interviewees, this could educate students on licensure as soon as they begin their studies and it could continue to educate them through the rest of their time spent studying in college. The brochure would also notify students of the dates and locations for the FE exam. The NSPE currently has informational brochures, however many of the interviewees have never seen these on their campus. At the same time, the brochures that they do have do not include the dates and locations of the exam (See Table III in Appendix C and Figure 4.2).

Each of the first three suggestions may not represent the majority of the interviewees, however all three could be combined into one goal. More specifically, a guest speaker could visit various engineering universities to promote licensure, inform students about licensure and the FE exam, and even distribute informational brochures. In this case, the suggestions of 64% of the interviewees are being carried out. In other words, the majority of the schools would agree that a guest speaker performing the above tasks would be an effective way for the NSPE to increase the number of engineering students taking the FE exam (See Figure 4.3).

Approximately 10% of the interviewees said that a review course sponsored by the NSPE would help raise the number of students taking the FE exam. The review course would cover all of the information the student needs to know in order to pass the FE exam. As a supplement, the interviewees suggested that sample exams or old exams be used to aid the students in preparation. Of the universities interviewed, 71% currently

Figure 4.3



hold a review course and it has not proven to have great success in getting students to take the FE exam (See Table III in Appendix C and Figure 4.3).

There were many other suggestions made by the interviewees as to how to increase the number of engineering students taking the FE exam. However, the percentage of interviewees who made the suggestions is too low to discuss at this time. These suggestions will be valuable when making recommendations to the NSPE and are listed in Table IV in Appendix C.

Once the project team had reviewed all of the suggestions made by the interviewees, the university programs were studied to determine if any of the programs that were suggested were currently being used on any other engineering campuses. If the suggested programs were being used by a university, the team calculated a percentage to

determine whether or not that program was successful. Ideally, these percentages could be used to support the team's recommendations to the NSPE. However, some of the student percentages are not complete or are inaccurate due to the discrepancy with the state boards and the FE exam.

There were some suggestions that did not pertain to the scope of our project. These suggestions were directed at increasing the number of students taking the FE exam, however they did not pertain to the project team's objective of promoting licensure and the FE exam to engineering students on college campuses. These suggestions will be mentioned to the NSPE when making recommendations but since they do not directly effect our main objective, they will not be mentioned in great detail in this report.

Approximately 22% of the interviewees said that faculty members were the best people to reach the students and educate them about licensure. They felt that increasing the number of licensed faculty would indirectly increase the number of students taking the FE exam. The idea is that faculty who are licensed PEs will promote the exam to their students. This is a concept that the NSPE may want to consider and it will be discussed further in the project team's final recommendations.

Another common suggestion was that the NSPE should work to eliminate industry exemptions and require that all engineers become licensed PEs. This suggestion is not directed at the scope of the team's project, but it could be useful in getting more students to take the FE exam.

Many interviewees believed that the NSPE's attempt to increase the number of students taking the FE exam was necessary, however it was not possible for the problem to be fixed with the participation of only one society. They felt that the NSPE needed to

work with other engineering societies towards a common goal. Some of these societies include the NCEES, ASME, ASCE, IEEE, and ASEE. If more people work to promote licensure and the FE exam to engineering college students, the chances are more students will become aware of the benefits of licensure and take the FE exam.

The results of the project team's research reaffirm the fact that fewer students are taking the FE exam than in the past and that there is a problem in the way licensure is perceived and promoted on college campuses. The results also indicate correlations between the number of students taking the FE exam and the programs universities use to promote licensure to its engineering students. Most importantly, the results give the project team some possible suggestions and ideas to market licensure to engineering students and ultimately increase the number of engineering students taking the Fundamentals of Engineering Exam.

6.0 CONCLUSIONS

The statistical data concerning the percentage of students taking the FE Exam collected during this research project does not reflect an accurate amount of participation by students at respective engineering schools. State licensing boards as well as engineering schools were contacted to gather the quantitative information desired. Originally the project team made two assumptions before starting the process of accumulating this quantitative data. First, individual state boards help administer the exam so the project team envisioned that they would categorize respective schools within their state, and also have on record the number of students that took the FE exam from a particular school. If the team had any trouble obtaining information from state boards, engineering schools would then be contacted. Second, the project team presumed engineering schools would have records concerning the number of students taking the FE exam, which tests engineering concepts that senior undergraduate students should know.

Accumulating the quantitative data previously described was a problematic task, which astonished fellow colleagues. Several state boards that help the NCEES administer the FE exam were unable to provide the necessary statistical information. The boards stated they did not keep record of students taking the FE exam from a particular school within a given state. This statement contradicted the responses made by respective engineering schools.

The engineering schools acknowledged that they received statistical reports concerning students taking the exam from the state boards themselves. Institutions also complained that the data reported was inaccurate because the number of students taking

the FE exam differed from the number reported by state boards. The reason many schools know this is because a faculty member at the engineering school would instruct a review course for students going to take the FE exam, and enrollment of students was recorded by the engineering school itself. Therefore, having spoken with these faculty members, many commented that reports received from individual licensing boards differed from students going to take the exam from their engineering school.

There is also a fill-in "oval" under the "M" subtitle option on the FE exam that students can fill out, which would indicate what school they currently attend or attended, but the problem is that not all students fill in this "oval" (See Appendix D). Proctors are not doing a good job of instructing students to fill out this necessary information. This affects state licensing boards because they can not keep accurate data concerning the number of students taking the FE exam from individual schools. As a result, the percentage of students taking the FE exam is inaccurate. State boards are so unorganized, though, that seeking information for specific schools in a state is a project within itself.

The findings and experience gained from communicating with state licensing boards as well as engineering schools have been tremendous. There is an obvious communication problem with state boards and engineering schools across the country. Since state boards do not have accurate information about students taking the FE exam, engineering schools should not be expected to have it either because the reports they receive are generated by these same state licensing boards. This all boils down to the structure of the exam and the ineffective methods state boards use to record information.

Several state boards claimed that they did not record information for a school unless more than five students took the FE exam for a given engineering school. In other

cases, engineering schools have stated that a good amount of students indicated that they attended a specific school on the cover sheet of the exam, but the statistical information reported does not necessarily indicate that participants were all undergraduate college seniors. This could mean that these people were already working in industry and were graduates of that particular university. The current structure of the exam and chaotic system state boards use to record information needs to be changed to keep accurate information.

A direct correlation can be made between the unsystematic record keeping and low percentage of students taking the FE exam. First of all, without accurate record keeping it is difficult to conclude that the number of students who are taking the FE exam has declined. More importantly, inaccurate records make it very difficult to pinpoint exactly where the problem lies in the promotion of licensure. If universities and engineering societies cannot determine what is wrong, they are unable to correct the problem. Hence, the number of engineering students who take the FE exam will continue to decrease. State licensing boards need to clean up their act so universities can determine how to improve the way licensure is promoted on their campuses.

Many schools encourage students to take the FE exam and pursue a PE license, but many engineering faculty feel that a PE license is not necessary for all engineering fields. Many representatives claimed it would be necessary for a civil engineering major to get licensed, but having a PE license was not important for an engineering field such as electrical or chemical. The reason is because most electrical and chemical engineers are not working directly with the public. The biggest advantage of being a PE is that it allows an engineer to submit designs and consult on projects that will affect the public

directly. Industrial exemption laws allow an electrical or chemical engineer to practice without a license because it is rare that they will work directly with the public. Engineering schools are informing students about the licensure process, but many representatives feel that it is not necessary for all engineering students who will go on to work in industry.

Conclusions drawn from the quantitative data collected would be inconclusive due to the inaccuracy mentioned. Analyzing the quantitative data is significant, but examining the qualitative information collected during semi-standardized telephone interviews is critical to this research project. The qualitative feedback gathered presents a great insight into how licensure is perceived and promoted on college campuses. On the other hand, it is more of a risk to draw conclusions from the quantitative data, which is inaccurate.

Analyzing the qualitative results collected, a common theme often emerged through telephone interviews. Representatives claimed that students are not well educated about licensure and the process of becoming a professional engineer (PE). If undergraduate senior college students do not understand the benefits of licensure, and how it can help their engineering careers down the road they will have no desire to pursue a PE license. Once students understand the importance of having a PE license they will look for more information about the process of becoming a professional engineer. This is a point that informational sessions and brochures, which were suggested, can effectively address. Once students understand the process, they can attend review courses that will help them get a better idea about the type of questions on the exam.

Educating students sounds relatively easy but there are obstacles that can dissuade students from becoming a professional engineer. A large percentage of interviewees stated that the engineering faculty should become PEs themselves. Students can more easily question the reason they should even pursue licensure when their own professor is not licensed. Another obstacle is the exemption in industry where only a single person within a company is required to be licensed. The perception here is if one can forgo the time and money required to pursue licensure and still become successful, then there is no point in taking the FE exam. Students do not want to invest money and time studying when they can make a good salary without a PE license.

In conclusion, encouraging engineering students to take the FE exam and pursuing licensure will be difficult. Educating prospective test-takers is a great first-step, but until engineering students hear and see the benefits they will have no aspiration to become a PE.

7.0 RECOMMENDATIONS

The results and conclusions of this report have allowed the project team to render several valuable recommendations that could help the NSPE better assess and respond to the current decline in its membership. These recommendations come from conversations with the deans and faculty of the engineering universities randomly selected for interviews. The findings were also supported from published articles, engineers in industry, and representatives from the NSPE. The recommendations offer solutions and advice to the NSPE that address the objectives of the project.

The project team chose to bypass several popular programs either suggested by college faculty or in existence at numerous engineering universities. The most popular of these was a review course aimed at preparing students to take the FE exam. This program is currently in use by over 70% of all engineering schools in the project frame. A review course was also suggested by 8.6% of all deans and faculty interviewed.

However, while this program may be the most popular in terms of preparing for the FE exam, the numbers of students taking the exam has declined sharply over the past five years. Therefore, the project team would not recommend a program that has not been successful in getting more students to take the exam. Although the review course is a great tool in preparing those who are already interested in licensure for the FE exam, it does not provide an incentive for students to seek an interest in becoming a PE.

Another program deliberately overlooked by the project team involves NSPE student chapters and their efforts to promote licensure on campus. Of the schools interviewed, 35.6% have a good relationship with the student chapters. This includes

help from the student chapters in promoting the FE exam and informing students about licensure.

The project team has decided against recommending that the NSPE work harder to establish more student chapters across the country. This project would require large amounts of work to start new chapters and establish a strong student member base on campuses. The percentage of students taking the exam at schools with NSPE student societies is 46.6%. This is 1% below the average percentage of students taking the FE exam based on the data collected during this project. This percentage, coupled with the large amount of time and effort required to start new chapters persuaded the project team to look to other programs from which to make recommendations.

Moreover, many deans have suggested that starting new NSPE student chapters would not work because most universities already have so many engineering societies that the market is totally "saturated." They say that students would not be interested because there are already more than enough engineering societies to keep them busy.

The project team has come up with one primary recommendation and several secondary recommendations for the NSPE. The primary recommendation consists of the one recommendation that offers a solution to achieving the goals of the project and is most feasible for the NSPE. The secondary recommendations will help the NSPE confront other issues that are not directly related to the goals of the project but will help the organization become more responsive to licensure issues that directly affect the future of membership in the society.

7.1 Primary Recommendation

The primary recommendation includes one comprehensive plan that would allow the NSPE to meet their objective of increasing membership. This would be done by better educating college students about the advantages of getting a PE license and informing them of the steps they need to take to get a license.

Currently, the NSPE does little to promote licensure and the FE exam on campuses. Engineering schools are left to decide for themselves whether or not to promote licensure and the exam to students. For the most part, only schools with higher percentages of faculty licensed as PEs go out and promote these issues to students. Consequently, the primary recommendation by the project team will provide an immediate solution to this ongoing problem experienced at engineering schools throughout the country.

7.1.1 Guest Speaker

The primary tool that could be of the most value to the NSPE in accomplishing the goals of this project includes guest speakers who would make presentations on engineering college campuses. The speakers would be sponsored by a partnership between the NSPE and NCEES. Having the guest speakers on campus would be the best way to meet the goal of the project, which is promoting licensure at engineering universities.

These guest speakers could be faculty members at the university, professionals in industry, or members of the NSPE state societies. However, every speaker should be a licensed PE. Selection of the guest speaker would be up to the NSPE. The most efficient way to cover universities throughout the country would be to have a guest speaker in different geographic locations throughout the U.S. Each speaker would be responsible for visiting every engineering college in his or her designated geographical area.

The goal of the guest speaker is threefold. First and foremost, the speaker would educate the students on licensure as well as motivate them to take the FE exam by highlighting the advantages of getting licensed. Secondly, the event would function as an information session where students could ask questions and get feedback on any concerns they may have about the FE exam and the licensure process as a whole. The speaker would inform them of the steps necessary to get a PE license. Finally, the speaker would distribute brochures at the beginning and end of the presentation. Included in the brochures would be a bulleted list of some of the perks of being a PE along with the necessary steps a student would take to become licensed. In addition, testing locations and dates would also be written in the brochure.

In order to ensure a large turnout by engineering student bodies, this presentation must be effectively advertised on campus. The best means of advertising would be to mail posters to faculty, engineering offices, and student engineering organizations two weeks before the guest speaker presents on campus. The posters would include the date and time of the event along with a brief summary of the topics of the presentation. The NSPE must advertise this event because students will not go to a presentation they do not know about.

Having a guest speaker addresses the top three suggestions given to the project team by the 60 deans and faculty members interviewed. When combined, this accounts for 64% of all suggestions made during the interviews. This percentage is noteworthy in that the college deans and faculty were not asked for specific suggestions but rather for any advice that could help students become more in tune to licensure and its benefits.

Currently, the NSPE is working on an initiative to provide a "Speakers Tool Kit" aimed at helping volunteer guest speakers talk to NSPE Student Chapters around the country. These speeches are aimed at promoting licensure. This ongoing initiative could help the project team's recommendation by providing a base from which the NSPE could take the step from simply talking to Student Chapters to talking to entire student bodies of engineering universities. Since the foundation for such a project exists at the NSPE, the undertaking recommended by the project team should be relatively easy to initiate.

The proposed guest speakers would also compliment another ongoing NSPE project aimed at promoting licensure. The project involves the creation of a promotional video aimed at educating college students about the advantages of becoming a licensed PE. Showing the video at these presentations is a "win-win" situation for the NSPE. Thus, two powerful media will be presented to the students in one presentation. Brochures that highlight test dates and contacts for review courses and study aids would further remind students when they can take the FE exam.

The project team has researched colleges that have faculty who speak to the students to educate them on licensure and the path to becoming a professional engineer. These faculty members take their own time to do this and are not sponsored by the NSPE or NCEES. One such faculty member from the University of Wyoming by the name of

John W. Steadman, PE has a presentation that could help the NSPE initiate its own guest speaker presentation. Professor Steadman, a past president of the NCEES, has given this presentation to students across the country including a special presentation given to student members of the NSPE at a national conference in Washington DC. His presentation highlights everything the project team deems necessary for college students to have a better idea of licensure and the FE exam. . The Professor has offered to have this presentation posted on the NSPE web page to increase licensure awareness to students accessing the NSPE web site. This presentation has been included in Appendix E for consultation.

This recommendation has been discussed with Professor Steadman, who believes that sponsoring guest speakers who discuss licensure and the FE exam on campuses would be an effective method of educating students about licensure. In fact, Professor Steadman offered his support in volunteering to serve as the guest speaker for the schools in his area. He has also given the NSPE the go ahead to use his presentation as a model for the proposed guest speakers to utilize. Furthermore, he added that he has a network of PEs across the country who might be willing to speak at universities in their areas across the country.

The possibility of joint funding with the NCEES stems from conversations with representatives from that council. The representatives seemed very interested in the project and wanted to be informed of any results the project might yield. Furthermore, the representatives expressed an interest in working with the NSPE on a marketing campaign aimed at students at engineering universities.

As with any project there are some obstacles that must be undertaken by the NSPE. The first "road block" would be funding the project. The NSPE must first decide if this project would be worth the time, effort, and costs incurred to the society. The next hurdle for the society would be to actually set up the program. This would require selecting the speakers. The society would need to determine whether or not these speakers would travel around the country or if they would be selected so that they would only need to speak at universities in their geographic region. Finally, the NSPE would need to put together a common presentation that would accommodate universities throughout the nation as well as the multiple engineering disciplines at the universities.

In order to make this project easier to put together and to fund, the NSPE should look to other organizations as a source of both manpower and common goals before initiating this project. The NCEES is currently funding a study, due to be completed in spring 2000, with goals to those of this project. Instead of seeking the advice of college faculty and deans, the NCEES has opted to interview focus groups of college students to get their thoughts on how to better promote licensure and the FE exam.

The data obtained as a result of this project could be of use to the NSPE in that it could support grounds for a guest speaker. The NCEES has already expressed interest in working with the NSPE on a project aimed at educating engineering students about the benefits of becoming licensed. Furthermore, they are interested in the results of this project and have requested a final copy of this report. As a result, both societies should look at the possibilities of hosting guest speakers on campuses as a joint effort. This would enable both societies to reap the benefits of the guest speaker while at the same time it would reduce the costs for the proposed guest speakers.

Consequently, the project team has come up with this recommendation and taken steps to get the project moving in the right direction. The NSPE will be able to make the decision about whether they wish to take the project on. As with any undertaking, cost will be a major factor in deciding the fate of the project. Again, the NSPE will be left to determine whether or not the benefits outweigh the costs.

In conclusion, the project team believes that simply instructing students by means of a motivational speaker and visual aides would be a great "first step" in educating students across the country about the advantages of getting a PE license and the steps needed to get the license. Again, this recommendation is drawn from numerous suggestions by the 60 engineering deans and faculty interviewed as part of this project.

7.2 Secondary Recommendations

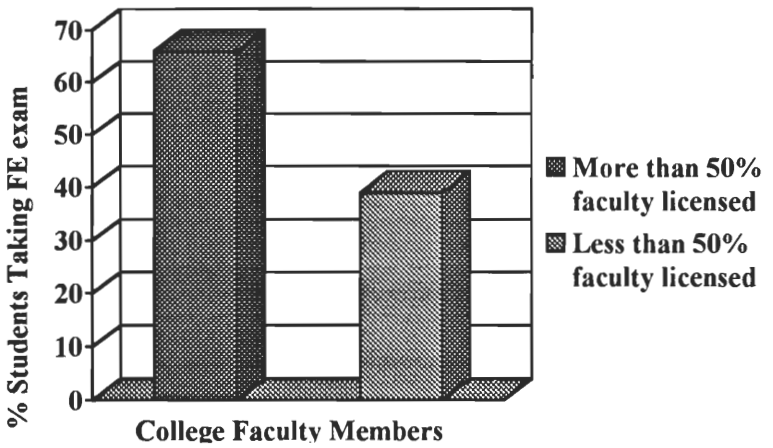
Over the course of the interviews, the project team encountered several issues that contribute to the decline in membership being experienced by the NSPE. Although these issues are not included in the project's goal statement, they are important to the future of licensure and the NSPE. These recommendations do not have an action plan as suggested in the primary recommendation of this project. However, they are intended to serve as advice or starting points for future projects or areas of research at the NSPE.

7.2.1 Faculty Licensure

The one aspect of campus life to which the NSPE should attend more carefully if it wishes to increase student awareness of licensure is college faculty. College faculty members are an invaluable tool in promoting licensure to students. Whether they take a short digression from lecture to talk about licensure or simply a one-on-one conversation, faculty members are powerful tools in getting students on the road to a PE license. Best of all, they are role models for students and their advice is free.

A study conducted as part of this project has shown that colleges with higher percentages of licensed faculty have a larger number of students taking the FE exam. As stated in the results section, schools with 50% or more faculty with PE licenses sent an average of 66% of their students to take the FE exam. On the other hand, schools with

Figure 6.1



less than 50% of their faculty having PE licenses had only 39% of their students taking the FE exam. Therefore, we can conclude that faculty with a PE license do more to promote licensure and the FE exam to their students.

This recommendation is further supported by recommendations made by college deans and faculty during interviews conducted by the project team. Of the 60 college

deans and faculty interviewed, 22% suggested that in order to better promote the exam, more college faculty need to be licensed PEs.

In order to get more faculty members to pursue licensure, the NSPE needs to offer them incentives. A great incentive to get to faculty licensed would be the allocation of grant money to those who pass the FE exam. Faculty are always looking for grant money to help finance research. If the NSPE had the resources, this grant program has the potential to be successful in getting more faculty to become licensed.
Another incentive for faculty to get licensed would be to offer them a special discounted faculty membership in the NSPE. In this case, the membership fee for a licensed faculty could be similar to the cost of student membership.

Although this cost is much less than the cost of a normal membership for someone with a PE license, the society would reap the benefits of having more faculty licensed. Having more faculty licensed means more role models at universities promoting licensure to students. More students taking the FE exam means more Professional Engineers in the future. This incentive program could be extremely beneficial to the society, college faculty, and students.

7.2.2 Industrial Incentives

The next secondary recommendation for the NSPE includes working with industry to increase licensure. Although the NSPE has been negotiating with industry for sometime now without success, there must be some kind of compromise worked out in the future if the NSPE wants to open the door to licensure as an industrial requirement.

Currently, industrial exemption laws throughout the country are the primary reason why engineers do not get licensed. Since laws exempt engineers from needing a license to practice in industry, many engineers do not feel the need to get a license.

According to the NSPE, many industries would rather spend money to train their employees rather then pay for the renewal of their PE licenses each year. For this reason, many industries refuse to open their doors to licensure. However, even though most industrial companies are currently opposed to licensure, there is a vast potential for future growth.

Therefore, a continued effort by the NSPE to work towards opening up industry to licensure would be beneficial to the future of the society. Again, while negotiations so far have been unsuccessful, the society needs to press the issue with industries if they seek to experience substantial growth in membership in the future.

7.2.3 Establishing a Relationship with the NCEES

The final secondary recommendation to the NSPE deals with establishing a closer relationship with the NCEES for the purposes of promoting licensure to college students. Both societies have similar goals in this area. If the resources of both could be mobilized together, larger projects could be undertaken for the benefit of both societies. Currently, the relationship between the NSPE and NCEES is friendly but not collaborative.

The project team had a hard time initially obtaining information from the NCEES important to the research. However, as the project progressed, the team learned that the NCEES was interested in the findings and offered hints at a possible collaboration in

terms of promoting licensure on college campuses. Currently, the NCEES is funding a project consisting of focus groups of students with the same goals as this project. The project will be completed in the spring of 2000. The project team recommends that the NSPE keep in close touch with the NCEES so that in the future, results of these two projects could be combined for a possible joint effort by both societies to promote licensure and the FE exam.

7.3 Conclusions

Over the course of this project, the team presented their weekly findings to other student project teams working for different organizations. By the end of the presentations, the project team had convinced several members from other student teams to start the path to licensure. Again, simply educating the students is a great start for licensure promotion across college campuses. However, a long term goal for the NSPE if it wants to educate college students about licensure should be to increase the total percentage of faculty who have a PE license.

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Appendix A

About the NSPE

The National Society of Professional Engineers (NSPE) is the only engineering society that represents individual engineering professionals and licensed engineers (PEs) across all disciplines. Founded in 1934, NSPE strengthens the engineering profession by promoting engineering licensure and ethics, enhancing the engineer image, advocating and protecting PEs' legal rights at the national and state levels, publishing news of the profession, providing continuing education opportunities, and much more. NSPE serves some 60,000 members and the public through 54 state and territorial societies and more than 500 chapters.

NSPE Strategic Plan

NSPE state and national leaders from across the country came together in late January 1999 for an unprecedented Leadership Consensus Congress that approved a new vision, mission, and goals to guide the Society for the next three years. At the same Atlanta meeting, the NSPE Board of Directors then unanimously endorsed the plan. The objectives accompanying each goal will give a new focus to NSPE's program planning and budgeting.

Vision

NSPE is the premier national organization that promotes and defends the professional interests of all engineering professionals.

Mission

NSPE is the national society of engineering professionals from all disciplines that promotes the ethical and competent practice of engineering, advocates licensure, and enhances the image and well-being of its members.

Core Values

- Protection of the public
- Ethical conduct
- Professionalism
- Competency
- Fulfillment of member needs
- Service to the public
- Licensure

Goals

1. Promote the competent, ethical, and professional practice of engineering.

- Support the licensure process as defined by the various jurisdictions, including vigorous enforcement of the statutes.
- Encourage those who are not specifically required by statutes to be licensed to choose licensure as a legal, public, and personal declaration of their educational and professional achievement.
- Collaborate with other organizations to continually enhance and standardize the licensure process, including examination options and formats, continuing professional competency, national mobility, international practice, and areas of certification.
- Develop and distribute an economical and efficient licensure examination preparation program.
- Promote the use of NSPE membership as the universally recognized indication of those committed to the ethical, competent, and professional practice of engineering.
- Develop and implement an effective plan to communicate the importance of the competent, ethical, and professional practice of engineering to policy makers and the public.
- Develop a pro-active role in addressing ethical violations and member discipline.

2. Enhance the image and stature of engineering professionals.

- Develop and implement a major public relations campaign to the public.
- Publicize major achievements of engineering and engineering professionals.
- Develop education campaigns on the importance of licensure.
- Publicize Society activities.
- Develop a campaign to enhance the recognition and stature of engineering professionals in the workplace.
- Develop a program to educate engineers regarding improvement of their own public image.
- Encourage engineers to participate in civic, community and governmental activities.

3. Provide education, career development, networking opportunities, and other benefits to engineering professionals and students.

- Improve NSPE's role of serving as an information resource to members and state societies.
- Evaluate to improve or discontinue the Society's "endorsed products" programs, and implement new programs.
- Promote awareness of engineering and provide educational programs for pre-college students.
- Develop and implement career planning and career development programs.
- Develop and implement a career-growth mentoring program that includes bridging the gap between earning an engineering degree and becoming licensed.
- Develop models for student chapters, and market these to colleges and universities.
- Develop business plans for each NSPE program, product, and service.
- Publicize the benefits of NSPE membership with specific focus on younger engineers and students, including the use of the World Wide Web.
- Evaluate and expand educational programs for engineering professionals.
- Develop ideas and programs to facilitate networking opportunities for today's environment.

4. Advocate the interests of engineering professionals and protect the public through an effective government relations program.

- Monitor national, state, and local public policy issues.
- Coordinate efforts of national, state, and local resources on public policy issues.
- Advocate on behalf of the engineering professional on public policy issues.
- Communicate with stakeholders regarding public policy issues and activities.
- Promote increased political involvement by engineering professionals.
- Promote strategic alliances to increase effectiveness on legislative and regulatory issues.
- Assess and raise awareness of public policy issues that are of interest to a significant segment of the engineering profession.

5. Align the structure, activities, and governance of the society to optimize support and resources for all programs.

- Develop a streamlined governance structure for the Society.
- Implement revised membership categories.
- Complete, implement and maintain improvements to the records management system.
- Examine and implement changes to the Society's meeting structure to optimize participation by members.
- Develop and integrate student programs with other NSPE activities.
- Increase net membership by the development and implementation of improved membership marketing/ public relations campaigns.
- Improve inter-professional and inter-society interactions
- Improve communications of programs and activities throughout the Society.
- Strengthen the partnership between national, state, and chapter organizations.
- Improve the use of technology to enhance member awareness, involvement, participation, and efficiency of Society operations.
- Commit to ongoing strategic planning process and the allocation of resources according to the plan.
- Eliminate programs that cannot be linked to the Strategic Plan.

Facts About NSPE

Founded: 1934
Members: 60,000+
State Organizations: 54 state and territorial societies
Local Chapters: more than 500
Budget: $6,000,000
Staff: 49
Executive Director: Patrick J. Natale, P.E.

Phone: 703/684-2800
Fax: 703/836-4875
E-mail: For general inquiries, customer.service@nspe.org

Membership Categories

- **Licensed Member**—Engineers licensed in a U.S. state (Professional Engineers) or holders of an equivalent licensure from another country
- **Member**—EIs (Engineer Interns)/EITs (Engineers-in-Training) or holders of an equivalent credential from another country
- **Member**—Graduates of Accreditation Board for Engineering and Technology (ABET)-accredited engineering programs, or the international equivalent
- **Student Member**—Students in ABET-accredited engineering programs or an engineering or pre-engineering program that can lead to licensure

*All memberships are individual; there are no company memberships (except in relation to certain practice divisions).

- Activity Areas
  - Engineering licensure
  - Government relations
  - Professional issues
  - Ethics
  - Legal issues
  - Continuing education
  - Employment
  - Salaries
  - Practice areas
  - Publications
  - Public relations
  - Student issues

- Practice Divisions
  - Professional Engineers in Construction
  - Professional Engineers in Education
  - Professional Engineers in Government
  - Professional Engineers in Industry
  - Professional Engineers in Private Practice

- Major Publications
  - *Engineering Times*, monthly, with special Practice Division section
  - "U.S. Engineering Press Review," weekly broadcast e-mail
  - "NSPE Update," monthly broadcast e-mail
  - *Engineering Licensure Laws: A State-by-State Summary and Analysis*
  - *NSPE Income & Salary Survey*, annually
  - *Compensation & Benefits in Consulting Engineering Firms*, annually

- World Wide Web Site: www.nspe.org

- SPE Annual Convention and Exposition— July 27-August 1, 2000, Norfolk, Virginia; includes NSPE's Professional Edge education sessions and exhibits, Board of Directors Meeting, and Practice Division Board of Governors Meetings.

Appendix A

National Society of Professional Engineers ®

May 27, 1999

Dr. Susan Vernon-Gerstenfeld
Director Washington, DC Project Center
Worcester Polytechnic Institute
100 Institute Road
Worcester, MA 01609-2280

Dear Susan:

I'm sorry you missed the opportunity to visit NSPE last month but I hope your trip to Costa Rica went well. I enjoyed meeting with Dave DiBiasio and Marianne Janack and am looking forward to another rewarding experience working with the 1999 WPI interns this fall.

As we have previously discussed, the proposed project will be focused on the subject of promoting licensure on university campuses. Specifically, the scope will include researching how licensure is perceived and promoted at various engineering schools, including the total number/percentage of faculty members and deans who are licensed as well as the total number/percentage of engineering students taking the Fundamentals of Engineering (FE) Exam, by discipline. The project may also involve surveys, including existing promotional programs and materials, as well as the design of new programs and products to help promote the value of licensure. The 1999 NSPE Strategic Plan includes the development and dissemination of activities that promote licensure to students and faculty as a high priority item.

Please feel free to contact me directly at (703) 684-2855) or mberman@nspe.org if you need any additional information. I look forward to working with you again, along with the other WPI faculty members, to create a worthwhile and fulfilling experience for both the interns and the NSPE staff and volunteer members involved in the program.

Sincerely,

Marla Berman, P.E.
Director, Education Services

cc: P. Natale, P.E.
A. Schwartz

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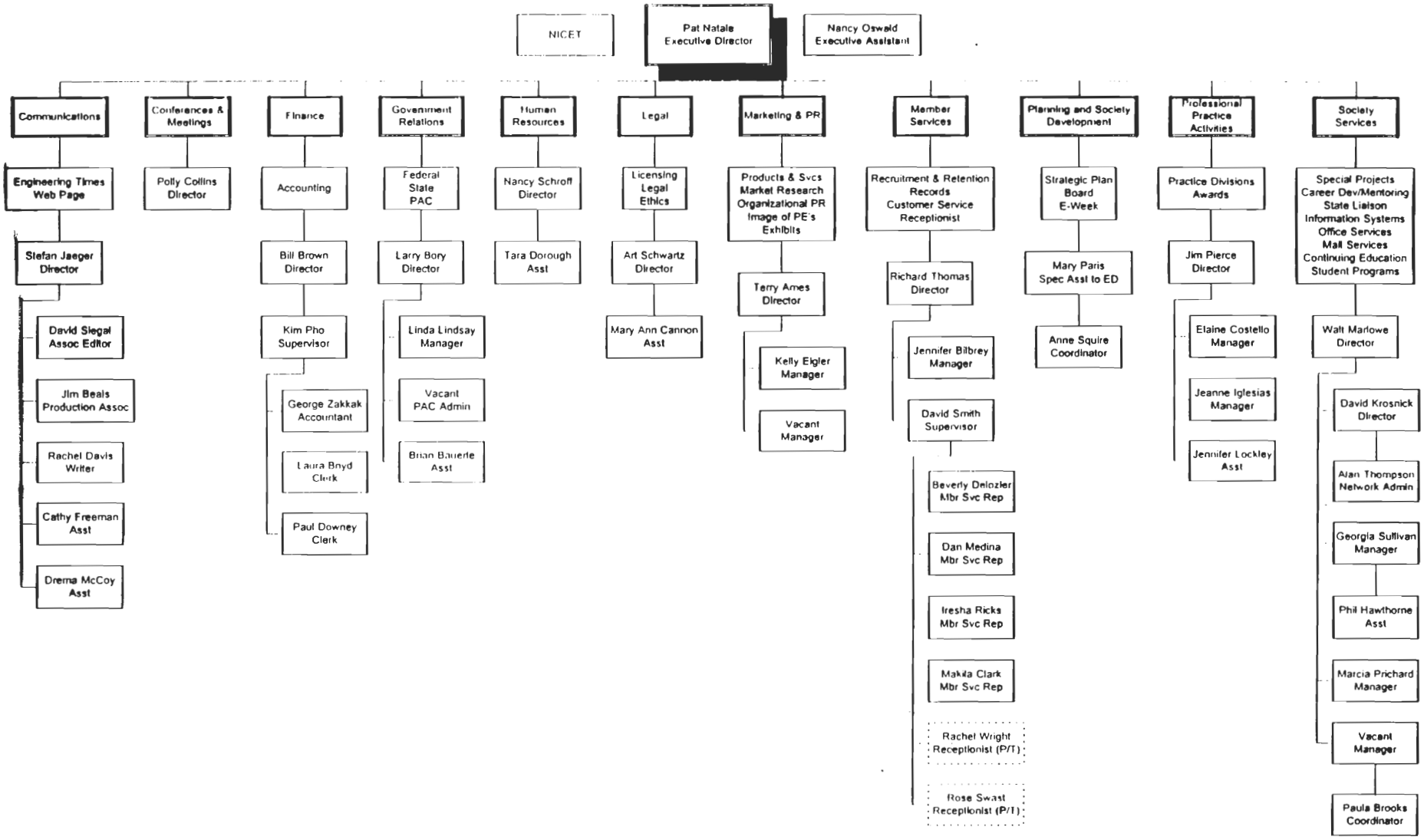
ALEXANDRIA, VIRGINIA 22314-2794
703 • 684 • 2800 FAX 703 • 836 • 4875
WORLD WIDE WEB • www.nspe.org

Appen. A

NSPE Staff Organizational Chart



Revised 11/12/99

Appendix A

Consolidated NSPE Budget (All Funds)
1999 - 2000 Fiscal Year

	REVENUE		DIRECT EXPENSES		OVERHEAD		TOTAL EXPENSES	
	Budget 98 - 99	Budget 99 - 00	Budget 98 - 99	Budget 99 - 00	Budget 98 - 99	Budget 99 - 00	Budget 98 - 99	Budget 99 - 00
NSPE General Fund	$ 6,300.6	$ 6,166.0	$ 3,673.4	$ 3,436.4	$ 2,616.3	$ 2,729.6	$ 6,289.7	$ 6,166.0
Practice Divisions								
50 PEC	66.0	67.6	52.8	45.1	25.6	27.5	78.4	72.6
51 PEE	0.4	-	-	-	-	-	-	-
52 PEG	8.0	-	7.4	10.5	9.4	2.8	16.8	13.3
53 PEI	28.8	26.4	31.4	35.8	27.1	36.2	58.5	72.0
54 PEPP	459.5	483.7	262.5	289.6	179.0	170.5	441.5	460.1
55 PEE-SUP	100.0	23.8	42.2	11.5	17.7	12.2	59.9	23.7
Total Practice Divisions	662.7	601.5	396.3	392.5	258.8	249.2	655.1	641.7
Other Funds								
40 NICET	1,956.6	1,762.0	863.5	892.6	862.9	869.4	1,726.4	1,762.0
42 NIEE	25.5	-	21.2	-	23.3	-	44.5	-
46 E-Week	1,226.5	1,378.0	968.3	1,097.0	47.5	54.3	1,015.8	1,151.3
Total Other Funds	3,208.6	3,140.0	1,853.0	1,989.6	933.7	923.7	2,786.7	2,913.3
Consolidated Total	$ 10,171.9	$ 9,907.5	$ 5,922.7	$ 5,818.5	$ 3,808.8	$ 3,902.5	$ 9,731.5	$ 9,721.0

Appendix B

Telephone Interview Data Sheet

Interview Time: _____ **Date:** _____

Interviewer: _____

Interviewee: _____

University: _____

Questions

- Are you a licensed professional engineer?

- Is there a graduation requirement to take the FE exam? If yes, do you require the students to only take the exam or both take and pass the exam?

- What are your perceptions of licensure and the FE exam?

- What does the NSPE (or other groups) do on your campus to promote the FE exam?

- What does your university currently do to promote licensure on campus?

- Does the university offer any incentives to its faculty to take the exam and become licensed?

Students

Faculty

- Do you think the NSPE could do more to promote the FE exam on your campus?

- What do you think they could do to improve the percentage of engineering students taking the FE exam?

Comments:

APPENDIX C - Table I - University Programming

College	State	% Seniors	% of Faculty	State Board/Student Chptr Involvement	Review Course	Faculty Incentives	Guest Speaker	Info Session	Promoted by Faculty
College 1	Texas	57.38%	50%		X				
College 2	Utah	38%	50%	X	X				X
College 3	Rhode Island	8.82%							
College 4	California	30.70%	47.80%		X		X		
College 5	District of Columbia		18%	X	X			X	
College 6	Ohio	86.33%	50%	X	X		X		
College 7	Ohio	47.37%	71.10%		X				
College 8	Ohio	30.14%	34%					X	
College 9	Iowa	68.18%	0%		X				
College 10	New Jersey		36.60%			X			
College 11	Florida	3.13%			X				X
College 12	Pennsylvania	53.57%	50%		X			X	
College 13	Michigan		33%		X				
College 14	Pennsylvania	54%	28.50%		X	X			
College 15	New York		40%		X				
College 16	Maryland	6.25%	10%	X			X		
College 17	Kansas	59.82%		X	X				
College 18	Michigan		70%	X	X				
College 19	Louisiana	73.50%	50%	X		X	X	X	
College 20	Wisconsin	50.19%	57.50%		X				
College 21	Wisconsin	41.85%	36%	X					
College 22	Massachusetts		9%						
College 23	New York		33%		X				
College 24	North Carolina	63.37%	20%	X	X			X	X
College 25	Ohio	24.70%			X				
College 26	Oklahoma		70%		X				
College 27	Virginia				X				
College 28	Oklahoma		40%		X				
College 29	New York	5.20%							

College	State	% Seniors	% of Faculty	State Board/Student Chptr Involvement	Review Course	Faculty Incentives	Guest Speaker	Info Session	Promoted by Faculty
College 30	Washington		50%		X				
College 31	Illinois	76.40%			X				
College 32	Iowa		25%					X	
College 33	New York		33%		X	X			
College 34	New York		15%	X	X				
College 35	Pennsylvania		38%		X	X			
College 36	Texas	42.00%	85%	X	X				X
College 37	Texas	68.29%	30%		X				
College 38	Maryland		30%						
College 39	Connecticut	24.78%							
College 40	Massachusetts		20%		X				
College 41	North Carolina	47.65%	35%	X	X	X			
College 42	Alaska	91.20%	50%						
College 43	California	26.75%	35%	X	X				X
College 44	Ohio	24.70%	40.82%	X	X				
College 45	Georgia	100%	52%	X	X				
College 46	Iowa		15%						
College 47	Kentucky	35.98%	22%			X			X
College 48	Maine	89.95%	50%		X				X
College 49	Minnesota		40%	X	X				
College 50	Missouri	100%	40%		X				
College 51	North Dakota	93.51%			X	X			
College 52	Indiana	35.70%	12%		X				
College 53	Oregon		50%		X				
College 54	Texas	40.21%	78%	X					X
College 55	Vermont	53.29%	36.67%						
College 56	Wisconsin	41.85%	12.50%						
College 57	Colorado	46%	23%				X	X	
College 58	Pennsylvania	50%	29.50%	X	X		X		
College 59	Missouri		20%	X					
College 60	Michigan		18%				X	X	

College	State	% Seniors	% of Faculty	State Board/Student Chptr Involvement	Review Course	Faculty Incentives	Guest Speaker	Info Session	Promoted by Faculty
College 61	Kansas	28.70%	30%		X	X			
College 62	Pennsylvania		50%		X				
Total Percentages:		46.70%	32.34%	32.70%	70.60%	15.50%	12%	15.50%	14.30%

NOTE - 25% of State Licensing Boards did not have the number of students taking the FE exam

NOTE - Schools with 100% Student Percentages require the FE exam for graduation

APPENDIX C - Table II - Less Popular University Programs

University Program		Percentage of Schools
Exam Dates Advertised		1.70%
School Funds FE Exam		3.40%
Exam Held on Campus		5.00%
Graduation Requirement		5.00%
Informational Brochures		8.60%

APPENDIX C - Table III - Most Common Suggestions

College	Review Course	NSPE Guest Speaker	Info/Incentives Session	Faculty Persuasion	Info Brochure
College 1					
College 2		X	X	X	
College 3					
College 4		X			
College 5					
College 6					
College 7	X	X			
College 8				X	
College 9					
College 10	X				
College 11					X
College 12		X	X		
College 13		X			
College 14			X		X
College 15		X			
College 16			X		
College 17			X		
College 18					X
College 19					
College 20					
College 21		X			
College 22					
College 23				X	

College	Review Course	NSPE Guest Speaker	Info/Incentives Session	Faculty Persuasion	Info Brochure
College 24					
College 25		X			
College 26					
College 27				X	
College 28					
College 29					
College 30			X		X
College 31	X				
College 32			X		X
College 33					
College 34					
College 35	X			X	
College 36		X			X
College 37		X			
College 38	X	X			
College 39					
College 40					
College 41					
College 42		X			
College 43			X		
College 44					
College 45		X			
College 46					
College 47					
College 48			X		X

College	Review Course	NSPE Guest Speaker	Info/Incentives Session	Faculty Persuasion	Info Brochure
College 49					X
College 50			X		
College 51				X	
College 52					X
College 53					
College 54		X	X		
College 55				X	
College 56					
College 57				X	
College 58					
College 59					
College 60					X
College 61					
College 62		X	X		
Totals:	8.60%	26%	21%	12%	17%

NOTE - all total percentages are based on 62 interviewees

APPENDIX C - Table IV - Less Popular Suggestions

Suggestion	% of Interviewees who made suggestion
Increase number of licensed faculty	10.30%
Market Exam to all majors	7%
Make the FE exam more affordable	7%
Improved web pages	5%
Hold FE exam on campus	5%
Have student chapters promote licensure	5%
Online review course	3.40%
Video	3.40%
Give free sample exams	3.40%
Journal for students to track progress towards FE exam	1.70%
Give 6 month trial membership to students passing FE exam	1.70%
Advertise exam dates	1.70%

National Council of Examiners for Engineering and Surveying

Fundamentals of Engineering Examination
Morning Session Answer Sheet

SIDE 1

A NAME (Use a Soft No. 2 Lead Pencil Only.)

Last Name (Please Print) First Name MI (Middle Initial)

B TEST CENTER DATE AND LOCATION (Please print.)

Test Date

Test Center City

Test Center State

DIRECTIONS

- [illegible]
- Make dark marks that completely fill the oval.
- Erase cleanly any marks you wish to change.
- Make no stray marks on this form.
- Do not fold, tear or mutilate this form.

C NAME

First 4 Letters of Last Name | Initial of First Name

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

D DATE OF BIRTH

Month | Day | Year

Jan. Feb. March April May June July Aug. Sept. Oct. Nov. Dec.

Day: 0 1 2 3 / 0 1 2 3 4 5 6 7 8 9 — Year: 0 1 2 3 4 5 6 7 8 9 / 0 1 2 3 4 5 6 7 8 9

E EXAMINEE IDENTIFICATION NUMBER

0 1 2 3 4 5 6 7 8 9

F TEST FORM

0 1 2 3 4 5 6 7 8 9

G Fill in the oval corresponding to the large letter printed in the upper right-hand corner of your test booklet.

- A
- B
- C

H I am taking the Fundamental of Engineering Examination for the:

- First time
- Second time
- Third time (or more)

I If you are a graduate of or enrolled in an engineering or engineering technology curriculum, please fill in ONE of the ovals below to indicate your major undergraduate curriculum.

- Aeronautical/ Aerospace
- Agricultural
- Architectural
- Bio-Engineering
- Ceramic
- Chemical
- Civil
- Computer
- Construction
- Electrical
- Engineering Management
- Engineering Mechanics
- Engineering Physics/ Engineering Science
- Environmental
- Fire Protection
- Food Process
- Forest
- General Engineering
- Geological and Geophysical
- Human Factors
- Industrial
- Manufacturing
- Materials
- Mechanical
- Metallurgical
- Mineral
- Mining
- Naval Architecture and Marine
- Nuclear
- Ocean
- Petroleum
- Plastics
- Polymer Science and Engineering
- Radiological Health
- Surveying
- Systems
- Textile
- Welding
- Other

J Fill in the ovals that best describe your highest educational attainment.

I AM:

- a graduate of
- enrolled in

- a four-year or more ABET accredited ENGINEERING curriculum.
- a four-year or more ABET accredited ENGINEERING TECHNOLOGY curriculum.
- a four-year or more ENGINEERING curriculum not accredited by ABET.
- a four-year or more ENGINEERING TECHNOLOGY curriculum not accredited by ABET.
- None of the above.
- Do not know.

K If you are a graduate of or enrolled in an engineering curriculum, please fill in the two ovals to indicate the last two digits of the year of your graduation.

0 1 2 3 4 5 6 7 8 9 / 0 1 2 3 4 5 6 7 8 9

L BOARD CODE

0 1 2 3 4 5 6 7 8 9 / 0 1 2 3 4 5 6 7 8 9

M SPECIAL CODE

0 1 2 3 4 5 6 7 8 9 / 0 1 2 3 4 5 6 7 8 9