Example Pathways to 30 Credits:

Alternatives to a Master's Degree under "Master's or Equivalent"

A report prepared by the
ASCE Equivalent 30 Credits Task Committee
of the ASCE Raise the Bar Committee
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Executive Summary

The National Council of Examiners for Engineering and Surveying (NCEES) has a primary objective within its strategic plan to "increase educational requirements for initial licensure." Toward that goal, NCEES is in the process of drafting a position statement in support of an increase in the educational prerequisites for engineering licensure. Previously contained in the NCEES Model Law and Model Rules, those prerequisites are either a master's degree in engineering or an equivalent 30 credits to become a professional engineer (known as the MOE provisions). While the master's degree requirement is well understood, the alternative option for an equivalent 30 credits is less understood. To help illustrate the equivalent 30 credits path for engineers pursuing licensure, five sample scenarios were developed. These scenarios reflect a future when MOE provisions have taken effect in the states and a "registry" has been created (currently planned by NCEES) to validate/approve which courses qualify. Under the MOE provisions at least 15 of the 30 credits must be technical engineering courses. *(See the report for the complete scenarios.)*

Scenario 1: College Credits Only, No Master's Degree—After graduation with a bachelor's degree in engineering, Emily Post Bakaloriat already had six credits that qualified for the equivalent 30 credits path (college courses not needed to fulfill her BSE degree requirements). After going to work, she obtained the additional 24 credits by taking one three-credit course each semester either at her nearby alma mater or evening courses online from universities across the country.

Scenario 2: Firm's In-house Courses as First Choice—Jack Inhouser works for a large engineering firm that maintains an in-house "university." Such in-house education programs are generally not in a position to offer many technical courses, focusing primarily on topics related to leadership and management. Jack took 18 two-day in-house courses which, with pre-work and homework, counted as one college credit each. Fifteen of the credits were non-technical; three technical. He obtained the remaining 12 of his needed 15 technical credits through outside online courses.

Scenario 3: Technical Associations as Only Source—Nonie Proffit, a graduate mechanical engineer, works for an employer who provides educational reimbursement only for courses directly applicable to her job. To meet this company requirement, Nonie took courses from technical/professional associations, including certification courses that provided credentials in building energy use, building energy modeling, and plumbing design. The larger technical societies had added homework and assessment to numerous courses and thus had become approved for equivalent 30 education.

Scenario 4: Credits from Multiple, Diverse Providers—Manny Sources received a BS in civil engineering after attending two different community colleges and a large university. Working for a small roadway design company, he focused on variety for equivalent 30 education. He enrolled in management and leadership training, in-person college and online college classes, professional association and private provider courses, and an association certification program.

Scenario 5: Industry Employer as Key Source—Eli Trik, a graduate electrical engineer, works for a large regional electric company. For the advanced education to pursue licensure, Eli concentrated on the specific engineering aspects of his new employer, which were covered in the company's in-house electric power-related education. Overall, he generally matched Jack Inhouser's approach (Scenario 2), except Eli included an online graduate certificate program.

The diversity of possible approaches to achieve the equivalent 30 credits provides flexibility for employees and employers in fulfilling the future educational needs for licensure under the MOE provisions. Licensure candidates can find an approach that fits them and their employers by mixing and matching in-person and online courses while taking advantage of public and private universities, company and agency in-house programs, private sector vendors, and associations.

Once the MOE provisions are enacted by state legislatures, the market will likely evolve to offer even more opportunities—and likely at competitive prices. This makes it difficult to predict today what kind of scenarios might be the most viable and popular in the future. For example, the price of online education will likely decrease over time, and Massive Open Online Courses (MOOCs) might evolve to provide truly inexpensive alternatives. With many employers already providing their employees financial support for advanced education, taking university courses to prepare for licensure, for example, should readily fit into what firms are already supporting.

For those who work in large consulting firms that have in-house "universities," the opportunity exists to gain a portion of the 30 credits in-house, thus integrating the path to licensure with an educational program already in place. In addition, professional and trade associations for engineers currently offer a wide range of education options, from short webinars to multi-day live seminars. Several associations have already had discussions about evolving their courses to include homework and a formal assessment that would meet the requirements for the equivalent 30 credits path. Some associations offer courses in practice topic areas that may not be available in advanced college curricula, which would give engineers in some specific disciplines the opportunity to find courses particularly relevant to their work.

A potential source for the equivalent 30 credits could come from in-house training in sectors such as electric utilities, the chemical industry, and manufacturing. If coupled with the required homework and assessment, such courses would fit into the already established scheme of training engineers for their specific role in the company.

As with all education, the process requires an investment. Countless engineers invest in their own post-baccalaureate education as a way to advance professionally and to increase life-time earnings potential. Companies that employ engineers have long histories of supporting their employees' education as a way to improve company performance and enhance the financial bottom line.

Generalizations about the cost of the future equivalent 30 pathway are difficult to make, since each decision for each part of the equivalent 30 credits affects the result, and the higher education marketplace is rapidly evolving. Overall, it is estimated that the equivalent 30 approaches will reflect the same range of costs encountered in a university-based master's degree.

In the end, the numerous equivalent 30 pathways for fulfilling the educational requirements under the MOE provisions, coupled with the basic option of a traditional master's degree—anything from a practice masters to a research oriented master's with thesis—offer flexibility, variety, and rich content, which will advance the profession and enhance the contributions of future professional engineers.

Example Pathways to 30 Credits:
Alternatives to a Master's Degree under "Master's or Equivalent"

A Report of the ASCE Equivalent 30 Credits Task Committee—September 2014

In 2006 the National Council of Examiners for Engineering and Surveying (NCEES) adopted additional educational requirements for licensure—generally referred to as the master's or equivalent (MOE) provisions—as part of its Model Law and Model Rules. To avoid comity concerns for the NCEES records program, in 2014 NCEES instead called for the drafting of a position statement to reflect those MOE recommendations and removed MOE language from the Model Law. The MOE provisions, with their guidance for protecting the public health, safety, and welfare, propose a future increase in the educational prerequisites for engineering licensure, requiring either a master's degree in engineering or an equivalent 30 credits to become a professional engineer. While the master's degree requirement is well understood, the alternative option for an equivalent 30 credits—outside a master's degree—is less understood.

This report, with its illustrative scenarios, has been developed to highlight the many non-master's degree options available to future engineers under the MOE provisions.

What the MOE Provisions Say

The MOE provisions[1] outline the following requirements for the equivalent 30 credits pathway:

- At least 15 of the minimum 30 credits must be technical upper-level undergraduate- and/or graduate-level courses in engineering. The remaining 15 can be of the same technical nature, if so wished, or they can be other courses relevant to the practice of engineering, including engineering-related science, mathematics, and professional practice topics, the latter including topics such as business, communications, contract law, management, ethics, public policy and quality control.
- All 30 additional credits must be equivalent in intellectual rigor and learning assessment to upper-level undergraduate and/or graduate courses offered at institutions that have a program accredited by EAC/ABET.
- None of the 30 credits can have been used to fulfill the bachelor's degree requirement.
- The term "credit" is defined as a semester hour, or its equivalent, from an "approved course provider."

Who is considered an "approved course provider" is also listed in the MOE provisions:

- An institution that has an EAC/ABET program.
- An institution or organization accredited by an NCEES-approved accrediting body. These may include regional accreditation bodies and other appropriate discipline accreditations. Such an institution or organization would be approved to develop and offer courses that meet the requirement of the MOE provisions.
- An institution or organization that offers specific courses that are individually cleared by an NCEES-approved accrediting body and that also meet the requirements specified under the MOE provisions.

For the system to work effectively and efficiently, an entity—currently termed a "registry"—will have to be established to approve what courses count for the equivalent 30 credits approach.

[1] From August 2013 NCEES Model Law [130.10 (C)(1)(c)] and Model Rules [230.10]

NCEES will likely take on the role of developing and maintaining that registry *(see "Appendix 1: What Needs to Happen" on page 16)*.

Scenarios for Obtaining the Equivalent 30 Credits

Attaining a master's degree might be the most straightforward method of gaining the needed prerequisites for licensure under the MOE provisions, but for a variety of reasons individuals might find it advantageous to take the equivalent 30 credits route, which offers a wide variety of flexibility and customization to personal and employer needs.

For example, some engineers may not be academically qualified to undertake a master's degree program, or the master's degree programs available to a particular engineer might mandate mostly technical content, and that engineer may prefer to take half the 30 credits in non-technical subjects. In addition, some engineers might want to take advantage of in-house education from their employer to fulfill their requirements. Others may find that they can get education more attuned to their field of practice through courses from professional associations, industry vendors, or private education providers. In some cases, an engineer simply may not be able to commit to an intensive program of study to get a traditional master's degree and will seek a more flexible path.

The five scenarios presented here represent a variety of approaches for engineers to obtain the required 30 credits. All of the scenarios assume the following:

- The MOE provisions have taken effect in the state in which the engineer will get licensed.
- The bachelor's degree obtained is EAC/ABET accredited or a verified equivalent.
- NCEES (or another entity) has established a registry to validate/approve courses for the equivalent 30 credits approach.
- The courses taken have been approved by the registry.

The scenarios also take place at least eight years into the future, since the effective date of the MOE provisions should not affect students just beginning their engineering education (with four years of university education and four years of experience still to come before licensure). However, the scenarios are developed based upon today's educational and training opportunities, and today's broad variation in costs, since a perfect crystal ball is not available.

Each scenario includes a narrative and then a "Snapshot" overview, which also provides the estimated costs for that particular story line. Of course, educational technologies will evolve and course providers will react to market forces, opening new pathways and new flexibility not yet foreseen.

Scenario 1: Emily Post Bakaloriat—College Credits Only, No Master's Degree

Emily Post Bakaloriat pursued a BS degree in civil engineering from XYZ University, a public college in her home state. She had entered college with a significant number of advanced placement credits, and in one semester of her sophomore year, she had taken a sixth class. As she approached the last semester of her senior year, Emily and her faculty counselor realized that she needed to take only two more courses to fulfill all requirements for a civil engineering degree. To keep up a full schedule of classes so she could still qualify for athletics participation

(12 credits), Emily decided to take a 300-level and a 400-level three-credit engineering course to start on the additional credits needed for licensing. Emily also took the step to have the university note on her transcript that the two additional courses were not required to fulfill her civil engineering degree, knowing that this would be important when she applied for licensure under the equivalent 30 credits scenario.

Upon graduation, Emily landed a job with ABC Engineering, a firm specializing in water resource engineering in the same small college town. After two years with the firm, ABC said it would provide tuition assistance for the additional 24 credits that Emily needed to qualify for licensure, provided that she agreed to remain with the firm at least one year after the completion of her final course. The best source for these courses appeared to be her alma mater, but her grade point average just missed meeting the minimum for acceptance into the school's highly competitive civil engineering master's program. Emily and her firm were not interested in her completing the research and thesis requirements for a master's degree at XYZ; they believed that maximizing specific types of course work was most important to their needs. In the end, Emily received provisional admission to take master's level courses as well as some 400-level non-engineering undergraduate courses.

Emily decided to take one three-credit course each semester, with a goal of finishing her remaining 24 credits in four years. A challenge Emily faced was that many of her target courses were offered during the day and could be disruptive to her full-time work, so she focused on late afternoon classes—one and a half hours of class room lecture two times per week. At the end of her second year, Emily discovered that only morning classes were available and realized she would have to look online. She soon discovered that an ever-increasing number of universities were offering online courses, with the flexible scheduling that generally entailed. This put a variety of curricula at her disposal, since she did not need to meet the requirements of a particular master's degree program. Emily decided to take courses from institutions that offer EAC/ABET-accredited engineering programs because there would be no question about their acceptability under the system established by the registry that approves course providers.

It also turned out that the online courses were less expensive than her local university, and in the end, Emily received 12 of her remaining 24 credits online. Of her 30 needed credits, Emily took 18 in water resources-related technical courses (which exceeded the minimum 15 technical credits required by the new MOE provisions in her state's licensure statute), and the remaining 12 in project management, communications, and business management.

SNAPSHOT 1
Emily Post Bakaloriat—College Credits Only, No Master's Degree

Emily's Background

- Graduated with BS in civil engineering with 126 credits, which included six 300-level and 400-level engineering credits that were not required for graduation with a BSE. The six credits counted toward the equivalent 30 requirements.
- Worked in the town of her alma mater. Two years after starting work, began pursuit of the additional 24 credits needed for licensure.
- Although just missing the GPA qualifications for the master's program, Emily was allowed to attend her alma mater (an in-state public university) for master's-level and upper-level undergraduate courses.

- She took one three-credit course each semester. After four semesters, the day-time course scheduling interfered with work and she switched to evening online courses from other universities.

How Long It Took for 30 Credits

With six credits already in hand before taking a job, four years of six credits per year while working.

Emily's Credits

Credits	*Education*	*Cost*
6	Two 3-credit semester engineering courses (300 and 400 level) as part of her full-time class load but not required for graduation with a BSE degree ($1,500 per course)	$3,000
12	Four 3-credit semester courses at an in-state public university in Emily's town of employment ($1,500 per course)	$6,000
12	Four 3-credit semester courses taken online from various universities across the country ($900 per course) Among the in-person and online courses, 18 credits were engineering technical courses, 12 were in project management, communications, and business management.	$3,600
30		**$12,600**

Advantages

- Using a local university for part of the education allowed for in-person interaction with faculty, students.
- Online courses allowed for flexibility from multiple providers without needing to focus on specific master's program requirements.
- Provided in-depth education in Emily's specialty; also allowed for non-technical courses.

Challenges

- The need to ensure that a university identify on a transcript any advanced-level courses that are not required to fulfill the requirements of a BSE degree but that may qualify for the equivalent 30 credits.
- In-person courses on campus were generally scheduled during the day for non-working students. It was a challenge to find times not interfering with work.
- On-campus courses were more expensive than online courses.
- Online courses lacked the personal give-and-take learning experience among students, faculty.

Scenario 2: Jack Inhouser—Firm's In-house Courses as First Choice

Jack Inhouser earned a BS in civil and environmental engineering and accepted his first job with GHY Engineering, a large, multinational firm that maintains a respected company in-house training program—informally called GHY University. With the goal of working as an environmental engineer, Jack planned to get licensed and, with the concurrence of his employer, began to map out a plan to complete the needed equivalent-30 credits in a timeframe that would take advantage of in-house training as much as possible while keeping time away from his desk to a relative minimum. Speed was not the top priority.

Jack learned that the firm conducted a large number of "lunch and learn" type training that met the professional development hour (PDH) requirements to maintain an existing license, but these did not have the intellectual rigor and learning assessments to be approved by the registry. However, Jack also found that GHY University offered a significant number of two-day courses which, when counting the four days of combined pre-work and graded homework, would be equivalent to one advanced-level college credit hour. The course catalog showed that the maximum of 15 non-technical credits would be readily available within GHY in such areas as leadership and management, project management, business and risk management, and quality management. He also discovered that only a few of the two-day courses fit into the technical category (where the minimum needed for licensure was 15 credits), primarily in engineering innovation and sustainability. While the latter was very good content, it was often too general and not specific to his technical interests. He heard from the GHY University director that this relative lack of technical courses was common among the in-house training offerings at large firms.

After finding three one-credit technical courses that he could take through GHY University, Jack then had to seek 12 credits of technical education outside of his engineering firm. Jack opted for online courses since they were more economical and more flexible for his schedule.

Jack's two-day in-house courses were usually held on two successive days (Tuesday-Wednesday), with pre-work and homework done outside of office hours. In each of the first four years, Jack took two of those one-credit in-house courses and one three-credit external online course in the evening, never having more than one course active at the same time. With 20 credits complete (including 12 external technical credits within Jack's specialty), Jack then took three one-credit in-house courses in his fifth year, and then an average of two courses each year for the next three and a half years, finishing with 30 credits after eight and a half years.

SNAPSHOT 2
Jack Inhouser—Firm's In-house Courses as First Choice

Jack's Background

- Graduated with BS in civil and environmental engineering and got a job with a large, multi-national engineering firm that maintained an in-house "university."
- To get licensed, the goal was to use as much in-house training as possible, which was available mainly in non-technical areas such as leadership and management, project management, business and risk management, and quality management. A limited number of in-house technical courses were in engineering innovation and sustainability.

- Speed of completing the 30 credits needed for licensure was not the top priority.
- The firm offered a significant number of two-day courses which, when counting the four days of combined pre-work and homework, were equivalent to one advanced-level college credit hour.
- After taking the maximum 15 non-technical credits allowed for licensure in-house, and three in-house technical courses, Jack attained the rest of his technical credits through online courses, which were more economical and schedule flexible than live courses at the nearest university.

How Long It Took for 30 Credits

Starting with five credits each year for four years, then three credits in the fifth year, and finally seven credits over three and a half years, Jack's approach took a total of eight and a half years.

Jack's Credits

Credits	*Education*	*Cost*
15	15 one-credit non-technical courses within the engineering firm.	*
3	Three one-credit technical courses within the engineering firm.	*
12	Four 3-credit semester courses taken online from various universities across the country within Jack's specialty of environmental engineering ($900 per course)	$3,600
30		****

**A number of large firms see the value of running in-house "universities" to advance company goals. The investment for such courses, if one adds in the opportunity cost of the employee's work time used, comes to about $2000 per credit. Using such education also for equivalent 30 purposes would be a similar investment, but not extra if the course addresses both purposes. Formal assessment would need to be included.*

Advantages

- Using firm's in-house courses provided company-specific understanding of the material and allowed Jack the ability to expand his working network within the organization.
- Using external technical courses provided in-depth education in Jack's specialty.
- Engineers such as Jack may have taken some of these courses anyway, regardless of licensure needs, so the courses can often serve double duty.

Challenges

- In-house courses led to 36 days where Jack was not supporting client projects. (He likely would have participated in a portion of these anyway as part of his general professional development.)
- This approach can extend over many years given that the internal courses are generally short two-day courses resulting in only one credit hour

Scenario 3: Nonie Proffit—Technical Associations as Only Source

Nonie Proffit graduated with a BS degree in mechanical engineering and, given her personal financial constraints, decided to go directly to work even though getting advanced education, as well as getting licensed, was a goal (she took and passed the Fundamentals of Engineering exam before graduation). It turned out that her employer provided educational reimbursement only for courses directly applicable to her job as a mechanical engineer. Given her personal financial situation, Nonie looked for ways to achieve her equivalent 30 credits through reimbursable courses provided by the technical associations in her field.

With the passage of the MOE provisions in numerous states, the larger technical societies had added homework and assessment options to many of their classes, including those in their certification programs, and actively sought registry approval. Nonie began to concentrate in HVAC engineering work and decided to pursue certification in building energy use, building energy modeling, and plumbing design.

In each of the first three years, Nonie pursued structured online learning courses from her technical associations in a variety of HVAC and plumbing engineering topics. For certification she attended intense two- to three-day classes at her technical society's annual conference, where she also took and passed certification tests, translating into four total credits. In each of those same three years, Nonie took two three-credit online association courses, which included six credits in engineering management. That was a considerable load and with a first child on the way, Nonie then slowed down to achieve the final eight credits over the next three years, thus completing her licensure requirements in six years.

SNAPSHOT 3
Nonie Profit—Technical Associations as Only Source

Nonie's Background

- Graduated with a BS in mechanical engineering and, given budget constraints, went directly to work.
- Employer provided educational reimbursement only for courses directly applicable to Nonie's job as a mechanical engineer, so she looked for equivalent 30 credits through her technical associations.

- With the passage of the MOE provisions in numerous states, the larger technical societies had added homework and assessment options to many of their classes and certification programs and thus became approved for equivalent 30 education.
- Nonie pursued courses in a variety of HVAC and plumbing engineering topics. For certification she attended two- to three-day classes at her technical society's annual conference, where she also took and passed certification tests.
- Achieved certification in building energy use, building energy modeling, and plumbing design.
- Took six credits in engineering management.

How Long It Took for 30 Credits

During her first three years, received 22 credits. Got the final eight credits over the next three years, thus finishing in six years.

Nonie's Credits

Credits	*Education*	*Cost*
26	Took eight 3-credit online courses from her technical associations and one 2-credit course ($800 per credit*). Six of those credits were in engineering management.	$20,800*
4	Took two 2-day and one 3-day intensive certification course, and passed the certification exams in building energy use, building energy modeling, and plumbing design.	$3,200*
30		**$24,000***

**Reflects current prices for individual courses from sample associations. Future package pricing for equivalent 30 use will likely bring costs down.*

Advantages

- Focuses most of the education squarely on the technical areas that can be immediately applied to work, with flexibility to branch into non-technical education as needed.
- Allows for courses in specialized technical areas, such as HVAC and plumbing design, that are less likely to be available in a master's program.
- Before enactment of the MOE provisions in her state's licensure law, technical associations in Nonie's area had already developed a broad selection of advanced course work.
- Association courses might be more nimble in adapting to the development of new technologies than a traditional master's program.

- Education used for the equivalent 30 credits can also be used to achieve discipline-specific certifications.

Challenges

- Will require the technical associations to achieve registry approval, which will generally require the addition of homework and assessment to courses and perhaps a new level of rigor and some new faculty.
- To compete with the cost of a traditional master's degree, may require associations to provide package pricing, since current individual course pricing may come to a higher total than a master's.

Scenario 4: Manny Sources—Credits from Multiple, Diverse Providers

Manny Sources was not a typical undergraduate engineering student. Because of changing interests, financial situations, and family moves, he attended several institutions, including two different community colleges and a large university. He eventually graduated with a civil engineering degree, much to the delight of his parents. As can be imagined, Manny did not have a clear technical focus upon leaving college.

Manny began his career with a small roadway design company working on projects almost exclusively for the state highway department. He soon came to realize that a variety of post-graduate education in the technical, management, and leadership arena would fit his goal of becoming a more well-rounded engineer and, along with a PE license, advance his career within the firm. He opted for the equivalent 30 credit pathway to obtain his required education for licensure.

A hectic work schedule in a small firm prevented Manny from taking many formal, regularly scheduled classes, so for the 15 technical credits required, Manny opted for nine credits through online, self-paced classes offered by both a civil engineering association and a private training provider marketing to the field. Those covered highway, geotechnical, and transportation topics. The addition six technical credits came from an in-person college course in advanced hydraulics, which was offered at night, and an online college course in urban planning. Manny got three credits in management from an association design-build certification program, which also helped increase Manny's value in the marketplace. An additional six credits came through private leadership seminar providers.

SNAPSHOT 4
Manny Sources—Credits from Multiple, Diverse Providers

Manny's Background

- Received a BS in civil engineering after completing 120 credits from two different community colleges and a large university, steering clear of a technical focus in any one discipline.

- Began career with a small roadway design company and soon realized he would need a variety of additional advanced education in the technical, management, and leadership arena, along with a PE license, to advance in his career. Manny opted for the equivalent-30 credit route with a continued focus on variety.
- A hectic work schedule in a small firm prevented Manny from taking many formal, regularly scheduled classes.
- Looking for a strong dose of management and leadership in addition to the needed 15 technical engineering credits, Manny opted for a combination of in-person college credits, online college credits, courses offered by his professional association and private providers, and education that was part of an association certification program.

How Long It Took for 30 Credits

Over a five-year period, took the college classes during the typical school year, with others taken at various times throughout the year, as they were offered by the provider and as time allowed.

Manny's Credits

Credits	*Education*	*Cost*
12	2 in person and 2 online 3-credit college courses (average $400 per credit)	$4,800
9	Technical training from association and private training providers ($800 per credit)	$7,200
3	Association certification program ($800 per credit)	$2,400
6	Leadership training (private seminar providers; average $1000 per credit)	$6,000
30		**$20,400**

Advantages

- Allowed Manny to experience a diversity of engineering topics.
- Provided flexibility and variety relative to the type and method of education.
- Provided company and marketplace recognition from certification.

Challenges

- Did not provide a concentration in a single technical discipline.
- Included a wide range of costs per credit due to the different types of education.
- Geographic location determined the availability of in-person college classes and training seminars.

Scenario 5: Eli Trik—Industry Employer as Key Source

Eli Trik graduated with a BS in electrical engineering with 124 credits and worked the first fifteen years of his career at two large electrical equipment manufacturers that did not encourage professional licensure because of the industry exemption. Mid-career, Eli heard of a great opportunity for new challenges and moved into the electric utility industry with a large regional electric company. The new company valued and encouraged engineering licensure and Eli knew before he even took the job that he had to get his PE to advance. He was happy that he had already taken and passed the FE exam during his senior year in college and did not have to make up that step.

Eli had been an excellent student and would have had no difficulty qualifying for the master's program at the local university to secure the needed 30 credits. However, rather than pursuing a formal master's degree, Eli wanted to immerse himself in the specific engineering aspects of his new employer, which had enhanced a limited number of its in-house courses to include the homework and assessment needed to qualify for registry approval.

Eli's overall course work took a similar path as Jack Inhouser's (Scenario 2), except Eli included an online graduate certificate program for nine credits and maintained a faster pace, completing his 30 credits in four and a half years.

SNAPSHOT 5
Eli Trik—Industry Employer as Key Source

Eli's Background

- Graduated with BS in electrical engineering with 124 credits and passed the Fundamentals of Engineering exam during his senior year to become an engineer intern.
- Worked the first fifteen years of his career for two large electrical equipment manufacturers that did not encourage professional licensure because of the industry exemption.
- Mid-career, moved to a large regional electric company that valued and encouraged engineering licensure. Eli got on the licensure track.
- Immersed himself in the specific engineering aspects of his new employer, focusing on the in-house electric power-related training for which his company had gotten equivalent-30 approval.
- Generally matched Jack Inhouser's approach (Scenario 2), except Eli included an online graduate certificate program and maintained an overall faster pace.

How Long It Took for 30 Credits

With three credits every semester and often three credits in the summer, finished in four and a half years.

Eli's Credits

Credits	*Education*	*Cost*
18	Six 3-credit in-house courses in electric power engineering, tailored specifically to the knowledge applied by the company.	*
9	Three 3-credit online courses as part of a university graduate certificate program in electric power engineering ($900 per course).	$2,700
3	One evening course at the local university in project management.	$1,500
30		*****

** A number of large engineering organizations see the value of providing in-house education to advance company goals. Using such education also for equivalent 30 purposes would be a similar investment, but not extra if the course addresses both purposes. Formal assessment would need to be included.*

Advantages

- In-house courses allow an industry employer to specifically tailor the knowledge to what will be applied in the company's work, courses that would not be available from a university.
- Such targeted education can help a company retain employees, since the education provided may be most applicable to the specific company's needs.
- Since such in-house education is already provided to enhance performance, incorporating the assessment component can allow the course to do double duty for an employee's road to licensure.

Challenges

- Companies in some industries may base their in-house education on what they consider proprietary technology or processes, so they might not be willing to open their courses to outside evaluation for equivalent-30 approval.
- Making sure the in-house courses have the needed rigor, homework, and assessment could raise costs for the company somewhat.

Investing in Advanced Education

As with all education, the process requires a monetary investment. Countless engineers invest in their own post-baccalaureate education as a way to advance professionally and to increase life-time earnings potential. Companies that employ engineers have long histories of supporting their employees' education as a way to improve company performance and enhance the financial bottom line.

Generalizations about the cost of the future equivalent 30 pathway are difficult to make, since each decision for each part of the equivalent 30 credits affects the result and the higher education marketplace is rapidly evolving. Today a traditional master's degree program can cost anywhere from $8,000 to $20,000 from an in-state public university and two to three times that amount from a private university. As we have seen in the scenarios above, costs for the variety of flexible options fall into similar ranges.

As noted, one option for the equivalent 30 is to take university courses exclusively, without the MSE degree, and the price will be about the same as for a master's. If one decides to take courses from an association or a private vendor, the cost may come to about $800 per equivalent credit; however, that represents today's environment. In a future under the MOE provisions, the market will likely evolve to provide packages of association and vendor advanced courses to meet the requirements of licensure, and the aggregate costs will likely fall more in line with the price of a traditional master's.

Moreover, online education—from universities, associations, and private vendors—could become a common path for fulfilling the equivalent 30 option. Today, an online 3-credit course from a public university costs about $900, but those opportunities will continue to evolve and prices will likely continue to fall, not to mention the potential for MOOCs (Massive Open Online Courses). Rigorous and assessed MOOCs in engineering might become common, opening up a new, lower-priced option.

Who actually bears the cost of advanced education will also vary from situation to situation. In some cases, educational support from the employer—often part of education programs already in place regardless of licensure requirements—will cover most of the expense because of the benefit that devolves to the firm. In some cases, the individual engineer may make the investment, with the prospect of greater earnings potential from attaining the PE. Every possible combination of costs divided between the employer and the employee will of course occur.

A number of larger engineering companies already have in-house "universities" to advance their employees, including the use of work hours as part of the educational investment. If a course has the needed rigor and assessment, it can have the dual purpose of both providing needed knowledge and counting toward licensure requirements, which becomes an added benefit for the firm.

In all this, the goal is for the engineer to achieve licensure, and that opens responsibility and career advancement doors. One recent salary survey showed that median income for PEs is about 6% higher than for unlicensed engineers, so the costs of education will be recouped over time, not to mention potentially enhanced job security. The employer, for its part, receives an engineer who will contribute to higher quality products and more satisfied clients—the reason employers invest in education in the first place.

Conclusion

The diversity of possible approaches to achieve the equivalent 30 credits provides flexibility for employees and employers in fulfilling the future educational needs for licensure under the MOE provisions. Licensure candidates can find an approach that fits them and their employers by mixing and matching in-person and online courses while taking advantage of public and private universities, company and agency in-house programs, private sector vendors, and associations.

Once the MOE provisions are enacted by state legislatures, the market will likely evolve to offer even more opportunities—and likely at competitive prices. This makes it difficult to predict today what kind of scenarios might be the most viable and popular in the future. Certainly, taking only university courses to fulfill the equivalent 30 requirements (Scenario 1) will remain a fairly straightforward approach in lieu of a master's, especially since online options give access to universities across the country. Others may be interested in, say, 15 non-technical university credits taken to develop greater management skills, a mix that might not fulfill the requirements for an engineering master's degree program at some engineering colleges.

Generally, cost savings can be achieved if in-state public universities are chosen over private ones, or if online education is pursued. The price of online education will likely decrease over time, and MOOCs might evolve to provide truly inexpensive alternatives. With many employers already providing their employees financial support for advanced education, taking university courses to prepare for licensure should readily fit into what firms are already supporting.

For those who work in large consulting firms that have in-house "universities" (Scenario 2), the opportunity exists to gain a portion of the 30 credits in-house, thus integrating the path to licensure with an educational program already in place. Given the way such firm education programs are now structured, it is unlikely that all the needed 15 technical credits would be available, and when they are offered, such courses tend to be more general as opposed to specific in their technical focus. Outside providers could be used for those technical courses, as some firms do now, opening the door to choices outlined in the other scenarios.

Professional and trade associations for engineers currently offer a wide range of education options, from short webinars to multi-day live seminars (Scenario 3). Several associations have already had discussions with NCEES about evolving their courses to include homework and a formal assessment that would meet the requirements for the equivalent 30 credits path. Some associations offer courses in practice topic areas that may not be available in advanced college curricula, which would give engineers in some specific disciplines the opportunity to find courses particularly relevant to their work. Currently, such association-produced courses are priced on an individual basis for today's market, and multiplied by 30 credits might be more expensive than a simple master's today. But as adoption of the MOE provisions becomes more common, package pricing that is more competitive with an MSE will likely emerge for engineer interns who might take a suite of courses.

The multi-source approach of Scenario 4 offers flexibility and varied training, something that might suit personalities who like learning in a variety of settings through a variety of providers. Engineers and the firms that employ them will need to balance the value of additional credentials, such as a master's degree or specialized certification, and develop education plans that deliver the maximum value for their situation. Having the flexibility to shop for cost-effective course types among multiple providers will also appeal to some. The range of possibilities will make the overall cost of 30 credits vary widely, depending on the choices made.

A potential source for equivalent 30 credits could come from in-house training in sectors such as electric utilities, the chemical industry, and manufacturing (Scenario 5). If coupled with the required homework and assessment, such courses would fit into the already established scheme of training engineers for their specific role in the company. Since engineers from disciplines such as electrical, mechanical, and chemical working in industry traditionally do not get licensed in high numbers, the question remains whether industry would make the effort to meet equivalent 30 assessment requirements and whether the proprietary nature of some courses might make some companies reluctant to opening their courses to the scrutiny of a registry approval process.

While all the scenarios in this report were conceived to highlight different sources for education, any aspect of any scenario can be mixed and matched according to the needs and situation of the particular engineer.

The numerous equivalent 30 pathways for fulfilling the educational requirements under the MOE provisions, coupled with the basic option of a traditional master's degree—anything from a practice masters to a research oriented master's with thesis—offer flexibility, variety, and rich content, which will advance the profession and enhance the contributions of future professional engineers.

Appendix 1
What Needs To Happen

For equivalent 30 credits scenarios to become a reality, a number of actions must be pursued.

Enacting the MOE Provisions

The most obvious step is that states will need to enact the MOE provisions as part of their licensure statute. As for timing, the statute should not take effect until at least eight years after passage so that those already embarking on an engineering education do not have the rules for licensure changed in midstream (taking into account four years of undergraduate education and four years of experience before licensure).

National Registry

With the MOE provisions in place, NCEES has indicated it is prepared to begin developing a national education registry that would approve the course providers and, for those organizations that choose not to be a course provider, single courses. Such a registry will be crucial since the state licensure boards may not have the resources or the desire to evaluate whether a licensure applicant's coursed have met the equivalent 30 requirements.

In this context, NCEES could serve as the entity to provide the following:

- Establish the standard for coursework rigor and assessment.
- Evaluate whether the providers offer courses that meet the standards.
- Maintain a record of institutions and organizations that offer approved coursework.
- Maintain a record of individuals and the courses they have taken and passed in pursuit of the equivalent 30 credits, with a verification of those who have completed the process.
- Serve as a resource to individuals participating in the equivalent 30 credits approach.
- Serve as a convenient, single-source records holder for individuals and state licensing boards.

Registry Costs

In the equivalent 30 approach, there will be an economic cost both to the organizations that are developing and providing the approved coursework and to NCEES (or an equivalent) in running its registry. The cost to NCEES has not yet been estimated, and it is still unclear who will bear the cost of providing the registry service—the individuals seeking licensure? the organizations providing the approved coursework? the state licensure boards? NCEES itself? It is unlikely that state boards will accept any direct costs; as a result, the expense will likely fall to individuals and organizations.

NCEES has experience in providing a service similar to the equivalent 30 registry. For many years, NCEES has operated a records program in which individual licensees can gain "fast-track comity." The program includes storing and transmitting professional records (such as transcripts, exam results, employment references) for those applying for licensure in an additional state or territory. The cost is borne by the licensee in having their record in the system, which includes a $25 annual renewal fee, a $150 application fee, and a $60 record transmittal fee.

Maintaining the equivalent 30 registry program would seem to incorporate many of the same features as the current records program and thus require similar expenditures. Additional features such as assessing and approving course providers or approving specific courses may need the services of consultants. This would involve an extra expense to NCEES that is currently unknown. The NCEES Education Committee has been given the ongoing charge to explore the details of such an equivalent 30 registry program. The process is in its initial stages and much work remains to be done before an acceptable system is in place.

Appendix 2
Links to Additional Resources

Raise the Bar for Engineering website

ASCE Raise the Bar information web pages

ASCE Policy 465—*Academic Prerequisites for Licensure and Professional Practice*

Civil Engineering Body of Knowledge for the 21st Century, Second Edition

History of NCEES Engineering Education Initiative

NSPE Policy 168 *Engineering Education Requirements*

NSPE Position Statement No. 1737—*Licensure and Qualifications for Practice*

The Vision for Civil Engineering in 2025

Online university courses

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Appendix 3
Equivalent 30 Credits Task Committee Members

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