PURDUE UNIVERSITY COLLEGE OF ENGINEERING

Why get licensed?

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Disclaimer

The information provided by this lecture is that of Prof. Drnevich as an individual and does not represent an official position of the Indiana Registration Board for Professional Engineers or the Indiana Society of Professional Engineers.

Topics:

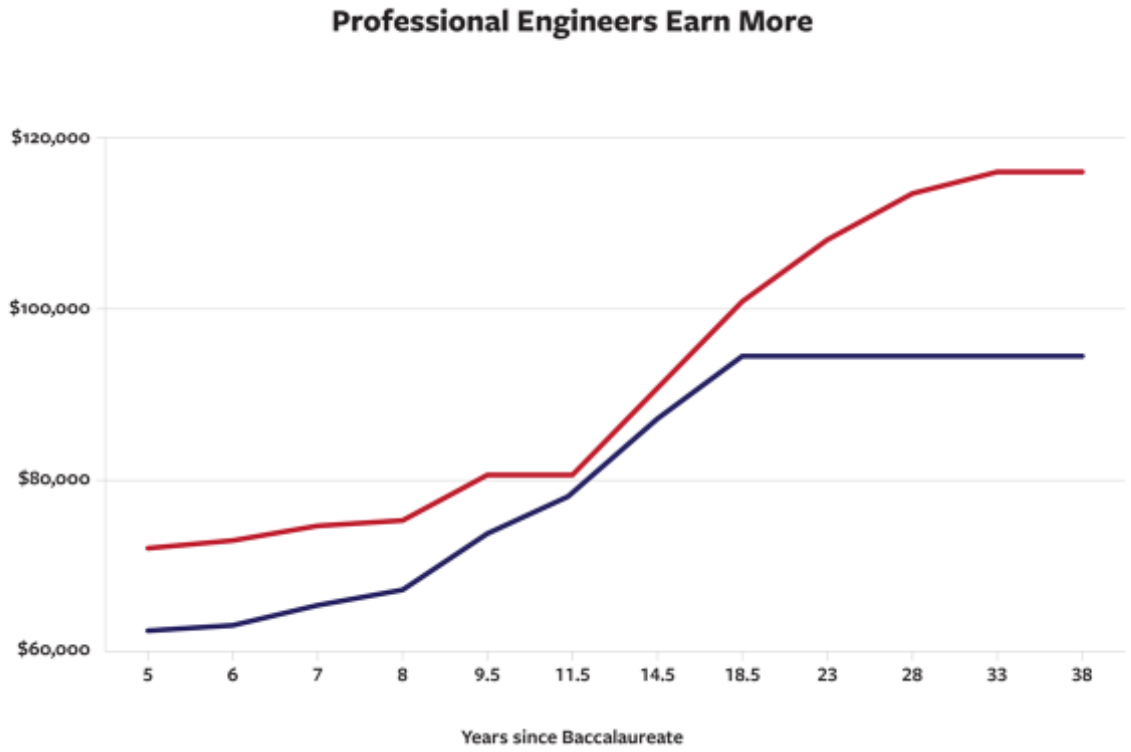
- Why get licensed?
- Engineers in the profession
- Law on the Practice of Engineering
- Professional Registration
- Professional/Technical Societies
- Concluding Thoughts
- Address questions

Why Get Licensed?

- Mark of a professional
- Required for practice engineering involving health, welfare, and safety of the public
- Ethics requirements
- Career development and growth
- Continuing Education
- Prestige and respect
- Flexibility
- Salary

PE's Earn More

https://ncees.org/education/ncees-speakers-link-and-speakers-kit/

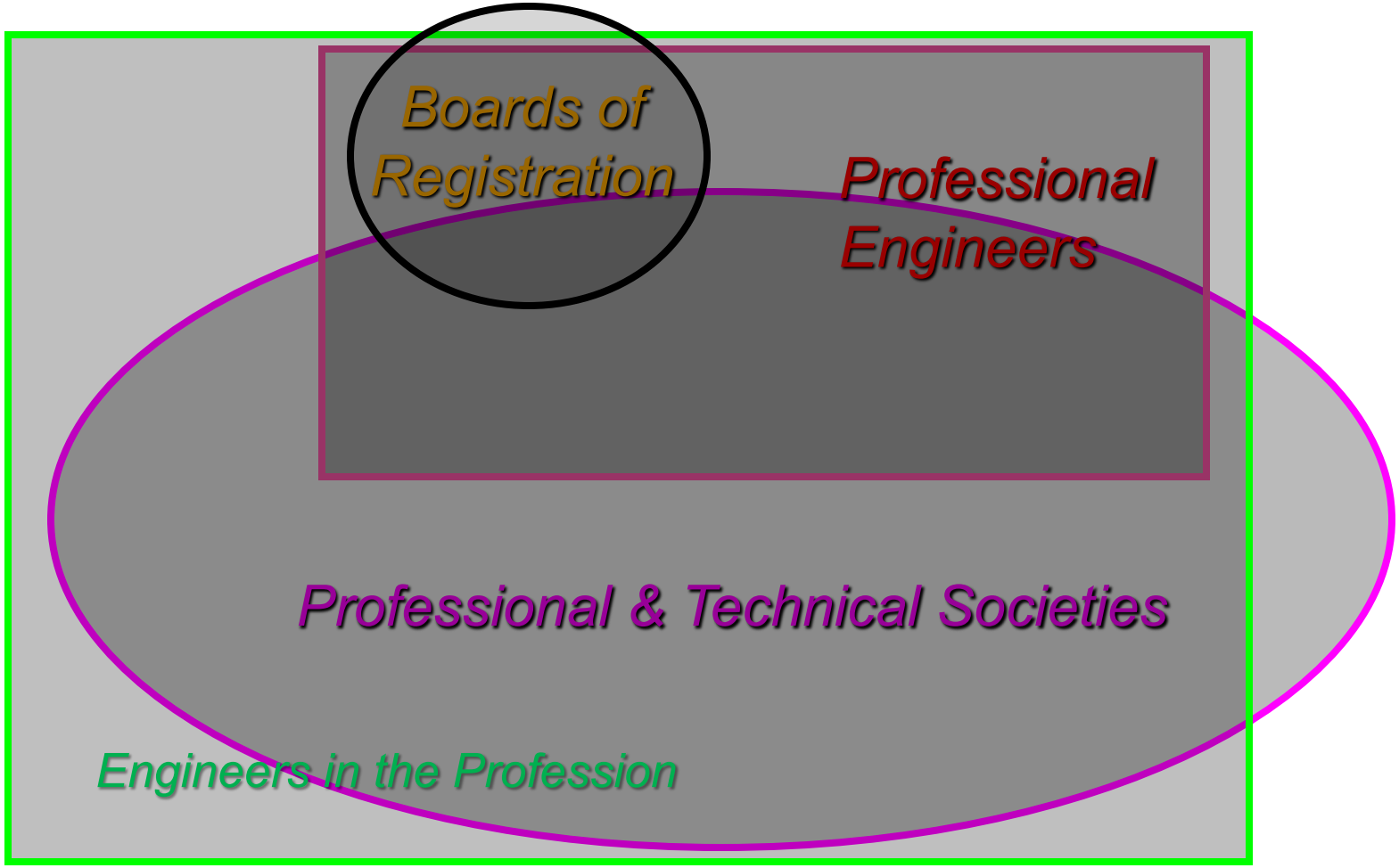


*Figures based on the most recent 'Engineering Salary Survey' by the *American Association of Engineering Societies (AAES)*. Throughout the course of a career, the median salary of a professionally licensed engineer earns a higher salary than an unlicensed engineer. *

Benefits of PE License

https://youtu.be/kXg8uzPbyEg

Engineers in the profession



Professional Engineer
Indiana Law: IC 25-31-1-2 (b)

- "Professional engineer" means an individual who, by reason of that individual's special knowledge of the mathematical and physical sciences and the principles and methods of engineering analysis and design which are acquired by education and practical experience, is qualified to engage in the practice of engineering as attested by that individual's registration as a professional engineer.

Who can practice engineering?

- According to the law, only licensed professional engineers can practice engineering

Practice of Engineering

Indiana Law: IC 25-31-1-2 (d)

"Practice of engineering" means any service or creative work that the adequate performance of requires engineering education, training, and experience in the application of special knowledge of the mathematical, physical, and engineering sciences to services or creative work that includes the following:

(1) Consultation.

(2) Investigation.

(3) Evaluation.

(4) Planning, including planning the use of land and water.

(5) The design of or the supervision of the design of engineering works and systems.

(6) Engineering surveys and studies or the supervision of engineering surveys and studies, ...

(7) Evaluation of construction for the purpose of assuring compliance with specifications, plans, and designs, in connection with any public or private utilities, structures, buildings, machines, equipment, processes, work systems, or projects.

Industrial Exemption
Indiana Law: IC 25-31-1-20

Exempt persons

(a) An employee or a subordinate of any person who holds a certificate of registration under the provisions of this chapter is exempt from the provisions of this chapter if the practice of the employee or subordinate does not include responsible charge of design or supervision.

(b) This chapter does not require registration for the purpose of practicing engineering by an individual or a business:

(1) on property owned or leased by that individual or business unless the engineering practice involves the public health or safety, or the health or safety of the employees of that individual or business;

*(2) **for the performance of engineering which relates solely to the design or fabrication of manufactured products**; or*

(3) that is registered as a landscape architect under IC 25-4-2 and while the individual or business is engaged in the practice of landscape architecture planning the use of land or water.

Professional Registration

- Required by law for the professional practice of engineering
- Each state and territory has a "registration law"
- Implemented by a Board of Registration http://www.in.gov/pla/engineer.htm
- National Council of Examiners for Engineering and Surveying (NCEES) generate and grade the FE and PE exams used by boards of registration http://www.ncees.org

Steps to Professional Licensure

1. Graduation from program in engineering acceptable to the Board* (EAC ABET accredited)

2. Passing the Fundamentals of Engineering (FE) Exam

3. Four years of engineering practice experience
   - One year granted for MS degree in engineering
   - Two years granted for PhD degree in engineering

4. Passing the Principles and Practice (PE) Exam

* Special Previsions Exist for persons without EAC ABET accredited degrees. Refs.: http://iac.iga.in.gov/iac//iac_title?iact=864; *864 IAC 1.1-2.1-2 Definitions*; *864 IAC 1.1-2.1-3 Education and work experience*

Computer-Based FE Exam

- Started in January 2014
- Is taken at Pearson-Vue Testing Centers
- Available over four, three-month-long testing windows each year
  - Window 1: Jan-Mar
  - Window 2: April-June
  - Window 3: July-Sept
  - Window 4: Oct-Dec

Computer-Based FE Exam, Cont'd.

- Apply to NCEES to register for FE and FS exams (http://ncees.org/engineering/fe/)
  - Provide information
  - Pay $175 fee
- Schedule Exam with Pearson-Vue
  - Choose location (Purdue is among 7 in Indiana; many in every state to choose from)
  - Choose from dates available.

Computer-Based FE Exam, Cont'd.

- The FE exam is a computer-based test (CBT). It is closed book with an electronic reference.
- Examinees have 6 hours to complete the exam, which contains 110 multiple-choice questions.
  - The 6-hour time also includes a tutorial, a break, and a brief survey at the conclusion.
- The FE exam uses both the International System of Units (SI) and the US Customary System (USCS).

Computer-Based FE Exam, Cont'd.

- Seven separate exams:
  - Chemical CBT Exam Specifications
  - Civil CBT Exam Specifications
  - Electrical and Computer CBT Exam Specifications
  - Environmental CBT Exam Specifications
  - Industrial CBT Exam Specifications
  - Mechanical CBT Exam Specifications
  - Other Disciplines CBT Exam Specifications
- Get exam day testing details at:
  - ***www.youtube.com****/watch?v=5YbpV48rNK4*

Chemical CBT FE Exam

https://ncees.org/wp-content/uploads/FE-Chem-CBT-specs-1.pdf

Knowledge Area	***Number of Questions***
1. Mathematics	*8-12*
2. Probability and Statistics	*4–6*
3. Engineering Sciences	*4-6*
4. Computational Tools	*4–6*
5. Materials Science	*4–6*
6. Chemistry	*8–12*
7. Fluid Mechanics/Dynamics	*8-12*
8. Thermodynamics	*8-12*
9. Materials/Energy Balance	*8-12*

Chemical CBT FE Exam, Cont'd.

Knowledge Area	***Number of Questions***
10. Heat Transfer	*8-12*
11. Mass Transfer and Separation	*8–12*
12. Chemical Reaction Engineering	*8-12*
13. Process Design and Economics	*8-12*
14. Process Control	*5-8*
15. Safety, Health, and Environment	*5-8*
16. Ethics and Professional Practice	*2-3*

Civil CBT FE Exam

https://ncees.org/wp-content/uploads/FE-Civil-CBT-specs.pdf

Knowledge Area	***Number of Questions***
1. Mathematics	*7–11*
2. Probability and Statistics	*4–6*
3. Computational Tools	*4–6*
4. Ethics and Professional Practice	*4–6*
5. Engineering Economics	*4–6*
6. Statics	*7–11*
7. Dynamics	*4–6*
8. Mechanics of Materials	*7–11*
9. Materials	*4–6*

Civil CBT FE Exam, Cont'd.

Knowledge Area	***Number of Questions***
10. Fluid Mechanics	*4–6*
11. Hydraulics and Hydrologic Systems	*8–12*
12. Structural Analysis	*6–9*
13. Structural Design	*6–9*
14. Geotechnical Engineering	*9–14*
15. Transportation Engineering	*8–12*
16. Environmental Engineering	*6–9*
17. Construction	*4–6*
18. Surveying	*4–6*

Electrical & Computer CBT FE Exam

https://ncees.org/wp-content/uploads/FE-Ele-CBT-specs.pdf

Knowledge Area	***Number of Questions***
1. Mathematics	*11-17*
2. Probability and Statistics	*4–6*
3. Ethics and Professional Practice	*3–5*
4. Engineering Economics	*3–5*
5. Properties of Electrical Materials	*4–6*
6. Engineering Sciences	*6–9*
7. Circuit Analysis (DC and AC Steady State)	*10-15*
8. Linear Systems	*5–8*
9. Signal Processing	*5–8*

Electrical CBT FE Exam, Cont'd.

Knowledge Area	***Number of Questions***
10. Electronics	*7-11*
11. Power	*8–12*
12. Electromagnetics	*5–8*
13. Control Systems	*6–9*
14. Communications	*5-8*
15. Computer Networks	*3-5*
16. Digital Systems	*7-11*
17. Computer Systems	*4–6*
18. Software Development	*4–6*

Environmental CBT FE Exam

https://ncees.org/wp-content/uploads/FE-Env-CBT-specs.pdf

Knowledge Area	***Number of Questions***
1. *Mathematics*	*4–6*
2. *Probability and Statistics*	*3–5*
3. *Ethics and Professional Practice*	*5–8*
4. *Engineering Economics*	*4–6*
5. *Materials Science*	*3–5*
6. *Environmental Science and Chemistry*	*11–17*
7. *Risk Assessment*	*5–8*
8. *Fluid Mechanics*	*9–14*
9. *Thermodynamics*	*3–5*

Environmental CBT FE Exam, Cont'd.

Knowledge Area	***Number of Questions***
10. Water Resources	*10–15*
11. Water and Wastewater	*14–21*
12. Air Quality	*10–15*
13. Solid and Hazardous Waste	*10–15*
14. Groundwater and Soils	*9–14*

Industrial CBT FE Exam

https://ncees.org/wp-content/uploads/FE-Ind-CBT-specs.pdf

Knowledge Area	***Number of Questions***
1. Mathematics	*6-9*
2. Engineering Sciences	*5-8*
3. Ethics and Professionalism	*5-8*
4. Engineering Economics	*10-15*
5. Probability and Statistics	*10-15*
6. Modeling and Computations	*8-12*
7. Industrial Management	*8–12*
8. Manufact., Prod., and Service Systems	*8-12*
9. Facilities and Logistics	*8-12*

Industrial CBT FE Exam, Cont'd.

Knowledge Area	***Number of Questions***
10. Human Factors, Ergonomics, and Safety	*8-12*
11. Work Design	*8–12*
12. Quality	*8-12*
13. Systems Engineering	*8-12*

Mechanical CBT FE Exam

https://ncees.org/wp-content/uploads/FE-Mec-CBT-specs.pdf

Knowledge Area	***Number of Questions***
1. Mathematics	*6-9*
2. Probability and Statistics	*4–6*
3. Computational Tools	*3–5*
4. Ethics and Professional Practice	*3–5*
5. Engineering Economics	*3–5*
6. Electricity and Magnetism	*3-5*
7. Statics	*8-12*
8. Dynamics, Kinematics, and Vibrations	*9–14*
9. Mechanics of Materials	*4–6*

Mechanical CBT FE Exam, Cont'd.

Knowledge Area	***Number of Questions***
10. Material Properties and Processing	*8-12*
11. Fluid Mechanics	*9-14*
12. Thermodynamics	*13-20*
13. Heat Transfer	*9-14*
14. Meas., Instrumentation, and Controls	*5-8*
15. Mechanical Design and Analysis	*9-14*

OTHER DISCIPLINES
CBT Exam Specifications

https://ncees.org/wp-content/uploads/FE-Other-CBT-specs-1.pdf

Knowledge	***Number of Questions***
1. Mathematics and Adv. Engineering Mathematics	*12–18*
2. Probability and Statistics	*6–9*
3. Chemistry	*7–11*
4. Instrumentation and Data Acquisition	*4–6*
5. Ethics and Professional Practice	*3–5*
6. Safety, Health, and Environment	*4–6*
7. Engineering Economics	*7–11*

OTHER DISCIPLINES
CBT Exam Specifications, Cont'd.

Knowledge	***Number of Questions***
8. Statics	*8–12*
9. Dynamics	*7–11*
10. Strength of Materials	*8–12*
11. Materials Science	*6–9*
12. Fluid Mechanics and Dynamics of Liquids	*8–12*
13. Fluid Mechanics and Dynamics of Gases	*4–6*
14. Electricity, Power, and Magnetism	*7–11*
15. Heat, Mass, and Energy Transfer	*9–14*

Comparison of Knowledge Areas

FE Exam Disciplines

Chem.	Civil	Elec & Comp	Environmental	Industrial	Mechanical	Other Disciplines
Mathematics	Mathematics	Mathematics	Mathematics	Mathematics	Mathematics	Mathematics
Probability and Statistics	Probability and Statistics	Probability and Statistics	Probability and Statistics	Probability and Statistics	Probability and Statistics	Probability and Statistics
Ethics and Prof.l Prac.	Ethics and Professional Prac.	Ethics and Prof.Pract.	Ethics and Professional F	Ethics and Professionalism	Ethics and Prof. Pract.	Ethics and Professional Pract.
Process Des. and Econ.	Engineering Economics	Engineering Economics	Engineering Economics	Engineering Economics	Engineering Economics	Engineering Economics
Engineering Sciences	Statics	Engineering Sciences		Engineering Sciences	Statics	Statics
Materials Science	Mechanics of Materials	Prop. of Electrical Mat'ls.			Mechanics of Materials	Strength of Materials
	Dynamics				Dyn., Kinemat., and Vibr.	Dynamics
Fluid Mechanics/Dyn.	Fluid Mechanics		Fluid Mechanics		Fluid Mechanics	Fluid Mech. and Dyn.of Liq.
Safety, Health, and Envir.	Environmental Engineering		Envir. Sci. and Chem.			Safety, Health, and Environ.
	Materials		Materials Science		Material Prop. and Proc.	Materials Science
Computational Tools	Computational Tools			Modeling and Computations	Computational Tools	
Chemistry						Chemistry
Thermodynamics			Thermodynamics		Thermodynamics	Heat, Mass, and Energy Trans.
		Circuit Analysis			Electricity and Magnetism	Electricity, Power, and Magn.
Disciipline Specific Courses						
Materials/Energy Bal.	Hydraulics and Hydrol. Sys.	Linear Systems	Risk Assessment	Industrial Management	Heat Transfer	Fluid Mech. and Dyn. of Gases
Heat Transfer	Structural Analysis	Signal Processing	Water Resources	Manufact., Prod., & Serv. Sys.	Meas., Instrum., and Cont.	Instrument. and Data Acquisit.
Mass Transfer and Sep.	Structural Design	Electronics	Water and Wastewater	Facilities and Logistics	Mech. Design and Anal.	
Chemical Reaction	Geotechnical Engineering	Power	Air Quality	Hum. Fact., Ergonom., & Saf'ty		
Process Control	Transportation Engineering	Electromagnetics	Solid and Haz. Waste	Work Design		
	Construction	Control Systems	Groundwater and Soils	Quality		
	Surveying	Communications		Systems Engineering		
		Computer Networks				
		Digital Systems				
		Computer Systems				
		Software Development				

Engineer-in-Training (EIT)

- Once the required education is completed and the FE exam is passed, must apply to State Board for certification as an EIT.
  - Requires submitting transcripts and other info. (https://www.in.gov/pla/files/EIT_online(4).pdf)
  - Must be certified as EIT before taking PE exam.
  - All state boards accept passed FE exam
  - FE exam does not expire
  - Indiana Board information available at: http://www.in.gov/pla/engineer.htm

FE Exam Takers and Pass Rates

Exam	Volume	Pass rate	Format	Availability	Last updated
FE Chemical	1,095	75%	CBT	Year-round	Jul-19
FE Civil	6,531	68%	CBT	Year-round	Jul-19
FE Electrical and Computer	1,477	69%	CBT	Year-round	Jul-19
FE Environmental	871	80%	CBT	Year-round	Jul-19
FE Industrial and Systems	367	59%	CBT	Year-round	Jul-19
FE Mechanical	4,430	77%	CBT	Year-round	Jul-19
FE Other Disciplines	1,270	78%	CBT	Year-round	Jul-19

FE Exam Pass Rates

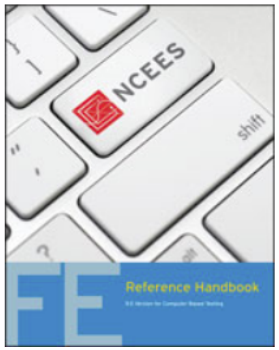
- Nationwide – Approximately 70%
- Purdue – Greater than 90%

	National Pass Rate	Purdue Pass Rate
All Major National Exams	84%	96%
Speech, Language Pathology	85%	100%
Registered Nurse	86%	95%
Doctor of Audiology	70%	100%
Fundamentals of Engineering	76%	95.1%
# of exams Purdue beat the national pass rate: 11 of 11		

Ref.: Mitch Daniels Open Letter, Jan. 2017

Register for Exams at NCEES, LLC.

- Handles registration and administration of exams
  https://ncees.org/engineering/
- NCEES Examinee Guide
  https://ncees.org/exams/examinee-guide/
  - Very strict rules and security
  - Closed book; on-line booklet provided



- Preparation Materials

https://ncees.org/exams/exam-preparation-materials/

http://pearsonvue.com/demo/

Principles and Practice (PE) Exams

(Taken after 4 years of engineering practice experience*)

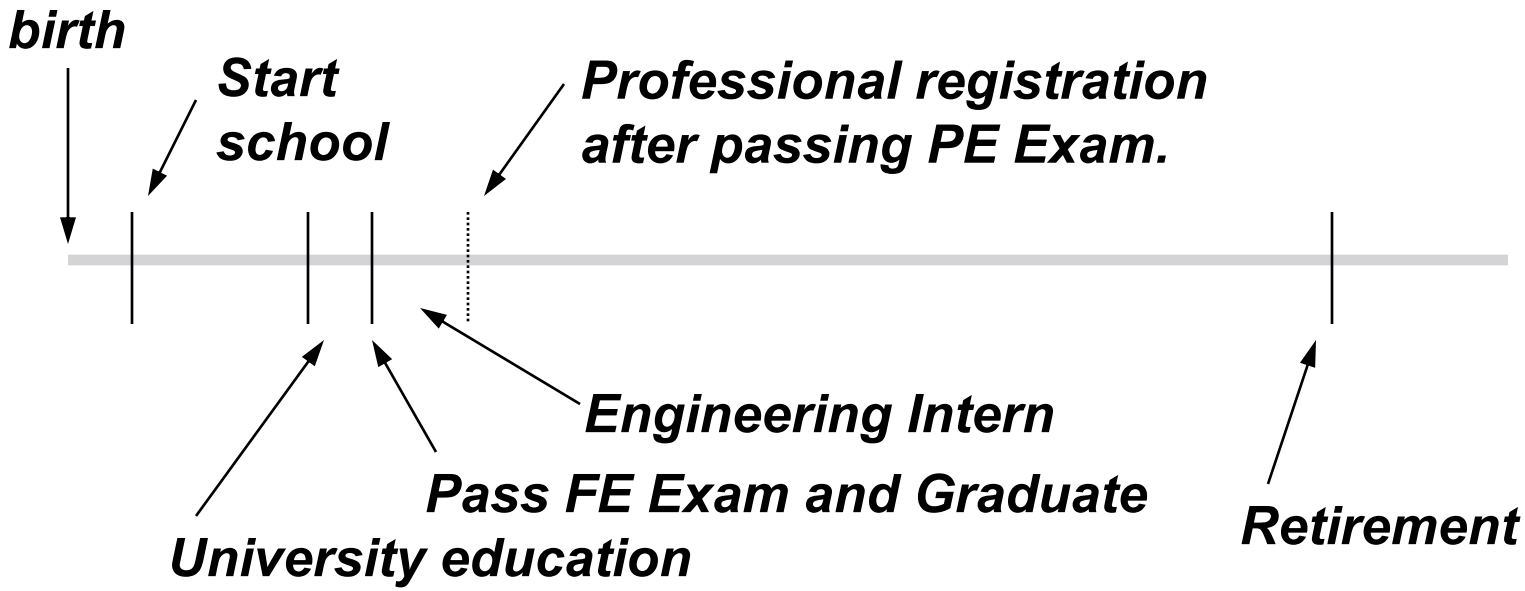
- PE Agricultural & Biological
- PE Architectural
- PE Chemical
- PE Civil
- PE Control Systems
- PE Electrical and Computer
- PE Environmental
- PE Fire Protection
- PE Industrial
- PE Mechanical
- PE Metallurgical and Materials
- PE Mining and Mineral Processing
- PE Naval Architecture and Marine Engineering
- PE Nuclear
- PE Petroleum
- PE Structural I
- PE Structural II
- PS Surveying

** Some states now do not require any waiting time after passing the FE exam to take the PE exam.*

Questions and Review Help

- See NCEES Information:
  - http://ncees.org/exams/fe-exam/
- Review Sessions sponsored by PSPE
  - https://purduepspe.com/fe/
- Review Sessions sponsored by Chi Epsilon
  - https://engineering.purdue.edu/~xe/FEReview.html
- Free online FE Review Course from Georgia Tech.
  - https://www.coursera.org/learn/fe-exam/

Time line for Engineers



Note: For surveyors, the corresponding exams are the FS and PS exams.

Continuing Education

- 40 of the states now have Continuing Education requirements for maintaining licenses.
  - Typically require 24 to 30 hours per biennium for renewal of license
  - Approved activities vary, but always include courses and short courses related to the practice of engineering
  - Rules for Indiana were established in 2010 and updated in 2014

Continuing Education Question

- How does a professional acquire new knowledge and keep up with developments in the field?
- Answer: By continuing your education by formal and self study and by becoming involved with professional and technical societies.

Professional and Technical Societies

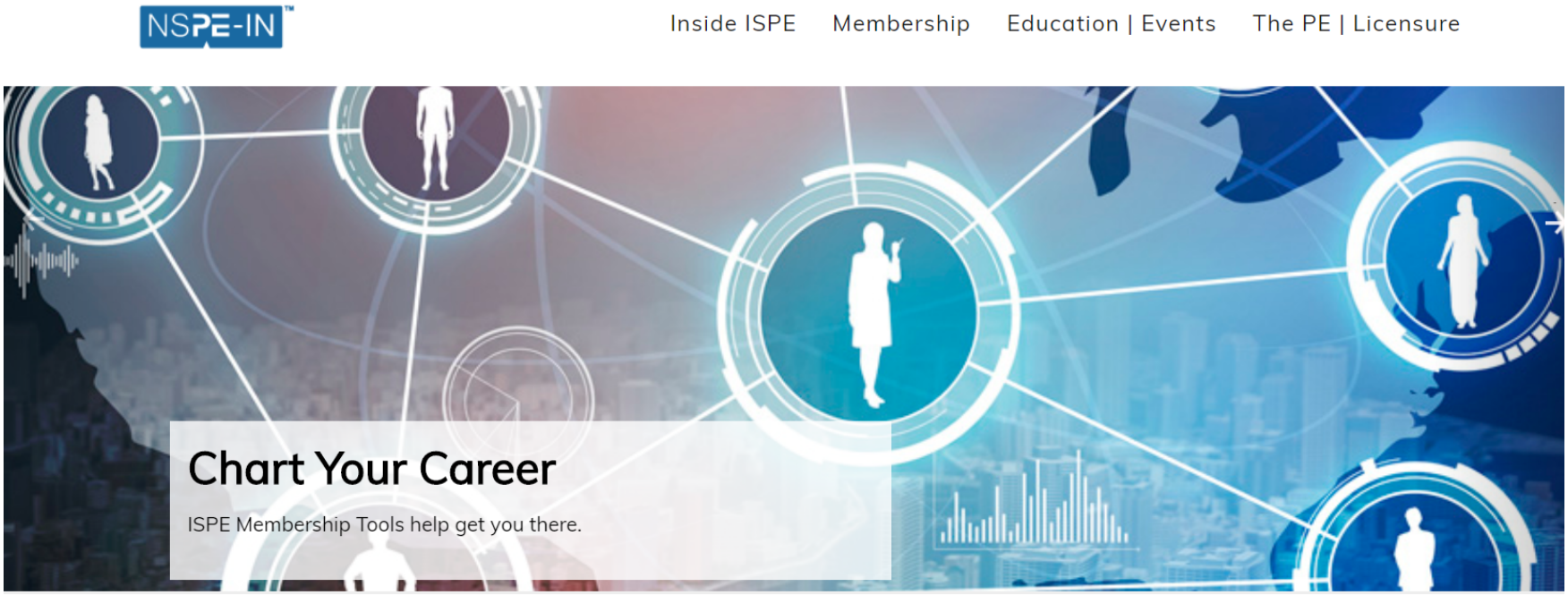
- Source of new knowledge and technologies – Continuing Education
- Sense of identity to the professional
- Represents the profession to government and society
- Codes of Ethics
- Develop leadership skills
- Networking
- Other

Recommended Prof./Tech. Orgs.

- Professional Org.
  - NSPE/ISPE with local chapters and student chapters (PSPE at Purdue)
  - SWE, NSBE, SHPE, EWB, etc.
- Technical Orgs.
  - Basic Founder Societies, e.g. ASABE, ASCE, ASME, IEEE, IIE, etc.
  - Specialty Societies, e.g. ACI, PAWMA , ITE, etc.

Indiana Society of Professional Engineers (ISPE)

http://www.indspe.org



Indiana Professional Engineer Journal

https://indspe.org/ispe/About/IPEJ/ISPE/IPE_Journal.aspx?hkey=367183c2-f556-4691-b717-fcf14a909130&WebsiteKey=03a07aba-86ed-43bc-95fe-b15a6650bfb6

National Society of Professional Engineers (NSPE) www.nspe.org

NSPE™ NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

Student Membership

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Free Resources for **Students** Looking for a job after graduation

... **student membership** entitles you to deep discounts on a wide variety of publications including FE/PE Exam ...

https://www.nspe.org/membership/type-membership/student-membership

Active Participation in Prof/Tech Student Organizations

Purdue Society of Professional Engineers

Our History, Events, Membership, Research Roundtable, Rube Goldberg Competition, Order of the Engineer, Field Trips, MathCOUNTS, Community and Social Activities

http://purduepspe.com/

https://engineering.purdue.edu/PSPE/

Purdue University 2019 Student Organization of the Year Excellence Award

Concluding Thoughts

- Reasons to become licensed:
  - Required by the law to practice engineering
  - Money
  - Status/Respect
  - Career Flexibility
- Licensure is a 4-step process
  1. Education from ABET accredited program
  2. Pass FE Exam (exam is changing to CBT in 2014)
  3. Four years of experience as an EIT
  4. Pass the PE Exam
- Professional and Technical Societies play an important role in the professional lives of engineers.

Things you need to do:

- Obtain a broad engineering education
  - Keep in mind the topics covered in the FE Exam
- Plan to take the FE Exam
  - Apply for it at the beginning of the last semester before graduating
- Choose a job that provides qualifying work experience for the PE Exam
- Prepare for and take the PE Exam at your earliest possible date
- Continue participating in professional and technical organizations after graduation
- Continue to learn about your profession

Questions and Discussions

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Thanks for listening!

Vince Drnevich

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