THE FUTURE OF PROFESSIONAL ENGINEERING: CONTINUED PROTECTION OF THE PUBLIC HEALTH, SAFETY, AND WELFARE THROUGH PROFESSIONAL ENGINEERING LICENSURE

A Report of the Future of Professional Engineering Task Force to the National Society of Professional Engineers Board of Directors

July 2018

This report was developed by a team of volunteers appointed to the Future of Professional Engineering Task Force of the National Society of Professional Engineers ("NSPE") from June 2016 to July 2018. The summaries, recommendations, and conclusions were developed over a two-year period through various discussions, exchanges, and considerations by the Task Force. The opinions and recommendations presented in this paper are intended to encourage further understanding and discussion of the topics identified herein; they do not necessarily reflect those of NSPE, the individual members of the Task Force, the professional organizations or local, state, or federal agencies identified herein, or the employers or other affiliated professional organizations or societies of the Task Force members. Only those recommendations later incorporated into NSPE Professional Policies, Position Statements, or other official NSPE documents or communications represent the position of NSPE.

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TABLE OF CONTENTS

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The FOPE Task Force presents this report to NSPE with the intent that it will encourage thoughtful discussion around the recommendations identified herein. While the FOPE Task Force worked diligently to analyze key issues and concerns from many different perspectives and gathered input from many different sources, additional input and insight is warranted as professional engineering progresses through the twenty-first century. Further, this report is not intended to be, or capable of being, all-encompassing of every key considerations related to professional engineering and the continued protection of the public health, safety, and welfare.

INTRODUCTION

In 1907, Wyoming enacted the first engineering licensure law to protect the public health, safety, and welfare.[1] By 1922, the American Association of Engineers developed a platform for engineering that included the "passage of an engineers' registration law in every state and the enforcement of existing registration laws."[2] In 1934, the National Society of Professional Engineers ("NSPE") was formed, requiring that members be professional engineers ("PEs") or those on the licensure track.[3]

At the time, only 28 states had enacted engineering licensure laws.[4] By 1959, when Alaska and Hawaii were granted their statehood, every state in the United States had a PE licensure law.[5] Today, every state regulates the practice of engineering to ensure public safety by granting only PEs the authority to sign engineering plans, reports, and formal observations, and offer their services to the public.

Engineering Degree or PE License?

ONLY a PE may prepare, sign and seal, and submit engineering plans and drawings to a public authority for approval, or seal engineering work for public and private clients.

PEs shoulder responsibility for not only their work, but for the lives affected by that work.

PEs must hold the public health, safety, and welfare paramount in their work. A PE who does not practice engineering holding this obligation paramount is subject to discipline or license revocation by the PE licensing board of their state or United States jurisdiction.

LICENSURE for a consulting engineer or a private practitioner is a legal requirement for those in responsible charge of work, be they principals or employees.

LICENSURE for engineers in government has become increasingly significant. Many federal, state, and municipal agencies require that governmental engineering positions, particularly those considered higher level and responsible positions, be filled only by PEs.

[1] National Society of Professional Engineers. 100 Years of Engineering Licensure. *Available at* https://www.nspe.org/resources/press-room/resources/100-years-engineering-licensure (accessed February 5, 2018).
[2] *Id.* Some states continue to use the term "registration" or "registered" instead of "licensure" or "licensed" when referring to professional engineers. "Licensure" and "licensed" will be used throughout this report, consistent with the National Council of Examiners for Engineering and Surveying ("NCEES"), the national non-profit organization composed of engineering and land surveying licensure boards of all states and territories of the United States.
[3] *Id.* "Those on the licensure track" refers to those actively pursuing licensure, whether as students of an engineering baccalaureate degree program, or an engineer intern ("EI") or engineer-in-training ("EIT") as designated by their state. "EI" will be used throughout this report to refer to both engineer interns and engineers-in-training.
[4] *Id.*
[5] *Id.* While Montana was the last state to adopt a professional engineering licensure law in 1947, the territories admitted as states after this date already had licensure laws in place pre-statehood.

THE FUTURE OF PROFESSIONAL ENGINEERING TASK FORCE

On June 25, 2016, NSPE initiated the work of the Future of Professional Engineering ("FOPE") Task Force[6] to evaluate the future of professional engineering and identify ways in which the overall awareness of the PE license can be increased among engineering graduates, regulators, and the public. As previously discussed, it is the duty of the PE to hold the public health, safety, and welfare paramount above all other considerations. The FOPE Task Force was created to ensure that as societal expectations, technology, and regulatory environments change for PEs over the next century, that the public health, safety, and welfare continue to be the paramount considerations in the design, observation, and development of the built environment and in the deployment of technological advancements for the betterment of society.[7]

The work of the FOPE Task Force commenced with a two-hour, town-hall-style, conversation at the 2016 NSPE Professional Engineers Conference ("PECON") to which all conference attendees were invited to participate. The session was guided by fundamental principles enumerated by the authors of *The Future of the Professions: How Technology will Transform the Work of Human Experts*, Richard and Daniel Susskind. These authors predicted "that increasingly capable machines, operating on their own or with non-specialist users, will take on many of the tasks that have been the historic preserve of the professions." Their analysis examined the way expertise is produced and distributed in our society. These fundamental changes, they predict, "will lead eventually to a dismantling of the traditional professions."[8]

[6] The FOPE Task Force includes 13 individuals who are PEs, certified engineering technicians and technologists, EIs, and non-licensed individuals whose backgrounds include state licensing board involvement, business owners, consulting engineers, former public sector employment, non-engineering employment, leaders within NSPE and other engineering or non-engineering organizations, and industry engineers. The FOPE Task Force is comprised of: Adam Stodola, PE (Chair); Shelley Macy, PE (Vice-Chair), Amy Barrett, PE; Keri Burchard-Juarez, PE; Mike Clark, CAE; Mike Conzett, PE; David D'Amico, PE; Russell Freier, CET; Thomas J. Frericks, Jr., CT; Rick Guerra, PE; Austin S. Lin, EI; Arthur Schwartz, CAE; Kodi Jean Verhalen, PE, Esq.; and Michelle Winkelmann, PE.

[7] For purposes of this report, the term "built environment" encompasses both those areas traditionally contemplated in this term (i.e. roads, bridges, damns, processing and production plants, water treatment works, vehicles, etc.) and also emerging areas where engineering plays a key role in the operation of an item for large-scale or personal use (i.e. the coding algorithms and physical operations upon which autonomous features make operational decisions in place of human intervention).

[8] Richard and Daniel Susskind. *The Future of the Professions: How Technology will Transform the Work of Human Experts* at 2 (2015).

Fundamentally, all professions around the world are facing these challenges. And this is certainly not the first time in history that technological changes and human ingenuity have had a substantial effect on the way in which certain tasks are performed in society. In the United States, for example, the industrial revolution resulted in a shift from a manual-labor society in which individuals performed painstaking tasks at all levels of production to a technology- and machine-based approach to production.[9] This shift resulted in (1) a notable change in the way in which products were produced for market and (2) the lowering of prices.[10] The industrial revolution also ameliorated the kind of labor shortages that plagued the 18th and 19th centuries.[11] The current changes in technology are significantly different than those experienced during the industrial revolution, however, as those earlier technological advancements still required substantial human intervention for design, construction, operations, and decision-making. Today's changes in technology are providing opportunities for and advancements into each aspect of, design, construction, operations, and decision-making, as well. Through the use of technology and automation to carry out these critical built environment tasks, the professions are being impacted by shifting societal expectations and market disruptions.

> "Professionals" are human specialists, while "the professions" refers to the occupational groups and institutions to this professionals currently belong.
> – *The Future of the Professions* at 15

The Susskinds define professionals, for purposes of their critical analysis, as having four similarities: (1) specialist knowledge; (2) credentials that determine admission to the profession; (3) regulated activities; and (4) a common set of values.[12] They challenge the professions to evaluate four key areas of their practice to maintain relevance as technology and societal expectations change and progress:

- Is there an entirely new way to organize work?

[9] Wikipedia. Industrial Revolution in the United States. *Available at* https://en.wikipedia.org/wiki/Industrial_Revolution_in_the_United_States (accessed June 8, 2018).
[10] *Id.*
[11] *Id.*
[12] *The Future of the Professions: How Technology will Transform the Work of Human Experts* at 15.

- Must all current licensed work continue to be done only by licensed professionals?
- Can licensed professionals be trusted to admit if services could be delivered by non-licensees?
- Is the traditional arrangement still fit for purpose and serving society well?[13]

The conversation around these four questions covered numerous topics during NSPE's PECON 2016. The FOPE Task Force distilled those topics into four areas:

Internal
- Licensure
- Role of the PE

External
- Value
- Messaging

These four areas were used to develop the initial charges of the FOPE Task Force.

1. Identify internal and external issues related to the profession and how these issues directly affect the success and sustainability of the profession. Issues may include, but are not limited to, licensure, the role of the PE, the delivery of professional engineering services, and how PEs communicate the importance and successes of the profession.
2. Develop recommendations that address both the internal and external issues the task force identifies, specifically related to licensure, the role of the PE, the value of the profession, and messaging (internal to NSPE, internal to the profession, and external to the public at large).

Based on this initial organization of information, the FOPE Task Force was structured to directly address these four areas. To that end, four subgroups were formed to provide the depth and breadth necessary to focus on these issues and identify specific topics for investigation and further work to develop recommendations to NSPE related to the practice of the PE.

In the spring and summer or 2017, the FOPE Task Force provided substantive analysis and recommendations for focus by NSPE. The NSPE Board of Directors approved further work by the FOPE Task Force into summer 2018 based on the initial recommendations developed by the

[13] *Id.* at 32-33.

FOPE Task Force. In developing this report, the FOPE Task Force reached out to the professional engineering community for input on trends and key areas of interest for PEs. Additionally, the FOPE Task Force looked at other licensed and certified professions to draw parallels, identify trends, and learn from actions they have taken to respond to changing technology and societal expectations.

This report summarizes the FOPE Task Force's work and provides recommendations to ensure the continued viability of the profession and, in turn, to ensure that the public health, safety, and welfare continue to be the paramount considerations in the (1) design, observation, and development of the built environment and (2) deployment of technological advancements for the betterment of the society.

FUTURE OF PROFESSIONAL ENGINEERING REPORT

From June 2016 to July 2018, the FOPE Task Force prepared in-depth analyses associated with 11 areas of focus related to the future of professional engineering. The detailed analysis, discoveries, and recommendations are available as appendices to this report as follows:

Appendix A: Emerging Technology

Appendix B: Industrial Exemption

Appendix C: Public Policy and Professional Engineering

Appendix D: Engineering Education

Appendix E: Licensure Model and Mobility

Appendix F: International Licensure

Appendix G: Role of CET and CT

Appendix H: Alternative Delivery Methods

Appendix I: Public Sector Engagement

Appendix J: Defining and Communicating Value

Appendix K: Communication Plan

An overview of this material is provided in this summary report, but additional information and background are provided on each topic in the appendices. Each appendix has been drafted as a stand-alone paper.

The FOPE Task Force notes that while civil engineers comprise the largest contingent of NSPE members, the work of the FOPE Task Force did not focus on one engineering discipline. Instead, the FOPE Task Force sought to examine the entire PE profession. In its analysis, the FOPE Task Force identified, as a broad recommendation, that PEs should pay close attention to how they are preparing for (from the client/municipality/government perspective) or responding to (from the consultant or service-based perspective) requests for proposals ("RFP") for built-infrastructure projects, PEs need to ensure they are transitioning from a role as a technical resource to that of a counselor or trusted advisor, responsible for identifying the key issues that must be addressed on the client's behalf. Such critical professional engineering analysis cannot be performed solely by machines or technology and requires human involvement. This interaction can be illustrated by comparing two example RFPs. The first RFP is for "the design of a new right turn lane into a shopping complex." The second RFP is written more broadly for "the development of an ingress and egress design that alleviates the current challenges experienced at a shopping complex." The latter allows for the consulting PE to provide, and the client to receive, the most creative solutions to the real issue (ingress and egress to a shopping complex) and provides the most economic use of financial and technical resources. This provides society the best outcome, ensuring that the best and highest value solution is deployed to address the issue that must be resolved through the engineering project.

EMERGING TECHNOLOGY

The expanding use of technology in the design and construction of engineered products, processes, and systems has the potential to put pressure on the need for engineers to be licensed as well as how engineers fulfill their roles. As to the latter, the use of increasingly more complex software can shift routine engineering tasks from the realm of the engineer to that of the technician or even to the end user. Sophisticated software and modeling, when tied to appropriate codes and standards, can create a scenario in which the design and construction of a product can be accomplished with minimal human involvement and with, perhaps, no need for the involvement of a PE. If the professional engineering community continues with the mantra "it won't happen to us" or "I will always be needed," it risks being marginalized, or worse, in the technology tidal wave.

> We predict that increasingly capable machines, operating on their own or with non-specialist users, will take on many of the tasks that have been the historic preserve of the professions.
> – *The Future of the Professions* at 2

In such a future world (aspects of which we are already witnessing), outside forces will challenge the need for licensure. After all, the computer (or a successor technology) could be seen as the productive and reliable tool that has no internal biases or no "bad days in the office." While we all know that human intelligence is required to design and build the technology, there could be a temptation to discount the role of human beings as technology does more and more of the "thinking and creating." In such cases, one may see the expanding use and complexity of technology as a threat to licensure. While acknowledging these very real scenarios, PEs must resist the urge to fear change. Technology will always be with PEs and professional engineering. PEs must, instead, have the desire and the ability to embrace the inherent change.

The role of licensure in the future is expected be as important and necessary as it is today. There is one component of licensure that is unique from technology: the "conscience" of human beings that no machine can possess. It is the reality that the PE must hold paramount

the health, safety, and welfare of the public. It is the ethical chip of the engineer that no computer has. Licensure should constantly remind PEs that their duty is to place the interests of the public over and above all other considerations.

The public deserves and demands that a license should exist to protect them. A computer will not be held accountable by the public. If we fail to respond to our changing world, then we will fail in our responsibility to the public we serve.

NSPE must acknowledge and accept the evolution of technology into the engineering profession and use it and control it, accordingly. This begins with separately identifying the specific engineering tasks that can and cannot be computerized (or automated). We need to ensure that the public is protected by having PEs hold responsibility for the software and computer engineering required for automated processes and implementation of limited artificial intelligence as its value is studied, analyzed and proven in the profession. Traditional methodologies are giving way to more efficient, technologically strong, and automated processes.

Further, professional engineering must be on the forefront when it comes to the delivery of engineering services. There are many options for delivery of sealed professional documents. They include paperless documents and interactive data/models. Sensitivity to the end users must also be included for mobile-device viewing. The evolution of CAD drawings to Revit Models has made freely transferring work more of a reality. PEs must lead the change to address how, for example, Revit Models and 3D models of infrastructure have changed project delivery for the consulting professional engineers and what the ramifications are. Global standardization of engineering practices will impact the development of projects, and it is important for these standards to be developed by the professional engineering community.

INDUSTRIAL EXEMPTION

The "industrial exemption" is a provision under most state licensing laws that exempts companies that manufacture products or perform engineering services from the requirement that a PE oversee the product's design of the company's services. Engineering services that are exempt from PE licensure differs by state[14], although the engineering community often refers to the "industrial exemption" as a single piece of legislation. The industrial exemption has contributed to the reality that between 15-20 percent of graduate engineers ever become licensed. Further, this can also lead to engineers practicing in multiple jurisdictions potentially violating state and territorial laws as they may assume their practice does not require a license in State B if their practice fell under the industrial exemption of State A.[15]

> The first [anxiety or concern from the professional] is a strong 'status quo bias' – a preference for continuing to do things as they are done today.
>
> – *The Future of the Professions* at 43

Because of the industrial exemption, essential attributes of a PE, such as exercise of independent judgment and exertion of responsible charge or control over subject matter within his/her expertise are too often inhibited, at best, or silenced, at worst. This can cause a lack of professional discretion that could ultimately lead to disastrous consequences for the health, safety and welfare of the public.

To help ensure that professional engineering maintains the recognized and generally-understood status as a profession, it must coexist with business and industry without relinquishing ultimate control of engineering work. This will require engineers to assertively advocate for the elimination of each state's industrial exemption regulation. A different engineering culture – requiring a paradigm shift – will be required to achieve this goal, which the FOPE Task Force acknowledges is not easily accomplished. NSPE is at a critical point today

[14] National Society of Professional Engineers. Exemptions to Engineering Licensure Laws (2016). *Available at* https://www.nspe.org/resources/exemptions-engineering-licensure-laws (accessed March 6, 2017).
[15] *See* National Society of Professional Engineers. Exemptions to Engineering Licensure Laws (2016). *Available at https://*www.nspe.org/resources/licensure/exemptions-engineering-licensure-laws (accessed March 6, 2017).

and NSPE, its state societies, other engineering societies, legislators, and public safety advocates must come together to collaboratively and proactively engage in this issue.

The argument in favor of the industrial exemption centers on professional liability and the assignment of risk, specifically, whether the liability burdens of large markets should be borne by corporations or government agencies instead of falling on the shoulders of one person or design team. While elimination of the industrial exemption would require that all activities defined by a state as the "practice of engineering" be performed only by or under the responsible charge of a PE, the same is true of other professions. Such as, if one goes to an expert for legal advice, that expert is a lawyer, or to an expert for medical advice, that expert is a physician, physician's assistant, nurse practitioner, or other licensed medical professional.

NSPE should utilize its legal expertise, relationship with state societies, and the NSPE member base to guide legislatures to protect professionals engaged in industries where these exemptions exist to limit the personal financial liability of the individual PE employees. This would allow society to gain the benefit of the expertise of PEs who have been vetted by accepted state standards, with their employers – industrial corporations – remaining legally and financially responsible for their management directives. Under this model, any design modifications or changes to industrial products, processes or other devices or engineering services would be required to be performed under the supervision of the PE in responsible charge, ensuring the engineering design/service was evaluated with the protection of public health, safety, and welfare as a paramount consideration.

Given the existence of varying definitions of what is included in a specific state's industrial exemption, it is critical that engineering graduates understand this variability in practice. Therefore, and as discussed in more detail in the Engineering Education section of this report, NSPE must become a resource for engineering educators to inform and advise engineering students on the variability of practice and engineering licensure requirements. There is no greater disservice to an engineering graduate than to allow students to graduate from an engineering program - with the belief that their degree is the ***only*** credential they will need to

practice engineering, only to find immediately after graduation or in the future that they will require an engineering license to perform an engineering job or to start an engineering business that impacts the public health, safety, and welfare.

PUBLIC POLICY AND PROFESSIONAL ENGINEERING

Legislative Attacks on Occupational Licensing

Across the United States, there are a growing number of bills being introduced in state legislatures that could weaken or eliminate professional engineering licensure.[16] Most of the legislation arises out of a belief that "less government and less regulation" is better. This legislation has been primarily supported by groups such as the American Legislative Exchange Council.[17] It may be a reality that there are too many occupations requiring a license to practice in that occupation, such as florists[18] or other activities. However, each occupation and profession should be considered independently on its own and not automatically included in broad legislative mandates to eliminate occupational licensing merely because a license is required for practice.

> The "Grand Bargain:"
> *In acknowledgement of and in return for their expertise, experience, and judgement, which they are expected to apply in delivering affordable, accessible, up-to-date, reassuring, and reliable services, and on the understanding that they will curate and update their knowledge and methods . . . and that they will always act honestly, in good faith, putting the interests of clients ahead of their own, we (society) place our trust in the professions in granting them exclusivity over a wide range of socially significant services and activities . . . .*
> *– The Future of the Professions* at 22

Professional engineering licensure is different from many other occupations or professions. Professional engineering licensure is a fundamental means of

[16] National Society of Professional Engineers. Threats to Professional Licensure. *Available at* https://www.nspe.org/resources/issues-and-advocacy/action-issues/threats-professional-licensure (accessed June 23, 2018).
[17] *See* American Legislative Exchange Council. The Occupational Licensing and Job Creation Act. *Available at* www.alec.org/model-policy/the-occupational-licensing-relief-and-job-creation-act/ (accessed March 6, 2017). Other groups supporting similar legislation are Americans for Prosperity, the Institute for Justice, and the Goldwater Institute, among others.
[18] This is only provided as an example licensed occupation and the FOPE Task Force offers no opinion on whether a license should be required for such activities.

protecting the public in a broad range of areas involving health, safety and welfare. Professional engineering licensure sets the legally-recognized standard of practice under state law and regulation is based on an engineer's education, experience, examination, continuing professional development, and other relevant qualifications. It also establishes the local professional standard of care of all PEs when practicing engineering under the laws of that state. The larger challenge for professional engineering licensure is that many members of the public do not understand the licensure model (education, examination, and experience requirements) associated with the practice of professional engineering and the work required to be performed by PEs. This issue is rooted in two common challenges: 1) the public generally does not understand the differentiation between a degreed engineer and a PE and 2) broadly speaking and with some exceptions, historically professional engineers have not been politically active and there are very few PEs in legislative roles across the United States. These themes are discussed in detail in the sections on Communicating the Value of the PE and the Role of the PE in Public Policy, respectively, of this report.

To address these and related challenges, NSPE and all other engineering societies must work harder to articulate the clear difference between professional engineering licensure and all other occupational licenses. In addition, there should be a concerted public relations effort to raise the public's awareness regarding the health, safety, and welfare benefits resulting from professional engineering licensure. The FOPE Task Force has determined that the threat to professional engineering licensure (and, in turn, to the continued protection of the public health, safety, and welfare) at the state level is a clear and present danger and is growing. As part of this effort, in addition to actively initiating, organizing, and participating in federal and state legislative coalitions and other likeminded professional groups opposing such efforts, outreach should be made to key attack proponents on occupational licensure to educate these groups relative to the value of professional engineering licensure to the public and why such licensure should be exempted from any legislation introduced to eliminate occupational licensure in a state or at the federal level.

Professional engineering operates similarly to service professions such as accountancy, legal, and medical. NSPE should continue to closely monitor any changes to licensure models – in implementation, enforcement, and public perception, so NSPE can readily adapt to this changing landscape. In this effort, however, it is necessary for NSPE and its state societies to reach out to its members and PE non-members to inform them of the threats to licensure that have occurred in their state or neighboring states and the efforts NSPE and the state societies have undertaken to protect the professional engineering license. Through this effort, NSPE and the state societies should encourage PEs to become active in their own advocacy, either personally or through support of an advocacy effort like NSPE, against these occupational licensure efforts that undermine professional engineering licensure.

Licensure Versus Certification

Proponents of the elimination of occupational licensure often advocate in favor of professional and occupational certifications, which they argue are less restrictive and easier to obtain. Therefore, the argument continues, a greater number of people could qualify for certification, thereby eliminating the "barrier to entry" into the profession or occupation. This argument, however, fails to recognize that certain activities being attacked under these legislative initiatives relating to occupational licensure are of the types that directly impact the public health, safety, and welfare.

There are distinct differences between licensure and certification. The public generally does not appreciate the differences between the two classifications. Part of this is vernacular – the common language does not refer to other regulated professions as licensed (for example, common language does not refer to an attorney as a "licensed attorney" or a doctor as a "licensed doctor"). Instead, they are identified and understood by the title of the profession ("Attorney" or "Doctor") and then some may carry a special designation or certification

("Patent Attorney,"[19] "Attorney, [State Bar Association] Certified Real Property Law Specialist," or "Certified Plastic Surgeon," as examples).[20] In addition, as a point of history, the terms "engineer" and "engineering" preceded the establishment of professional engineering licensing laws at the state and territorial levels.

Certification is obtained after licensure in the learned professions of law and medicine. Further, in these learned professions, the core profession is the only title for those practicing therein, with certifications recognized after licensure and title.[21] These differences between licensure and certification must be effectively communicated both within the profession and to the public at large.

The public is generally familiar and recognizes the use of certifications in other licensed professions. In fact, there is even an organization for certifying licensing professionals for those working in fields responsible for licensing other professionals.[22] Further, if there are local, state, or federal regulations or legislation requiring a specific certification to perform a specific engineering task, the public does not, and should not be expected to, know that there may be a separate regulation or legislation that would exempt a PE from obtaining that engineering-related certification. For example, a state may require a specific certification to design a stormwater plan through one statue, but then also have another statute in an entirely different chapter, stating that a PE need not obtain that certification, without cross-reference in either statute. Such layered regulation makes it exponentially more difficult for the public to fully understand who must be hired to complete a specific engineering task.

[19] The American Bar Association's Model Rule of Professional Conduct, a corollary to the NCEES Model Law and Model Rules, states, in part that, while a lawyer may "communicate the fact that the lawyer does or does not practice in particular fields of law," recognizing only "Patent Attorney" or "Admiralty," as formal titles but allowing a lawyer certified as a specialist by an organization "approved by an appropriate state authority" or the American Bar Association to state that certification in communications along with the identification of the certifying authority. Further, a lawyer may communicate the fact that the lawyer does or does not practice in particular fields of law. American Bar Association, Model Rules of Professional Conduct, Rule 7.4 Communication of Fields of Practice and Specialization.

[20] Compare to a "Certified Public Accountant" where the license confers the title "Certified" but it is still a license.

[21] In the case of public accountancy, those practicing in the profession are recognized as "Certified Public Accountants" or "C.P.A.s" by applicable state law.

[22] Certified Licensing Professionals, Inc. *Available at* http://www.licensingcertification.org/ (accessed June 12, 2018).

Several engineering societies (including the American Society of Civil Engineers ("ASCE"), Society of Manufacturing Engineers ("SME"), International Society of Automation ("ISA"), and Structural Engineering Certification Board ("SECB")) advocate for, and offer, certifications in specialty areas. While both ASCE and SECB offer certifications only after an individual obtains a professional engineering license, SME and ISA grant certifications entirely separate from (including prior to) licensure. SME specifically offers certifications as both Certified Manufacturing Engineer ("CMfgE") and Certified Manufacturing Technologist ("CMfgT"). ISA focuses its Certified Automation Professional ("ISA-CAP") program across a global marketplace for multi-national corporations.[23]

The CMfgE, CMfgT, and ISA-CAP certifications require demonstration of education and work experience (with the CMfgE requiring "a minimum of eight combined years of manufacturing-related education and work experience," quite similar to what is required under the NCEES Model Law for PE licensure) followed by an exam.[24] In developing this certification, SME and ISA have gone even further in developing a body of knowledge, a competency model, and a three-year recertification process. SME has promoted its certification as an alternative to professional engineering licensing in engineering society discussion forums.

NSPE has adopted Position Statements 1737 and 1774 related to certifications for professional engineers. NSPE should continue to advocate against certification as a substitute for or in lieu of licensure for performing engineering tasks. NSPE should support local, state, and federal regulation and legislation that requires PE licensure for the practice or performance of engineering. Such licensure provides oversight by state boards and agencies to ensure the

[23] Unlike SME, however, ISA provides a direct link on its website about its CAP program to the American Association of Engineering Societies website detailing the difference between licensure and certification providing a link titled "Certification vs. Licensure" at the bottom of the webpage (http://www.aaes.org/sites/default/files/Differentiating_Licensure_and_Certification_for_Engr.pdf). *See* International Society of Automation. Certified Automation Professional. *Available at* https://www.isa.org/isa-certification/certified-automation-professional/ (accessed June 12, 2018).

[24] Society of Manufacturing Engineers. Certified Manufacturing Engineer. *Available at* www.sme.org/cmfge (accessed February 3, 2017); Society of Manufacturing Engineers. Certified Manufacturing Technologist. *Available at* www.sme.org/cmfgt (accessed February 3, 2017); International Society of Automation. Certified Automation Professional. *Available at* https://www.isa.org/uploadedFiles/Content/Training_and_Certifications/ISA_Certification/CAP%20Benefits%20Brochure.pdf#page=10 (accessed June 20, 2018).

competent and ethical practice of engineering to protect the public health, safety, and welfare. NSPE should consider modifying its position (specifically, Position Statement 1737) of opposing mandatory certification "beyond licensure."

Given the prevalence of certification programs and societal expectations for some certifications or specialization by licensed professionals, obtaining certifications should not be actively opposed going forward. In fact, acceptance of certain certifications may strengthen the profession and work to negate some attempts to fragment licensure by supporting a "PE license first" approach with certifications to bolster and confirm competence in certain areas of practice.[25] Instead, the FOPE Task Force recommends encouraging state licensing boards to actively evaluate engineering certification programs that could be employed to tailor the practice of professional engineering to that state. Specifically, the FOPE Task Force recommends that Position Statement 1737 be sunset and readopted with revisions as follows:

> *7. . . . Professional engineering licensure is the only qualification for engineering practice, unless other post-PE certification is required by a state PE licensing board for a particular practice of engineering. NSPE and its state societies actively oppose attempts to enact any local, state, or federal legislation or rule that would mandate certification in lieu of ~~or beyond~~ licensure as a legal requirement for the practice of engineering. Any post-PE certification requirements adopted by a state PE licensing board must provide for a grandfathering or other pathway to practice for those PEs already practicing in that area of engineering practice.*

The FOPE Task Force recommends that Position Statement 1774 be sunset and readopted with revisions as shown in Appendix C to this report.[26]

[25] This is so long as the certification programs, when adopted, do not block out PEs who have already been practicing competently in those areas, allowing for a period of grandfathering, similar to what was allowed for the legal and medical professions when they moved from an apprenticeship to education/examination path to practice.

[26] NSPE Position Statement 1774 with revisions is not reproduced here due to its overall length.

Fragmentation of Licensure

The regulation of PEs varies among states. Some states license all engineers as PEs. Other states license by specific engineering disciplines (by use of a Title Act, Practice Act or both). In all cases, however, PEs are required to practice only in areas of their competence. This is different than the practice of law or medicine, for example. All states regulate these professions only as "attorney" or "lawyer" and "doctor." Titles for medical professionals such as "pediatrician," "plastic surgeon," and "cardiovascular surgeon" are conferred after obtaining licensure as a "medical doctor (M.D)" and then earning a separate nationally-approved certification in a medical specialty. The possible embrace of a similar certification process for PEs is discussed in the section above.

The fragmentation among PEs with terminology such as "engineer," "professional engineer," "licensed engineer," and "registered engineer," is already confusing to the general public. Discipline-Specific engineering titles fosters the potential for even greater fragmentation of the engineering profession. Further, continued support and adoption of Discipline-Specific Title Acts or Discipline-Specific Practice Acts provide further opportunity for conflict that may benefit those seeking to eliminate occupational licensing, as discussed above, as these acts create and even more restrictive path than would be otherwise the case.

One way to address the concern that discipline-specific licensure could further fracture the engineering profession, is to incorporate the certification process into a state's existing process for licensing PEs. NSPE should work diligently with both NCEES and its state boards and with the NSPE state societies to advocate that separate discipline-specific licensure not be supported (i.e. Discipline-specific Title and Practice Acts). Instead, certifications in certain areas of practice or expertise after obtaining a PE license should be supported. This could include, as an example, similar to the practice of the American Bar Association or American Medical Association. If a certification program is recognized by NCEES or the state licensing board, then it is an appropriate certification required for specialized areas of practice, such as Structural Engineering in states that determine such additional certification is necessary to protect the public health, safety, and welfare.

The SECB is a national organization that provides Structural Engineering Certification. To obtain this certification, one must be licensed as a PE, complete successful passage of the 16-Hour structural engineering NCEES examination, complete continuing education in six different categories, and complete annual recertification. Such a framework could be recognized by state licensing boards if the certification and recertification processes do not change and if a state determines that a PE should also obtain Structural Engineering certification for certain engineering activities to ensure another layer of protection for the public health, safety, and welfare.

NSPE should continue to advocate for the elimination of Discipline-Specific Title and Practice Acts, as these acts continue to not only confuse the public at large, but also make for cumbersome and confusing processes for legislatures to understand and, also, as it relates to the general mobility of PE licensure. Further, adoption of such positions (elimination of Discipline-Specific Title and Practice Acts and Support for Post-PE Certifications) would be more in line with the consistency of approaches adopted by other licensed and publicly-understood professions of the law and medicine.

Another recent development within engineering licensure, primarily promoted by the civil engineering community, is a change in the education requirements for PE licensure. There has been an ongoing effort by ASCE to require additional education after attainment of an engineering bachelor degree as a condition for professional licensure.

The overall academic structure of the bachelor degree for engineering has changed over time and must be closely understood and monitored by NSPE. NSPE participates actively in the ABET education accreditation criteria development process. It is important to note, however, that while the academic structure of engineering bachelor's degrees has changed, it does not necessarily mean that the current academic structure is "wrong" or "inadequate." It has been argued, however, that because licensure is considered to be the pinnacle of professional practice, allowing the broadest abilities to practice engineering in the United States, education

requirements for individuals seeking licensure can be different than those seeking only an engineering degree.

Consistent with other learned professions, a degree demonstrates a *minimum acceptable* level of education. In any area of the practice of engineering, for one to be *competent and qualified* in that area one will need to obtain additional training or education. It is not necessary, however, that the additional training or education need to be formal academic education and may be done through various training programs or intensive on-the-job training after undergraduate graduation. NSPE must be diligent and ensure that in all cases, it is the public interest that is being protected.

Procurement of Professional Engineering Services

The long-term sustainability of professional engineering is in harmony with the PE's role in protecting the public. To that end, steps must be taken to create and maintain a competitive environment for the delivery of professional design services through Qualification Based Selection ("QBS"). This environment must highlight the value of the profession while preventing it from becoming a mere commodity.

In a recent letter to a state's legislators, NSPE laid out the following position:

> *QBS is a procedure whereby service providers are retained on the basis of qualifications, rather than price factors. Under the QBS method, the procuring agency reviews the qualifications submitted by interested individuals and firms, ranks respondents, and then negotiates with the most qualified respondent for a mutually agreeable contract.*

Further, NSPE provided four reasons as to why it is imperative that QBS methods are used.

1. QBS protects the public welfare
2. QBS protects the taxpayer
3. QBS benefits small firms
4. QBS promotes technical innovation

Choosing an engineering firm for a project can have far-reaching implications. How a project is designed and engineered in the early stages can affect its costs, performance, and quality throughout its entire lifecycle. Therefore, it does not pay to treat engineering like a commodity and compare firms by price only. This is one scenario where paying a little more upfront can save huge costs and headaches down the road. In view of this, QBS has become the mantra in choosing engineering firms, with many government agencies requiring it. NSPE and PEs must continue to advocate on behalf of the use of QBS and place emphasis on the value it provides. Without it, the public could be denied the benefit of those most qualified to provide engineering services.

The Role of the PE in Shaping Public Policy

Engineers have long been recognized for their critical thinking and problem-solving skills. Moreover, the PEs in our country have pledged an oath to hold the public health, safety, and welfare above all other considerations in exchange for practicing with a state-granted license. These skills and commitment to public health, safety and welfare uniquely position professional engineering to be a positive and driving influence on the public policy making process.

Despite the obvious need for critical thinking and problem-solving skills in the development and implementation of public policy, engineers are currently underrepresented in policy making bodies. Today, engineers represent a modest 0.9 percent of the US Congress as compared to 41.5 percent attorneys and 4.4 percent healthcare professionals.

To ensure that the public health, safety, and welfare are preserved in the future, PEs must play a greater role in shaping and/or otherwise informing public policy. Far more PEs will need to enter the public service arena by appointment or election to public office. Even greater numbers of PEs will need to be increasingly visible and actively engage in the political process by building relationships with policy makers and providing much needed technical support and guidance.

ENGINEERING EDUCATION

Engineering Education Generally

Over the past forty years, the world has changed, and the nature of the practice of engineering at a professional level has changed with it. The planning, design, and implementation of engineering projects now takes place fully in a societal context, requiring extensive public and stakeholder input in project decision-making and heightened consideration of economic, environmental, public policy, code compliance, legal, and regulatory matters. More than ever before, this requires advanced professional practice skills on the part of PEs in the areas of communication, leadership and a broad understanding of the societal context. In technical areas, an explosion of scientific and engineering information has led to the need for both greater breadth of science and engineering knowledge and for much greater depth of technical knowledge in ever-narrowing areas of technical practice.

The education of engineers in preparation for professional practice in a four-year baccalaureate program faces two daunting and equally important challenges. First, the body of knowledge required for practice as a PE has been and is expanding rapidly, both in terms of science and engineering knowledge and skills, and the need for more professional practice skills. Secondly, the total credit hours for a bachelor of science degree has faced a downward trend. This is not, necessarily, to say that engineering graduates today are "less educated" as technological advancements have changed the way engineering tasks are taught and accomplished.

> Our basic methods of educating have not changed much for centuries.
> – *The Future of the Professions* at 55

The combination of an expanding body of knowledge and declining credit requirements has resulted primarily in a decrease in engineering content in terms of both breadth and depth. Furthermore, we are generally not expanding the professional practice content in engineering education, even though professional practice requirements are accelerating.

It is for these reasons that the National Academy of Engineering—formed to advise the US Congress on engineering matters—concluded in a major report that "it is evident that the

exploding body of science and engineering knowledge cannot be accommodated within the context of the conventional four year baccalaureate degree."[27]

NCEES has, therefore, set a goal to make a strong system of licensing engineers even stronger by increasing the minimum engineering education required to practice as a PE. This education, however, need not only be through formal academic education. NCEES believes that expanding the education requirement will better prepare PEs to meet professional demands and will significantly enhance their careers. NCEES also believes that expanding the education requirement will promote greater proficiency in the practice of professional engineering for the protection of the public health, safety, and welfare. To that end, NCEES has in place Position Statement 35, "Future Education Requirements for Engineering Licensure."[28]

Nationwide, the financial constraints on engineering education will continue to place stress on our existing understanding of the PE. Engineering education is placing greater emphasis on teamwork within the educational structure at the request of industry. Thus, there is less of an emphasis on an individual having embraced a "body of knowledge" and more on a "collective body of knowledge" within the team. To complete a baccalaureate degree within the four-year time frame, students have less educational emphasis on the fundamentals of engineering potentially resulting in being less prepared to sit for an exam on these topics.

The team approach requiring a few PEs on staff is already prevalent in many governmental agencies (i.e., USACE, EPA, USDA), industries (Boeing, Airbus) and private industry (K-Tron, Great Plains, Koch).

The FOPE Task Force concurs with NCEES that the current baccalaureate degree which is now the educational standard for engineering licensure is becoming insufficient to accommodate the expanding body of knowledge required for practice as a PE. Global competitiveness is at risk and engineering education should be reformed to respond to this risk. The FOPE Task Force

[27] National Academy of Engineering. *Educating the Engineer of 2020* at 52 (2005).
[28] National Council of Examiners for Engineering and Surveying. *Future Education Requirements for Engineering Licensure Position Statement 35* (August 2015).

therefore supports increasing the minimum engineering education required to practice as a PE. This additional education may be fulfilled by an academic engineering degree beyond the baccalaureate degree but, *the FOPE Task Force recommends that alternative pathways other than formal academic education* be developed to fulfill the additional education requirement. One such alternative could consist of coursework and/or workshops that have sufficient content rigor and outcomes assessment that is more robust than traditional continuing education.

Licensure of Engineering Educators

In today's university structure, faculty members are expected to focus even more on active research leading to publications and contributions to the overall university goals. A majority of department's promotion and tenure requirements do not utilize the PE as an accomplishment worth of credit towards promotion. Thus, the PE is currently only of importance to faculty who are actively involved in consulting engineering outside the university or who participate in research activities that interface with an industry requiring professional engineering licensure to utilize their equipment.

With historically low or no salary increases, engineering faculty are fortunate in that they can practice their profession as a means of supplementing their personal income. Salary issues have also led to a reduction in interest in becoming members of NSPE because the rate of return with NSPE investment is low for a faculty member.

Little incentive is given for an engineering faculty member to obtain a professional engineering license, unless there is a desire to practice their profession outside the University structure as a consulting engineer. Within the University, most faculty members have spent 8-10 years completing a PhD degree program. The dissertation defense within a doctoral program alone is an extensive examination of the knowledge possessed by that individual. Many faculty members feel that it is impractical for a faculty member to be subjected to an exam to verify his or her knowledge base.

It is also important to note that where an unlicensed engineering professor may be able to complete some activities that fall within one state's definition of the practice of engineering within the University because it is an enumerated "education exemption" in that state, those may not be available if that professor moves to another University in a different state with a different "education exemption." Also, there is an important policy difference in research done solely within the bounds of a research institution and research done reaching beyond the walls of the institution, such as connecting into an electric distribution grid or field-testing a laboratory innovation. This is where an alternative pathway to licensure may be worth further exploration, if the goal is to get engineering educators licensed.

Currently, Wyoming is the only state with a state statute allowing for an alternative pathway to licensure for engineers with a Doctor of Philosophy ("PhD") in engineering. The intent in doing so was to capture those in academia and achieve the multiple goals of licensing faculty, meeting state statute for instructing upper level engineering courses in the case of an unlicensed dean and to continue to promote the traditional professional engineering pathway to students and subsequently increase the number of professional engineers. Due to its uniqueness, the Wyoming license is only for practice of professional engineering in Wyoming and is not accepted by other states via comity.

Until the metrics are known, NSPE should evaluate whether to support and promote such alternatives or to propose other alternatives. For example, the PE license requires that the engineer practice *only* in his/her area of competence. Perhaps there is an alternative in which tenured faculty could obtain a PE license by demonstrating proof of research in engineering fields and attainment of tenure status, *plus* passing of a multi-hour ethics examination offered by NCEES. While considering whether alternative pathways to licensure are appropriate, NSPE should forego efforts or using resources to attempt and get all engineering faculty licensed. Instead, a determination of where, when, and why engineering licensure *may* be required would be a more appropriate area of focus for NSPE.

Engineering Education on Licensure

However, the focus should not be solely on getting university engineering faculty licensed. Instead, efforts should focus on getting materials into the hands of engineering educators to share with undergraduate engineering students. Professional engineering licensure may be required for them to practice depending on their area of practice, their employer, and their jurisdiction. Further, educating that while one jurisdiction may not require PE licensure to practice a certain engineering-related activity, another may is critical. Therefore, it is of the greatest importance for an engineering student to pass the Fundamentals of Engineering ("FE") exam and sit for the Principles and Practice of Engineering exam as soon as possible. NSPE has previously attempted to encourage ABET to require the sharing of this information, even anecdotally, with undergraduate engineering students, but ABET has not incorporated this into its education criteria. Further, with well-known institutions abandoning ABET-accreditation, other avenues for communication must be explored.

This information should also be shared with undergraduate engineering verification groups within each of the discipline-specific engineering societies as they have the direct lines of communication with the engineering education programs around the country, outside of a formal ABET process. Also, given the recent Memorandum of Understanding executed between NSPE and the National Society of Black Engineers ("NSBE"), which has a phenomenal on-campus presence in engineering programs around the country, NSPE could provide an education module to be used by NSBE chapters in a meeting with its student members explaining, in essence, that although they may not need a PE license tomorrow, it may be required someday, and having the tools in their toolkit will set them up for a more rewarding career.

Beyond incorporating the subject of licensure into the engineering education curriculum, several key revisions to engineering education should be explored to ensure students in all disciplines are prepared upon graduation. Engineering faculty should impress upon all engineering students the need for a commitment to lifelong learning, whether by obtaining advanced degrees through formal academic education or education through technical societies

or other entities to ensure competence in one's area of practice or to expand into a new area of practice. Further, certain fundamental education concepts promoted in engineering design and seminar courses, including project management, leadership capabilities, risk assessment, initiative, making decisions in the face of uncertainty, the urgency and will to deliver on time in the face of constraints or obstacles, resourcefulness and flexibility, trust and loyalty in a team setting, and the ability to relate to others, including the ability to recognize explicit or implicit bias as well as ways to address and overcome these obstacles. Additional engineering education considerations are discussed in more detail in Appendix D to this report.

> Before [professionals] are recognized as fully-fledged practitioners who can work independently, professionals are generally required to undergo extensive education, training, and indenture, and be able to demonstrate that they gained sufficient knowledge and practical experience along the way; and that they received adequate supervision.
>
> – *The Future of the Professions* at 16

LICENSURE MODEL AND MOBILITY

NCEES is a national organization dedicated to advancing professional licensure for engineers and surveyors. NCEES develops, administers, and scores the examinations used for engineering and surveying licensure in the United States. It also facilitates professional mobility and promotes uniformity of the U.S. licensure processes through services for its member licensing boards and licensees. Professional mobility means the movement between the US states/territories and around the world of engineering professionals capable of independent practice having met the requirements for licensing or registration. At this time, each state and territory requires application for licensure in their regulated environments. Wyoming, New Mexico, and a few other states have led the charge in developing and entering into an agreement to set up a mechanism for multi-state application and licensure for Model Law Engineers ("MLEs").[29]

Individuals licensed in one state or U.S. territory are often interested in becoming licensed to practice in additional jurisdictions. However, comity licensure provisions vary significantly from

[29] MLE is an NCEES designation whereby: the MLE has (1) a bachelor's degree in engineering from an EAC/ABET-accredited program, (2) four years of acceptable engineering work experience, (3) passed the NCEES FE and PE exams, (4) no felony convictions, and (5) a clean disciplinary record.

jurisdiction to jurisdiction. For example, some but not all U.S. jurisdictions require that candidates graduate from an accredited program, and some jurisdictions may waive examination requirements if candidates have obtained postgraduate education or have extensive experience. Jurisdictions may also differ in their specific requirements regarding what constitutes acceptable engineering experience. Candidates who received their initial license based on different standards may encounter future difficulty in becoming licensed by comity in other jurisdictions. An important component of the NCEES Records Program is the MLE designation, which NCEES developed to simplify the comity licensure process. Most jurisdictions have adopted all or parts of the NCEES Model Law, and they can expedite the licensure process for engineers who meet all criteria for the MLE designation.

The application of the MLE designation is, however, not consistent across all United States territories and states. This creates mobility challenges, protracted application times, and, at times, an inability of a PE licensed in one jurisdiction to obtain reciprocal licensure in another state without completing a separate education or experience requirement. While not insurmountable, these mobility challenges are frustrating for licensees. Streamlining the mobility process across jurisdictions would not only ease the entrepreneurial opportunities for licensees and expedite the cross-border use of PEs where a temporary shortage may exist but such streamlining would also ensure protection of the public health, safety, and welfare through consistent application processes and also potentially encourage those who may not otherwise need a license in their particular practice or jurisdiction to obtain licensure that can be efficiently transferred between jurisdictions.

NSPE must continue to promote mobility of the professional engineering license to accommodate the needs of a more mobile society. To do so, NSPE should continue to support the NCEES model laws and rules for licensure, which provide for licensure for the practice of engineering by PEs only and by the same method, avoiding the introduction of additional iterations of licensure laws, which just create barriers for the mobility of professional engineering licensure.

PEs must be able to work in other jurisdictions with very little time impact as they move into more national and international markets, including the potential use of temporary licenses. This could be similar to the *pro hac vice* process used by the legal community for situation-specific practice outside an already-licensed jurisdiction. Continuity and process streamlining which eliminate bureaucratic barriers are valued by today's PEs. A unified message to both the private and public sectors is necessary for the survival of the current licensing system.

INTERNATIONAL LICENSURE

The world has been growing toward one world market since the recognition of interconnected dependency through imports and exports to improve individual country's economies and ultimately the quality of life for its citizens. Mobility of professional engineers is a key part of the strategic plan for NCEES both domestically and internationally.

NSPE must continue to promote mobility of a PE license to accommodate the needs of a more mobile society. The efficient mobility of PEs in national and international markets is critical. Continuity and process streamlining which eliminate bureaucratic barriers are valued by today's professional engineers. A unified message to both the private and public sectors is necessary for the survival of the current licensing system.

THE ROLE OF THE CERTIFIED ENGINEERING TECHNICIAN AND CERTIFIED ENGINEERING TECHNOLOGIST

As technology continues to revolutionize the day-to-day tasks of the professional engineer, so does the public demand a competitive business model in order for professional engineering to remain viable. To draw a parallel to describe such a model, we look to the legal and medical profession. Operating similarly to paralegals or physician assistants, Certified Engineering Technicians and Certified Engineering Technologists ("CET" and "CT") may be able to provide competitive value to the engineering

> Many [of the professions] have become increasingly introspective, driven into greater specialization, so that practitioners within a given profession often have a limited view of the work and achievements of their own colleagues, still less of the activities and progress in other disciplines.
>
> *– The Future of the Professions* at 3

profession. From a cost-benefit perspective, the use of a CET/CT can provide an efficient approach to the delivery of professional design services, under the supervision of the professional engineer in responsible charge. Identifying tasks that have traditionally been completed by both PEs and unlicensed engineers that could/should be completed by technicians, under the supervision of the PE in responsible charge, could help the profession be more sustainable and competitive.

Traditionally, the EI fulfilled this area in the business structure, providing for a more competitive professional services pricing model. This recommendation does not change the need or requirement of the PE, but is a more inclusive and flexible, value added tool in the professional engineer's toolbox to provide a broader array of services for the public. In this way, the future of the profession can evolve with the recognition of the need for licensure. In addition, alternate career paths can work together to eliminate further erosion caused by industrial exemptions and other threats.

The professional engineering community should develop a better understanding of the capabilities of CETs/CTs and, more importantly, identify ways in which the technician community could expand their competency base. This could be a first step in the deeper implementation of CET/CTs in the delivery of professional design services through a more blended model.[30]

> Might there be entirely new ways of organizing professional work, ways that are more affordable, more accessible, and perhaps more conducive to an increase in quality than the traditional approach?
>
> – *The Future of the Professions* at 31

To further this blending, the FOPE Task Force recommends that NSPE, with the assistance of its

[30] The National Institute for Certification in Engineering Technologies ("NICET") is a division of NSPE. Since the Institute was founded in 1961, nearly 150,000 engineering technicians and technologists have met NICET's rigorous certification criteria – including a proctored written examination, documented work experience and on-the-job performance. The number of NICET-certified engineering technicians (CET) and certified technologists (CT) continues to grow rapidly as more government agencies and private sector engineering firms, contractors and testing laboratories rely on NICET certification to confirm the qualifications of their engineering technician and technologist workforce. NICET-certified engineering technicians and technologists are required to renew their certification every three years by accumulating 90 Continuing Professional Development credits; and are expected to adhere to a Code of Ethics.

engineering technician and technologist certification body, NICET, and the volunteer technical association, the American Society of Certified Engineering Technicians, seek opportunities to better communicate to its members, the broader professional engineering community, and the public at large, the critical role performed by CETs/CTs. The FOPE Task Force also recommends that NSPE communicate, at all available opportunities, how CETs and CTs can add value to the practice of professional engineering and, in turn, to clients, by allowing PEs to focus on creating solutions in the big-picture sense and allowing CETs and CTs to perform critically important technical work on drawings or calculations that are then reviewed by the PE in responsible charge of that project or that portion of the project. This is similar to the way in which medical doctors highlight the important role performed by physician assistants, nurse practitioners, and nurses in their practice, attorneys emphasize the critical impact paralegals and law clerks have in their practice. Professional engineering has been much slower to adopt this approach than have the medical and legal professions.

ALTERNATIVE DELIVERY METHODS

Alternate Delivery Methods ("ADMs") have gained increasing popularity with government agencies over the previous decade.[31] ADMs can be broadly described as any method by which government or other publicly funded entities procure and contract for the construction of public infrastructure other than traditional Design Bid Build. ADMs include Design Build, Progressive Design Build, Construction Manager at Risk, Integrated Project Delivery, Competitive Sealed Proposal and A+B Bidding. States have varying rules that regulate how ADMs can be used by agencies and political subdivisions within the state.

[31] National Society of Professional Engineers. Project Delivery Methods in the Public Sector – Position Statement 1779. *Available at* https://www.nspe.org/sites/default/files/resources/GR%20downloadables/Project-Delivery-Methods-in-the-Public-Sector.pdf (accessed March 30, 2018).

Each type of ADM provides different benefits and risks to the owner. Factors such as safety, function, time from conception to completion, capital and life-cycle costs, environmental quality, and appearance may each play a role in the owner's decision to utilize a particular ADM. Owners typically use ADMs in an effort to reduce project schedules and increase project quality. As contracts are developed and negotiated for specific projects, the allocation of risk, control and other factors can be further defined and tailored to the needs of the project and desires of the contracting parties. Generally, as the owner's schedule and budget risk decrease, so does the owner's control over material choices and design elements.

> Whether inclined towards imminent revolution or longer-term evolution, there are very few professionals or providers who have thought deeply about the future and concluded that the professions will carry on indefinitely as they have for the past fifty years.
>
> *– The Future of the Professions* at 104

NSPE should consider (1) developing an ad-hoc committee of NSPE members from around the country with diverse experience using ADMs for various project types and owners; (2) producing and actively maintaining an ADM body of knowledge[32] from the PE's perspective; and (3) developing a Guidance Document for public owners regarding the use of ADMs.

PUBLIC SECTOR ENGAGEMENT

As stated by the NSPE Board of Ethical Review:

> *Professional engineers working in the public sector have a unique role in serving as guardians of various health, safety, and welfare issues. In addition to their basic professional role in holding paramount the public health, safety, and welfare, engineers in the public sector are empowered to make recommendations and approve only those drawings, plans, and specifications that are consistent*

[32] As part of this effort, NSPE should revisit its existing professional engineering body of knowledge for updating.

with engineering standards. In many ways, engineers in the public sector are a key line of defense in protecting the public.[33]

To that end, engaging public sector PEs, in general, in support for professional engineering licensure issues and in membership in NSPE is important to build resources and advocates in key decision-making and stakeholder positions to ensure the continued protection of the public health, safety, and welfare in the development of the built environment and the deployment of various engineering technologies. To encourage such engagement, the FOPE Task Force recommends that NSPE develop and implement a rate for public sector PEs and those on the PE track, consistent with the direction of the NSPE House of Delegates in July 2017. Then, following such development, undertake an active public sector PE member marketing campaigns.

> Still others will want to say that a job in the professions should be 'a career of human significance . . . in terms of human welfare and advancement.
>
> – *The Future of the Professions* at 17

The American Bar Association offers membership to government lawyers at an approximately 43 percent discount at its maximum. The American Medical Association offers membership to military physicians at an approximately 33 percent discount. The American Public Works Association offers membership to a public agency (that includes covering dues of rostered members) at a discount of approximately 31 percent (when compared to the same corporate group membership rostered member roster).

Beyond general engagement of public sector PEs, advocacy to ensure that selection committees for federal, state, and municipal infrastructure projects should include a PE or multiple PE's to analyze the technical aspects that are required for firms to meet a qualifications-based selection process. NSPE and its state societies should work with appropriate state or local governments to incorporate qualified PEs in the selection process. Additionally, NSPE should work with federal agencies to ensure that qualified PEs are available and identified for

[33] National Society of Professional Engineers. Board of Ethical Review. *Engineer's Duty to Adhere to Codes, Standards and Guidelines*. *Available at* https://www.nspe.org/resources/ethics/board-ethical-review/public-health-and-safety-engineer-s-duty-adhere-codes (accessed June 1, 2018).

participation in the selection process, perhaps even maintaining an NSPE Community solely dedicated to individuals who would be qualified for these selection committees. In furtherance of these efforts, NSPE should work cooperatively with the American Public Works Association ("APWA"), ASCE, and Society of American Military Engineers ("SAME") (three of the largest public sector membership organizations) on key issues.

COMMUNICATING THE VALUE OF THE PROFESSIONAL ENGINEER

As discussed previously in this report, during its work, the FOPE Task Force identified multiple ways in which PEs communicate what they do in response to the question, "What do you do?" Those responses included the following, among other responses: "I'm an engineer," "I'm a PE," "I'm a licensed engineer," "I'm a registered engineer," "I'm a [discipline or specialty] engineer," "I'm a consultant," and "I'm a project manager," The fact that a PE can communicate what their profession is in so many ways creates additional confusion among the public about who PEs are and why licensure is critical for our profession. PEs can benefit greatly from developing consistency in telling our story to the public.

> Most professionals are comfortable with this broad statement: routine work can be handed over to machines, but human experts will still be needed for the tricky stuff that calls for creativity, innovation, and strategic insight.
>
> *– The Future of the Professions* at 278

NSPE takes ownership of our public identity as PEs and helps define who we are, what we do and what we value. Right now, the public has a generally positive view of "engineers," but a big part of the story is missing. The term "engineer" is broad and all-encompassing. Many surveys of public view of professions do not offer any level of detail as to what kind of engineers they are including in that survey. And general knowledge of "professional engineer" versus "engineer" is limited. Additionally, communication of "professional engineering" versus "the engineering profession" can be challenging, even among PEs and PE regulators.

In general, engineers are seen as intelligent introverts who toil alone on important projects. While this may be true for some in professional engineering, PEs are those pulling together

project teams, heading engineering departments or corporations, developing creative solutions to everyday problems, and providing critical insight and expertise to find ways to improve life in our society. It is imperative that NSPE take the charge in changing the "introverted professional engineer" perspective as we are the ones who can communicate best what it is we do and challenge long-held assumptions about professional engineering.

PEs are collaborative solution creators who are socially engaged, innovative, and community minded. We can also help people understand that all PEs abide by a code of ethics that says we "must be dedicated to the protection of the public health, safety, and welfare." In most states, following language similar to the NSPE Code of Ethics or NCEES Model Rules of Professional Conduct is part of the legislative requirements for licensure. Given that this exists already and is known to the professional engineers, NSPE should continually and exhaustively promote and market this code to the general public so that ethics or good moral character and value are synonymous with professional engineers. Care must be taken to only promote and not compare so as to not degrade unlicensed engineers or technicians.

NSPE is already educating the public about and advocating for the engineering profession. But we can learn new ways of communicating from other professions. For example:

- *American Medical Association* –advocates on behalf of medical professionals and patients, maintains a model code of ethics, takes positions on policy issues, issues press releases, makes recommendations related to public health issues
- *American Bar Association* – advocates on behalf of legal professionals and consumers of legal services, maintains a model code of ethics, takes positions on policy issues, issues press releases, makes recommendations related to legal, governmental, and judicial issues
- *American Institute of Certified Public Accountants* – Administers the C.P.A. certification
- *Certified Financial Planners* – national sustained advertising campaign
- *Society for Human Resource Management* – national sustained advertising campaign

These organizations have made their licenses[34] and certifications part of the vernacular. Everyone knows what profession an M.D., J.D./Esq., and C.P.A. are practicing. Perhaps NSPE can publicize the "P.E." in a way that increases the public's familiarity with it while tying it to the Code of Ethics. This message should be communicated to both the public and within the profession so that the public sees the value in professional engineers, unlicensed engineers see the value of licensure, and PEs feel pride in their profession. PE Day and the new, more consistent and compelling branding is a great start, but can also get quickly diluted in "EWeek," "Engineers' Day," "#ILookLikeAnEngineer," etc. Communicating why we do what we do as PEs, versus communicating only *what* we do can aid in this effort for a great public understanding and appreciation of professional engineering.

Some other ways to increase awareness of professional engineering are:

- Continue and expand the use social media
- Engage with college students to help them understand they are part of a proud and valued profession
- Engage with professors to promote licensure
- Sponsor local events geared toward science and engineering
- Issue press releases
- Publish studies
- Provide opportunities and tools for PEs to share their stories
- Continue to *applaud* those in academia who pursue licensure personally and *actively develop materials for educators, whether or not PEs,* to promote it to their students accordingly

As our profession continues to further define the PE and professional engineering licensure for the public, our society's trust in and respect for engineers will grow. There will be an increased understanding of the value of the engineering perspective and people will expect to see engineers involved in important decisions about public infrastructure. This will lead to better

[34] Although called "Certified Public Accountants" the regulatory construct is really a license to practice accountancy.

and more informed deliberations about public investments in our systems of critical infrastructure.

SUMMARY OF RECOMMENDATIONS

To ensure the continuation of the practice of professional engineering, and thereby the continued protection of the public health, safety, and welfare in engineering endeavors, the Future of Professional Engineering Task Force recommends that NSPE consider the following:

- Emerging Technology
    - Develop or identify continuing education focused on new areas of engineering practice with legislators or other key regulatory stakeholders as the target audience to assist in their understanding of how the public health, safety, and welfare may be impacted by changes.
    - Develop or identify continuing education on new technology tools and applications to aid EIs, PEs, and CET/CTs in the practice of engineering, including the integration of emerging technologies into traditional engineering tools.
    - Develop written materials (tapping into legal and ethical experts who also hold a PE license) to discuss ethical implications, risks, and advantages of a connected society and areas where the public health, safety, and welfare may be at risk in such connectivity.
- Industrial Exemption
    - Positively recognize and encourage particular industries or industry partners promoting professional engineering licensure in states where that industry would otherwise be exempt from licensure requirements.
    - Proactively communicate what is and is not considered the practice of engineering requiring a PE license and not wait for someone to come upon the state-by-state summaries containing this information on the NSPE website.
    - Equip state society partners to articulate what is and is not encompassed by their state's industrial exemption when speaking with local and state regulators, including drawing important parallels to the legal and medical professions and

concerns related to the public health, safety, and welfare in instances of unregulated practice.

- Public Policy and Professional Engineering
  - Legislative Attacks on Occupational Licensing
    - Continue and ramp up communication efforts on the core principles of professional engineering licensure. Provide state society partners materials that are PE licensure-specific that focus on how PE licensure is similar to that of the legal or medical professions (which are often more understood by legislators and regulatory authorities) with a section where each state society partner can highlight several key PE distinctions for the intended audience.
    - Establish a legislative outreach Community within NSPE to communicate to all members (automatically enrolling all members in the Community along with the open forum Community, but allowing a member to opt out) about active occupational licensing legislative efforts and also to provide more awareness of the activities NSPE undertakes in furtherance of the protection of the PE license and the public health, safety, and welfare through various government relations efforts.
  - Licensure Versus Certification
    - Sunset Position Statements 1737 and 1774 and adopt new language related to certifications after obtaining a PE license.
    - Advocate for elimination of private certifications that seek to supplant licensure.
    - Instead, support private certifications, as approved by NCEES or state/territorial licensing boards, that are obtained post-PE license and provide further examination and verification of qualifications for initial certification and continuing education for maintenance of that certification to perform in specific areas of professional engineering (such as “Professional Engineer, Certified Structural Engineer” or “PE, CSE”).

- Fragmentation of Licensure
  - Cease using the terminology of "registered PE" or "registered engineer" as "registration" solely requires payment of a fee and identification of an individual on a roster. Use of this term further confuses and fragments the profession. PEs are "licensed" as recognized by NCEES having completed an education, examination, and experience evaluation by a state or territorial regulatory authority.
  - Advocate against restrictive discipline-specific Title and Practice Acts (maintaining support for and advocating for state licensure laws that license engineers and "professional engineers") and equip state society partners with materials that are state-specific to advocate against the adoption of, and advocate for the elimination of, where applicable, such restrictive discipline-specific Title and Practice Acts.
  - Communicate parallels with the legal and medical professions where all licensed practitioners are "lawyer/attorney" or "doctor," respectively, with other credentialing around that core and protected title approved for use by state boards of licensure.
  - Adopt throughout NSPE communications the encompassing use of "professional engineer" and not various iterations thereof like "licensed engineer."
  - Adopt a position supporting post-PE certifications that continue to require PE licensure as an initial requirement for that certification (along with the advocacy against restrictive discipline-specific Title and Practice Acts).
- Procurement of Professional Engineering Services
  - Continue to advocate on behalf of QBS and its important role in protecting the public health, safety, and welfare.

- Role of the PE in Shaping Public Policy
  - Look for opportunities to form alliances and/or otherwise cooperate with other engineering organizations to increase the engagement and active participation of PEs in the shaping of public policy.
  - Seek out and support engineering programs that currently offer curricula and/or degrees in Engineering and Public Policy, while encouraging wider adoption of similar programs at other engineering institutions.
  - Identify and prepare qualified Professional Engineers for public service and ultimately work to secure their appointment or election.

- Engineering Education
  - Advocate for the adoption of alternative pathways other than formal academic education which could be developed to fulfill additional education requirements beyond a baccalaureate degree prior to professional engineering licensure. One such alternative could consist of coursework and/or workshops that have sufficient content rigor and outcomes assessment that is more robust than traditional continuing education. This would be consistent with the recommendations in current NSPE Policy 168 and NCEES Position Statement 35.
  - Cease efforts to "get all engineering faculty licensed" and instead shift efforts to getting materials into the hands of educators that they may then use ton inform undergraduate engineering students to enforce that engineering licensure may be required for them to practice depending on their area of practice, their employer, and their jurisdiction. Further, that education should include informing students that while one jurisdiction may not require PE licensure to practice a certain engineering-related activity, another may. Therefore, it is of the greatest importance for an engineering student to pass the FE exam and sit for the Principles and Practice of Engineering exam as soon as such examination is allowed. Also share this information with undergraduate engineering verification groups within each of the discipline-specific engineering societies as

they have the direct lines of communication with the engineering education programs around the country, outside of a formal ABET process.

- Licensure Model and Mobility
    - Continue to support the education, examination, and experience requirements for professional engineering licensure across all states and territories of the United States.
    - Support multi-state compacts that provide broad reciprocity between states if an individual is determined eligible for licensure in one of the signatory states (i.e. licensure in one provides for licensure in all without separate verifications for each application for professional engineering licensure).
    - Explore support of temporary professional engineering licensure upon moving to a new state or territory so as to not infringe upon one's ability to obtain employment.
    - Explore support of project-specific professional engineering licensure in a state in which an individual is not licensed provided, however, they have a local PE support the project-specific licensure, similar to the *pro hac vice* system employed in the legal profession.
    - Actively advocate with state society partners and partners in other technical and professional engineering associations for states to comport their professional engineering licensure laws to the NCEES model laws and model rules, including those of continuing education, to ensure mobility and also the individual competency of PEs.
- International Licensure
    - Continue to promote the standard supported and regulated by NCEES.
    - Provide an international pathway to membership in NSPE.
- The Role of the CET/CT and the PE
    - Communicate to NSPE members, and in communications to the professional engineering community, and the public at large, the CET and CT fields.

- Communicate, at all available opportunities, how CETs and CTs can add value to the practice of professional engineering and, in turn, to clients, by allowing PEs to focus on creating solutions in the big-picture sense and allowing CETs and CTs to perform technical work on drawings or calculations that are then reviewed by the PE in responsible charge of that project or that portion of the project.
- Communicate parallels between PEs, CETs, and CTs to the way in which medical doctors make use of physician assistants, nurse practitioners, and nurses in their practice or attorneys make use of paralegals and law clerks in their practice.

- Alternative Delivery Methods
  - Develop an NSPE Task Force with diverse experience using alternative delivery methods (project owners, sponsoring governmental entities, engineering services (PEs and CETs/CTs), and financing) to produce and maintain (at regular intervals) a best management practices and lessons learned document that could be presented annually at PECON with updates in experience or example projects.
  - Develop and maintain an ADM body of knowledge from the PE's perspective
  - Develop a guidance document for public owners regarding the use of alternative delivery methods and the importance of inclusion of PEs in the process.
- Public Sector Engagement
  - Develop focused partnerships (formally or informally) with the APWA, ASCE, and SAME – three of the largest organizations with public sector membership – with the specific goal of increasing, and maintaining, public sector engagement in the (1) long-term sustainability of professional engineering, including through membership in NSPE; (2) support of NSPE advocacy efforts on behalf of the PE license and continued protection of the public health, safety, and welfare in projects funded by public tax dollars or constructed for the benefit of the public; or (3) education sponsored by NSPE of key issued facing public sector engineers (licensed and non-licensed) that are of importance to the continued protection of the public health, safety, and welfare.

- Develop and offer a government PE rate for membership in NSPE and provide various platforms for government PEs to collaborate either amongst themselves regarding best practices or amongst private practice and industry PEs.
- Actively work to increase the number of public sector members in NSPE so as to provide additional perspectives to the work of NSPE in support of the PE license and the protection of the public health, safety, and welfare.
- Advocate that all federal, state, and municipal infrastructure project selection committees include a PE or multiple PEs to analyze the technical aspects that are required for firms to meet a qualification based selection process. Increasing membership in NSPE of employees of these key employers will also provide opportunities to extol the value of PEs for potential resources as needed by these key employers for project development.

- Value of the PE
  - Develop an NSPE Task Force whose sole charge is to define and communicate the value of PEs. This Task Force would engage NSPE Membership, Leadership, and Staff to collectively define the value of professional engineering and, more importantly, effectively communicate the value of PEs to those already in the profession, those in public office, and the general public.
- Broad Area Recommendations
  - Communicate the importance of PEs moving from a position of technical resource to trusted advisor and counselor in the overall development of a project.
  - Reevaluate the ways in which members self-select “Interest Groups” and, instead, consider moving to “Practice Areas” to better collaborate among colleagues as, for example, someone may move from industry, to private practice, to government, but in that career progression, may work in the area of wastewater treatment, controls, and compliance.

CONCLUSION

The preamble to the NSPE Code of Ethics states:

> *Engineering is an important and learned profession. As members of this profession, engineers are expected to exhibit the highest standards of honesty and integrity. Engineering has a direct and vital impact on the quality of life for all people. Accordingly, the services provided by engineers require honesty, impartiality, fairness, and equity, and must be dedicated to the protection of the public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct."*

As long as there is a group of people willing to "place service before profit . . . and the public welfare above all other considerations . . . ." the PE will be of value. However, for that value to be realized there must be an understanding of what PEs do and why they are critical to the continued health, safety, and welfare of the public and the built environment. Communicating that value to the public at large to ensure they not only understand who a PE is but also why the PE is important to their daily lives remains a challenge. Absent this, the grand bargain on which professional engineering has provided great advancements in protecting the public health, safety, and welfare will wither.

> [Various defects in the current structure of the professions] will and should lead to a renegotiation of the grand bargain; a rebalancing of the relationship between the professions, the state, and society.
>
> – *The Future of the Professions* at 32

The FOPE Task Force has attempted to identify ways in which NSPE can mobilize its members as well as non-member PEs in this effort, as we must depend on ourselves to communicate our value. To do this, emphasis must shift from "what" we do to "why" we do it. The message must be that we protect the safety, health, and welfare of the public through our technical expertise and unwavering code of ethics.

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APPENDICES

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APPENDIX A: EMERGING TECHNOLOGY

Background

The expanding use of technology in the design and construction of engineered products, processes, and systems has the potential to put pressure on the need for engineers to be licensed as well as how engineers fulfill their roles. As to the latter, the use of increasingly more complex software can shift routine engineering tasks from the realm of the engineer to that of the technician or even to the end user. Sophisticated software and modeling, when tied to appropriate codes and standards, can create a scenario in which the design and construction of a product can be accomplished with minimal human involvement and with, perhaps, no need for the involvement of a PE. If the professional engineering community continues with the mantra "it won't happen to us" or "I will always be needed," it risks being marginalized, or worse, in the technology tidal wave.

In such a future world (aspects of which we are already witnessing), outside forces will challenge the need for licensure. After all, the computer (or a successor technology) could be seen as the productive and reliable tool that has no internal biases or no "bad days in the office." While we all know that human intelligence is required to design and build the technology, there could be a temptation to discount the role of human beings as technology does more and more of the "thinking and creating." In such cases, one may see the expanding use and complexity of technology as a threat to licensure. While acknowledging these very real scenarios, professional engineers ("PEs") must resist the urge to fear change. Technology will always be with PEs and professional engineering. PEs must, instead, have the desire and the ability to embrace the inherent change.

For PEs to gain credibility in a public forum on emerging technology, we have to improve the level of technical fluency in these subjects beginning with middle school through college, and eventually the engineer intern ("EI") talent pipeline. We must promote and develop technological expertise in these new areas while still fostering a strong, consistent advocacy for engineering ethics.

The role of licensure in the future is expected be as important and necessary as it is today. There is one component of licensure that is unique from technology: the "conscience" of human beings that no machine can possess. It is the reality that the PE must hold paramount the health, safety, and welfare of the public. It is the ethical chip of the engineer that no computer has. Licensure should constantly remind PEs that their duty is to place the interests of the public over and above all other considerations.

The public deserves and demands that a license should exist to protect them. A computer will not be held accountable by the public. If we fail to respond to our changing world, then we will fail in our responsibility to the public we serve.

NSPE must acknowledge and accept the evolution of technology into the engineering profession and use it and control it, accordingly. This begins with separately identifying the specific engineering tasks that can and cannot be computerized (or automated). We need to ensure that the public is protected by having PEs hold responsibility for the software and computer engineering required for automated processes and implementation of limited artificial intelligence as its value is studied, analyzed and proven in the profession. Traditional methodologies are giving way to more efficient, technologically strong, and automated processes.

Further, professional engineering must be on the forefront when it comes to the delivery of its services. There are many options for delivery of sealed professional documents. They include paperless documents and interactive data/models. Sensitivity to the end users must also be included for mobile-device viewing. The evolution of CAD drawings to Revit Models has made freely transferring work more of a reality. PEs must lead the change to address how, for example, Revit Models and 3D models of infrastructure have changed project delivery for the consulting professional engineers and what the ramifications are. Global standardization of engineering practices will impact the development of projects, and it is important for these standards to be developed by the professional engineering community.

The fields of present and future engineering technologies impacting society are growing along

an exponential rate, not a linear one. These fields will be led by experts in these new technologies. PEs have an opportunity to be a part of this leading field as connectors of the technology to the societal implications of such technologies, linking engineering and engineering ethics.

- **Continue Promoting the Brand of the EI/PE** - For PE voices to be heard, the general public must be aware of professional engineering licensure overall. The public will not turn to PEs if they are unaware of what a PE does.
- **Make Technological Impact to have an Ethical Impact** - PEs must go beyond being informed on the sidelines. Taking leadership roles in the specific details behind emerging technologies is the primary way of building credibility in advising on those technologies.
- **Start with the End User and End with the Technology: "Design Ethics In"** - PEs must understand the end "users" or beneficiaries of emerging technologies. We must first understand user needs and the key ethical issues to be considered before designing the end product or process, across multiple ethical "layers."

Ethical Considerations

To understand engineering ethics in emerging technologies, we must first understand that it is not technology itself that impacts an end user, but what that technology enables an end user to do.

Ethics in emerging technologies can be thought of in three layers:

1. **Ethics of the End User** - Why does a user wish to engage in a particular technology to begin with? What are the motivations behind what a technology enables a user to do vs. a user investing time and effort to actually do it? Are technologies inadvertently designed to be biased for/against users? Are some user populations excluded as a byproduct of technological availability and access?
2. **Ethics of the Ecosystem** - Technology is an increasingly connected ecosystem. Where the public adoption of the internet connected computer terminals to one another, new

technologies are creating increasingly dependent ecosystems:

- Autonomous vehicles are a connected network of cars, passengers, and destinations.
- The Internet of Things ("IoT") are a connected network of software-driven hardware connecting users' homes.
- Artificial Intelligence is a connected network of knowledge, information, tasks and decision making.
- What are the ethical implications, risks, and advantages of these ecosystems and their impact to societal good?

3. **Ethics of Connected Societies** - Technology connecting users to products and other users accelerates the pace at which data and information are transferred as well as the speed of decisions being made which impact each stakeholder. Are there collective societal impacts to what technology does and does not allow?

Engineering ethics that connect each layer to the other evolve in parallel.

Educate Early and Often

PEs should continue promoting the integration of emerging technologies into traditional engineering tools. Traditional foundations of engineering — engineering sciences, physics, mathematics, analytical thinking, are all here to stay. However, the way in which they are applied and the speed at which they can impact society is rapidly accelerating.

Fluency – Present PEs must become comfortable at speaking the language of new and emerging technologies. The education of future engineers in the engineering pipeline must also include this fluency in order to have meaningful impact to society when they enter the engineering profession.

Early Career Integration of Ideas Important to Engineering Ethics — encourage technological awareness on the path to obtaining EI classification. Many next generation engineers will be familiar with usage and fluency in tech use, but the nuances of ethical usage of a technology need to be part of this education.

Public Perception of PEs, Engineering Ethics, and Technology

Technological experts are plentiful and growing, but PEs have a unique opportunity to lead these discussions from the perspective of engineering ethics. For PE expertise to be relevant in emerging technologies, we must holistically continue to promote the purpose of PEs to the general public.

If the general public is not aware of the "brand" of EIs and PEs, then PE advocacy for public well-being in emerging technologies will be limited in its efficacy. While the National Society of Professional Engineers ("NSPE") and state societies are working to foster awareness of PEs, there are three defining criteria that PEs can highlight to help elevate the public image of PEs.

First, PEs should emphasize that not having a license does not imply not having ethics. One who is licensed as a PE has undergone state-level evaluation through testing and an examination of their professional record, verifying that an individual with a PE license is recognized as a professional by the state and is bound by law to protect public well-being.

Second, many emerging technologies have accompanying certifications or educational certificates of completion that recognize expertise in a given topic. As such, certification and licensure differences are not semantic ones. Certification indicates that one has obtained a skill in a technology. Professional licensure is demonstration that, regardless of specific skill, that engineers have demonstrated dedication and support for public safety over time in a method that is recognized by the state in which the engineer has been licensed to practice.

Third, engineering is technology. "I'm not good with computers," is not a badge of honor. While it is often mentioned in jest, it is damaging to the public perception of how engineers and non-engineers perceive PEs. To be advocates of public well-being in emerging technologies, PEs must be "good at technology." As part of our duties to stay informed in our respective engineering fields, investing the time to become conversant in new technologies is how PEs must approach our work.

Learn then Promote

For PEs to become effective advocates of engineering ethics in emerging technologies, PEs must possess a basic fluency of the new technologies being discussed. For example, it is alone insufficient to advocate that "machine learning must be designed with public safety in mind." Instead PEs must understand what aspects of machine learning design can have the most impact to public well-being and speak technically and collaboratively on paths forward.

Lacking that understanding would be the equivalent of advocating, for example, that "we must build chemical plants safely" without first possessing an engineering understanding of chemical reactions, reactor design, and the technical variables that make a particular chemical plant design more or less safe than another.

For example, NSPE Position Statement 1772 on Autonomous Vehicles states that "Licensed Professional Engineers should be employed by autonomous vehicle and autonomous technology developers." As a profession of PEs, what can we do to help prepare a talent pipeline of EIs/PEs into the autonomous vehicle industry that can speak to the ethical implications of having/not having particular capabilities in this technology?

Anyone can advocate for public safety, but we must raise awareness of the roles of PEs that actually assist in making such technologies safe.

As a profession of PEs, what can we do to help prepare a talent pipeline of EIs/PEs into the autonomous vehicle industry that can speak to the ethical implications of having / not having particular capabilities in this technology?

Conclusion

One of the most direct ways of PE involvement in emerging technologies is to have expert fluency in a given technology and, with an understanding of public safety and well-being as demonstrated by being licensed, design in those ethical considerations while emerging technologies are in early stage development. Engineering ethics are not "bolted on" after the fact.

By raising the public awareness of PEs in society, PEs can move from advocacy to active, hands-

on participation in these emerging fields. Given the rate at which societies are becoming increasingly connected by new technologies, engineering ethics is now more scalable than ever before and the reach of public well-being more vast. If we continue to understand that the power of any technology is not the technology itself but that which it enables the end user to do, understanding both the positive and negative risks, PEs can make a significant impact in how new technologies reach and ultimately, benefit, society.

Current NSPE Professional Policies and Position Statements

- NSPE Professional Policies: PP-122 and PP-168
- NSPE Position Statements: PS-1737, PS-1772, and PS-1778

Recommendations

To ensure the continuation of the practice of professional engineering, and thereby the continued protection of the public health, safety, and welfare in engineering endeavors, the Future of Professional Engineering Task Force recommends that NSPE:

- Develop or identify continuing education focused on new areas of engineering practice with legislators or other key regulatory stakeholders as the target audience to assist in their understanding of how the public health, safety, and welfare may be impacted by changes.
- Develop or identify continuing education on new technology tools and applications to aid EIs, PEs, and CET/CTs in the practice of engineering, including the integration of emerging technologies into traditional engineering tools.
- Develop written materials (tapping into legal and ethical experts who also hold a PE license) to discuss ethical implications, risks, and advantages of a connected society and areas where the public health, safety, and welfare may be at risk in such connectivity.

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APPENDIX B: INDUSTRIAL EXEMPTION

Background

Nearly a third of America's workers must have some form of government-issued license to do their jobs.[35] This number is almost seven times higher than it was just fifty years ago[36] and is a striking shift from a time before the Civil War, when anyone could engage in virtually any occupation or profession without a license.[37] Today, every state requires some form of licensing for an average of ninety-two occupations.[38] One of the first such groups to act with respect to engineering was a small group of civil engineers in Louisiana, which began lobbying in about 1898 for laws to restrict the practice of civil engineering to engineering license holders.[39] Initially, the legislature rebuffed their proposals when other civil engineers opposed them.[40] The proponents of licensing eventually succeeded in 1908,[41] but, before they did, a notable civil engineer and Wyoming's state engineer, Clarence Johnston, lobbied for[42] and obtained in Wyoming in 1907 what has come to be recognized as the first engineering licensing law in the United States, although the law was very limited in its scope.[43]

The "industrial exemption" is a provision under most state licensing laws that exempts companies that manufacture products or perform engineering services from the requirements

[35] Morris M. Kleiner. N.Y. Times, *Why License a Florist?* at A35 (May 28, 2014). Focus of this article is on the most demanding form of licensing, referred to as "license," "licensure," or "licensing." Government typically uses it to license persons who pass an examination and satisfy education, experience, and character requirements. Less demanding forms of licensing include certification, in which authorization is granted after verification of persons' education or expertise in that field and does not preclude others from practicing the occupation, and registration, in which a person merely declares that he or she is practicing, provides contact information and pays a fee.
[36] During the 1950s, about 4.5% of the American workfoce worked on jobs requiring a license. Morris M. Kleiner. *A License for Protection: Why are States Regulating More and More Occupations?*, 29 REG. 17 (2006).
[37] Council of State Governments. *Occupational Licensing Legislation in the States* at 19 (1952).
[38] Adam B. Summers. Reason Found, *Occupational Licensing: Ranking the States and Exploring Alternatives* at 5 (2007). *Available at* http://reason.org/files/762c8fe96431b6fa5e27ca64eaa1818b.pdf (accessed December 7, 2014). "The most regulated state in the nation is California, which requires licenses for 177 job categories . . . ." *Id.*
[39] Louisiana Professional Engineering and Land Surveying Board. *History of the Board 1908-1950* at 2. *Available at* http://www.lapels.com/History_of_the_Board_1908-1950.pdf (accessed December 27, 2017).
[40] *Id.*
[41] *Id.*
[42] Wyoming State Engineers Office. S*eventh Biennial Report of the State of the Engineering to the Governor of Wyoming* (1905).
[43] National Society of Professional Engineers. 100 Years of Engineering Licensure. *Available at* https://www.nspe.org/resources/press-room/resources/100-years-engineering-licensure (accessed February 5, 2018).

that a professional engineer ("PE") oversee the product's design of the company's services. In the 1940's, to make certain that the engineering being done within the confines of industry did not implicate licensing laws, industry mounted a campaign to gain legislation exempting from licensure engineering, as defined by the state, done by an employee of a manufacturer or industrial firm. Industry asserted that, so long as it (industry) was willing to take responsibility for its engineers' work and was liable for their negligence, licensing of engineers employed by company was unnecessary for protection of the public's interests.

Currently there are states that do not have an industrial exemption, and a number of others that have exemptions so broad that they allow the unlicensed practice of any kind of engineering—whether it is ancillary or primary—so long as it is done within their defined industry context.

Engineering services that are exempt from PE licensure differs by state,[44] although the engineering community often refers to the "industrial exemption" as a single piece of legislation. Each state independently formulates its engineering licensing laws; thus, the laws vary significantly from state to state as each takes its own nuanced approach. Every state exempts from licensure engineers whose practices fit within one or more of five categories: (1) engineers working under the supervision of a PE who takes responsibility for the unlicensed engineer's work; (2) engineers employed by public utilities; (3) engineers employed by the federal government; (4) engineers employed by a state government; and (5) "in-house" engineers employed by a manufacturing or other business firm (known as the "industrial exemption").[45]

The result is a hodgepodge of inconsistent laws. Currently there are states that do not have an industrial exemption, and a number of others that have exemptions so broad that they allow the unlicensed practice of any kind of engineering—whether it is ancillary or primary—so long as it is done within their defined industry context. Depending on the state, the exemptions to the requirement of a license to practice engineering extends to those in government, railroads, utilities, industry/ manufacturing, and research & development. The industrial exemption has

[44] National Society of Professional Engineers. Exemptions to Engineering Licensure Laws (2016). *Available at* https://www,nspe.org/resources/exemptions-engineering-licensure-laws (accessed March 6, 2017).
[45] Louisiana Professional Engineering and Land Surveying Board. *History of the Board 1908-1950* at 2. *Available at* http://www.lapels.com/History_of_the_Board_1908-1950.pdf (accessed December 27, 2017).

contributed to the reality that only about 15-20 percent of graduate engineers ever become licensed. Further, this can also lead to engineers practicing in multiple jurisdictions and unintentionally violating state and territorial laws as they may assume their practice does not require a license in State B if their practice fell under the industrial exemption of State A.

In part because of the industrial exemptions, essential attributes of a PE, such as exercise of independent judgment and exertion of responsible charge or control over subject matter within his/her expertise may be too often inhibited, at best, or silenced, at worst. This can cause a lack of professional discretion that could ultimately lead to disastrous consequences for the health, safety and welfare of the public.

Industry was able to kill an effort in 1993 to pare back the exemption in Louisiana, even after much effort was made to accommodate industrial interests.

To help ensure that professional engineering maintains the recognized and generally-understood status as a profession, the industrial exemption must be seriously curtailed. This will require engineers to advocate for the elimination of each state's industrial exemption regulation, including the tailoring of expansive state-level exemptions to the professional engineering licensure laws of that state. A different engineering culture – requiring a paradigm shift – will be required which the Future of Professional Engineering ("FOPE") Task Force acknowledges is not easily accomplished. To achieve this goal, the National Society of Professional Engineers ("NSPE"), its state societies, other engineering societies, legislators, and public safety advocates must come together to collaboratively and proactively engage in this issue.

Eliminating the exemption will not be easy. Industrial management has good reason to want to retain the status quo; it is in control. For example, when attempts were made in Texas during 2003 to eliminate the exemption, industry was effective in blocking the efforts. According to a National Counsel of Examiners of Engineering and Surveying ("NCEES") task force, "The industry lobbies, arguing economic development via contracted cheaper foreign engineering services,

were able to stop any action . . . ."[46] Industry was able to kill an effort in 1993 to pare back the exemption in Louisiana, even after much effort was made to accommodate industrial interests. Engineers working in industry have little personal incentive for change. They avoid the hassles of difficult examinations and times of apprenticeship typically associated with licensing, and they enjoy the "safe harbor" of engaging in an interesting job within an organization that assumes responsibility for their work.

Understanding that eliminating the exemption will require a revolution of sorts, opponents of the exemption have called for a multi-faceted campaign. An NCEES task force has recommended beginning the campaign in the nation's engineering classrooms. The group calls for convincing engineering faculty to place more emphasis on licensure, especially in engineering ethics courses, in hope of making licensure seem like the natural next step for graduates of engineering school. Given the existence of varying definitions of what is subsumed in a specific state's "industrial exemption," it is critical that engineering graduates understand this variability in practice. Therefore, and as discussed in more detail in the Engineering Education section of this report, NSPE must become a resource of materials for engineering educators to inform classroom lectures or discussions on the variability of practice and licensure requirements. There is no greater disservice to an engineering graduate than allowing them to graduate from an undergraduate or graduate engineering program with the belief that their degree is the only credential they will need to practice engineering, only to find they immediately or in the future want a career in a state or area of practice where professional engineering licensure has been deemed necessary to ensure protection of the public health,

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[46] National Society of Professional Engineers. Demonstrating Qualifying Engineering Experience for Licensure (July 28, 2007). *Available at* http://www.nspe.org/resources/licensure/resources/demonstratingqualifying-engineering-experience-licensure (accessed February 6, 2018).

safety, and welfare.

The FOPE Task Force also recommends working for modifications of reciprocity laws to facilitate interstate practices. The FOPE Task Force understands, too, that it must find a way to "grandfather" the hundreds of thousands of unlicensed engineers currently working in industry.[47] Finally, the FOPE Task Force recommends an all-out public relations campaign. The public will need to understand why the elimination should be undertaken, industry will need to understand why this change would to its long-term benefit, the profession will have to agree to some form of initial compromise on some of the legs of licensure, and the licensing boards will have to address comity. To assist in this effort, the FOPE Task Force recommends that NSPE form a new task force charged with this effort, as discussed further in Appendix J of this report.

So long as the public fails to perceive the danger posed by the industrial exemption — its facilitation of badly engineered industrial and manufactured products — legislative complacency will surely continue. The public must be made aware that engineering licensing laws rarely apply to the engineering work being done in their states and that the overwhelming majority of engineering is being done by unlicensed engineers. Legislators will be far more responsive to the outcries of a public demanding explanation for why, if the legislatures deemed licensing laws to be necessary for the public's protection, they have seen fit to excuse all but a few engineers from licensure.

The argument in favor of the industrial exemption centers on professional liability and the assignment of risk, specifically whether the liability burdens of large markets should be borne by corporations or government agencies instead of falling on the shoulders of one person or design team. While elimination of the industrial exemption would require that all activities defined by a state as the "practice of engineering" be performed only by or under the responsible charge of a PE, the same is true of other professions. If one goes to an expert for

[47] Paul M. Spinden The Enigma of Engineering 's Industrial Exemption to Licensure: The Exception that Swallowed A Profession. *Available at* http://digitalcommons.liberty.edu/cgi/viewcontent.cgi?article=1071&context=lusol_fac_pubs (accessed November 1, 2017).

legal advice, that expert is a lawyer, or to an expert for medical advice, that expert is a physician, physician's assistant, nurse practitioner, or other licensed medical professional.

NSPE should utilize its legal expertise, relationship with state societies, and the NSPE member base to guide legislatures to protect professionals engaged in industries where these exemptions exist to limit the personal financial liability of the individual PE employees. This would allow society to gain the benefit of the expertise of PEs who have been vetted by accepted state standards, with their employers – industrial corporations – remaining legally and financially responsible for their management directives. Under this model, any design modifications or changes to industrial products, processes, or other devices or to engineering services would be required to be performed under the supervision of the PE in responsible charge, ensuring the engineering design/service was evaluated with the protection of public health, safety, and welfare as a paramount consideration. To ensure this fuller understanding of the important role PEs currently play, and could play, in protecting the public health, safety, and welfare, PEs have the opportunity to promote licensure every time they present to a regulatory or deciding board. They are active with planning commissions, city councils, county commissioners, utility regulatory boards and commissions, legislators, school boards, board of directors – private and public, etc. NSPE should provide resources to its members to assist them in providing this important information beyond the professional engineering community.

Professional engineering licensure is an effective means of protecting the public's health, safety, and welfare. It sets the legally-recognized standard of practice under state law and regulation that is based on an engineer's education, experience, examination and other relevant qualifications. It also establishes the local standard of care of all PEs when practicing engineering under the laws of that state.

Given the existence of varying definitions of what is included in a specific state's industrial exemption, it is critical that engineering graduates understand this variability in practice. Therefore, and as discussed in more detail in the Engineering Education section of this report, NSPE must become a resource for engineering educators to inform and advise engineering

students on the variability of practice and engineering licensure requirements. There is no greater disservice to an engineering graduate than to allow students to graduate from an engineering program - with the belief that their degree is the ***only*** credential they will need to practice engineering, only to find immediately after graduation or in the future that they will require an engineering license to perform an engineering job or to start an engineering business that impacts the public health, safety, and welfare.

Current NSPE Professional Policies and Position Statements

- NSPE Position Statements: 1737, 1747, 1748, 1766, 1764, 1767 and 1778

Recommendations

To ensure the continuation of the practice of professional engineering, and thereby the continued protection of the public health, safety, and welfare in engineering endeavors, the FOPE Task Force recommends that NSPE:

- Positively recognize and encourage particular industries or industry partners promoting professional engineering licensure in states where that industry would otherwise be exempt from licensure requirements.
- Proactively communicate what is and is not considered the practice of engineering requiring a PE license and not wait for someone to come upon the state-by-state summaries containing this information on the NSPE website.
- Equip state society partners to articulate what is and is not encompassed by their state's industrial exemption when speaking with local and state regulators, including drawing important parallels to the legal and medical professions and concerns related to the public health, safety, and welfare in instances of unregulated practice.

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APPENDIX C: PUBLIC POLICY AND PROFESSIONAL ENGINEERING

Public policy spans a broad array of topics with respect to professional engineering. The Future of Professional Engineering ("FOPE") Task Force has organized this appendix to cover the following topics as related to public policy and professional engineering:

- Legislative Attacks on Occupational Licensure
- Licensure Versus Certification
- Fragmentation of Licensure
- Procurement of Professional Engineering Services
- The Role of the Professional Engineer ("PE") in Shaping Public Policy

These subjects and key concerns are first discussed, with all the recommendations related to public policy and professional engineering included at the end of this appendix.

Legislative Attacks on Occupational Licensing

Nearly a third of America's workers must have some form of government-issued license to do their jobs.[48] This number is almost seven times higher than it was just fifty years ago[49] and is a striking shift from a time before the Civil War, when anyone could engage in virtually any occupation or profession without a license.[50] Today, every state requires some form of licensing for an average of ninety-two occupations.[51]

> Most of the legislation arises out of a belief that "less government and less regulation" is better.

Across the United States, there are a growing number of bills being introduced in state legislatures that could

[48] Morris M. Kleiner. N.Y. Times, *Why License a Florist?* at A35 (May 28, 2014). Focus of this article is on the most demanding form of licensing, referred to as "license," "licensure," or "licensing." Government typically uses it to license persons who pass an examination and satisfy education, experience, and character requirements. Less demanding forms of licensing include certification, in which authorization is granted after verification of persons' education or expertise in that field and does not preclude others from practicing the occupation, and registration, in which a person merely declares that he or she is practicing, provides contact information and pays a fee.
[49] During the 1950s, about 4.5% of the American workfoce worked on jobs requiring a license. Morris M. Kleiner. *A License for Protection: Why are States Regulating More and More Occupations?*, 29 REG. 17 (2006).
[50] Council of State Governments. *Occupational Licensing Legislation in the States* at 19 (1952).
[51] Adam B. Summers. Reason Found, *Occupational Licensing: Ranking the States and Exploring Alternatives* at 5 (2007). *Available at* http://reason.org/files/762c8fe96431b6fa5e27ca64eaa1818b.pdf (accessed December 7, 2014).

weaken or eliminate professional engineering licensure.[52] Most of the legislation arises out of a belief that "less government and less regulation" is better. This legislation has been primarily supported by groups such as the American Legislative Exchange Council.[53] It may be a reality that there is a proliferation of occupations that require a license for someone to work in that occupation, such as florists[54] or other activities. However, each occupation and profession should be considered independently on its own and not automatically included in broad legislative mandates to eliminate occupational licensing merely because a license is required for practice in a certain profession or occupation.

The larger challenge for professional engineering licensure is that many members of the public do not understand the licensure model (education, examination, and experience requirements) associated with the practice of professional engineering and the work required to be performed by PEs.

Professional engineering licensure is different from many other occupations or professions. Professional engineering licensure is a fundamental means of protecting the public in a broad range of areas involving health, safety and welfare. Professional engineering licensure sets the legally-recognized standard of practice under state law and regulation is based on an engineer's education, experience, examination, continuing professional development and other relevant qualifications. It also establishes the local professional standard of care of all PEs when practicing engineering under the laws of that state. The larger challenge for professional engineering licensure is that many members of the public do not understand the licensure model (education, examination, and experience requirements) associated with the practice of professional engineering and the work required to be performed by PEs. This issue is rooted in two common challenges: 1) the public generally does not understand the differentiation between a degreed engineer and a PE and 2) broadly speaking and with some exceptions, historically professional engineers have not

[52] National Society of Professional Engineers. Threats to Professional Licensure. *Available at* https://www.nspe.org/resources/issues-and-advocacy/action-issues/threats-professional-licensure (accessed June 23, 2018).

[53] *See* American Legislative Exchange Council. The Occupational Licensing and Job Creation Act. *Available at* www.alec.org/model-policy/the-occupational-licensing-relief-and-job-creation-act/ (accessed March 6, 2017). Other groups supporting similar legislation are Americans for Prosperity, the Institute for Justice, and the Goldwater Institute, among others.

[54] This is only provided as an example licensed occupation and the FOPE Task Force offers no opinion on whether a license should be required for such activities.

been politically active and there are very few PEs in legislative roles across the United States. These themes are discussed in detail in the sections on Communicating the Value of the PE and the Role of the PE in Public Policy, respectively, of this report.

One argument in favor of the elimination of occupational licensing is that health and safety concerns can often be addressed through less restrictive alternatives to licensing laws such as registration or certification. Professional engineering licensure is clearly different. PE licensure is an effective means of protecting the public's health, safety, and welfare. It sets a legally-recognized standard of practice under state law and regulation that is based on an engineer's education, experience, examination, and other relevant qualifications. It also establishes the local standard of care of all PEs when practicing engineering under the laws of that state.

Occupational regulation has many forms. The occupational regulation of engineers in the United States generally takes three forms. The least restrictive form is registration, in which individuals file their names, addresses, and qualifications with a government agency before practicing their occupation. The registration process may include posting a bond or filing a fee.

In contrast, certification permits any person to perform the relevant tasks, but the government — or sometimes a private, nonprofit agency — administers an examination or other method to determine qualifications and certifies those who have achieved the level of skill and knowledge for certification. For example, travel agents and car mechanics are generally certified but not licensed. The toughest form of regulation is licensure; this form of regulation is often referred to as "the right to practice." Under licensure laws, working in an occupation for compensation without first meeting government standards is illegal. Engineers must be licensed to practice professional engineering as described in each individual state's statutes.

To address these and related challenges, the National Society of Professional Engineers ("NSPE") and all other engineering technical societies must be able to articulate the clear difference between professional engineering licensure and other occupational licenses. In addition, there should be a concerted public relations effort to raise the public's awareness regarding the health, safety, and welfare benefits resulting from professional engineering licensure. The FOPE

Task Force has determined that the threat to professional engineering licensure (and, in turn, to the continued protection of the public health, safety, and welfare) at the state level is a clear and present danger and is growing. As part of this effort, in addition to actively initiating, organizing, and participating in federal and state legislative coalitions and other likeminded professional groups opposing such efforts, outreach should be made to key attack proponents on occupational licensure to educate these groups relative to the value of professional engineering licensure to the public and why such licensure should be exempted from any legislation introduced to eliminate occupational licensure in a state or at the federal level.

Professional engineering operates similarly to service professions such as accountancy, legal, and medical. NSPE should continue to closely monitor any changes to licensure models – in implementation, enforcement, and public perception, so NSPE can readily adapt to this changing landscape. In this effort, however, it is necessary for NSPE and its state societies to reach out to its members and PE non-members to inform them of the threats to licensure that have occurred in their state or neighboring states and the efforts NSPE and the state societies have undertaken to protect the professional engineering license. Through this effort, NSPE and the state societies should encourage PEs to become active in their own advocacy, either personally or through support of an advocacy effort like NSPE, against these occupational licensure efforts that undermine professional engineering licensure.

Licensure Versus Certification

Proponents of the elimination of occupational licensure often advocate in favor of professional and occupational certifications, which they argue are less restrictive and easier to obtain. Therefore, the argument continues, a greater number of people could qualify for certification, thereby eliminating the "barrier to entry" into the profession or occupation. This argument, however, fails to recognize that certain activities being attacked under these legislative initiatives relating to occupational licensure are of the types that directly impact the public health, safety, and welfare.

> The public generally does not appreciate the differences between the two classifications [of licensure or certification].

There are distinct differences between licensure and certification. The public generally does not appreciate the differences between the two classifications. This confusion can compromise the effectiveness of these credentials. Some of the current misunderstanding is due to lack of basic knowledge about credentials, their benefits and limitations, and credentialing terminology. The Council of Engineering and Scientific Specialty Boards and NSPE have come together in the past to address these issues.

Part of this is vernacular – the common language does not refer to other regulated professions as licensed (for example, common language does not refer to an attorney as a "licensed attorney" or a doctor as a "licensed doctor"). Instead, they are identified and understood by the title of the profession ("Attorney" or "Doctor") and then some may carry a special designation or certification ("Patent Attorney," [55] "Attorney, [State Bar Association] Certified Real Property Law Specialist," or "Certified Plastic Surgeon," as examples). [56] In addition, as a point of history, the terms "engineer" and "engineering" preceded the establishment of professional engineering licensing laws at the state and territorial levels and one can obtain a college degree in "engineering."

In general terms, "licenses" and "certifications" can be understood as follows:

Licenses - Professional Engineering (PE) licenses are issued by specific boards appointed by states and territories of the United States. They require completion of an educational degree in a particular area of study, a sufficient period of experience acceptable to the licensing board as directed by their governing statutes and regulations, and successful completion of competency examinations specific to their field of practice. Such licenses are state-specific, i.e., individuals must be licensed by each jurisdiction in which they wish to practice.

[55] The American Bar Association's Model Rule of Professional Conduct, a corollary to the NCEES Model Law and Model Rules, states, in part that, while a lawyer may "communicate the fact that the lawyer does or does not practice in particular fields of law," recognizing only "Patent Attorney" or "Admiralty," as formal titles but allowing a lawyer certified as a specialist by an organization "approved by an appropriate state authority" or the American Bar Association to state that certification in communications along with the identification of the certifying authority. Further, a lawyer may communicate the fact that the lawyer does or does not practice in particular fields of law. American Bar Association, Model Rules of Professional Conduct, Rule 7.4 Communication of Fields of Practice and Specialization.

[56] Compare to a "Certified Public Accountant" where the license confers the title "Certified" but it is still a license.

Licenses are employed by state and territorial jurisdictions to regulate the practice of engineering and to protect the public from incompetence and misconduct of professional engineers. This allows for uniform vetting of engineers with degrees of differing structure, validation of acceptable experience, continuing education requirements and testing of the basic knowledge required to provide professional engineering services to the public.

Certifications - Certification attests to an individual's capability to perform a defined task or related series of tasks, commonly referred to as a body of knowledge. Obtaining a certification is a voluntary act; there is no legal requirement that a certification be obtained to practice a profession or deliver a service. However, some market conditions may operate to require or give preference to those who have a particular certification; a market requirement for certification is far more common in the medical profession than it is in engineering.

Certification requires a sufficient period of experience acceptable to the certifying body and successful completion of an examination. Many also require a collegiate degree in a particular area of study. Some certifications require professional licensure as a prerequisite. Certifications are not constrained by political boundaries.

Some certification programs are accredited; others are not. Accredited certification programs have been scrutinized by one or more of the three nationally-recognized certification accreditation bodies to ensure that the programs are operated consistent with recognized credentialing practices. Certification is obtained after licensure in the learned professions of law and medicine. Further, in these learned professions, the core profession is the only title for those practicing therein, with certifications recognized after licensure and title.[57] These distinctions are important and differences between licensure and certification must be effectively communicated both within the profession and to the public at large.

The Relationship between Licenses and Certifications - Licenses and accredited certifications are granted using similar credentialing practices, *i.e.*, they rely upon a prescribed education

[57] In the case of public accountancy, those practicing in the profession are recognized as "Certified Public Accountants" or "C.P.A.s" by applicable state law.

program, applicable experience of some duration and scope, and an examination of the individual's knowledge and judgment. Both ensure that the credentialed individual is minimally competent in the scope of the service regulated. Licenses are required for a professional to offer services to the public. Certifications are not required and do not grant authority to a professional to offer services to the public.

Overall, licenses and accredited certifications are complementary credentials. Together, they testify to the public about an individual's general and specific capabilities. Where licenses do not exist, accredited certifications provide the public the only independent testimony to an individual's capabilities. However certifications do not legally regulate an individual's practice. Only licenses regulate practice with the force of law.

The public is generally familiar and recognizes the use of certifications in other licensed professions. In fact, there is even an organization for certifying licensing professionals for those working in fields responsible for licensing other professionals.[58] Further, if there are local, state, or federal regulations or legislation requiring a specific certification to perform a specific engineering task, the public does not, and should not be expected to, know that there may be a separate regulation or legislation that would exempt a PE from obtaining that engineering-related certification. For example, a state may require a specific certification to design a stormwater plan through one statue, but then also have another statute in an entirely different chapter, stating that a PE need not obtain that certification, without cross-reference in either statute. Such layered regulation makes it exponentially more difficult for the public to fully understand who must be hired to complete a specific engineering task.

Appropriate Uses of Credentials - Licenses and certifications can attest to an individual's capabilities. The possession of one or more of these credentials indicates to the public that the holder's capabilities have been vetted using regularly accepted practices. Certifications should not be used in lieu of, or to supplant, professional engineering licenses as they do not have the

[58] Certified Licensing Professionals, Inc. *Available at* http://www.licensingcertification.org/ (accessed June 12, 2018).

same level of regulatory oversight associated with them. Certifications, can, however, provide additional layers of qualification verification when properly and strategically deployed.

Licenses identify the individuals who are legally authorized to offer regulated services to the public. Certifications do not. Regrettably, some government licensing bodies use the word certification (or registration) in the title granted to licensees.

Both licenses and accredited certifications can be appropriately used as parameters to qualify individuals for employment, for consulting assignments, for advancement, or for employment rewards.

National Council of Examiners for Engineering and Surveying ("NCEES") Position Statement - The position statement of the NCEES regarding certification is as follows:

> NCEES does not oppose those programs wherein professional organizations and societies recognize or certify their members for any purpose, provided such certification does not imply legal licensure. NCEES opposes certification by any organization or society wherein the purpose of such certification is to substitute for legal licensure as established by the statutes of the various jurisdictions.

The whole conversation of licensing versus certification has taken on a somewhat different tenor in the past two years due to the move among many state jurisdictions to restrict or eliminate occupational licensing.

Proponents of bills to eliminate occupational licensing advocate that certifications are less restrictive and easier to obtain. Therefore, the argument continues, a greater number of people could quality for certification, thereby eliminating a potential obstacle to entrepreneurship.

There are distinct differences between licensure and certification, especially in the practice of engineering. The general public generally does not understand the differences between the two classifications. Part of this is vernacular – the common language does not refer to other regulated professions as licensed (for example, common language does not refer to an attorney

as a "licensed attorney" or a doctor as a "licensed doctor"). Instead, they are identified and understood by the title of the profession ("Attorney" or "Doctor") and then some may carry a special certification ("Patent Attorney" or "Attorney, [state bar association] Certified Real Property Law Specialist").

Certification is not a "bad" thing, but it is generally distinct from the education, experience, and examination requirements of licensure. It is a way for an individual to show additional expertise in a particular area of engineering. This must be effectively communicated to legislators and the public.

NSPE has adopted Position Statement 1737 which provides:

> *Following licensure as a professional engineer, individuals may voluntarily have their expertise in a specified field of engineering recognized through an appropriate specialty certification program. Such certification must not imply that other licensed professional engineers are less qualified for practice in a particular field of specialty. Professional engineering licensure is the only qualification for engineering practice. NSPE and its state societies actively oppose attempts to enact any local, state, or federal legislation or rule that would mandate certification in lieu of or beyond licensure as a legal requirement for the practice of engineering. . . .*

NSPE Position Statement 1774 provides additional information on this issue:

> *Private certification programs are not a substitute for licensure. In fact, private certification may have the effect of confusing the public's understanding of the role of licensed professional engineers and blur the distinction between the practice of engineering by licensed professionals and other services, particularly when such private certification programs employ engineering titles in their private certification programs.*

NSPE should continue to advocate against certification as a substitute for or in lieu of licensure for performing engineering tasks. NSPE should support local, state, and federal regulation and legislation that requires PE licensure for the practice or performance of engineering. Such licensure provides oversight by state boards and agencies to ensure the competent and ethical practice of engineering to protect the public health, safety, and welfare. NSPE should, however, modify its position (specifically, Position Statement 1737) of opposing certification "beyond licensure." Given the prevalence of certification programs and societal expectations for some certifications or specialization by licensed professionals, obtaining certifications should not be actively opposed going forward.

In fact, acceptance of certain certifications may strengthen the profession and work to negate some attempts to fragment licensure by supporting a "PE license first" approach with certifications to bolster and confirm competence in certain areas of practice.[59] Given the prevalence of certification programs and societal expectations for some certifications or specialization by licensed professionals, obtaining certifications should not be actively opposed going forward. In fact, acceptance of certain certifications may strengthen the profession and work to negate some attempts to fragment licensure by supporting a "PE license first" approach with certifications to bolster and confirm competence in certain areas of practice.[60] Instead, the FOPE Task Force recommends encouraging state licensing boards to actively evaluate engineering certification programs that could be employed to tailor the practice of professional engineering to that state. Specifically, the FOPE Task Force recommends that NSPE consider sunset of Position Statement 1737 with re-adoption including as follows:

> *7. . . . Professional engineering licensure is the only qualification for engineering practice, unless other post-PE certification is required by a state PE*

[59] This is so long as the certification programs, when adopted, do not block out PEs who have already been practicing competently in those areas, allowing for a period of grandfathering, similar to what was allowed for the legal and medical professions when they moved from an apprenticeship to education/examination path to practice.

[60] This is so long as the certification programs, when adopted, do not block out PEs who have already been practicing competently in those areas, allowing for a period of grandfathering, similar to what was allowed for the legal and medical professions when they moved from an apprenticeship to education/examination path to practice.

licensing board for a particular practice of engineering. NSPE and its state societies actively oppose attempts to enact any local, state, or federal legislation or rule that would mandate certification in lieu of ~~or beyond~~ licensure as a legal requirement for the practice of engineering. Any post-PE certification requirements adopted by a state PE licensing board must provide for a grandfathering or other pathway to practice for those PEs already practicing in that area of engineering practice.

These changes would bring NSPE in line with NCEES and the licensing community. Additionally, the FOPE Task Force recommends that NSPE consider sunset of Position Statement 1774 and readopt a new Position Statement as shown below.

NSPE Position Statement No. xxxx— Use of Certification Credentials

Adopted: May 2016

NSPE Contact: Committee on Policy and Advocacy

It is the position of NSPE that the importance of engineering licensure should not be minimized or diluted by the use of certification titles issued by private certification programs and offered in lieu of engineering licensure (e.g., certification programs offered by non-governmental groups or organizations). Certification titles and private certification programs should not, in any way, imply engineering licensure. The requirement for any certification related to the practice of engineering be predicated on one having first obtained an engineering license.

DISCUSSION: The professional practice of engineering is regulated by state and territorial licensing boards. These boards are created by the state and territorial governments for the protection of the health, safety and welfare of the public. State engineering licensing boards examine the qualifications of engineering licensure applicants, issue jurisdictional licenses to those who meet legally established qualifications to practice professional engineering, and enforce the

laws that govern engineering practice. Importantly, state engineering licensure board have the legal authority to take disciplinary action against licensed professional engineers who engage in improper, unethical or illegal conduct. Penalties for such improper, unethical or illegal action may include censure, suspension or revocation of a professional engineer's license. Private certification programs are not a substitute for engineering licensure or for the verification of qualifications for the practice of engineering. In fact, private certification may have the effect of confusing the public's understanding of the role of licensed professional engineers and blur the distinction between the practice of engineering by licensed professionals ~~and other services~~, particularly when such private certification programs employ engineering titles and make them available to non-licensed engineers ~~in their private certification programs~~. In addition, private certification programs, absent state or national regulatory oversight, lack the level of personal and professional accountability provided by the professional engineering licensure process as required and administered under state or territorial law.

RECOMMENDATIONS:

1. To better separate private certifications from the licensure process, NSPE advocates that all jurisdictions should restrict the use of the title "engineer" to licensed professional engineers in their engineering licensure laws and regulations. Additional certifications deemed necessary by the state or territorial licensing board to practice engineering may use the title "engineer" so long as such certifications are available only to those that have already obtained professional engineering licensure.

2. NSPE advocates that state and territorial jurisdictions recognize that licensure is the first requirement to the practice of engineering.

3. To avoid confusing the public's understanding of certifications with licensure and the role of licensed professional engineers, licensed professional engineers

are encouraged to employ the PE designation as their primary credential designation, before the use of other professional, academic or certification designations.

Several engineering societies (including the American Society of Civil Engineers ("ASCE"), Society of Manufacturing Engineers ("SME"), International Society of Automation ("ISA"), and Structural Engineering Certification Board ("SECB")) advocate for, and offer, certifications in specialty areas. While both ASCE and SECB offer certifications only after an individual obtains a professional engineering license, SME and ISA grant certifications entirely separate from (including prior to) licensure. SME specifically offers certifications as both Certified Manufacturing Engineer ("CMfgE") and Certified Manufacturing Technologist ("CMfgT"). ISA focuses its Certified Automation Professional ("CAP") program across a global marketplace for multi-national corporations.[61]

The CMfgE, CMfgT, and ISA-CAP certifications require demonstration of education and work experience (with the CMfgE requiring "a minimum of eight combined years of manufacturing-related education and work experience," quite similar to what is required under the NCEES Model Law for PE licensure) followed by an exam.[62] In developing this certification, SME and ISA have gone even further in developing a Body of Knowledge, a Competency Model, and a three-year recertification process. SME has promoted its certification as an alternative to professional engineering licensing in engineering society discussion forums.

[61] Unlike SME, however, ISA provides a direct link on its website about its CAP program to the American Association of Engineering Societies website detailing the difference between licensure and certification providing a link titled "Certification vs. Licensure" at the bottom of the webpage (http://www.aaes.org/sites/default/files/Differentiating_Licensure_and_Certification_for_Engr.pdf). *See* International Society of Automation. Certified Automation Professional. *Available at* https://www.isa.org/isa-certification/certified-automation-professional/ (accessed June 12, 2018).

[62] Society of Manufacturing Engineers. Certified Manufacturing Engineer. *Available at* www.sme.org/cmfge (accessed February 3, 2017); Society of Manufacturing Engineers. Certified Manufacturing Technologist. *Available at* www.sme.org/cmfgt (accessed February 3, 2017); International Society of Automation. Certified Automation Professional. *Available at* https://www.isa.org/uploadedFiles/Content/Training_and_Certifications/ISA_Certification/CAP%20Benefits%20Brochure.pdf#page=10 (accessed June 20, 2018).

Fragmentation of Licensure

The regulation of PEs varies among states. Some states license all engineers as PEs Other states license by specific engineering disciplines (by use of a Title Act, Practice Act or both). In all cases, however, PEs are required to practice only in areas of their competence. This is different than the practice of law or medicine, for example. All states regulate these professions only as "attorney" or "lawyer" and "doctor." Titles for medical professionals such as "pediatrician," "plastic surgeon," and "cardiovascular surgeon" are conferred after obtaining licensure as a "medical doctor (M.D)" and then earning a separate nationally-approved certification in a medical specialty. The possible embrace of a similar certification process for PEs is discussed in the section above.

The fragmentation among engineers with terminology such as "engineer," "professional engineer," "licensed engineer," and "registered engineer," is already confusing to the general public. Discipline-Specific engineering titles fosters the potential for even greater fragmentation of the engineering profession. Further, continued support and adoption of Discipline-Specific Title Acts or Discipline-Specific Practice Acts provide further opportunity for conflict that may benefit those seeking to eliminate occupational licensing, as discussed above, as these acts create and even more restrictive path than would be otherwise the case.

One way to address the concern that discipline-specific licensure could further fracture the engineering profession, is to incorporate the certification process into a state's existing process for licensing PEs. NSPE should work diligently with both NCEES and its state boards and with the NSPE state societies to advocate that separate discipline-specific licensure not be supported (i.e. Discipline-specific Title and Practice Acts). Instead, certifications in certain areas of practice or expertise after obtaining a PE license should be supported. This could include, as an example, similar to the practice of the American Bar Association or American Medical Association. If a certification program is recognized by NCEES or the state licensing board, then it is an appropriate certification required for specialized areas of practice, such as Structural

Engineering in states that determine such additional certification is necessary to protect the public health, safety, and welfare.

The SECB is a national organization that provides Structural Engineering Certification. To obtain this certification, one must be licensed as a PE, complete successful passage of the 16-Hour structural engineering NCEES examination, complete continuing education in six different categories, and complete annual recertification. Such a framework could be recognized by state licensing boards if the certification and recertification processes do not change and if a state determines that a PE should also obtain Structural Engineering certification for certain engineering activities to ensure another layer of protection for the public health, safety, and welfare.

NSPE should continue to advocate for the elimination of Discipline-Specific Title and Practice Acts, as these acts continue to not only confuse the public at large, but also make for cumbersome and confusing processes for legislatures to understand and, also, as it relates to the general mobility of PE licensure. Further, adoption of such positions (elimination of Discipline-Specific Title and Practice Acts and Support for Post-PE Certifications) would be more in line with the consistency of approaches adopted by other licensed and publicly-understood professions of the law and medicine.

It is important to note, however, that while the academic structure of engineering bachelor's degrees has changed, it does not necessarily mean that the current academic structure is "wrong" or "inadequate."

Another recent development within engineering licensure, primarily promoted by the civil engineering community, is a change in the education requirements for professional engineering licensure. There has been an ongoing effort by ASCE to require additional education after attainment of an engineering bachelor degree as a condition for professional licensure.

The overall academic structure of the bachelor degree for engineering has changed over time and must be closely understood and monitored by NSPE. NSPE participates actively in the ABET education accreditation criteria development process. It is important to note, however, that

while the academic structure of engineering bachelor's degrees has changed, it does not necessarily mean that the current academic structure is "wrong" or "inadequate." It has been argued, however, that because licensure is considered to be the pinnacle of professional practice, allowing the broadest abilities to practice engineering in the United States, education requirements for individuals seeking licensure can be different than those seeking only an engineering degree.

The position of the National Academy of Engineering on education beyond a bachelor's degree is detailed as:

> Educating the Engineer of 2020
>
> To prepare the engineer of 2020 for that challenging future, the NAE undertook an in-depth study of how engineering education would have to change. Among the several recommendations:
>
> - The bachelor's degree should be considered a pre-engineering or "engineer in training" degree.
> - The master's degree should become the recognized engineering "professional" degree.
> - Institutions should take advantage of flexible accreditation criteria in developing curricula and expose students to the essence of engineering early in their undergraduate experience.
> - University education should produce engineers who can both define and solve problems.
> - Institutions must teach students how to be lifelong learners.
> - Engineering undergraduate programs should introduce interdisciplinary learning and use case studies of both engineering successes and failures as a learning tool.

The bachelor's degree may be defined as: a credential that normally requires at least four but not more than five years of full-time equivalent college-level work. This includes all bachelor's

degrees conferred in a five-year cooperative (work-study) program. The overall academic structure of the bachelor degree for engineering has changed over time and must be closely understood and monitored by NSPE. NSPE participates actively in the ABET education accreditation criteria development process. It is important to note, however, that while the academic structure of engineering bachelor's degrees has changed, it does not necessarily mean that the current academic structure is "wrong" or "inadequate."

Consistent with other learned professions, a degree demonstrates a *minimum acceptable* level of education. In any area of the practice of engineering, for one to be *competent and qualified* in that area one will need to obtain additional training or education. It is not necessary, however, that the additional training or education need to be formal academic education and may be done through various training programs or intensive on-the-job training after undergraduate graduation. NSPE must be diligent and ensure that in all cases, it is the public interest that is being protected.

Additional components of future engineering education to prepare PEs for life after graduation are discussed in Appendix D of this report.

Procurement of Professional Engineering Services

The long-term sustainability of professional engineering is in harmony with the PE's role in protecting the public. To that end, steps must be taken to create and maintain a competitive environment for the delivery of professional design services through Qualification Based Selection ("QBS"). This environment must highlight the value of the profession while preventing it from becoming a mere commodity.

In a recent letter to a state's legislators, NSPE laid out the following position:

> *QBS is a procedure whereby service providers are retained on the basis of qualifications, rather than price factors. Under the QBS method, the procuring agency reviews the qualifications submitted by interested individuals and firms,*

ranks respondents, and then negotiates with the most qualified respondent for a mutually agreeable contract.

Further, NSPE provided four reasons as to why it is imperative that QBS methods are used.

1. QBS protects the public welfare
2. QBS protects the taxpayer
3. QBS benefits small firms
4. QBS promotes technical innovation

Choosing an engineering firm for a project can have far-reaching implications. How a project is designed and engineered in the early stages can affect its costs, performance, and quality throughout its entire lifecycle. Therefore, it does not pay to treat engineering like a commodity and compare firms by price only. This is one scenario where paying a little more upfront can save huge costs and headaches down the road. In view of this, QBS has become the mantra in choosing engineering firms, with many government agencies requiring it. NSPE and PEs must continue to advocate on behalf of the use of QBS and place emphasis on the value it provides. Without it, the public could be denied the benefit of those most qualified to provide engineering services.

The Role of the PE in Shaping Public Policy

We often hear that history repeats itself. The history behind professional engineering licensure in the United States is a history worth learning, but not repeating. The professional engineering license, as with many other icenses across the county, came about over 100 years ago due to the need for standardization and accountability in the Wild West. The first state to offer an license for the practice of engineering was Wyoming in 1908. By 1920 PE licensure was available in 10 states, including Wyoming, Louisiana, Florida, Illinois, Colorado, Michigan, Idaho, Iowa, Nevada and Oregon. With licensure laws and requirements varying from state to state, many realized that a reciprocal license would be needed and in the 1920's what would eventually become the NCEES began to take shape. By 1950, each of the 50 states plus the

District of Columbia had enacted some form of licensure law.[63] Today all states and territories of the United States regulate the practice of engineering at the state level by issuing licenses to practitioners based *solely* on education, experience, and examination requirements. Additionally, those state boards of licensure are responsible for investigating complaints and administering appropriate civil penalties over PE licensees when necessary, ensuring there is effective oversight that ensures the continued protection of the public health, safety, and welfare.

Many states enacted laws after major disasters. California created a state licensing board a year after the 1928 collapse of a dam on the Santa Clara River which killed more than 500 people. In 1937, Texas created its state licensing board months after more than 300 students and teachers died in a natural gas explosion attributed to faulty engineering at an elementary school in New London, Texas. In communications about the value of PE licensure, it is important to remind the audience, whether legislators, regulators, the community of engineering professionals, or the public at large, why PE licensure was created and the ethical requirements tied to the PE license.

Increasing technological advancements push other aspects of society to advance as well, including politics. Over $3.4 billion was spent on lobbying efforts in the United States in 2017.[64] Effective lobbying and advocacy requires mastering a "seven-second soundbyte."[65] To ensure that the political construct advances along with technological advancements, engineers, particularly PEs, must engage in the political process to ensure that the societal implications that may arise with advancements in technology are appropriately and accurately addressed.

Engineers have long been recognized for their critical thinking and problem-solving skills. Moreover, the PEs in our country have pledged an oath, and are bound by law, to hold the

[63] While some of the now-50 states were still territories at this time, they had adopted PE licensure laws within those territories.
[64] Statista. Total Lobbying Spending in the United States from 1998 to 2017. *Available at* https://www.statista.com/statistics/257337/total-lobbying-spending-in-the-us/ (accessed June 20, 2018).
[65] American Society of Engineering Educators. *The Engineer's Role in Public Policy* at 2 (2003). *Available at* https://peer.asee.org/the-engineer-s-role-in-public-policy.pdf (accessed June 1, 2018).

public health, safety and welfare above all other considerations in exchange for practicing with a state-granted license. These skills and commitment to public health, safety, and welfare uniquely position professional engineering to be a positive and driving influence on the public policy making process.

Despite the obvious need for critical thinking and problem-solving skills in the development and implementation of public policy, engineers are currently underrepresented in policy making bodies. Today, engineers represent a modest 0.9 percent of the US Congress as compared to 41.5 percent attorneys and 4.4 percent healthcare professionals.

There must be PEs willing to take up service in government or public policy activities.

To ensure that the public health, safety, and welfare are preserved in the future, PEs must play a greater role in shaping and/or otherwise informing public policy. Far more PEs will need to enter the public service arena by appointment or election to public office. Even greater numbers of PEs will need to be increasingly visible and actively engage in the political process by building relationships with policy makers and providing much needed technical support and guidance.

To undertake such engagement, PEs must not only meet with their legislators and regulators, but must also be willing to take on the role of citizen-PE. There must be PEs willing to take up service in government or public policy activities. This includes running for elected office, proactively seeking out panels and groups convened by governmental agencies where PE skills and knowledge would be valuable, finding opportunities to teach in engineering courses as a guest lecturer, advocating on behalf of the adoption of specific legislation (such as the type described in NSPE Position Statement 1780) or forming coalitions of PEs and other interested stakeholders in key issues and discussing those issues with key legislators and regulators. As PEs, we pledge to hold the public health, safety, and welfare above all other considerations – to do so, we must ensure that the laws and regulations governing engineering issues that will touch the public include the appropriate protections and oversight to ensure continued protection of the public health, safety, and welfare. To take on these roles will mean that at

times PEs who volunteer will not be accepted, will receive rejections, or may not always have their conclusions incorporated into final laws or regulations. Such a marked change cannot happen overnight, but it can, over time, have an impact and effectuate the changes necessary to achieve these goals.

Additional Background Data

Demographics vs representation in US Congress

- In 2010 total population of US was approximately 308,700,000.
- In 2010 there were approximately 2,495,000 engineers in the US – 0.8% of total population;[66] only 5 of the 541 seats in congress were filled by engineers (0.9%)[67]
- In 2010 there were approximately 1,225,452 attorneys in the US – 0.4% of total population;[68] 225 of the 541 seats in congress were filled by attorneys (41.5%)[69]
- In 2010 there were approximately 15,700,000 healthcare professionals in the US – 5% of total population;[70] during the same time 24 of the 541 seats in congress were filled by healthcare professionals (4.4%)[71]

Engineering Curricula Geared Toward Engineering and Public Policy

- Berkley – MS Public Policy and Engineering
- Carnegie Mellon – Engineering and Public Policy degree programs
- Northeastern University – MS in Engineering and Public Policy
- Dartmouth – Engineering and Public Policy modified major
- Purdue – Engineering and Public Policy Minor
- Princeton – Center of Information Technology Policy

[66] US Bureau of Labor Statistics. National Data. May 2010. *Available at* https://www.bls.gov/oes/tables.htm. (accessed July 5, 2018).
[67] Wikipedia. Members of the 11th United States Congress. *Available at* https://en.wikipedia.org/wiki/Members_of_the_111th_United_States_Congress. (accessed July 5, 2018).
[68] US Bureau of Labor Statistics. National Data. May 2010. *Available at* https://www.bls.gov/oes/tables.htm. (accessed July 5, 2018).
[69] Wikipedia. Members of the 11th United States Congress. *Available at* https://en.wikipedia.org/wiki/Members_of_the_111th_United_States_Congress. (accessed July 5, 2018).
[70] US Bureau of Labor Statistics. National Data. May 2010. *Available at* https://www.bls.gov/oes/tables.htm. (accessed July 5, 2018).
[71] Wikipedia. Members of the 111th United States Congress. *Available at* https://en.wikipedia.org/wiki/Members_of_the_111th_United_States_Congress. (accessed July 5, 2018).

- McMaster University – Engineering and Public Policy program

Ongoing NSPE public policy outreach/initiatives

- States are currently hosting PE Days at their state capital
- Community forum on threats to licensure

Public policy outreach/initiatives by other engineering organizations

American Council of Engineering Companies ("ACEC")

- Public Policy Council
- Action Alert Center
- Online Congressional Directory
- Congressional Scorecard
- Communities
- Councils and Forums

American Society of Civil Engineers ("ASCE")

- Key Contact Program
- Key Contact Briefing Conference Calls
- "Click and Connect with Congress"
- State Legislative Tracking Service
- Legislative "Fly-Ins"
- State "Drive-Ins" and "Legislative Days"
- Section/Branch Government Relations Committees

Engineering Change Lab USA ("ECL-USA")

- Public Policy Sub-Group
- *Still in early stages of formation and strategic planning*

American Institute of Architects ("AIA")

- Legislative Action Center

Current NSPE Professional Policies and Position Statements

- NSPE Professional Policies: PP-02, PP-30, PP-45, PP-50, PP-58, PP-61, PP-66, PP-75, PP-96, PP-122, PP-152, PP-166, PP-167, PP-170, PP-171, PP-173
- NSPE Position Statements: PS-1737, PS-1747, PS-1748, PS-1750, PS-1751, PS-1766, PS-1767, PS-1771, PS-1774, PS-1778, PS-1779, and PS-1780

Recommendations

To ensure the continuation of the practice of professional engineering, and thereby the continued protection of the public health, safety, and welfare in engineering endeavors, the FOPE Task Force recommends that NSPE:

- Legislative Attacks on Occupational Licensing
  - Continue to closely monitor and ramp up communication efforts on the core principles of professional engineering licensure. Provide state society partners materials that are PE licensure-specific that focus on how PE licensure is similar to that of the legal or medical professions (which are often more understood by legislators and regulatory authorities) with a section where each state society partner can highlight several key PE distinctions for the intended audience. In addition, NSPE must encourage PEs to become active in their own advocacy against these occupational licensure efforts that subsume professional engineering licensure, either personally or through support of NSPE.
  - Establish a legislative outreach Community within NSPE to communicate to all members (automatically enrolling all members in the Community along with the open forum Community, but allowing a member to opt out) about active occupational licensing legislative efforts and also to provide more awareness of the activities NSPE undertakes in furtherance of the protection of the PE license and the public health, safety, and welfare through various government relations efforts.

- Licensure Versus Certification
    - Sunset Position Statements 1737 and 1774 and adopt new language related to certifications after obtaining a PE license.
    - Continue advocacy efforts against certifications required by non-licensing state agencies in lieu of professional engineering licensure, as they relate to the practice of engineering. NSPE must also advocate that certification should not take precedence over licensure and that PE licensure should be obtained first with specialty certification after that.
    - Support private certifications, as approved by NCEES or state/territorial licensing boards, that are obtained post-PE license and provide further examination and verification of qualifications for initial certification and continuing education for maintenance of that certification to perform in specific areas of professional engineering (such as "Professional Engineer, Certified Structural Engineer" or "PE, CSE").
- Fragmentation of Licensure
    - Cease using the terminology of "registered PE" or "registered engineer" as "registration" solely requires payment of a fee and identification of an individual on a roster. Use of this term further confuses and fragments the profession. PEs are "licensed" as recognized by NCEES having completed an education, examination, and experience evaluation by a state or territorial regulatory authority.
    - Advocate against restrictive discipline-specific Title and Practice Acts (maintaining support for and advocating for state licensure laws that license engineers and "professional engineers") and equip state society partners with materials that are state-specific to advocate against the adoption of, and advocate for the elimination of, where applicable, such restrictive discipline-specific Title and Practice Acts.
    - Communicate parallels with the legal and medical professions where all licensed practitioners are "lawyer/attorney" or "doctor," respectively, with other

credentialing around that core and protected title approved for use by state boards of licensure.

- Adopt throughout NSPE communications the encompassing use of "professional engineer" and not various iterations thereof like "licensed engineer."
- Adopt a position supporting post-PE certifications that continue to require PE licensure as an initial requirement for that certification (along with the advocacy against restrictive discipline-specific Title and Practice Acts).

- Procurement of Professional Engineering Services
  - Continue to advocate on behalf of QBS and its important role in protecting the public health, safety, and welfare.
- Role of the PE in Shaping Public Policy
  - Look for opportunities to form alliances and/or otherwise cooperate with other engineering organizations to increase the engagement and active participation of PEs in the shaping of public policy.
  - Seek out and support engineering programs that currently offer curricula and/or degrees in Engineering and Public Policy, while encouraging wider adoption of similar programs at other engineering institutions.
  - Identify and prepare qualified PEs for public service and ultimately work to secure their appointment or election.

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APPENDIX D: ENGINEERING EDUCATION

Background

Engineering Education

Over the past forty years, the world has changed, and the nature of the practice of engineering at a professional level has changed with it. The planning, design, and implementation of engineering projects now takes place fully in a societal context, requiring extensive public and stakeholder input in project decision-making and heightened consideration of economic, environmental, public policy, code compliance, legal, and regulatory matters. More than ever before, this requires advanced professional practice skills on the part of professional engineers in the areas of communication, leadership and a broad understanding of the societal context. In technical areas, an explosion of scientific and engineering information has led to the need for both greater breadth of science and engineering knowledge and for much greater depth of technical knowledge in ever-narrowing areas of technical practice.

The education of engineers in preparation for professional practice in a four-year baccalaureate program faces two daunting and equally important challenges. First, the body of knowledge required for practice as a professional engineer ("PE") has been and is expanding rapidly, both in terms of science and engineering knowledge and skills, and the need for more professional practice skills. This expanded body of knowledge no longer fits in the four year "bucket." Secondly, the "bucket" is getting smaller. A bachelor of science degree ("BS") in engineering in the 1930's typically required 150 or more credits.[72] In the 1970's, it was typically in the mid-130's. Now, it is trending toward 120. Of the programs that report credit requirements to the American Society for Engineering Education, 17 percent are now at 120, and the median is less than 128. Each year, several more institutions drop their engineering program requirements to 120 credits.

[72] Paul Robbins, PE. *Building for Professional Growth: A History of the National Society of Professional Engineers, 1934–1984* (1984).

The combination of an expanding body of knowledge and declining credit requirements has resulted primarily in a decrease in engineering content in terms of both breadth and depth. Each individual program deals with the narrowing of curriculum requirements in its own unique way. As examples of long-term changes in civil engineering curriculum content, programs have been reducing requirements for thermodynamics, electrical circuits, surveying (yielding future engineers who lack a basic understanding of geometrics), engineering economics (yielding future engineers who don't understand the concept of present worth and the time value of money), and/or upper-level undergraduate engineering electives needed to provide any manner of technical depth. Not all programs make all these types of changes, but these are examples of compromises that are made. This year, at least two US civil engineering programs announced changes to no longer require dynamics, yielding future engineers who have very limited backgrounds in the engineering science of motion and momentum. Each change reduces the breadth and/or depth of science and engineering background at a time when the background required for practice at the professional level is increasing. Furthermore, we are generally not expanding the professional practice content in engineering education, even though professional practice requirements are accelerating.

It is for these reasons that the National Academy of Engineering—formed to advise the US Congress on engineering matters—concluded in a major report that "it is evident that the exploding body of science and engineering knowledge cannot be accommodated within the context of the conventional four year baccalaureate degree."[73]

Virtually every other profession in the US has faced the fact that the body of knowledge required to practice at a professional level (i.e., licensure) necessitates education beyond the baccalaureate level. It is not surprising that engineering has reached this point as well. The National Council of Examiners for Engineering and Surveying ("NCEES") has concluded that the current baccalaureate degree which is now the educational standard for engineering licensure is becoming insufficient to accommodate the expanding body of knowledge required for practice as a PE. The technological revolution of the 21st century and the ever-increasing need

[73] National Academy of Engineering. *Educating the Engineer of 2020* at 52 (2005).

for engineers to address more complex issues have increased the demands placed on today's practicing PEs.

NCEES has therefore set a goal to make a strong system of licensing engineers even stronger by increasing the minimum engineering education required to practice as a PE. It believes that expanding the education requirement will better prepare PEs to meet professional demands and will significantly enhance their careers. NCEES also believes that expanding the education requirement will promote greater proficiency in the practice of professional engineering for the protection of the public health, safety, and welfare. To that end, NCEES has in place Position Statement 35, "Future Education Requirements for Engineering Licensure."[74]

The body of knowledge related to the licensed practice of engineering has dramatically expanded in recent decades and will continue to do so. Concurrently, the number of credit hours required for graduation has decreased due primarily to political and economic pressures in virtually all states to provide baccalaureate programs with fewer hours of coursework (an average of 144 credits 25 years ago to an average of about 128 credits today).[75] The combination of an expanding body of knowledge and declining credit requirements has resulted in a decrease in engineering content in terms of breadth and depth.[76] Engineering students do not have time to attain technical depth and, in most cases, lack exposure to project management, leadership, ethics, communications, finance, management, and other courses important and essential for many areas of professional practice in the 21st century.[77] The body

[74] National Council of Examiners for Engineering and Surveying. *Future Education Requirements for Engineering Licensure Position Statement 35* (August 2015).
[75] Craig N. Musselman, PE. National Academy of Engineering. *Requiring A Master's or Equivalent as a Prerequisite for Engineering Licensure – The Rationale and Implementation* (June 2009); Johnathan Patterson. Science in Society, *Engineers should take a skills proficiency test* (November 2017).
[76] National Society of Professional Engineers Licensure and Qualifications for Practice Committee. *Why It Is Important to Raise the Educational Bar for Future Engineering Licensure* (2013).
[77] Craig N. Musselman, P.E., Jon D. Nelson, P.E., and Monte L. Phillips, Ph.D., P.E. National Council of Examiners for Engineering and Surveying, *The Positive Impact of "B+M/30" On the Engineering Profession* (2008); Danielle Boykin. PE Magazine, *Is a Bachelor's Degree Enough?* (November, 2009).

of knowledge required to enter the practice of engineering in the future does not fit within the curricula currently provided by undergraduate engineering programs.[78]

The principal issues that have been found lacking in our engineering education are the basis of the future of engineering in the US and being competitive in the global market. Requiring additional education as a prerequisite for licensure as a professional engineer is about keeping pace with the minimum requirements for practice as a professional engineer.

The Future of Professional Engineering ("FOPE") Task Force concurs with NCEES that the current baccalaureate degree which is now the educational standard for engineering licensure is becoming insufficient to accommodate the expanding body of knowledge required for practice as a PE. The technological revolution of the 21st century and the ever-increasing need for engineers to address more complex issues have increased the demands placed on today's practicing engineers. Our global competitiveness is at risk and engineering education needs to be reformed to respond to this risk.

Nationwide, the financial constraints on engineering education will continue to place stress on our existing understanding of the PE. Engineering education is placing greater emphasis on teamwork within the educational structure at the request of industry. Thus, there is less of an emphasis on an individual having embraced a "body of knowledge" and more on a "collective body of knowledge" within the team. To complete a BS degree within the four-year time frame, students have less educational emphasis on the fundamentals of engineering potentially resulting in being less prepared to sit for an exam on these topics.

The team approach requiring a few PEs on staff is already prevalent in many governmental agencies (i.e., USACE, EPA, USDA), industries (Boeing, Airbus) and private industry (K-Tron, Great Plains, Koch).

[78] Bill Murphy. *Former Lockheed Martin CEO Norm Augustine offers prescription for 'reengineerig engineering education'*.

The FOPE Task Force therefore supports increasing the minimum engineering education required to practice as a PE. This additional education may be fulfilled by an academic engineering degree beyond the baccalaureate degree but, the FOPE Task Force recommends that alternative pathways other than formal academic education be developed to fulfill the additional education requirement. One such alternative could consist of coursework and/or workshops that have sufficient content rigor and outcomes assessment that is more robust than traditional continuing education. This would be consistent with the recommendations in current National Society of Professional Engineers ("NSPE") Policy 168 and NCEES Position Statement 35. Expanding the education requirement will better prepare PEs to meet professional demands and will enhance their ability to compete in a global market.

NSPE already supports continued lifelong learning of PEs to promote greater proficiency in engineering practice for the protection of the public health, safety, and welfare. Through Position Statement 1752 NSPE maintains that NSPE has concluded that the following requirements for core curriculum and additional outcomes are necessary to properly prepare individuals for professional practice. The FOPE Task Force recommends certain revisions to the core curriculum and additional outcomes as herein incorporated.

CORE CURRICULUM

Undergraduate engineering education in accredited programs in the United States require graduates with the ability to:

- Apply knowledge of mathematics, science, and engineering;
- Design and conduct experiments;
- Design a system, component, or process to meet desired needs within a broad set of constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
- Function on multidisciplinary teams;
- Identify, formulate, and solve engineering problems;
- Understand professional and ethical responsibility;
- Communicate effectively;

- Understand the impact of engineering solutions in global, economic, environmental, and societal contexts;
- Recognize the need for life-long learning;
- Understand contemporary issues; and
- Use the techniques, skills, and modern engineering tools necessary for engineering practice.

ADDITIONAL OUTCOMES

In addition to core curriculum requirements we advocate that additional outcomes beyond those included in current accreditation criteria are necessary for professional engineering practice:

- Leadership capabilities including the ability to assess risk and take initiative, the willingness to make decisions in the face of uncertainty, a sense of urgency and the will to deliver on time in the face of constraints or obstacles, resourcefulness and flexibility, trust and loyalty in a team setting, and the ability to relate to others, including the ability to recognize explicit or implicit bias and ways to address such instances.
- Assessment of risk and uncertainty be incorporated in the engineering thought process throughout engineering curricula, beginning with undergraduate engineering education
- Effective project management is essential to ensure that engineering projects have a positive effect on the public. The ability to apply project management principles should be an outcome attained by all engineering graduates.
- Public policies, including laws, regulations, institutions, codes, and standards, impact engineering disciplines in different ways; thus, engineering graduates need to know how public policy is established and who sets it at the various levels of government relative to their discipline.
- Understanding of business concepts both private and public.

- The public increasingly demands that sustainability concepts be applied to engineering projects in practice, and it is necessary to incorporate these concepts in the engineering thought process, beginning with undergraduate engineering education, if these concepts are to be thoroughly integrated into the design process in the future.

To adequately protect public health, safety, and welfare, PEs must have relevant knowledge of public policy, laws and regulations within the context of their profession. The professional practice of engineering requires dedication to lifelong learning. Beyond the fundamental education and experience for initial licensure, PEs must stay current with ever emerging technology and advancements to base meaningful judgment. Therefore, NSPE Professional Policies and Position Statements related to post-baccalaureate/pre-licensure education should be revised to include support for a requirement of documentation of continuing education that would meet the criteria for qualifying PE-renewal continuing education in that state or territory along with an application for PE licensure by that jurisdiction.

To be competitive engineers need to be creative and innovative while understanding and mitigating risk. There is a need for engineers to acquire and apply basic leadership skills. We need engineers who have learned how to be professionals and when the body of knowledge broadens, licensees must keep pace. NSPE recognizes four essential requirements of all licensed professionals:

- Education and experience adequate to base meaningful judgement
- Native capacity to perform at the professional level
- Sterling integrity and ethics
- Ongoing will to maintain the license agreement

Licensure of Engineering Education Faculty

In today's university structure, faculty members are expected to focus even more on active research leading to publications and contributions to the overall university goals. In a majority of department's promotion and tenure requirements do not utilize the PE as an

accomplishment worth of credit towards promotion. Thus, the PE is currently only of importance to faculty who are actively involved in consulting engineering outside the university or who participate in research activities that interface with an industry requiring professional engineering licensure to utilize their equipment.

With historically low or no salary increases, engineering faculty are fortunate in that they can practice their profession as a means of supplementing their personal income. Salary issues have also led to a reduction in interest of PE faculty in becoming members of NSPE because the rate of return with NSPE investment is low for a faculty member.

Little incentive is given for an engineering faculty member to obtain a professional engineering license, unless there is a desire to practice their profession outside the University structure as a consulting engineer. Within the University, most faculty members have spent 8-10 years completing a PhD degree program. The dissertation defense within a doctoral program alone is an extensive examination of the knowledge possessed by that individual. Many faculty members feel that it is impractical for a faculty member to be subjected to an exam to verify his or her knowledge base.

It is also important to note that where an unlicensed engineering professor may be able to complete some activities that fall within one state's definition of the practice of engineering within the University because it is an enumerated "education exemption" in that state, those may not be available if that professor moves to another University in a different state with a different "education exemption." Also, there is an important policy difference in research done solely within the bounds of a research institution and research done reaching beyond the walls of the institution, such as connecting into an electric distribution grid or field-testing a laboratory innovation. This is where an alternative pathway to licensure may be worth further exploration, if the goal is to get engineering educators licensed.

Currently, Wyoming is the only state with a state statute allowing for an alternative pathway to licensure for engineers with a Doctor of Philosophy ("PhD")in engineering. The intent in doing so was to capture those in academia and achieve the multiple goals of licensing faculty, meeting

state statute for instructing upper level engineering courses in the case of an unlicensed dean and to continue to promote the traditional professional engineering pathway to students and subsequently increase the number of professional engineers. Due to its uniqueness, the Wyoming license is only for practice of professional engineering in Wyoming and is not accepted by other states via comity.

Until the metrics are known, NSPE should evaluate whether to support and promote such alternatives or to propose other alternatives. For example, the PE license requires that the engineer practice *only* in his/her area of competence. Perhaps there is an alternative in which tenured faculty could obtain a PE license by demonstrating proof of research in engineering fields and attainment of tenure status, *plus* passing of a multi-hour ethics examination offered by NCEES. While considering whether alternative pathways to licensure are appropriate, NSPE should forego efforts or using resources to attempt and get all engineering faculty licensed. Instead, a determination of where, when, and why engineering licensure *may* be required would be a more appropriate area of focus for NSPE.

However, the focus should not be solely on getting university engineering faculty licensed. Instead, efforts should focus on getting materials into the hands of engineering educators to share with undergraduate engineering students. Professional engineering licensure may be required for them to practice depending on their area of practice, their employer, and their jurisdiction. Further, educating that while one jurisdiction may not require PE licensure to practice a certain engineering-related activity, another may is critical. Therefore, it is of the greatest importance for an engineering student to pass the Fundamentals of Engineering (“FE”) exam and sit for the Principles and Practice of Engineering exam as soon as possible. NSPE has previously attempted to encourage ABET to require the sharing of this information, even anecdotally, with undergraduate engineering students, but ABET has not incorporated this into its education criteria. Further, with well-known institutions abandoning ABET-accreditation, other avenues for communication must be explored.

This information should also be shared with undergraduate engineering verification groups within each of the discipline-specific engineering societies as they have the direct lines of communication with the engineering education programs around the country, outside of a formal ABET process. Also, given the recent Memorandum of Understanding executed between NSPE and the National Society of Black Engineers ("NSBE"), which has a phenomenal on-campus presence in engineering programs around the country, NSPE could provide an education module to be used by NSBE chapters in a meeting with its student members explaining, in essence, that although they may not need a PE license tomorrow, it may be required someday, and having the tools in their toolkit will set them up for a more rewarding career.

While engineering educators who perceive a particular career path, may encourage students to pursue licensure, it is not a topic discussed in all engineering programs. NSPE has weighed in on this issued through the ABET Criteria 5 process by advocating that licensure education must be part of engineering undergraduate education in that a faculty member has no way of knowing what path their students may take in their careers and knowing about the concept of licensure and the potential need for licensure in their future is a critical education component currently absent from the ABET criteria. ABET has rejected these requests. Instead, some individual technical societies, such as ASCE, have picked up this mantle and as part of their technical review of engineering education programs, inquire as to whether the concepts of licensure and ethics are incorporated into engineering curricula.

Beyond incorporating the subject of licensure into the engineering education curriculum, several key revisions to engineering education should be explored to ensure students in all disciplines are prepared upon graduation. Engineering faculty should impress upon all engineering students the need for a commitment to lifelong learning, whether by obtaining advanced degrees through formal academic education or education through technical societies or other entities to ensure competence in one's area of practice or to expand into a new area of practice. Further, certain fundamental education concepts promoted in engineering design and seminar courses, including project management, leadership capabilities, risk assessment,

initiative, making decisions in the face of uncertainty, the urgency and will to deliver on time in the face of constraints or obstacles, resourcefulness and flexibility, trust and loyalty in a team setting, and the ability to relate to others, including the ability to recognize explicit or implicit bias as well as ways to address and overcome these obstacles.

Current NSPE Professional Policies and Position Statements

- NSPE Professional Policies: PP-38, PP-65, PP-122, and PP-168
- NSPE Position Statements: PS-1752, PS-1766, and PS-1768

While the FOPE Task Force concurs that a greater emphasis must be placed on the engineering aspect of STEM education with significant changes to the core curriculum in the K–12 levels; we chose to base our discussion and recommendation on NSPE Position Statement No. 1752 and NSPE Professional Policy No. 168 which focus on the educational requirements for professional licensure.

Recommendations

To ensure the continuation of the practice of professional engineering, and thereby the continued protection of the public health, safety, and welfare in engineering endeavors, the FOPE Task Force recommends that NSPE:

- Advocate for the adoption of alternative pathways other than formal academic education which could be developed to fulfill additional education requirements beyond a baccalaureate degree prior to professional engineering licensure. One such alternative could consist of coursework and/or workshops that have sufficient content rigor and outcomes assessment that is more robust than traditional continuing education. This would be consistent with the recommendations in current NSPE Policy 168 and NCEES Position Statement 35.
- Revise the core curriculum and additional outcomes as included above by the FOPE Task Force. Additionally, it may be necessary to revise the NSPE Professional Engineering body of knowledge.

- Cease efforts to "get all engineering faculty licensed" and instead shift efforts to getting materials into the hands of educators that they may then use to inform undergraduate engineering students to enforce that engineering licensure may be required for them to practice depending on their area of practice, their employer, and their jurisdiction. Further, that education should include informing students that while one jurisdiction may not require PE licensure to practice a certain engineering-related activity, another may. Therefore, it is of the greatest importance for an engineering student to pass the FE exam and sit for the Principles and Practice of Engineering exam as soon as such examination is allowed. Also share this information with undergraduate engineering verification groups within each of the discipline-specific engineering societies as they have the direct lines of communication with the engineering education programs around the country, outside of a formal ABET process.

APPENDIX E: LICENSURE MODEL AND MOBILITY

Background

The National Council of Examiners for Engineering and Surveying ("NCEES") is a national organization dedicated to advancing professional licensure for engineers and surveyors.

NCEES develops, administers, and scores the examinations used for engineering and surveying licensure in the United States. It also facilitates **professional mobility** and promotes uniformity of the U.S. licensure processes through services for its member licensing boards and licensees.[79] Professional mobility means the movement between states and territories in the United States and around the world of professional engineers ("PEs") capable of independent practice having met the requirements for licensing or registration.[80] In order to consistently and effectively license engineers, we must have vetted educational institutions, training arrangements, and some measures of performance. Engineering is a global profession, changing with time and place but the principles are universally applied. In NCEES' Strategic Plan, *Absolute/full comity and mobility of practice*, is listed third in long term goals.[81] At this time, each state and territory requires application for licensure in their regulated environments. Wyoming, New Mexico, and a few other states have entered into an agreement to set up a mechanism for multi-state application and licensure for Model Law Engineers ("MLEs").[82] This process is currently under development.

PE's must be able to work in other jurisdictions with very little time impact as they move into more national and international markets

[79] National Council of Examiners for Engineering and Surveying. About. *Available at* https://ncees.org/about/ (accessed March 2018).
[80] Dr Peter Greenwood, Hon FIEAust, FIET, SMIEEE, CPEng, EngExec. Mobility of Engineering Professionals for WFEO Standing Committee on Education In Engineering (December 2011).
[81] National Council of Examiners for Engineering and Surveying. Strategic Plan (2015). *Available at* http://ncees.org/wp-content/uploads/2016/05/Strategic-Plan-February-2015.pdf (accessed March 2018).
[82] MLE is an NCEES designation whereby: the MLE has (1) a bachelor's degree in engineering from an EAC/ABET-accredited program, (2) four years of acceptable engineering work experience, (3) passed the NCEES FE and PE exams, (4) no felony convictions, and (5) a clean disciplinary record.

Enhanced Mobility – (MLE Program)

Individuals licensed in one state or U.S. territory are often interested in becoming licensed to practice in additional jurisdictions. However, comity licensure provisions vary significantly from jurisdiction to jurisdiction. For example, some but not all U.S. jurisdictions require that candidates graduate from an accredited program, and some jurisdictions may waive examination requirements if candidates have obtained postgraduate education or have extensive experience. Jurisdictions may also differ in their specific requirements regarding what constitutes acceptable engineering experience. Candidates who received their initial license based on different standards may encounter future difficulty in becoming licensed by comity in other jurisdictions.

To expedite the process of becoming licensed in multiple jurisdictions, the National Council of Examiners for Engineering and Surveying established the Council Records Program. The program assists engineers by compiling all licensure credentials in one place, minimizing duplicate efforts, and reducing the processing time at the board level. A completed Council Record includes a concise report of education, experience, professional references, exam results, and licensure status. Once an engineer has successfully obtained a Record, NCEES can transmit it electronically to multiple jurisdictions.

An important component of the NCEES Records Program is the MLE designation, which NCEES developed to simplify the comity licensure process. Most jurisdictions have adopted all or parts of the NCEES Model Law, and they can expedite the licensure process for engineers who meet all criteria for the MLE designation.

To attain MLE status, applicants must meet four criteria:

1. They must have graduated from an engineering program accredited by the Engineering Accreditation Commission of ABET Inc.
2. They must have passed the NCEES Fundamentals of Engineering (FE) and Principles and Practice of Engineering (PE) exams.

3. They must have completed four years of acceptable engineering experience after confirmation of a bachelor's of science degree in an appropriately-accredited engineering program.
4. Their license must be clear of any disciplinary action.

Although a Council Record does not completely eliminate the need for paperwork, it does significantly streamline the application process for engineers whose services are needed beyond state borders.

Temporary Permits

In most states, a professional engineer who holds a current and valid license issued by a licensing authority in another state that is recognized by the state licensing board may apply for a temporary permit to provide engineering services for a specific project, not to exceed one year. A professional engineer is typically eligible for only one temporary permit; multiple temporary permits are not issued. Extensions on temporary permits are usually not issued. In the event that the project will not be completed within the one year period, the professional engineer must apply for licensure in order to continue practicing, or offering to practice, engineering in that state.

Opportunities to Promote Mobility

PEs can promote licensure every time they present to legislators, companies already operating or looking to operate between states or internationally. They can explain to these group and others the need to establish mobility standards to promote the safety, health and welfare of all people.

Diploma Privilege

One model for licensure of practice that is completely different from the current model would be a diploma privilege model or approach. Within the legal profession, the diploma privilege is a method by which one may practice law without having passed a state bar examination. Once used by 33 United States jurisdictions, only two states accept this model for practice: Wisconsin

and New Hampshire.[83] Wisconsin has offered the diploma privilege since 1870, when it was adopted for purposes of encouraging prospective lawyers to attend law school, instead of just studying the law, which was the legal training at the time. The diploma privilege was first abolished in 1917 in California. Other states followed, with the last abolishment occurring in 1988 in West Virginia. Since 1988 only one state has created a new diploma privilege program.

New Hampshire's program, which is quite different from Wisconsin's program, was approved by the state legislature in 2005 to encourage students to attend New Hampshire's law school and remain in the state to practice the law, with the first eligible class graduating in 2008. Wisconsin's program allows any student who graduates from one of the state's two law schools to immediately practice law in the state without needing to pass the bar examination. New Hampshire's program, in contrast, allows second- and third-year students to apply for admission to a special honors program. In the program, the students learn legal practicum basics, such as taking depositions or motion practice before tribunals. Those accepted to the program have portfolios of written work and records of oral performance reviewed by the New Hampshire state bar examiners each semester. If students pass all semester reviews by instructors and the state bar examiners, they are allowed to practice in the state after graduation from the program and law school, bypassing the bar examination. This licensing model was initially explored in 1992 and, after multiple evaluations and several years as a pilot, the program was adopted 17 years later.

Diploma privilege creates challenges as it is only recognized for mobility purposes by 25 states. This creates inconsistencies in the overall licensure model for the legal profession and, for someone admitted via diploma privilege, would require someone who may have practiced for many years or even decades to sit for the bar examination for admission to practice law in a new state.

Overall, the legal profession continues to evaluate admissions and licensure models for the practice of law that ensures a minimum level of competence. To understand the various

[83] Wikipedia. Diploma Privilege. *Available at* https://en.wikipedia.org/wiki/Diploma_privilege (accessed June 7, 2018).

iterations of admission to the legal profession, which creates its own challenges for mobility, it's important to understand the testing procedures adopted by a majority of jurisdictions. Unlike professional engineering, where all jurisdictions have adopted the engineering exams (fundamentals and principles and practice) developed by NCEES for verification of engineering competence, only 21 jurisdictions have adopted the Uniform Bar Exam for the verification of legal competence. The Uniform Bar Exam includes the Multistate Essay Examination, two Multistate Performance Test problems, and the Multistate Bar Examination. This portion of the examination process requires two 8-hour days of examination. In addition to this post-graduation examination (16 hours) there is a separate examination that those seeking admission to the practice of law must take and pass, the Multistate Professional Responsibility Examination (2 hours).[84]

For a period in 2015, there was a push by several law school deans to abolish the bar exam, thereby adopting a diploma privilege. These deans argued that the bar exam does not test real-world skills and only, instead, tests the ability of students to memorize information – seemingly ignoring that the essay portion of the Uniform Bar Exam is graded on both correct answers but also ability to spot issues and develop thoughtful organization of essay responses. Additionally, by 2016, a few jurisdictions allowed early taking of the bar examination by third-year law students instead of having to wait until after graduation to sit for the bar examination. Successful examinees must complete law school within a specific time after taking and passing the bar examination, but upon completion of law school are allowed to begin practicing law several months ahead of fellow graduates who wait until after graduation to sit for the bar examination.

While the diploma privilege, if applied to professional engineering (i.e., calling everyone who graduates from an engineering program a "PE"), would certainly increase the number of PEs in the United States, such an approach could have tremendous unintended consequences. An

[84] Despite only 21 states adopting the Uniform Bar Exam, all United States bars require passing of the Multistate Professional Responsibility Examination except Maryland, Wisconsin, and Puerto Rico. Both the Uniform Bar Exam and the Multistate Professional Responsibility Examination are developed by the National Council of Bar Examiners.

engineering diploma privilege has been conceptually explained as: "everyone who graduates with a baccalaureate degree in engineering could receive a PE license but the difference would be in obtaining separate approval/certification to be an engineer in responsible charge."

As differentiated from the licensure model for lawyers, the licensure model for engineers includes three independent components (i.e., education, examination, and experience). For the engineering license, a diploma privilege would essentially eliminate the examination and experience components. One can argue about the value of the Fundamentals of Engineering or Principles and Practice of Engineering, but it would be problematic to eliminate the traditional exams in one fell swoop. Regarding experience component, the diploma privilege would not require an engineer to gain mentorship and progressive experience under other PEs prior to becoming licensed and being able to call themselves a "PE."

One could reasonably wonder if the public would be adequately protected when new graduates are allowed to practice engineering right out of college. The diploma privilege would say: "Yes, you are good to go!" Finally, deciding what qualifies as an appropriate degree for purposes of an engineering diploma privilege may prove challenging. Some states currently allow non-ABET-degreed engineers to obtain PE licensure. Additionally, at least two previously-ABET-accredited engineering programs in the United States have dropped ABET accreditation, thus complicating what programs will qualify for licensure education, let along an added complexity of a diploma privilege.

Also to be considered is the body of knowledge ("BOK") required to practice engineering in a specific discipline. A BOK is different for each engineering discipline. Some technical engineering societies say the BOK for their discipline cannot be fulfilled within a baccalaureate degree program. The diploma privilege could be problematic when reasonable people argue that a master's degree should be the minimum requirement for licensure. Which diploma is acceptable? And, how do you get the public, legislators, and stakeholders to understand these various iterations?

Given the recent and aggressive attacks on occupational licensure that question whether licensure of engineers is necessary to protect the public health, safety, and welfare, if a PE license is given to "everyone at graduation," the next reasonable question from the dissenters would be: "if everyone gets a PE license just for graduating, without testing competence or requiring progressive and mentored experience, then why retain PE licensure at all."

Finally, trying to make a distinction between a "PE" at graduation and a "PE in Responsible Charge" makes the entire process of engineering licensure and determination of qualification by the general public unnecessarily convoluted and confusing. At this time, there are already challenges in ensuring the public understands the difference between a "PE" and a "degreed engineer" given the looseness with which the term "engineer" is used across the United States in commerce and education, the lack of common use of "I am a professional engineer" versus "I am an engineer" by the professional engineering community, the varying definitions state-by-state as to what activities require, or are exempt from, requiring professional engineering licensure, and the nuances associated between design and responsible charge. Approaching licensure in the conceptual way described above is more likely to harm the profession and put at risk the public health, safety, and welfare given the difficulty for Licensure Boards in investigating and enforcing a nuance such as "PE at graduation" and "PE in responsible charge" as well as introducing an additional level of confusion for the public.

Mobility

These multiple approaches to legal licensure and the various iterations thereof create substantial mobility challenges for lawyers seeking to practice in multiple jurisdictions. In addition to admission requirements varying across jurisdictions, there are further post-admission iterations as well. These include total hours of continuing education for renewal, varying renewal periods (bi-annual versus tri-annual), non-synchronous renewal periods or time frames (some set renewal periods and education periods by last name on date of admission whereas others are set by admission date and some are a hybrid thereof), and some states even require, by statute, membership in the jurisdiction's bar association to maintain licensure.

To aid in mobility, the legal profession has established a cross-jurisdictional admission process for purposes of temporary practice.

The legal profession offers an approach to practice in multiple jurisdictions that is significantly distinct from professional engineering. A lawyer admitted in one jurisdiction may seek the ability to temporarily (for the tenure of a particular case) practice in a jurisdiction to which they are not admitted. To do this, the lawyer must find another lawyer licensed in that target jurisdiction and be admitted by the tribunal overseeing the case at issue via motion of *pro hac vice*. The locally-admitted lawyer must participate in certain aspects of the case proceedings before that tribunal and takes certain involvement in the case, but this approach allows a non-jurisdictionally-admitted lawyer to practice in that jurisdiction for a short period of time for a particular matter in which they may be particularly experienced to assist with or to ensure continuity of representation for a client.

Compact Model

Another model for licensure is the "compact" model. The nursing profession has led the way in the implementation of this model. Removing barriers to cross-border practice, the Nurse Licensure Compact ("NLC") is an interstate agreement allowing a nurse to have one license and the privilege to practice in other compact states. Implemented in 2000, the NLC fosters public protection and access to care through the mutual recognition of one state-based license that is enforced locally and recognized nationally. Along with a majority of state nurses associations, hospital associations and health care facilities in every state overwhelmingly support the NLC. The NLC includes important patient safety features such as facilitation of the sharing of licensure, investigative and disciplinary action information among member states. Since the NLC's initial launch, advances in technology and an increasingly mobile nursing workforce and patient population have created the need to break down barriers to interstate practice. Access to care has expanded and telehealth has transformed care delivery and erased geographic boundaries. The NLC has the ability to remove the licensure barrier to telehealth practice for more than 4 million nurses.

Current NSPE Professional Policies and Position Statements Policies/Position Statements:

- NSPE Professional Policies: PP-45, PP-50, PP-58, PP-61, PP-65, PP-66, PP-75, PP-96, PP-122, PP-152, PP-166, PP-168, PP-171, and PP-173
- NSPE Position Statements: PS-1752, PS-1768, PS-1737, PS-1766, PS-1767, PS-1747, PS-1748, PS-1750, PS-1751, PS-1774, PS-1778, and PS-1780

Recommendations

NSPE must continue to promote the standards supported and regulated by NCEES and others involved in the national and international licensing mobility movement.

NSPE must continue to promote mobility of the PE license to accommodate the needs of a more mobile society. To achieve this, NSPE should continue to support the NCEES model laws and rules for licensure, which provide for licensure for the practice of engineering by PEs only and by the same method, avoiding the introduction of additional iterations of licensure laws, which just create barriers for the mobility of professional engineering licensure.

PEs must be able to work in other jurisdictions with very little time impact as they move into more national and international markets, including the potential use of temporary licenses. This could be similar to the *pro hac vice* process used by the legal community for situation-specific practice outside an already-licensed jurisdiction. Continuity and process streamlining which eliminate bureaucratic barriers are valued by today's PEs. A unified message to both the private and public sectors is necessary for the survival of the current licensing system.

NSPE should not advocate for a new model to licensure similar to the diploma privilege employed by two states for the practice of law.

To ensure the continuation of the practice of professional engineering, and thereby the continued protection of the public health, safety, and welfare in engineering endeavors, the Future of Professional Engineering Task Force recommends that NSPE:

- Continue to support the education, examination, and experience requirements for professional engineering licensure across all states and territories of the United States.
- Support multi-state compacts that provide broad reciprocity between states if an individual is determined eligible for licensure in one of the signatory states (i.e. licensure in one provides for licensure in all without separate verifications for each application for professional engineering licensure).
- Explore support of temporary professional engineering licensure upon moving to a new state or territory so as to not infringe upon one's ability to obtain employment.
- Explore support of project-specific professional engineering licensure in a state in which an individual is not licensed provided, however, they have a local PE support the project-specific licensure, similar to the *pro hac vice* system employed in the legal profession.
- Actively advocate with state society partners and partners in other technical and professional engineering associations for states to comport their professional engineering licensure laws to the NCEES model laws and model rules, including those of continuing education, to ensure mobility and also the individual competency of PEs.

APPENDIX F: INTERNATIONAL LICENSURE

Background

The world has been growing toward one world market since the recognition of interconnected dependency through imports and exports to improve individual country's economies and ultimately the quality of life for its citizens. As engineering increasingly becomes a profession that crosses international borders, some organizations have initiated efforts to not only facilitate the flow of engineers and projects but also to ensure rigorous standards of competence and professionalism.[85] Mobility of professional engineers is key part of the strategic plan for the National Council of Examiners for Engineering and Surveying ("NCEES") both domestically and is growing internationally.

NCEES first offered overseas exams in Japan in 2006, taking over administration there from the Oregon State Board of Examiners for Engineering and Land Surveying, which had provided the exams at the request of the Japan Technology Transfer Association.

NCEES signed an agreement with the Japanese PE/FE Examiners Council ("JPEC") to continue the exams. Another agreement with the Korean Professional Engineer Association ("KPEA") soon followed. "We found we were dealing with professionals with the same values and professionalism as [in the US]," [86] said Jerry Carter, current CEO of NCEES. In December of 2014, NCEES renewed its examination agreement with JPEC during a ceremony in Tokyo. NCEES also has agreements to offer the FE and PE exams in Canada, Saudi Arabia, the United Arab Emirates, Egypt, and Turkey with ongoing discussions for additional countries in Asia and the Middle East. Carter says one of the driving forces behind the growth in international exams has been the increase in ABET accreditation overseas. Once organizations become accredited, they've been interested in accessing the FE exam as an outcomes assessment tool.

The NCEES International Registry assists United States-based professional engineers who are seeking recognition in countries that are members of the Asia-Pacific Economic

[85] Eva Kaplan-Leiserson. PE Magazine, *Going Global* (April 2014).
[86] *Id.*

Cooperation (APEC) or the International Engineering Alliance (IEA), formerly the Engineers Mobility Forum (EMF).

The Washington Accord is an international agreement that is a constituent of the IEA between organizations and countries who have taken on the responsibility for accrediting engineering degree programs. It was originally signed in 1989 and is a multi-lateral agreement for validation of tertiary-level engineering qualifications to assist the mobility of professional engineers. The Accord outlines the mutual recognition, between the participating bodies, of accredited engineering degree programs. It also establishes and benchmarks the standard for professional engineering education across those bodies.[87] The Accord has grown from an initial group of six signatories to a well-structured and sought-after organization. The international recognition and portability of both educational qualifications and professional competency is becoming increasingly important in this age of global interdependence but unbalanced global development, which requires movement of engineering skills around the world.[88]

Currently there are fifteen signatories that make up the Washington Accord. They are as follows: Australia, Canada, Ireland, New Zealand, United Kingdom, United States,[89] Hong Kong China, South Africa, Japan, Singapore, Korea, Taiwan, Malaysia, Turkey, Russia; and six with provisional signatory status: Bangladesh, China, India, Pakistan, Philippines, and Sri Lanka.

PEs can promote licensure every time they present to academic institutions, board of directors, legislators, companies already operating or looking to operate internationally. They can explain to these group and others the need to establish a basic, uniform competency level to promote the safety, health and welfare of those all around the world and they can be assured regarding those they hire in foreign countries meet expected, known standards.

[87] Washington Accord. *Available at* http://www.ieagreements.org/accords/washington/, (accessed June 1, 2018).
[88] Basil Wakelin, Chair, IEA Governing Group. *25 Years of Washington Accord 1989-2014*. *Available at* http://www.ieagreements.org/assets/Uploads/Documents/History/25YearsWashingtonAccord-A5booklet-FINAL.pdf (2014) (accessed June 1, 2018).
[89] The U.S. signatory is ABET.

The world market continues to expand, and economies become more interconnected. As companies continue to move into foreign arenas the need for known measurements of professional standards that are regulated are desired to promote economic development. The greatest challenges appear to be in the ethics of differing cultures and stages of civilized advancement.

Current NSPE Professional Policies and Position Statements

- NSPE Professional Policies: PP-45, PP-50, PP-58, PP-61, PP-65, PP-66, PP-75, PP-96, PP-122, PP-152, PP-166, PP-168, PP-171, and PP-173
- NSPE Position Statements: PS-1752, PS-1768, PS-1737, PS-1766, PS-1767, PS-1747, PS-1748, PS-1750, PS-1751, PS-1774, PS-1778, and PS-1780

Recommendations

The National Society of Professional Engineers ("NSPE") must continue to promote the standards supported and regulated by NCEES and others involved in the international licensing movement. A marketing campaign to promote the NSPE Code of Conduct so that it is synonymous with professional engineering behavior much like the Hippocratic Oath is associated with physicians, would help all entities grasp the need for ethical as well as technical behavioral standards to uphold the health, safety and welfare of our societies.

To ensure the continuation of the practice of professional engineering, and thereby the continued protection of the public health, safety, and welfare in engineering endeavors, the FOPE Task Force recommends that NSPE:

- Continue to promote the standard supported and regulated by NCEES.
- Provide an international pathway to membership in NSPE.

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APPENDIX G: ROLE OF THE CERTIFIED ENGINEERING TECHNICIAN AND CERTIFIED ENGINEERING TECHNOLOGIST

Background

As technology continues to revolutionize the day-to-day tasks of the professional engineer, so does the public demand a competitive business model for professional engineering to remain viable. To draw a parallel to describe such a model, we look to the legal and medical profession. Operating similarly to paralegals or physician assistants, Engineering Technicians may be able to provide competitive value to the engineering profession. From a cost-benefit perspective, the use of a Certified Engineering Technician ("CET") or Certified Engineering Technologist ("CT") can provide an efficient approach to the delivery of professional design services, under the supervision of the professional engineer in responsible charge. Identifying tasks that have traditionally been completed by both licensed and unlicensed engineers that could/should be completed by technicians, under the supervision of the professional engineer ("PE") in responsible charge, could help the profession be more sustainable and competitive.

Traditionally, the engineer intern ("EI") fulfilled this area in the business structure, providing for a more competitive professional services pricing model. This recommendation does not change the need or requirement of the PE, but is a more inclusive and flexible, value added tool in to the PE's toolbox to provide a broader array of services for the public. In this way, the future of the profession can evolve with the recognition of the need for licensure. In addition, alternate career paths can work together to eliminate further erosion caused by industrial exemptions and other threats.

The professional engineering community should develop a better understanding of the capabilities of CETs/CTs and, more importantly, identify ways in which the technician community could expand their competency base. This could be a first step in the deeper implementation of CET/CTs in the delivery of professional design services through a more blended model.

The National Institute for Certification in Engineering Technologies ("NICET") is a division of NSPE. Since the Institute was founded in 1961, nearly 150,000 engineering technicians and technologists have met NICET's rigorous certification criteria – including a proctored written examination, documented work experience and on-the-job performance. The number of NICET-certified CET and CT continues to grow rapidly as more government agencies and private sector engineering firms, contractors and testing laboratories rely on NICET certification to confirm the qualifications of their engineering technician and technologist workforce. NICET-certified engineering technicians and technologists are required to renew their certification every three years by accumulating 90 Continuing Professional Development credits; and are expected to adhere to a Code of Ethics.

Because of the important role CET and CT can play in the deployment of professional engineering services across all engineering disciplines, the Future of Professional Engineering ("FOPE") Task Force recommends that NSPE, with the assistance of its engineering technician and technologist certification body, NICET, and the volunteer technician association, the American Society of Certified Engineering Technicians, better communicate to its members, the professional engineering community, and the public at large the critical role performed by CETs/CTs. The FOPE Task Force also recommends that NSPE communicate, at all available opportunities, how CETs and CTs can add value to the practice of professional engineering and, in turn, to clients, by allowing PEs to focus on creating solutions in the big-picture sense and allowing CETs and CTs to perform critically important technical work on drawings or calculations that are then reviewed by the PE in responsible charge of that project or that portion of the project. This is similar to the way in which medical doctors highlight the important role performed by physician assistants, nurse practitioners, and nurses in their practice, and attorneys emphasize the critical impact paralegals and law clerks have in their practice. Professional engineering has been much slower to adopt this approach than the medical and legal professions.

More and more the public served by the engineering profession is requiring higher quality and faster services, at a lower cost. Additionally, advances in technology have made it increasingly

difficult for PEs to remain proficient in every aspect of their technical specialty. As we have seen in the medical and legal professions, the inclusion and greater use of highly skilled and qualified support staff (i.e., certified paraprofessionals) has significantly increased the quality and speed of services in these professions, while keeping costs as low as possible for the consumer.

Paraprofessionals that lack the official authority (i.e., license) of the professional are frequently able to perform many tasks requiring significant knowledge in the field that were previously performed by licensed professionals, often as well as or better than the licensed professional, and may even function independently of direct professional supervision. In the medical profession, these support staff include medical technicians, technologists, nurses, nurse practitioners, and physician assistants. In the legal profession, these support staff include legal assistants and paralegals. In the engineering profession, these support staff must include engineering technicians, and engineering technologists.

The PE holds an engineering license and is qualified to be professionally responsible for engineering work. Such an individual comprehends and applies advanced knowledge of engineering principles in the solution of complex problems. The *Engineering Technologist* exerts a high level of judgment and generally specializes in one or more technical areas, while under the direct control and supervision of a Professional Engineer. A person working as an Engineering Technologist comprehends and applies knowledge embodied in widely accepted and applied procedures, processes, systems or methodologies, to the solution of broadly-defined problems. The *Engineering Technician* is a person that typically performs task-oriented scientific or engineering related activities, under the direct control and supervision of a Professional Engineer or direction of an Engineering Technologist. An Engineering Technician comprehends and applies knowledge embodied in standardized practices to the solution of well-defined problems.

Engineering Technologists have always been members of the engineering profession, even if they are not identified as such. Many governmental organizations and private corporations have developed job classifications that specify levels of education and experience which closely

reflect those of an Engineering Technologist. Engineering Technologists are often identified by their area of practice and expertise. For example, a Transportation Technologist at a state DOT may perform skilled technical tasks such as coordinating field survey crews, preparing project plans and specifications, providing on-site project management, or supervising construction materials testing activities. A Manufacturing Technologist for a private firm may be responsible for supervising assembly-line operations, assisting with product research and development, managing supply acquisitions and product distributions, or sales.

Engineering technicians are the "hands-on" members of the Engineering Team who work under the direction of engineers, scientists, and technologists. They have knowledge of the components, operating characteristics, and limitations of engineering systems and processes particular to their area of specialization. Technicians assist with project design, systems installation, construction management, systems commissioning, maintenance and repairs, updates and renovations, and the plethora of reports, standard specifications, permit applications, and other technical documents that must be prepared. Engineering technicians serve as surveyors, materials sampling and testing technicians, drafting technicians, construction inspectors, technical installers, and system programmers.

As with any other profession, the effectiveness of CET and CT involvement is tied directly to their knowledge and experience. Engineering Technologists will typically acquire their knowledge initially through a 4-year, bachelor's degree curriculum in Engineering Technology from a college or university program accredited by ABET-ETAC. Engineering Technicians typically acquire their knowledge either through a 2-year, associate degree curriculum in Engineering technology, or from on-the-job experience. This knowledge, and the skill to apply this knowledge, increases over time as individuals are exposed to a wider array of activities and environmental conditions.

Independent, third-party credentialing (i.e., from organizations such as NICET) for CETs and CTs demonstrates their acquired competencies, and a commitment to their chosen profession. Professional certification programs, much like professional licensure programs, will assess

individuals' knowledge (typically through an education requirement or a written examination), their skill at applying knowledge (typically through an assessment of on-the-job performance or a staged performance examination), and their relevant work experience over time. Continuing professional development, adherence to a Code of Ethics, and recertification every 3-5 years are also hallmarks of professional certification.

NICET currently offers certification for engineering technicians in twelve specialty areas. NICET-certified engineering technicians are required by governmental agencies throughout the United States – and at various levels of competency based on the work tasks being performed (see attached chart). In addition, many private sector specifiers require NICET-certified engineering technicians for their contracts; and many employers around the world require and recognize NICET-certified engineering technicians within their organizations to demonstrate the quality and economic value of the engineering services being provided to their clients. The following table provides a summary of CET and CT certifications required by governmental agencies:

Fire Alarms	Inspection & Testing of Water Based Systems	Water Based Systems Layout	Special Hazards Systems Layout	Construction Materials Testing	Geotechnical Engineering	Highway Construction	Bridge Safety Inspection
GSA Contracts	GSA Contracts	Alabama	Alaska	Alaska	Georgia	Alaska	Georgia
Alabama	Alaska	Alaska	Colorado	Arizona	Nebraska	Connecticut	Illinois
Alaska	Arizona	Arizona	Delaware	California	Ohio	Maine	Iowa
Arizona	Delaware	Arkansas	Iowa	Colorado	South Carolina	Nebraska	Louisiana
California	Florida	Colorado	Kentucky	Delaware		New York	Michigan
Delaware	Georgia	Connecticut	Montana	Maine		Ohio	Minnesota
Kansas	Iowa	Delaware	New Hampshire	Michigan		South Carolina	Nebraska
Kentucky	Kansas	Georgia	New Jersey	Nebraska		Utah	New Jersey
Michigan	Maryland	Idaho	New Mexico	Ohio			North Carolina

Fire Alarms	Inspection & Testing of Water Based Systems	Water Based Systems Layout	Special Hazards Systems Layout	Construction Materials Testing	Geotechnical Engineering	Highway Construction	Bridge Safety Inspection
Minnesota	New Jersey	Illinois	Ohio	South Carolina			Texas
Montana	Ohio	Indiana	Oklahoma				Washington
Nebraska	South Carolina	Iowa	Texas				Wisconsin
Nevada	South Dakota	Kentucky	Vermont				
New Hampshire	Texas	Louisiana					
New Jersey	Utah	Maine					
New Mexico	Washington	Maryland					
New York (City)	West Virginia	Minnesota					
Ohio		Nebraska					
South Carolina		New Hampshire					
South Dakota		North Carolina					
Texas		Ohio					
Utah		Pennsylvania					
West Virginia		South Carolina					
Wyoming		South Dakota					
		Tennessee					
		Texas					
		Vermont					
		Washington					
		Wisconsin					

In the truest sense, certified CETs and CTs should be viewed as individuals that has acquired a high level of knowledge and skill in their chosen area of specialty, and a significant amount of

practice in that field. Active participation in technical and professional membership organizations (such as the American Society of Certified Engineering Technicians), demonstrates a commitment to their chosen profession, and to the engineering community. Therefore, an individual that chooses engineering technology as a long-term occupation has the potential to add significant value to the Engineering Team.

From a cost-benefit perspective, the use of CETs and CTs can provide an efficient approach to the delivery of professional services. Identifying tasks that have traditionally been completed by both licensed and unlicensed engineers that can be completed by CETs and CTs, under the supervision of the PE, would help the profession be more sustainable and competitive in the future. This allows the PE to focus on the more complex tasks that they are uniquely qualified to perform, and delegate the widely accepted and applied tasks to qualified CETs and CTs. Many federal, state and local governmental agencies already recognize the value of having CET/CTs involved with the design, construction and maintenance of their engineering projects.

Traditionally, the EIT/EI fulfilled these more routine tasks in the business structure to provide a more competitive professional services pricing model. This recommendation to better utilize engineering technologists and engineering technicians does not change the need or requirement for PEs, but is an inclusive, value added role in to the professional engineer's toolbox to provide the best possible services for the public. In this way, the future of the profession can evolve with the recognition of the need for licensure of engineers and certification for engineering technologists and engineering technicians; and qualified individuals in these two career paths can work together to eliminate further erosion caused by industrial exemptions and other threats.

Current NSPE Professional Policies and Position Statements

- NSPE Professional Policies: PP-166
- NSPE Position Statements: PS-1749

Recommendations

To ensure the continuation of the practice of professional engineering, and thereby the continued protection of the public health, safety, and welfare in engineering endeavors, the FOPE Task Force recommends that NSPE:

- Communicate to NSPE members, and in communications to the professional engineering community, and the public at large, the CET and CT fields.
- Communicate, at all available opportunities, how CETs and CTs can add value to the practice of professional engineering and, in turn, to clients, by allowing PEs to focus on creating solutions in the big-picture sense and allowing CETs and CTs to perform technical work on drawings or calculations that are then reviewed by the PE in responsible charge of that project or that portion of the project.
- Communicate parallels between PEs, CETs, and CTs to the way in which medical doctors make use of physician assistants, nurse practitioners, and nurses in their practice or attorneys make use of paralegals and law clerks in their practice.

APPENDIX H: ALTERNATIVE DELIVERY METHODS

Background

Alternate Delivery Methods ("ADMs") have gained increasing popularity with government agencies over the previous decade. ADMs can be broadly described as any method by which government or other publicly funded entities procure and contract for the construction of public infrastructure other than traditional Design Bid Build. ADMs include Design Build, Progressive Design Build, Construction Manager at Risk, Integrated Project Delivery, Competitive Sealed Proposal and A+B Bidding. States have varying rules that regulate how ADMs can be used by agencies and political subdivisions within the state.

Each type of ADM provides different benefits and risks to the owner. Factors such as safety, function, time from conception to completion, capital and life-cycle costs, environmental quality, and appearance may each play a role in the owner's decision to utilize a particular ADM. Owners typically use ADMs in an effort to reduce project schedules and increase project quality. As contracts are developed and negotiated for specific projects, the allocation of risk, control and other factors can be further defined and tailored to the needs of the project and desires of the contracting parties. Generally, as the owner's schedule and budget risk decrease, so does the owner's control over material choices and design elements.

Owners typically use ADMs in an effort to reduce project schedules and increase project quality.

Owners face the following risks when using ADMs:

1. Lack of experience developing and negotiating contracts
2. Lack of control over material choices and design elements
3. No direct contractual relationship with design engineer

The first two of these risks are relatively well understood and described in several guidance documents published by the Construction Management Association of America ("CMAA") and

the Design Build Institute of America ("DBIA").[90] However, the risks associated with the absence of a direct contractual relationship between the owner and the engineer are less well understood. Due the experience and insight members of the National Society of Professional Engineers ("NSPE") members have gained using ADMs over the past two decades, NSPE is well positioned to provide guidance to owners on managing these risks.

Current NSPE Professional Policies and Position Statements

- NSPE Professional Policies: PP-22, PP-45, PP-50, PP-58, PP-61, PP-96, PP-122, PP-131, PP-149, PP-166, and PP-171
- NSPE Position Statements: PS-1749, PP-130, PS-1777, PS-1747, PS-1748, PS-1750, PS-1751, PP-66, PS-1774, PP-75, PS-1778, and PS-1780

Recommendations

To ensure the continuation of the practice of professional engineering, and thereby the continued protection of the public health, safety, and welfare in engineering endeavors, the Future of Professional Engineering Task Force recommends that NSPE:

- Develop an NSPE Task Force with diverse experience using alternative delivery methods (project owners, sponsoring governmental entities, engineering services (PEs and CETs/CTs), and financing) to produce and maintain (at regular intervals) a best management practices and lessons learned document that could be presented annually at PECON with updates in experience or example projects.
- Produce and maintain an ADM body of knowledge from the PE's perspective.
- Develop a guidance document for public owners regarding the use of alternative delivery methods and the importance of inclusion of PEs in the process.

[90] Construction Management Association of America. *An Owner's Guide to Project Delivery Methods* (2012). *Available at* https://cmaanet.org/files/Owners%20Guide%20to%20Project%20Delivery%20Methods%20Final.pdf (accessed March 2017);Design Build Institute of America. *Design Build Done Right* (2014). *Available at* https://www.dbia.org/resource-center/Documents/Best_Practices_2014.pdf (accessed March 2017).

APPENDIX I: PUBLIC SECTOR ENGAGEMENT

As stated by the National Society of Professional Engineers' ("NSPE's") Board of Ethical Review:

> *Professional engineers working in the public sector have a unique role in serving as guardians of various health, safety, and welfare issues. In addition to their basic professional role in holding paramount the public health, safety, and welfare, engineers in the public sector are empowered to make recommendations and approve only those drawings, plans, and specifications that are consistent with engineering standards. In many ways, engineers in the public sector are a key line of defense in protecting the public.*[91]

To that end, engaging public sector professional engineers ("PEs"), in general, in support for professional engineering licensure issues and through membership in NSPE is important to build resources and advocates in key decision-making and stakeholder positions to ensure the continued protection of the public health, safety, and welfare in the development of the built environment and the deployment of various engineering technologies. To encourage such engagement, the FOPE Task Force recommends that NSPE develop and implement a rate for public sector PEs and those on the PE track, consistent with the direction of the NSPE House of Delegates in July 2017. Then, following such development, undertake an active public sector PE member marketing campaign.

In reviewing other professional associations, three associations that offer discounts for public sector members stood out and were evaluated further. The American Bar Association offers membership to government lawyers at an approximately 43 percent discount at its maximum. The American Medical Association offers membership to military physicians at an approximately 33 percent discount. The American Public Works Association offers membership to a public agency (that includes covering dues of rostered members) at a discount of

[91] National Society of Professional Engineers. Board of Ethical Review. *Engineer's Duty to Adhere to Codes, Standards and Guidelines*. *Available at* https://www.nspe.org/resources/ethics/board-ethical-review/public-health-and-safety-engineer-s-duty-adhere-codes (accessed June 1, 2018).

approximately 31 percent (when compared to the same corporate group membership roster member inclusion).

Beyond general engagement of public sector PEs, advocacy to ensure that selection committees for federal, state, and municipal infrastructure projects should include a PE or multiple PE's to analyze the technical aspects that are required for firms to meet a qualification based selection process. NSPE and its state societies should work with appropriate state or local governments to incorporate qualified PEs in the selection process. Additionally, NSPE should work with federal agencies to ensure that qualified PEs are available and identified for participation in the selection process, perhaps even maintaining an NSPE Community solely dedicated to individuals who would be qualified for these selection committees. In furtherance of these efforts, NSPE should work cooperatively with the American Public Works Association ("APWA"), American Society of Civil Engineers ("ASCE"), and Society of American Military Engineers ("SAME") (three of the largest public sector membership organizations) on key issues.

Current NSPE Professional Policies and Position Statements

- NSPE Professional Policies: PP-152, PP-168, and PP-131
- NSPE Position Statements: PS-1778, PS-1737, and PS-1767

Recommendations

To ensure the continuation of the practice of professional engineering, and thereby the continued protection of the public health, safety, and welfare in engineering endeavors, the FOPE Task Force recommends that NSPE:

- Develop focused partnerships (formally or informally) with the APWA, ASCE, and SAME – three of the largest organizations with public sector membership – with the specific goal of increasing, and maintaining, public sector engagement in the (1) long-term sustainability of professional engineering, including through membership in NSPE; (2) support of NSPE advocacy efforts on behalf of the PE license and continued protection of the public health, safety, and welfare in projects funded by public tax dollars or

constructed for the benefit of the public; or (3) education sponsored by NSPE of key issued facing public sector engineers (licensed and non-licensed) that are of importance to the continued protection of the public health, safety, and welfare.

- Develop and offer a government PE rate for membership in NSPE and provide various platforms for government PEs to collaborate either amongst themselves regarding best practices or amongst private practice and industry PEs.
- Actively work to increase the number of public sector members in NSPE so as to provide additional perspectives to the work of NSPE in support of the PE license and the protection of the public health, safety, and welfare.
- Advocate that all federal, state, and municipal infrastructure project selection committees include a PE or multiple PEs to analyze the technical aspects that are required for firms to meet a qualification based selection process. Increasing membership in NSPE of employees of these key employers will also provide opportunities to extol the value of PEs for potential resources as needed by these key employers for project development.

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APPENDIX J: DEFINING AND COMMUNICATING VALUE

As discussed previously in this report, during its work, the Future of Professional Engineering ("FOPE") Task Force identified multiple ways in which professional engineers ("PEs") communicate what they do in response to the question, "What do you do?" Those responses included the following, among other responses: "I'm an engineer," "I'm a PE," "I'm a licensed engineer," "I'm a registered engineer," "I'm a [discipline or specialty] engineer," "I'm a consultant," and "I'm a project manager," The fact that a PE can communicate what their profession is in so many ways creates additional confusion among the public about who PEs are and why licensure is critical for our profession. PEs can benefit greatly from developing consistency in telling our story to the public.

> An engineer is a constructive artist. The art of engineering is based on science and mathematics, where the tools and materials are technological. It's a constructive art because engineers build and optimize things. And yes, the intent here is to highlight the concept that engineering is art —interpretation, design, creation, invention, and expression—in contrast to the common stereotype that the profession is rigid and formulaic.
>
> *– Citizen Engineer*
> by Greg Papadapolous and Dave Douglas:

The National Society of Professional Engineers ("NSPE") takes ownership of our public identity as PEs and helps define who we are, what we do and what we value. Right now, the public has a generally positive view of "engineers," but a big part of the story is missing. The term "engineer" is broad and all-encompassing. Many surveys of public view of professions do not offer any level of detail as to what kind of engineers they are including in that survey. And general knowledge of "professional engineer" versus "engineer" is limited. Additionally, communication of "professional engineering" versus "the engineering profession" can be challenging, even among PEs and PE regulators.

In general, engineers are seen as intelligent introverts who toil alone on important projects.[92] While this may be true for some in professional engineering, PEs are those pulling together project teams, heading engineering departments or corporations, developing creative solutions to everyday problems, and providing critical insight and expertise to find ways to improve life in our society. It is imperative that NSPE take the charge in changing the "introverted professional engineer" perspective as we are the ones who can communicate best what it is we do and challenge long-held assumptions about professional engineering.

PEs are collaborative solution creators who are socially engaged, innovative, and community minded.

PEs are collaborative solution creators who are socially engaged, innovative, and community minded. We can also help people understand that all PEs abide by a code of ethics that says we "must be dedicated to the protection of the public health, safety, and welfare." In most states, following language similar to the NSPE Code of Ethics or the National Council of Examiners for Engineering and Surveying Model Rules of Professional Conduct is part of the legislative requirements for licensure. Given that this exists already and is known to PEs, NSPE should continually and exhaustively promote and market this code to the general public so that ethics or good moral character and value are synonymous with professional engineers. Care must be taken to only promote and not compare so as to not degrade unlicensed engineers or technicians.

To raise awareness of the critical role of PEs in protecting the health, safety and welfare of the public, attention must be drawn to engineering failures as well as successes as they relate to the daily lives of human beings. Historically, engineers have been reluctant to share their success stories and even more so their failures. Only through repeated exposure to the societal

[92] American Society of Engineering Educators. *The Engineer's Role in Public Policy* at 2 (2003). *Available at* https://peer.asee.org/the-engineer-s-role-in-public-policy.pdf (accessed June 1, 2018). There remains a "popular perception that engineers are geeks, technonerds, or loners who have highly developed technical skills, but lack social skills. The popular perception (as illustrated in the Dilbert cartoons) is that engineers work alone, doing boring work in small offices surrounded by computers . . ." *Id.*

impacts of good and bad engineering practice, will the public come to truly understand and appreciate the role of the PE.

NSPE is already educating the public about and advocating for PEs. But we can learn new ways of communicating from other professions. For example:

- *American Medical Association* – administers medical licenses, takes positions on policy issues, issues press releases, makes recommendations related to public health issues, disciplines doctors for misconduct
- *American Bar Association* – grants and rescinds the right to practice law (at state level), disciplines attorneys for misconduct
- *American Institute of Certified Public Accountants* – Administers the C.P.A. certification
- *Certified Financial Planners* – national sustained advertising campaign
- *Society for Human Resource Management* – national sustained advertising campaign

These organizations have made their licenses part of the vernacular. Everyone knows what profession an M.D., J.D./Esq., and C.P.A. are practicing. Perhaps NSPE can publicize the "P.E." in a way that increases the public's familiarity with it while tying it to the Code of Ethics. This message should be communicated to both the public and within the profession so that the public sees the value in professional engineers, unlicensed engineers see the value of licensure, and PEs feel pride in their profession. PE Day and the new, more consistent and compelling branding is a great start, but can also get quickly diluted in "EWeek," "Engineers' Day," "#ILookLikeAnEngineer," etc.

Communicating why we do what we do as PEs, versus communicating only what we do can aid in this effort for a great public understanding and appreciation of professional engineering.

Communicating why we do what we do as PEs, versus communicating only ***what*** we do can aid in this effort for a great public understanding and appreciation of professional engineering. This includes the need to develop clear and effective talking points to be delivered that explain why PEs do what they do and not only what PEs do in their practice of engineering. Such communications should be updated

regularly and should also include state-specific information on the breadth of engineering activities that are exempt in that state from licensure, thereby not ensured the additional layer of regulatory oversight related to holding the public health, safety, and welfare paramount above all other considerations.

Some other ways to increase awareness of professional engineering are:

- Continue and expand the use social media
- Engage with college students to help them understand they are part of a proud and valued profession
- Engage with professors to promote licensure
- Sponsor local events geared toward science and engineering
- Issue press releases and publish studies
- Provide opportunities and tools for PEs to share their stories
- Continue to *applaud* those in academia who pursue licensure personally and *actively develop materials for educators, whether or not PEs,* to promote it to their students accordingly

As PEs work to further define the profession for the public's understanding, our society's trust in and respect for engineers will grow. There will be an increased understanding of the value of the engineering perspective and people will expect to see engineers involved in important decisions about public infrastructure. This will lead to better and more informed deliberations about public investments in our systems of critical infrastructure.

Current NSPE Professional Policies and Position Statements

- NSPE Position Statements: PS-1737, PS-1750, PS-1751, PS-1766, PS-1767, PS-1771, PS-1778, and PS-1779

Recommendations

To ensure the continuation of the practice of professional engineering, and thereby the continued protection of the public health, safety, and welfare in engineering endeavors, the FOPE Task Force recommends that NSPE:

- Develop an NSPE task force whose sole charge is to define and communicate the value of PEs. This task force would engage NSPE Membership, Leadership, and Staff to collectively define the value of professional engineering and, more importantly, effectively communicate the value of PEs to those already in the profession, those in public office, and the general public. This task force should be focused solely on developing and testing messaging and should include members but also marketing professionals.

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APPENDIX K: COMMUNICATION PLAN

The Future of Professional Engineering ("FOPE") Task Force completed its work and prepared this report for the National Society of Professional Engineers ("NSPE"). The FOPE Task Force, however, believes the information contained in this report may be of interest to other key stakeholders to the practice of professional engineering. Below, the FOPE Task Force proposes lists of other constituencies that may find various portions of this report of interest.

As a broad matter, the FOPE Task Force believes that until NSPE formally adopts anything specific from this report, any communications related to the report should include the following, or similar language to ensure avoidance of doubt regarding NSPE's position on any of the information contained herein:

> *This report was developed by a team of volunteers appointed to the Future of Professional Engineering ("FOPE") Task Force of the National Society of Professional Engineers ("NSPE") from June 2016 to July 2018. The summaries, recommendations, and conclusions were developed over a two-year period through various discussions, exchanges, and considerations by the FOPE Task Force. The opinions and recommendations presented in this paper are intended to encourage further understanding and discussion of the topics identified herein; they do not necessarily reflect those of NSPE, the individual members of the FOPE Task Force, the professional organizations or local, state, or federal agencies identified herein, or the employers or other affiliated professional organizations or societies of the FOPE Task Force members. Only those recommendations later incorporated into NSPE Professional Policies, Position Statements, or other official NSPE documents or communications represent the position of NSPE.*
>
> *The FOPE Task Force presents this report to NSPE with the intent that it will encourage thoughtful discussion around the recommendations identified herein. While the FOPE Task Force worked diligently to analyze key issues and concerns*

from many different perspectives and gathered input from many different sources, additional input and insight is warranted as professional engineering progresses through the twenty-first century. Further, this report is not intended to be, or capable of being, all-encompassing of every key considerations related to professional engineering and the continued protection of the public health, safety, and welfare.

As to particular topics, the FOPE Task Force has identified the following stakeholders, in addition to the NSPE membership, to which this information should be disseminated, that may be most interested in the material associated therewith. This list is not all-inclusive, but is intended to be a starting point for further communication of the FOPE Task Force's two years of work, this report, and any subsequent actions on recommendations contained herein that NSPE chooses to take.

Industrial Exemption:

- National Council of Examiners of Engineering and Surveying ("NCEES"), including member organizations of its Professional Engineering Licensure Coalition
- State licensing boards/administrators
- Students in engineering programs
- NSPE's Professional Engineering in Higher Education Interest Group
- Engineering Educators – providing materials on state-by-state summaries and inconsistencies in state definitions of industrial exemption for their own practice of engineering as well as for the education of students
- Legislators and Administrators of State and Federal Agencies

Public Policy and Professional Engineering

- NCEES, including member organizations of its Professional Engineering Licensure Coalition
- The broad professional engineering community (including all licensees)
- Federal and State Legislators and Agency Administrators

- Nationally-Active Political Action Committees supporting efforts to eliminate occupational licensure
- Engineering Educators – providing materials to educate students on the concept of "citizen PE" and regarding engineering programs offering courses or combined degrees in engineering and public policy

Engineering Education

- NCEES, including member organizations of its Professional Engineering Licensure Coalition
- State licensing boards/administrators
- American Society of Engineering Educators
- National Society of Black Engineers
- Nationally-Active Political Action Committees supporting efforts to eliminate occupational licensure

Licensure Model and Mobility/International Licensure

- NCEES, including member organizations of its Professional Engineering Licensure Coalition
- State licensing boards/administrators
- Students in engineering programs
- NSPE's Professional Engineers in Higher Education Interest Group
- Engineering Educators
- State Legislators

The Role of the Certified Engineering Technician and Certified Engineering Technologist

- NCEES, including member organizations of its Professional Engineering Licensure Coalition
- National Institute for Certification in Engineering Technologies
- American Society of Certified Engineering Technicians
- The broad professional engineering community
- Federal and State Agency Administrators

Alternative Delivery Methods

- NCEES
- State licensing boards/administrators
- Design Build Institute of America and other similar organizations
- Federal and State Agency Administrators

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