Professional Licensure: An Unethical Measure of Faculty Competence
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Abstract
The goal of any accredited university engineering program is to meet explicit educational criteria and prepare students for an engineering career. As stated by the US Military Academy, “the attributes required of the engineer of 2020 include strong analytical skills, practical ingenuity, creativity, communication skills, business and management skills, leadership abilities, and high ethical standards” [8]. The professional engineering license has been suggested as a prerequisite for university engineering faculty; however, many highly desired faculty members would find themselves unqualified under current licensure requirements. Requiring a professional engineering license for faculty members to teach technical subject matter could lead to significant decreases in faculty diversity.

Introduction
With more students graduating from engineering programs than ever before, it has become increasingly important to ensure that the institutions which cultivate these students into future engineers uniformly meet the highest educational and ethical standards. As stated by the Accreditation Board for Engineering and Technology, Inc., or ABET, “the faculty is the heart of any educational program,” and determining how to best equip them to educate and prepare our future engineers is critical to further developing the educational and ethical objectives in engineering programs [1]. One qualification that has been in the forefront of discussions in recent years is whether professional engineering licensure should be mandated for all university engineering faculty. While some states such as Idaho and Kentucky require licensure for all university faculty that teach advanced engineering courses, most states do not ([2] and [3]). In this paper, the ethical and practical implications of requiring engineering faculty to hold professional licensure will be considered in order to determine whether this is a feasible way to improve the current state of engineering educational programs.

Engineering Ethics
Engineers concerned about operating within strong ethical and professional guidelines follow the seven canons of the ASCE Code of Ethics. The two most important canons with respect to engineering faculty teaching technical subject matter are Canon 1, to hold paramount the safety, health and welfare of the public, and Canon 2, to perform services only in areas of one's competence [4]. Ethical faculty members must therefore be careful not to teach subject matter outside of their competence, and ethical engineering programs should hire faculty members that are highly qualified to address the student’s educational needs. University programs and faculty that fail to meet these ethical concerns could foreseeably graduate students deficient in the
knowledge and skills needed as they enter the workforce. Engineering programs that fall short of the ASCE Code of Ethics canons are fraudulent, cheating students out of knowledge they anticipated learning, as well as dangerous, because their students may lack the expertise to perform safely as engineers in the real world. The question of ethics with respect to professional licensure is therefore transposed into a question of competence: is the Professional Engineering (PE) license necessary for university engineering faculty to teach competently?

**Student Educational Goals**

Before one can answer the question of teaching competence, one must first ask what the educational goals of an undergraduate engineering program are. The best resources to answer this are the criteria of ABET Accreditation, the most highly respected and emulated standard of university engineering education [5]. In the *Criteria for Accrediting Engineering Programs, 2016-2017*, General Criterion 3, ABET lists 11 specific ‘Student Outcomes’ that a student is expected to attain by graduation. The ASCE Body of Knowledge 2nd Edition (BOK), a highly developed report that defines success for a Civil Engineering (CE) program, has explored these educational outcomes and grouped them into subcategories of theoretical and contemporary knowledge, soft skills, and technical expertise ([6] and [7]). A successful engineering program, BOK explains, must demonstrate that their students will attain these educational criteria by employing faculty members with sufficient knowledge and experience to teach them.

**Engineering Faculty**

In *The Civil Engineering Faculty of The Future*, a report conducted by the US Military Academy, faculty of different levels of experience and educational backgrounds were compared in terms of their ability to competently teach the BOK outcomes. The paper determined that no single background held a monopoly on the competences required, but rather that “the researcher, practitioner, and faculty member from other disciplines are all uniquely qualified to teach specific elements of the BOK” [8]. The results of who is best qualified to teach each element of the BOK are summarized in Table 1 below. The report discovered that PhD faculty of various STEM disciplines with zero industry experience were better equipped to apply knowledge of mathematics, science and engineering, to understand professional and ethical responsibility, to communicate effectively, and to possess knowledge of contemporary issues. However, faculty members with extensive industry experience, licensure, and bachelor degrees in civil or closely related engineering fields had the upper hand in terms of their ability to design systems, components and processes with specific needs, to function on multidisciplinary teams, and to possess the broad education necessary to understand the impact of engineering solutions in a global and societal context [8]. One of the most intriguing points made by the report was that some elements of the CE BOK were best fulfilled by faculty with research experience and PhDs in fields unrelated to CE. In recent years, scientific progress in fields such as bioengineering, chemistry, nanoengineering, and computer science have proven to be beneficial to CE, and
academics in these fields were vital members of successful engineering programs [8].

** Discipline Limitations**

Some, like Rob Lang, PE, former Dean and CE professor at University of Alaska Anchorage, have suggested mandating licensure for university faculty, as it would raise the stature of the engineering profession [9]. When considering the current requirements of the PE license with respect to the need for non-CE faculty in the CE department, however, it is clear how such a requirement could be highly restrictive. The first consideration is that the PE license would be extremely difficult, if not impossible, to obtain for majors like bioengineering and nanoengineering. To pass the final requirement for obtaining a PE license, one must pass the Principles and Practice of Engineering Exam, a rigorous 8-hour exam that is available in 25 engineering disciplines [10]. Unfortunately, however, there are no exams available for bioengineering, aerospace, and many other backgrounds mentioned by the US Military Academy report. The best long-term solution may be simply to extend the scope of licenses available to engineering backgrounds; but without this extension, mandating licensure would severely limit a university’s ability to form the diverse faculty critical to the success of any engineering program.

** Experience Limitations**

While some engineering backgrounds are not formally constrained from obtaining licensure, many would face great difficulty meeting the specifications of the mandatory engineering experience. In all 50 states, PE licensure demands that an individual obtain a minimum of 4 years of qualifying engineering experience evaluated by the state engineering licensure board. For individuals who decide to go into research, or work in fields of some of the aforementioned backgrounds, their work would not qualify as adequate engineering experience. If all tenured faculty members were required to be licensed, there could be a decrease in a program's ability to attract faculty who are researching cutting-edge science and technology. As stated by the US Military Academy, “It is extremely difficult to find a faculty member who is an outstanding researcher, has extensive academic credentials, and possesses experience in professional practice” [11]. Not only would this diminish engineering programs’ ability to create a diverse faculty, but students would lose the opportunity to study under faculty working on cutting-edge research and technology. Engineering students are expected to fill diverse roles after graduation, and an effective program should reflect the multitude of options available to the student.

** State Inconsistencies**

Another troubling restriction with professional licensure is that since many US states have different PE license requirements, meeting the qualifications in one state may not be enough for licensure in other states. In California and Kansas, for example, all qualifying engineering experience can only be considered after graduation from an ABET-accredited 4-year engineering program ([12] and [11]). In states like Hawaii and Delaware, however, since there is no official
education requirement (as it can be replaced by 12-15 years of engineering experience), it is possible for professional engineers to receive their licenses before graduation ([13] and [14]). This means that an engineer licensed in one state with years of industry experience and a degree from an accredited program may lack the requirements to apply for licensure in another state. Additional discrepancies across state lines apply to work credit for advanced degrees—that is, whether or not a Masters or PhD in an engineering discipline counts as engineering experience. California and Alaska, for example, consider a Masters and PhD in an engineering field as 1 and 2 years of qualifying experience, respectively; however, Arizona and Maryland do not treat the degrees as experience ([12], [15], [16], and [17]).

Another major difference among states is the “Continuing Professional Competency Requirement”, where a licensed engineer must show active involvement in the engineering community; otherwise, their license will be invalidated over time and require renewal. Unsurprisingly, the renewal time frame and engineering involvement differs from state to state and is often difficult to describe objectively as it is up to the discretion of each state’s engineering licensure board. If faculty licensure was required, given these current inconsistencies in technical requirements, universities may find it difficult to hire qualified faculty members with out-of-state licenses. As different states often have different building codes to address divergent geographies, climates, natural disasters and regional concerns, granting faculty greater ease in teaching in locations across the US would allow engineering programs to find educators with a wider range of experience-based backgrounds. Therefore, the best solution to address these inconsistencies would be to simply remove the state-based requirements and employ federal guidelines. Uniform federal guidelines could consider the present requirements of every state, select the guidelines that are deemed most important, and eliminate those that are considered excessive or limiting.

Professional Licensure
According to the National Society of Professional Engineers, the PE License is “the engineering profession’s highest standard of competence, a symbol of achievement and assurance of quality” [4]. In the United States, the PE license is the only credential that grants an engineer the permission to sign, seal, and submit engineering drawings, or work as a lead consulting engineer or private practitioner [4]. The license can represent a sense of knowledge and experience in working within contemporary social, economic, and political responsibilities—all of which are values greatly beneficial to any successful engineering program. The US Military Academy believes that university courses that focus on real-world design need to be taught by faculty with the competence to determine whether the coursework is realistic and relevant [8], and a PE license may be the best means to measure this competence. It would therefore be unethical for any engineering program not to have licensed engineers as critical members of the engineering faculty, despite the limitations described above.
Conclusion
When attempting to assess the ethics of engineering faculty, it seems clear that the most successful engineering programs are those that derive talent and experience from a plethora of backgrounds, both academic and professional. Civil engineering, among other engineering disciplines, is expected to see greater interdisciplinary coordination and research as technology and scientific understanding continues to improve. As a result, engineering faculty at educational institutions need to represent this diversity. Unfortunately, the professional engineering license has failed to evolve with this progress, and does not accurately reflect the dynamic and intertwined landscape of engineering. However, with increased representation of licensure for engineers of diverse backgrounds, improvements in accounting for qualifying engineering experience, and federal regulations that address state inconsistencies, the current static state of licensure can be properly addressed and possibly considered as a prerequisite for competent and ethical engineering faculty in the future.
References


### Appendix

Table 1: Who is Qualified to Teach the CE BOK [8]

<table>
<thead>
<tr>
<th>BOK Outcomes</th>
<th>Ph.D. in CE (research)</th>
<th>Masters in CE — some experience</th>
<th>Practitioner (Bachelors, 15+ years of experience)</th>
<th>Outside of CE discipline (Ph.D. or Masters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ability to apply knowledge of mathematics, science, and engineering</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>XX(^a)</td>
</tr>
<tr>
<td>2. Ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td>XX</td>
<td>c</td>
<td>XX</td>
<td>X</td>
</tr>
<tr>
<td>3. Ability to design a system, component, or process to meet desired needs</td>
<td>X</td>
<td>X</td>
<td>XX</td>
<td></td>
</tr>
<tr>
<td>4. Ability to function on multidisciplinary teams</td>
<td>X</td>
<td>XX</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>5. Ability to identify, formulate, and solve engineering problems</td>
<td>XX</td>
<td>X</td>
<td>XX</td>
<td></td>
</tr>
<tr>
<td>6. Understanding of professional and ethical responsibility</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>XX</td>
</tr>
<tr>
<td>7. Ability to communicate effectively</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>XX</td>
</tr>
<tr>
<td>8. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context</td>
<td>X</td>
<td>X</td>
<td>XX</td>
<td>XX</td>
</tr>
<tr>
<td>9. Recognition of the need for, and an ability to engage in life-long learning</td>
<td>XX</td>
<td>XX</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>10. Knowledge of contemporary issues</td>
<td></td>
<td></td>
<td>X</td>
<td>XX</td>
</tr>
<tr>
<td>11. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice</td>
<td>XX</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>12. Ability to apply knowledge in a specialized area related to civil engineering</td>
<td>XX</td>
<td></td>
<td>XX</td>
<td></td>
</tr>
<tr>
<td>13. Understanding of the elements of project management, construction, and asset management</td>
<td>XX</td>
<td>X</td>
<td>XX</td>
<td></td>
</tr>
<tr>
<td>14. Understanding of business and public policy and administration fundamental</td>
<td></td>
<td></td>
<td>X</td>
<td>XX</td>
</tr>
<tr>
<td>15. Understanding of the role of the leader and leadership principles and attitudes</td>
<td></td>
<td></td>
<td>X</td>
<td>XX</td>
</tr>
</tbody>
</table>

\(^a\) XX: best qualified to teach this outcome [8]

\(^b\) X: qualified to teach this outcome [8]

\(^c\) blank: probably unqualified to teach this outcome [8]