# PROFESSIONAL LICENSURE FOR SOFTWARE ENGINEERS: AN UPDATE

*By Mitchell A. Thornton*

**What's the motivation behind software engineering licensure, what's the latest information regarding examination content, and when will the examination begin to be administered?**

Professional engineering licensure has been in existence for several decades and was established to provide potential clients and the public with a means to determine the competence of engineers providing services. As engineering disciplines became more specialized, different requirements have emerged for each, including different examinations. Because of the wide proliferation of software in modern engineered products, development of a professional engineering licensure examination for software engineering practitioners was approved in August 2009. This approval occurred after 10 state licensing boards requested the development of the examination, and after a lead technical society agreed to serve as a sponsor.

Earlier in 2009, IEEE-USA, IEEE Computer Society, the National Society of Professional Engineers, and the Texas Board of Professional Engineers entered into a collaborative agreement to sponsor the development of a professional engineering (PE) licensure examination for practitioners in the discipline of software engineering. IEEE-USA serves as the lead technical organization for this effort, providing financial and subject matter expert volunteers.

There are many misconceptions and some apprehensions among the software engineering community with regard to the effect that the establishment of a licensure path for professional software engineers might have. This article will address some of these concerns by providing the background and motivation for establishing the path to licensure—and will also serve as a status report regarding the effort.

## Professional Engineering Licensure

The purpose of licensure for professional engineers is to enhance the ability of the public to ensure that services offered won't adversely affect health, safety, and welfare issues. Just as medical doctors and attorneys are licensed to practice, so are engineers who offer services and goods that the general public depends upon. The central concept behind licensure is to establish a means for the public to have some degree of confidence that professionals are competent to offer their services. The PE credential lets clients have an enhanced degree of confidence that practitioners have the capability to practice engineering in an ethical and safe manner.

In the US, PE licenses are regulated by jurisdictional boards composed of members who are recognized as professional engineering practitioners. The boards formulate rules and provide input to policy makers for the legal practice of engineering. Typically, the boards also are deeply involved in the regulation and enforcement of licensure law. Because the US jurisdictional boards are separate entities with no central federal governing body, the National Council of Examiners for Engineers and Surveyors (NCEES) was formed to support the individual boards in terms of activities related to licensure. One of the chief responsibilities of the council is the preparation, administration, and scoring of licensure examinations. Each of the jurisdictional licensing boards have membership within the Council and provide input regarding common aspects of licensure within the US.

Although there are many similarities among licensure law across the various boards, each board is solely responsible for the implementation of licensure law within its jurisdiction. For this reason, the requirements for licensure can vary among the different jurisdictions, although all boards utilize a path to licensure involving three principal components: education, experience, and examination. Although most boards have multiple paths for obtaining licensure, the most common path involves the licensure candidate demonstrating competence through holding a four-year engineering degree that's accredited through the Engineering Accreditation Commission of the Accreditation Board for Engineering Technology (EAC-ABET), having some number of years of full-time and verifiable engineering experience (typically the

number is four years), and successful completion of two different eight-hour examinations. The first examination is the Fundamentals of Engineering (FE) examination and is usually taken by a candidate shortly before graduating from a four-year engineering program. The second examination is the Principles and Practices examination, known as the PE exam, and is usually taken after four years of verifiable engineering experience has been obtained.

The idea is that an engineer who holds a PE license has demonstrated that they've satisfied the requirements designed to ensure that at least minimal competence has been achieved in their engineering discipline.

## Software Engineering Professional Licensure

The presence of computing devices is ubiquitous in today's society. Many of the computers we use in daily life are readily apparent and noticeable, such as the cell phones many of us carry. However, there are many computers embedded in devices that we use daily that might not be so apparent, such as the multiple processors integrated within our personal vehicles and within the appliances in our households. All of these computers require software to function and this software in turn provides control for these devices.

Because the purpose of professional engineering licensure is to offer the public some degree of confidence in the safety of engineered artifacts, and because an enormous number of these artifacts contain computers and software, many have felt that we need to establish a path to licensure for software engineers.

Misconceptions abound among software developers and businesses that rely upon software design and implementation. One of the chief concerns is that establishment of a PE licensure path for software professionals is an attempt to institute some means of limiting those who can practice and make a living in the area of software development. This is certainly not the case, nor the motivation for the establishment of a software engineering PE license. In fact, the interested parties are attempting to establish the path to licensure in a way that ensures that qualified people can gain licensure as easily as possible.

Another misconception is that after the software engineering licensure path has been implemented, all current software developers must gain licensure or cease to engage in software development activities. This most certainly won't be the case because licensure is really intended to be applicable to the development of engineering artifacts that have the potential to affect public health, safety, and welfare. The development of a mobile phone application that helps users solve crossword puzzles wouldn't likely be seen by the licensing boards as a safety-critical application. On the other hand, the developer of a nuclear plant's control software might well be an example where it's desirable to have some assurance that minimal competence is present. Ultimately, it will be the jurisdictional boards that decide which practitioners should hold PE licenses.

The intent and content of the PE licensure examination is another area where some software developers have apprehension. Because we've all attended many years of schooling, everyone is well-grounded in the use and grading of academic examinations. Academic examinations have quite a different purpose as compared to licensing examinations in that they're designed to categorize examinees in fairly fine-grained levels of ability. That is, academic examinations are designed to separate the "A" students from the "B" students, and so on. Alternatively, a licensure examination is intended only to serve as a measurement device to determine if a candidate has met or exceeded some minimal level of competence. It is of no concern as to how far above the level of minimal competence an examinee falls; this is a matter left to the judgment of the client or employer of a professional engineer. For this reason, many licensing boards only report a pass/fail result to licensure candidates, as the intent of such examinations isn't to determine if one engineer is smarter or better than another, but simply to have the engineer demonstrate some level of competence. In this vein, the questions on licensure examinations tend to be geared toward single concepts expressed as straightforward questions. There's no attempt to include harder, "bonus-like" questions on a licensure examination such as those that are typically found in academic tests.

A good analogy is to consider the licensing examination for driving an automobile on public roads. All drivers must pass the same examination and resulting driver's licenses all afford recipients the same amount of privileges regardless of the actual score obtained. The purpose of the driver's license is to afford the public some degree of confidence that an individual driving an automobile on public roads has demonstrated at least some minimal level of competence. The same is true for software PE licensees. Those who hold a PE license have demonstrated that they have at least some minimal level of competence

**Table 1. Software engineering professional engineering (PE) examination topics.**

| Major topic area | Approximate exam content percentage |
|---|---|
| Requirements | 17.5 |
| Design | 13.75 |
| Construction | 11.25 |
| Testing | 12.5 |
| Maintenance | 7.5 |
| Configuration management | 7.5 |
| Engineering processes | 7.5 |
| Quality assurance | 7.5 |
| Safety, security, and privacy | 15 |

with regard to practices within the field of software engineering.

## The Software Engineering PE Examination

The new examination's content has been established through a rigorous process similar to that used for other professional licensing examinations. A large number of professional software engineering practitioners were surveyed with the goal of determining a typical and comprehensive set of tasks that are performed and the required knowledge to perform those tasks. Through a detailed process, this information is analyzed and ultimately results in a set of specifications or knowledge areas that are reflected in the software engineering PE examination instrument.

After the examination specification is established, subject matter experts who cover the range of specification topics are identified, and they create and evaluate items that serve as the questions on the licensure examination. After an item is created, it undergoes a review and scrutiny by multiple other subject matter experts before it's deemed worthy of appearing on an actual examination. Furthermore, after the examination has been administered, detailed, and accepted statistical analyses are performed by professionals in the area of human testing methodology. This psychometric analysis is used in part to judge the effectiveness of each of the items that appeared on an examination and to further validate the effectiveness of the items. Finally, after all this analysis is complete, a licensure candidate's test scores are reported back to the governing jurisdictional board, and that board uses the examination score and other information regarding a candidate's educational and experiential

background to make the decision regarding licensure.

In April 2012, NCEES formally approved the topics and specifications of the new software engineering PE examination. Both the topical areas and the overall percentage of items devoted to each have been established and resulted from survey information from a large group of practitioners and further psychometric analyses. Table 1 lists the major topical areas and the percentage of examination items for each. More detailed information regarding the examination content is available at www.ncees. org/Documents/Public/Exam%20 specifications/PE%20Software%20 Apr%202013.pdf.

## Status of the Software PE Examination

Approval for creating the software engineering examination was granted in 2010, and a committee of subject matter experts was formed soon after under the auspices of the NCEES. The process for establishing an examination specification was undertaken and the specification was approved in early 2012. Currently the committee is generating and certifying a large bank of items from which a subset will be chosen and appear on a particular licensure examination form.

It's anticipated that a software engineering licensure examination will be available for administration by the jurisdictional licensing boards sometime

in 2013. It will be the decision of each jurisdictional licensing board as to whether the software engineering PE examination will be offered.

Although definite plans haven't been released, it's anticipated that at least the 10 state boards originally requesting the examination will offer it to prospective licensees who intend to practice in their jurisdictions. Many other licensing boards will likely also offer the examination.

The new path to professional engineering licensure for software engineers will help promote the interests of the public in providing another measure to enhance the quality of products and services with software components. From the practitioner's point of view, holding a PE license is an important credential and underscores a commitment to professional and ethical practice in the field of software engineering.

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