AdvanCE
Continuing Education

CE FOR PROFESSIONAL ENGINEERS

FLORIDA PE LICENSURE PROGRAM

PROFESSIONALLY CURATED CONTENT FOR LICENSE RENEWAL

INCLUDES MANDATORY TOPICS:

FLORIDA LAWS AND RULES - 1 HOUR

PROFESSIONAL ETHICS - 1 HOUR

DEADLINE TO RENEW: 2/28/2025

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AdvanCE is an approved Florida Board of Professional Engineers Continuing Education Provider: Provider #0009318

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FLORIDA PROFESSIONAL ENGINEERS

PROGRAM PRICING

COURSES 1&2	**$30**
COURSES 1,2,3 (5 PDH)	**$45**
ENTIRE PROGRAM (8 PDH)	**$55**

PROGRAM CODE: FLENG8

TEST QUESTIONS AND WAYS TO COMPLETE

Getting Started...

- Navigate to fl.eng.advancece.org.
- Select "Take Test" option on the home page or in the sidebar.
- Fill in the answers for all courses you'd like to receive credit for, hit "Submit."
- Create an account or sign in.
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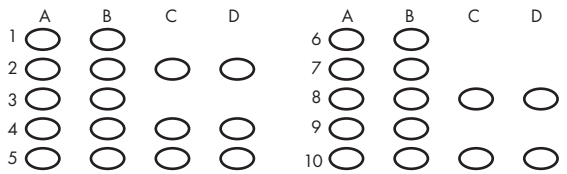
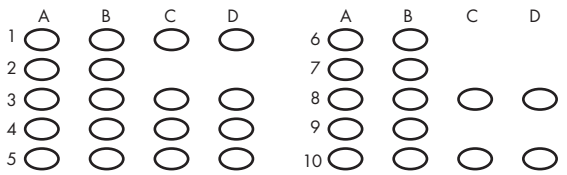
- Receive your certificate instantly via email.

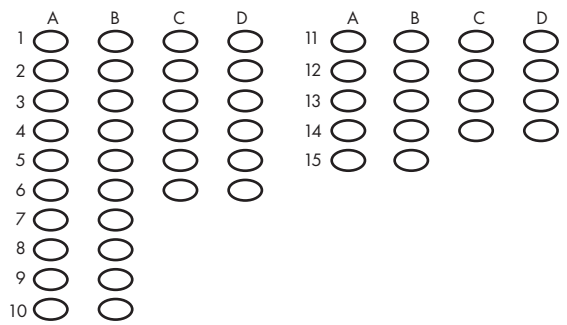
Course 1:
Laws and Rules for Florida Engineers



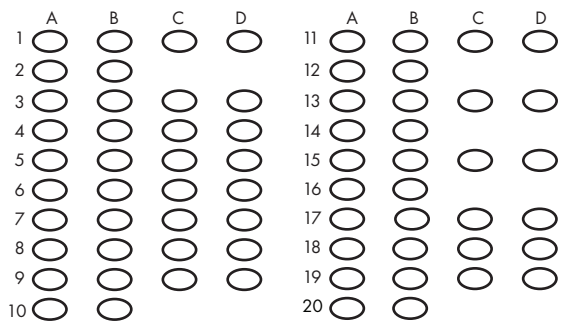
Course 2:
Ethics for Florida Engineers



Course 3:
Introduction to Project Management for Professional Engineers



Course 4:
Blockchain Fundamentals for Engineers: Bridging Traditional Protocols and Digital Innovation



AdvanCE Continuing Education

AdvanCE your Education,
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PROFESSIONAL ENGINEERS

CONTINUING EDUCATION REQUIRED FOR FEBRUARY 28, 2025 RENEWAL

Florida Laws & Rules

As a condition of biennial renewal, the Florida Board of Professional Engineers requires each person licensed as a professional engineer to complete 1 hour of continuing education related to the Florida laws and rules of professional engineers.

Professional Ethics

As a condition of biennial renewal, the Florida Board of Professional Engineers requires each person licensed as a professional engineer to complete 1 hour of continuing education related to Florida professional ethics.

Other Engineering CE Requirements

In addition to the two mandatory topics above, Professional Engineers licensed in Florida must take 16 continuing education (CE) course hours every two years in order to renew their licenses. Of the 16 hours, four must relate to area of practice. The remaining 12 hours may be related to any topic pertinent to the practice of engineering.

Board Information

We are a Continuing Education Provider, for any board related inquires, please contact the FBPE:

FLORIDA BOARD OF PROFESSIONAL ENGINEERS
2400 Mahan Dr.
Tallahassee, FL 32308
Phone: (850) 521-0500

Contact Us

Thank you for choosing AdvanCE as your continuing education provider. For questions or comments, please email support@advancece.org

LAWS AND RULES FOR FLORIDA ENGINEERS

Self-Assessment

1. Florida statutes are updated every two years.
A. True
B. False

2. Under Title XXXII of the Florida Statutes, Chapter ____ contains laws specific to the field of engineering.
A. 455
B. 321
C. 471
D. 61G15

3. Under Title XXXII of the Florida Statutes, Chapter 455 contains general provisions in the regulation of professions and occupations.
A. True
B. False

4. Chapters within FAC _____ contain the rules which regulate the practice of engineering governed by the Florida Board of Professional Engineers.
A. 61G15
B. 67G15
C. 91G15
D. 61G51

5. The Florida Engineers Management Corporation (FEMC) is a:
A. Non-profit, dual-purpose corporation
B. For-profit, single-purpose corporation
C. Non-profit, single-purpose corporation
D. For-profit, dual-purpose corporation

6. Under Rule: 61G15-19.0071, citation violations are violations for which there is no substantial threat to the public health, safety, and welfare.
A. True
B. False

7. Under Rule: 61G15-33.003, Engineering Documents applicable to power systems filed for public record no longer needs to contain information required by the Florida Building Code.
A. True
B. False

8. Under Chapter: 61G15-34 Mechanical Systems, who is responsible for the technical accuracy of work according to engineering standards and principles?
A. Engineer of Record
B. Independent Consultant
C. Prime Professional
D. Delegated Engineer

9. Under F.S. Chapter 455, Section 455.02, the department of business and professional regulation is required to expedite applications from the spouse of an active duty member of Armed Forces of the United States.
A. True
B. False

10. Which program was established under F.S. Chapter 471, Section 471.055?
A. Excellence in Engineering Program
B. Professional Engineer Training Program
C. Structural Engineering Recognition Program for Professional Engineers
D. Right of Way Training Program

ETHICS FOR FLORIDA ENGINEERS

Self-Assessment

1. Professional ethics is:

A. A set of standards
B. Defined by the professional community
C. Provides a guide for behavior that is expected from the professional
D. All of the above

2. Violating the professional engineering standards of behavior can have financial and legal consequences.

A. True
B. False

3. Considering if you are being honest with yourself is part of which step in the Steps to Ethical Engineering Decisions?

A. Consult with respected staff or outside professionals
B. Stop and Think
C. Consider foreseeable results of options
D. Develop options

4. Identifying alternate approaches is part of which step in the Steps to Ethical Engineering Decisions?

A. Stop and Think
B. Develop options
C. Determine facts known and unknown
D. Decide the course of action and take it

5. The "Consult with respected staff or outside professionals" step in the Steps to Ethical Engineering Decisions does not recommend which of the following:

A. Discuss the situation with a close friend or relative
B. Discuss the situation with a trusted professional
C. Discuss the situation with local media
D. Discuss the situation with legal council of the state boards

6. Under the Code of Ethics, if an engineers judgment is overruled under circumstances that endanger life or property, they are not required to notify their employer or client.

A. True
B. False

7. According to the Code of Ethics: Engineers shall hold paramount the safety, health, and welfare of the public.

A. True
B. False

8. When issuing statements to the public, it's important to remember:

A. Statements paid for by interested parties are never allowed.
B. Statements should include all relevant and pertinent information.
C. Engineers may express technical opinions before determining facts.
D. Dates on reports indicating when it was current are not necessary.

9. Engineers shall at all times strive to serve their employer over the public interest.

A. True
B. False

10. Which of the following is NOT required when using another engineer's work?

A. Naming the person or persons who are individually responsible when applicable.
B. Getting permission to duplicate a design supplied by the client.
C. Getting 4 signatures from respected staff members before accepting credit.
D. Enter into a positive agreement regarding ownership.

INTRODUCTION TO PROJECT MANAGEMENT FOR PROFESSIONAL ENGINEERS

Self-Assessment

1. What is the primary purpose of the Project nitiation phase?
A. To define project deliverables in detail
B. To execute the project plan
C. To define the task at a high level and achieve approval to proceed
D. To monitor project performance

2. Which of the following is NOT typically included in a Project Charter?
A. Budget
B. Gantt Chart
C. Scope
D. Stakeholders

3. Which risk assessment method uses a hierarchical decomposition of risks similar to a family tree?
A. SWOT Analysis
B. Delphi Technique
C. Failure Mode and Effects Analysis (FMEA)
D. Risk Breakdown Structure (RBS)

4. In the Project Planning phase, what tool is primarily used to manage the project's timeline visually?
A. Kanban
B. Scrum
C. Gantt Chart
D. Earned Value Management (EVM)

5. Which time management method emphasizes iterative cycles called sprints?
A. Kanban
B. Critical Path Method (CPM)
C. Scrum
D. Gantt Chart

6. What is the focus of Earned Value Management (EVM) in project management?
A. Assessing and controlling project risks
B. Comparing planned progress and budget with actual performance
C. Managing project communication strategies
D. Monitoring quality standards of deliverables

7. A feasibility study is only conducted after the Project Initiation phase is complete.
A. True
B. False

8. The Critical Path Method (CPM) helps identify the sequence of tasks that determines the project's minimum duration.
A. True
B. False

9. Project Execution is the phase where the project plan is put into action, and tasks are completed according to the schedule.
A. True
B. False

10. A Work Breakdown Structure (WBS) is used during the Project Closing phase to document lessons learned.
A. True
B. False

11. How does effective leadership contribute to team dynamics in project management?
A. By micromanaging team tasks to ensure efficiency
B. By fostering trust, understanding individual team member needs, and promoting open communication
C. By making all decisions without consulting team members
D. By focusing solely on achieving the project's technical objectives

12. Why is adaptability considered a crucial skill in project management?
A. It allows project managers to maintain strict adherence to the original plan
B. It helps project managers pivot and adjust plans in response to unforeseen challenges and changes
C. It ensures that all project tasks are completed by a single team member
D. It reduces the need for team collaboration

13. What is the primary purpose of setting vision and goals in project leadership?

A. To create a rigid plan that must be followed without deviation
B. To provide clear direction, inspire the team, and establish measurable objectives
C. To assign tasks to individual team members
D. To ensure that the project is completed as quickly as possible

14. In the context of conflict resolution, which approach is most effective for a project manager?

A. Ignoring conflicts in hopes they will resolve themselves
B. Addressing conflicts proactively, facilitating discussions, and finding compromises that align with project goals
C. Assigning blame to specific team members involved in the conflict
D. Enforcing a strict hierarchy where conflicts are not allowed

15. Ethical behavior in project management consists of protecting sensitive information, promoting fair treatment, and addressing environmental and social responsibilities

A. True
B. False

BLOCKCHAIN FUNDAMENTALS FOR ENGINEERS: BRIDGING TRADITIONAL PROTOCOLS AND DIGITAL INNOVATION

Self-Assessment

1. Blockchain is a:
A. Decentralized ledger system
B. Centralized ledger system
C. Cryptocurrency
D. Web 3.0

2. Blockchain ledgers are more secure than traditional ledgers because blockchain records are stored on a single machine.
A. True
B. False

3. What is a Soft Fork?
A. An update which adds new functionality and features to Blockchain
B. An update that splits the Blockchain to invalidate all previous transactions
C. The first transaction made after the mining of a new Block
D. The last transaction made in the current Block

4. Blockchain is particularly valuable in increasing the level of trust among network participants because it:
A. Can be inexpensive to build
B. Utilizes a central body to monitor and govern the flow of information
C. Provides cryptographic evidence about a set of transactions
D. Can be automated

5. Only _____ systems face the Byzantine Generals problem, as they have no reliable source of information or way of verifying the information they receive.
A. Decentralized
B. Centralized
C. Cryptocurrency
D. Web 3.0

6. A consensus mechanism is a:
A. Type of game theory
B. Secure code that enables the holder to prove ownership of their holdings
C. Cryptographic code used as a public key
D. System used to validate the authenticity of transactions and maintain the security of the underlying blockchain.

7. Which of the following is NOT a consensus mechanism for Blockchain?
A. Proof of Work
B. Proof of History
C. Proof of Stake
D. Proof of Ownership

8. Which of the following enables a holder to prove ownership of their holdings?
A. Crypto wallet
B. Private key
C. Public Key
D. Proof of Stake

9. Cryptographic hashing allows:
A. Reversible transactions
B. A set number of transactions to be recorded securely
C. Limitless transactions to be recorded securely
D. Compromised data to remain hidden

10. Blockchain-based Timestamping is the process of recording data on a blockchain to prove that it existed at a specific date and time.
A. True
B. False

11. What is Security by Timestamp?
A. A timestamp that marks when a hard fork has occurred on a Blockchain
B. A string of characters that uniquely identifies the document or event and indicates when it was created
C. A cryptographic hashing
D. A printed version of the record

12. Blockchain-based timestamps can be changed and removed once published to the blockchain ledger.
A. True
B. False

13. What is the capitalization gap?
A. The basis for the licensure system in the United States
B. The ethical obligation to ensure public safety and welfare
C. The time between initial investment and returned revenue
D. The profit range between purchase and returned revenue

14. Within the capitalization gap, the PE stamp serves as a proxy for a finished project on a balance sheet.

A. True
B. False

15. An Oracle Contract requires which of the following to execute adjudication?

A. All conditions met on a computed algorithm
B. The most appropriate person to perform the adjudication
C. Anyone who can assess digital data
D. A private key

16. As long as each component of the blockchain ecosystem is insurable, the entire system would remain insurable.

A. True
B. False

17. Banks and insurance companies rely on engineers to:

A. Negotiate payments for projects
B. Verify the design, materials, processes, components, and performance of all subjects that they finance
C. Run all adjudicated contracts
D. Adjudicate all smart contracts

18. Blockchain technology can combine components of physical and digital data to ambiguously perform while providing accuracy, speed, and _____.

A. Integrity
B. Peer-review processes
C. Common science and language of mathematics
D. Scalability of computer networks

19. Which of the following is NOT a viable application of blockchain:

A. Reporting discrepancies
B. Establishing prior art for innovative means and methods
C. Replacing the Professional Engineering Protocol
D. Releasing document revisions, schedule changes, change orders, material orders, or returns

20. Blockchain has the potential to reduce the costs of documentation, certification, and information control.

A. True
B. False

LAWS AND RULES FOR FLORIDA ENGINEERS

COURSE DESCRIPTION

This course covers recent updates to the laws and rules which govern the practice of engineering in Florida. The material will be covered in four parts: Part 1 contains an overview of Florida laws, rules, and regulators, Part 2 contains revisions to the Florida Administrative Code related to the practice of engineering, Part 3 contains revisions to the Florida Statutes, and Part 4 contains resources.

The information provided for each revised rule or statute comprises the date the revision went into effect, a brief summary of the changes, and the revised language (underlined) or a detailed summary of the revised language.

In order to complete the activity, you must read through the material and answer the self-assessment questions immediately following.

COURSE OBJECTIVE

The purpose of this course is to provide professional engineers licensed in Florida with relevant and significant changes to the laws and rules which govern their practice. Upon completion, learners will have a greater understanding of all recent revisions, as well as resources on where to find additional information.

FACULTY

Bart Ciambella P.E., M.B.A.

Completion of this course
satisfies Florida's

1 HOUR

requirement in Laws and Rules

Provider Approval:

AdvanCE is an approved Florida Board of Professional Engineers Continuing Education Provider: Provider #0009318

COURSE TOPICS

- Overview of laws, rules and regulators which govern the practice of engineering in Florida
- Revisions to Florida Administrative Code pertaining to the practice of engineering
- Revisions to Florida Statutes pertaining to business and engineering regulation
- Resources

Part 1: Overview of laws, rules and regulators which govern the practice of engineering in Florida

Florida Statutes

The Florida Statutes are a permanent collection of state laws organized by subject area into a code made up of titles, chapters, parts, and sections. The Florida Statutes are updated annually by laws that create, amend, transfer, or repeal statutory material.

Under Title XXXII, Chapter 455 contains general provisions in the regulation of professions and occupations, while Chapter 471 contains laws specific to the field of engineering.

Florida Administrative Code

The Florida Administrative Code (FAC) is the official compilation of the rules and regulations of Florida regulatory agencies. The Florida Department of State oversees the publishing of the FAC and updates it weekly.

Chapters within FAC 61G15 contain the rules which regulate the practice of engineering governed by the Florida Board of Professional Engineers.

Florida Board of Professional Engineers

The Florida Board of Professional Engineers (FBPE) was established under Chapter 471 of the Florida Statutes which made the board responsible for reviewing applications, administering exams, licensing qualified applicants, and regulating and enforcing the proper practice of engineering in the state.

The FBPE is composed of 11 members, nine of whom are licensed Professional Engineers representing multiple disciplines and two laypersons who are not and never have been engineers or members of any closely related profession or occupation. All members are appointed by the governor for terms of four years each.

Florida Engineers Management Corporation

Under Section 471.038, Florida Statutes, administrative, investigative, and prosecutorial services are provided to the FBPE by the Florida Engineers Management Corporation (FEMC). FEMC is a non-profit, single-purpose corporation that operates through a contract with the Department of Business and Professional Regulation.

FEMC's corporate board of directors is composed of seven members. Five directors are appointed by the Florida Board of Professional Engineers and must be Florida registrants. Two directors are appointed by the secretary of the Department of Business and Professional Regulation and must be laypersons not regulated by the Board.

Part 2: Revisions to FAC 61G15

1. Chapter: 61G15-18 Organization and Purpose

Rule: 61G15-18.011
Definitions.

- Effective Date: 6/5/2024
- Summary: Update to the rule language to include the current edition of the Florida Building Code and Florida Fire Prevention Code.

- As used in Chapter 471, F.S., and in these rules where the context will permit the following terms have the following meanings:

(6) The term "Florida Building Code" shall mean the Florida Building Code, 8th Edition, (2023), adopted by the Florida Building Commission through Rule 61G20-1.001, F.A.C., effective 12-31-23, which rule is incorporated herein by reference and which may be obtained at https://www.flrules.org/Gateway/reference.asp?No=Ref-13200.

(7) The term "Florida Fire Prevention Code" shall mean the Fire Code, Florida 2021 Edition, (2023), adopted by the Division of State Fire Marshal through rule Chapter 69A-60, F.A.C. The Florida Fire Prevention Code, effective 12-31-23, which rule chapter is incorporated herein by reference and which may be obtained at https://www.flrules.org/Gateway/reference.asp?No=Ref-16630.

(8) No later than December 31, 2024, the Board shall review and consider amendment, modifications, or repeal of this rule if review determines this rule creates barriers to entry for private business competition, is duplicative, outdated, obsolete, overly burdensome, or imposes excessive costs.

2. Chapter: 61G15-19 Grounds for Disciplinary Proceedings

Rule: 61G15-19.Disciplinary Guidelines; Range of Penalties; Aggravating and Mitigating Circumstances.

- Effective Date: 8/22/2021
- Summary: Substantial rewrite of rule text. Revisions to the rule are summarized below. We recommend reading the rule in its entirety here: *https://www.flrules.org/gateway/ruleNo.asp?id=61G15-19.004*

- This chapter provides a list of offenses and ranges of penalties for those offenses for the first, second, and third violation. Most offenses relate to licensure requirements, unlicensed or fraudulent practice or reporting, and other failure to comply with the board orders, rules, or breach of fiduciary duties. Penalties include fines up to $5,000, mandatory ethics or continuing education training, temporary license suspensions of 1-2 years, license probation for 1-2 years, or possible complete license revocation for repeat violations.

Probation may require monitoring through reviews every six months at the expense of the licensee.

Aggravating and mitigating circumstances are also listed; the Board will use these to determine if a lesser or greater penalty than the standard recommendation. Aggravators include scope and magnitude of damage, history of discipline. Mitigators which justify a reduction in penalty include cooperation and acceptance of responsibility, professional standing, and restitution paid for damages.

Rule: 61G15-19.0071 Citations.

- Effective Date: 8/22/2021
- Summary: Updated rule text to clarify

which disciplinary violations can be resolved through the issuance of a citation.

(1) As used in this rule, "citation" means an instrument which meets the requirements set forth in Section 455.224, F.S., and which is served upon a licensee or qualified business organization for the purpose of assessing a penalty in an amount established by this rule. *Citation violations are violations for which there is no substantial threat to the public health, safety, and welfare.*

(3) The following violations with accompanying fines may be disposed of by citation:

(a) An engineer who has practiced or offered to practice engineering through a corporation, partnership, or fictitious name which has not been properly qualified with the board. The fine shall be $100 for each month or fraction thereof of said activity, up to a maximum of $5,000. (See Sections 455.227(1)(j), 471.023, and 471.033(1)(a), F.S.)

(b) Practice with an inactive or delinquent license more than one month or if a Notice of Noncompliance has previously been issued for the same offense. The fine shall be $100 for each month or fraction thereof. (See Section 471.033(1)(i), F.S.)

(c) Business organization practicing without being properly qualified with the board more than one month or if a Notice of Noncompliance has previously been issued for the same offense. The fine shall be $100 for each month or fraction thereof. (See Section 471.023, F.S.)

(d) Failure to notify the Board of a change in the principal officer of the corporation or partner in a partnership who is the qualifying professional engineer for said corporation or partnership within one month of such change. The fine shall be $500. (See Section 471.023(4), F.S.)

(e) Unlicensed practice of engineering. The fine shall be up to $250 for each month depending on the severity of the infraction practice, up to a maximum of $5,000.00. (See Section 455.228(3)(a), F.S.)

(f) Failure to properly utilize a Title Block as required by paragraph 61G15-23.001(4)(a), F.A.C., if a Notice of Noncompliance has previously been issued for the same offense. The fine shall be $500.

(g) Failure to produce documentation of compliance with continuing education requirements within sixty (60) days of notification to the licensee of the requirement to produce said documentation – Notice of Noncompliance previously issued – paragraph 61G15-22.006(2)(c), F.A.C. The fine shall be $500.

(h) Failure to complete any or all CE required prior to renewal of license; all CE completed within thirty (30) days of notification to the licensee. Subsections 61G15-22.001(1) or 61G15-22.006(2), F.A.C. The fine shall be $500.

(i) Failure to properly qualify or register a business entity – Notice of Noncompliance previously issued – Section 471.023, F.S. The fine shall be $250.

(j) From January 1, 2023 until December 31, 2023, failure to properly sign and seal an Electronic

Multidimensional Model submitted as Final Work Product – subsection 61G15-23.001(4), F.A.C. – Notice of Noncompliance previously issued OR which results in adverse impacts to the customer or client. The fine shall be $500.

(k) Signing or sealing any document that depicts work which is beyond the licensee's profession or specialty therein or accepting and performing responsibilities the licensee is not competent to perform and which does not evidence any risk to public health, safety or welfare. (Sections 471.025(3), 455.227(1)(o), F.S., paragraphs 61G15-19.001(6)(c), (d), F.A.C.) The fine is $750.

(l) Incompetence (Subsection 61G15-19.001(5), F.A.C.) which does not evidence risk to public health, safety or welfare. The fine shall be $750.

(m) Violating any provision of Chapter 455, F.S. (Sections 471.033(1)(h) and 455.227(1)(q), F.S.); no evidence of intent or willful action and no evidence of risk to public health, safety or welfare.

(n) Failure to produce documentation of compliance with continuing education requirements within sixty (60) days of notification to the licensee of the requirement to produce said documentation

– Notice of Noncompliance previously issued – paragraph 61G15-22.006(2)(c), F.A.C. The fine shall be $500.

Rule: 61G15-19.008 Confidentiality of Investigations.

- Effective Date: 3/23/2022

- Summary: Update rule text to clarify other types of structures.

- The following violations have been deemed to involve the potential for substantial physical or financial harm to the public:

(1) Negligence, as defined in subsection 61G15-19.001(4), F.A.C., or misconduct, as defined in subsection 61G15-19.001(6), F.A.C., involving *either* threshold buildings as defined in Section 553.71(12), F.S.; *or the collapse or major damage to any structure; or leading to death or serious physical injury of any person.*

(2) No later than 90 days prior to December 31, 2022, the Board shall review and amend, modify, or sunset this rule if it determines this rule creates barriers to entry for private business competition, is duplicative, outdated, obsolete, overly burdensome, or imposes excessive costs. Failure by the Board to act in accordance with this provision will result in the expiration of this rule on December 31, 2022.

3. Chapter: 61G15-20 Application for Licensure, Education Requirements, and Experience

Rule: 61G15-20.0017 Application for Retired Status.

- Effective Date: 7/18/2022

- Summary: Updated rule text to include proper incorporation of applications and update address of the board.

- (1) A person wishing to apply for Retired Status shall submit a completed application to the Board. The instructions and application Form FBPE/005(Rev. *04/2022*), entitled "Application For Retired Status," which is incorporated by reference at *https://www.flrules.org/Gateway/reference.asp?No=Ref-14536*, copies of which may be obtained from the Board office *at 2400*

Mahan Drive, Tallahassee, Florida 32308 or from the Board's website at http://www.fbpe.org/licensure/application-process. The Board shall certify as eligible for Retired Status any applicant who has completed the application form and who has chosen to relinquish or not to renew his or her license, *unless disciplinary proceedings are pending against the applicant at the time of application for retired status.*

(4) No later than 90 days prior to December 31, 2026, the Board shall review and amend, modify, or sunset this rule if it determines this rule creates barriers to entry for private business competition, is duplicative, outdated, obsolete, overly burdensome, or imposes excessive costs. Failure by the Board to act in accordance with this provision will result in the expiration of this rule on December 31, 2026.

4. Chapter: 61G15-22 License Renewal, Continuing Education

Rule: 61G15-22.0002 Licensure Change of Status, Reactivation; Reinstatement of Void Licenses.

- Effective Date: 12/27/2021

- Summary: Updated the required procedures for reinstatement of void licenses and expand the means of obtaining required CE hours.

- (2) Reactivation of Inactive Licenses. Licensees may reinstate an inactive license and change their licensure status from inactive to active by remitting to FEMC a completed Change of Status Application, referenced in subsection (1), the fee specified by Rule 61G15-24.001, F.A.C., and proof of completion of eighteen (18) hours of continuing education obtained within the two (2) years immediately prior to application and in compliance with subsection 61G15-22.001(1), F.A.C.

(3) Reinstatement of Void Licenses. Persons previously licensed as professional engineers in Florida may not re-apply for licensure by examination or by endorsement pursuant to Section 471.013 or 471.015, F.S. Rather, pursuant to Sections 455.271(6) and 471.019, F.S., any person previously licensed as a professional engineer in Florida whose Florida license has become void must apply for reinstatement of the previous license. Application for reinstatement shall be made on form FBPE/023, Change of Status Application, referenced in subsection (1). In addition to a completed application form, all applications for reinstatement shall be accompanied by the following.

(a) The fees specified by Rule 61G15-24.001, F.A.C.;

(b) Documentation of satisfaction of any disciplinary obligations imposed against the void license;

(c) Passage of the Board's Laws and Rules Study Guide as detailed in Rule 61G15-20.0016, F.A.C.; and

(d) Documentation of one of the following:

1. Current active practice as a professional engineer in another U.S state or territory. Such documentation shall include verification of active licensure in good standing and compliance with such state or territory's continuing education requirements; or

2. Applicants not currently in active practice as a professional engineer must provide proof of completion of thirty-six (36) hours of *Board approved* continuing education, including two (2) hours of professional ethics and a one (1) hour course in Florida Laws and Rules. With the exception of the one (1) hour Florida Laws and Rules course, which can be taken online, the remaining thirty-five (35) hours must be *either in-person or synchronous live streaming/videoconference/interactive webinar OR obtained through distance learning CE courses provided by a national or Florida statewide engineering society or association pursuant to Rule 61G15-22.011, F.A.C.; other* online or distance learning courses will not be accepted.

(4) *No later than 90 days prior to December 31, 2026, the Board shall review and consider amendment, modification, or repeal of this rule if review determines this rule creates barriers to entry for private business competition, is duplicative, outdated, obsolete, overly burdensome, or imposes excessive costs. Failure by the Board to act in accordance with this provision will result in the expiration in this rule December 31, 2016.*

Rule: 61G15-22.008 Record Keeping.

- Effective Date: 4/4/2021

- Summary: Rule repealed. The subject matter is contained in 61G15-22.006(3), F.A.C.

5. Chapter: 61G15-23 Seals

Rule: 61G15-23.001 Signature, Date and Seal Shall Be Affixed.

- Effective Date: 6/29/2021, 11/15/2021

- Summary: Paragraph 5 was updated to allow licensees to sign and seal Electronic Multi-Dimensional Models as final work product and went into effect 6/29/2021. Paragraph 6 updated the requirements to conform with the individual rules and went into effect 11/15/2021.

-*(5) Additional Requirements for Multi-Dimensional Models. The Florida Board of Professional Engineers recognizes that the practice of engineering is evolving into increasingly frequent contractual requirements for licensees to submit final work product as an electronic multidimensional model. Accordingly, when a licensee's contract requires the submission of an electronic multidimensional model as final work product; which by contract, law, or rule must be signed, dated, and sealed, the licensee shall utilize the process specified in paragraph (4)(b), above, regarding engineering specifications or calculations.*

(6) As detailed in paragraph 61G15-30.003(1)(b), F.A.C., signed and sealed documents are presumed to comply with all applicable codes and standards in effect at the time of sealing. Unless the documents are amendments to documents previously signed and sealed by the engineer, and that fact is clearly noted at the time of submission, the licensee must affirmatively indicate on the documents any other edition of a code or standard, other than those currently in effect, with which he licensee intends the documents to comply.

6. Chapter: 61G15-31 Responsibility Rules of Professional Engineers Concerning The Design Of Structures

Rule: 61G15-31.003 Design of Structures Utilizing Prefabricated Wood Trusses.

- Effective Date: 10/25/2021

- Summary: Updated the incorporated reference.

- (1) When a Structural Engineer of Record and a Delegated Engineer exist as may be determined by applicable Florida law, the apportionment of responsibilities between the Structural Engineer of Record and a Delegated Engineer shall be as set forth in Chapter 2 of ANSI/TPI 1-*2014, National Design Standard for Metal Plate Connected Wood Truss Construction, which standard is incorporated herein by reference*, wherein the Structural Engineer of Record is the Building Designer and the Delegated Engineer is the Truss Designer as those terms are defined in said standard. *The material incorporated is copyrighted material and may be ordered from the Truss Plate Institute, 2670 Crain Highway, Suite 203, Waldorf MD 20601; it is also available for public inspection and examination, but may not be copied, at the Department of State, Administrative Code and Register Section, Room 701, The Capitol, Tallahassee, Florida 32399-0250, and at the Board office, 2400 Mahan Drive, Tallahassee, FL 32303.*

Rule: 61G15-31.006 Design of Structural Systems Utilizing Open Web Steel Joists and Joist Girders.

- Effective Date: 8/22/2021

- Summary: Removed old text of referenced information.

- (1) The Engineer of Record shall indicate on the Structural Engineering Documents the steel joist and joist girder designations as required in Section 2207 of the Florida Building Code, Building, *which is* incorporated by reference *in Rule 61G15-18.011(6), F.A.C.,* and shall indicate the appropriate standards for joist and joist girder design, layout, end supports, anchorage, bridging requirements, etc., including connections to walls. These documents shall indicate special requirements for concentrated loads, non-uniform loads, openings, extended ends, and resistance to uplift loads.

(3) No later than December 31, 2024, the Board shall review and consider amendment, modification, or repeal of this rule if review determines this rule creates barriers to entry for private business competition, is duplicative, outdated, obsolete, overly burdensome, or imposes excessive costs.

7. Chapter: 61G15-32 Responsibility Rules of Professional Engineers Concerning The Design Of Fire Protection Systems

Rule: 61G15-32.004 Design of Water Based Fire Protection Systems & Rule: 61G15-32.008 Design of Fire Alarms, Signaling Systems, and Control Systems.

- Effective Date: 3/23/2022

- Summary: Updated rules to properly match other responsibility rules. For Rule 61G15-32.008, these changes apply to paragraphs (3) and (8).

- *(3) For Engineering Documents pertaining to Fire Protection Systems exempted by the threshold requirements for mandatory use of professional engineering services, the Engineer of Record shall determine the level of detail shown on plans for a Fire Protection system. All such plans shall include a disclaimer stating the Fire Protection system is exempt from professional engineering services and shall provide a clear understanding of the minimum system requirements expected to be installed by the contractor and permitted by the authority having jurisdiction (AHJ). In the event the Engineer of Record provides more information and direction than is minimally required, he or she shall be held responsible for the technical accuracy of the work in accordance with applicable codes, standards, and sound engineering principles.*

(7) No later than 90 days prior to December 31, 2026, the Board shall review and amend, modify, or sunset this rule if it determines this rule creates barriers to entry for private business competition, is duplicative, outdated, obsolete, overly burdensome, or imposes excessive costs. Failure by the Board to act in accordance with this provision will result in the expiration of this rule on December 31, 2026.

8. Chapter: 61G15-33 Responsibility Rules of Professional Engineers Concerning The Design Of Electrical Systems

Rule: 61G15-33.003 Design of Power Systems.

- Effective Date: 11/15/2021

- Summary: Updated the required responsibility rules.

- (2) For Engineering Documents pertaining to Electrical Systems exempted by the threshold requirements for mandatory use of professional engineering services established by Section 471.003(2)(h), F.S., the Engineer of Record shall determine the level of detail shown on plans for an Electrical system. All such plans shall include a disclaimer stating the Electrical systems are exempt from professional engineering services and shall provide a clear understanding of the minimum system requirements expected to be installed by the contractor and permitted by the authority having jurisdiction (AHJ). In the event the Engineer of Record provides more information and direction than its minimally required, he or she shall be held responsible for the technical accuracy of the work in accordance with applicable codes, standards, and sound engineering principles.

(3) Electrical Engineering Documents for power systems that exceed the threshold requirements for mandatory use of professional engineering services must include the following information, if applicable to the particular project:

(a) Power distribution riser diagram.

(b) Conductor sizes (AWG or kcmil) and insulation type, or cable assemblies characteristics.

(c) Circuit interrupting devices, ratings and fault current interrupting capability.

(d) Location and characteristics of any surge protective devices, if included in the engineering design.

(e) Main and distribution equipment, control devices, locations and ratings.

(f) Circuitry of all outlets, equipment and devices.

(g) Feeder and service capacity calculations.

(h) Electrical legends.

(i) Grounding and bonding requirements.

(j) Instrumentation and control when necessary for safe operation or to show intended function.

(k) Engineering Documents applicable to power systems filed for public record shall also contain information required by the Florida Building Code, incorporated by reference in subsection 61G15-18.001(6), F.A.C.

(l) Engineers performing arc flash hazard analysis must determine arc flash approach distance, assess and convey the incident energy levels, and identify appropriate PPE class. Any such verification shall constitute an Engineering Certification as that term is defined in subsection 61G15-18.011(4), F.A.C., and must comply with the Responsibility Rules, including Rule 61G15-29.001, F.A.C.

(4*) No later than December 31, 2026, the Board shall review and consider amendment, modification, or repeal of this rule if review determines this rule creates barriers to entry for private business competition, is duplicative, outdated, obsolete, overly burdensome, or imposes excessive costs. Failure by the Board to act in accordance with this provision will result in the expiration of this rule on December 31, 2026*

9. Chapter: 61G15-34 Mechanical Systems.

- Effective Dates: 4/25/2021 – 8/4/2022

- Summary: Substantial rewrites to the rule language of 61G15-34.002, 61G15-34.003, 61G15-34.004, 61G15-34.005, 61G15-34.006, 61G15-34.007, 61G15-34.008, 61G15-34.009, and 61G15-34.0010 went into effect on 4/25/2021. Following the rewrites, old text of referenced information was removed from 61G15-34.002; there were clarification to the rule provisions in 61G15-34.003; the responsibility rules were updated in 61G15-34.003, 61G15-34.004, and 61G15-34.007. A summary of the revisions is provided below. We recommend reading the chapter in its entirety here: https://www.flrules.org/gateway/ChapterHome.asp?Chapter=61G15-34

- HVACR Systems should be based on and reference the Florida Building Code, Florida Fire Prevention Code, and other applicable standards (ASHRAE, NFPA, ASME, ANSI, IIAR, etc.). Rely on sound engineering practice if none are available to reference. The Engineer of Record must include a disclaimer on plans for HVACR systems stating that HVACR systems are exempt from professional engineering services and clearly outline contractor requirements and system requirements permitted by the authority having jurisdiction (AHJ). The Engineer of Record will be responsible for the technical accuracy of work according to engineering standards and principles.

Provide adequate information for the AHJ to determine compliance with codes, such as test methods, data, and tables from the design. List information relevant to mechanical equipment.

Explain electrical, fuel, pressure, heat transfer, cooling, and filtration requirements. Reference the Florida Building Code, Energy Conservation for motor sizes and quantities.

Comply with the Florida Building Code, Mechanical, for ventilation and energy recovery requirements and outside and inside design conditions. If inside design conditions are setback because of occupancy, occupied and unoccupied design conditions must be listed. When only a portion of a building is under renovation, write an air balance summary for all affected areas. If spaces have critical pressurization requirements, specify air quantities, room pressurization, and transfer air pathways. If conditions vary, include maximum and minimum design conditions in the pressurization summary.

Include load characteristics and capacities, process and fluid type, distribution of fluids, pressure drop, performance, and installation requirements in the design and analysis of process flow and fluid flow systems. These systems should reference the Florida Fire Prevention Code and other applicable standards and rely on sound engineering practice.

If applicable, include information for the AHJ to determine compliance with codes. If applicable to the equipment, add efficiencies, electrical and fuel requirements, motor sizes and quantities, fluid flow and pressure head quantities, and storage tank capacity.

Include floor plans and elevations, schematic flow diagrams, ductwork and insulation information, and system design requirements for independent project review. Specify materials for process and fluid flow systems and use fire protection devices. Include all data for calculations in compliance with the Florida Building Code, Energy Conservation, unless there is a design exemption. If applicable, list firestop systems.

Include load characteristics and capacities, fluid distribution, pressure drop, instrumentation, performance, and installation requirements in the design and analysis of plumbing systems. They should reference the Florida Building Code, Florida Fire Prevention Code, and other applicable standards.

Plumbing plans should include a disclaimer stating that plumbing systems are exempt from professional engineering services and outline the minimum system requirements to be installed and permitted by the AHJ. The engineer is held responsible for the technical accuracy of work based on codes and sound engineering principles. If applicable, include test methods, results, or data for the AHJ to determine compliance with Florida codes. All equipment must explain efficiencies, electrical and fuel requirements, fixture and fluid flow, pressure head quantities, heat transfer capacities, motor sizes and quantities, tank capacities, and interceptor and separator capacities.

Include floor and site plans to indicate minimum system requirements expected to be installed by the contractor. Use an isometric diagram with pipe sizes for various fluids and gasses. Explain insulation requirements and plumbing capacities on the isometric diagrams or a table in the plumbing plans. Refer to 61G15-34.007 section (f) for more details.

When applicable, include design data for septic tank drain field sizing a portable water system to minimize bacteria growth

and a domestic hot water system to prevent burning. The designs should follow accessibility requirements adopted by the AHJ. If not already in the HVAC system plans or Instrumentation and Control, add designs for a fuel gas system and Instrumentation and Control requirements. Identify and locate all plumbing equipment and accessories. Specify materials needed for plumbing systems. Include all data required to complete calculations for compliance with the Florida Building Code, Energy Conservation, if applicable. List firestop systems and system commissioning requirements in compliance with Energy Conservation.

10. Chapter: 61G15-35 Responsibility Rules of Professional Engineers Providing Threshold Building Inspection

Rule: 61G15-35.0021 Definitions.

- Effective Date: 3/28/2021, 4/5/2022

- Summary: Updated rule language and established an additional certification which went into effect 3/28/2021. Later, the rule was again updated to clarify new versus existing buildings, experience, etc. which went into effect 4/5/2022.

- As used hereinafter in this chapter, the following words or phrases shall be defined as follows. The Board does not intend for these definitions to apply to any similar wording, term, role, or description outside of Chapter 471 or 553, F.S. or the Florida Building Code Section 110.8 Threshold Building; or as such term may be used by a local Authority Having Jurisdiction in local regulations, codes, or ordinances.

(1) "Special Inspectors of Threshold buildings," also referred to as "Threshold Inspectors," "Special Inspectors," or "S.I.s" are defined by Section 553.719, F.S., Threshold Inspectors can perform inspections on all threshold buildings or perform any other services authorized by Section 553.79(5)(a), F.S. Florida Building Code section 110.8 provides additional requirements to the enforcing agency, Special Inspector, and fee owner.

(2) "Special Inspectors of Threshold buildings (Limited)", also referred to as "Threshold Inspectors (Limited)," can only perform inspections on Threshold Buildings with Repair (without Substantial Structural Damage), Alterations 1, Alterations 2, and Alterations 3 (without Substantial Structural Alterations) of threshold buildings. Special Inspectors (Limited) are not permitted to do inspections on new construction or threshold buildings with Repairs with Substantial Structural Damage or Alterations 3 with Substantial Structural Alteration. The terms Repairs, Alteration 1, Alteration 2, Alteration 3, Substantial Structural Damage, and Substantial Structural Alteration are as defined in the Florida Building Code, Existing Buildings.

(3) "Threshold Building" is as defined by the Florida Building Code, Section 110.08 and in 553.71(12), F.S.

(4) "Private Provider" is as defined in Section 553.791(1)(j), F.S. Private Providers carry out duties as authorized by Section 553.791, F.S. As set forth in Chapter 553, F.S., although the roles and duties of Special Inspectors and Private Providers may appear to be similar or overlap, they are not synonymous and as specified in that chapter, are not interchangeable.

(5) Inspections requested by local Authority Having Jurisdiction in local regulations, codes, or ordinances for non-threshold buildings are not part of this chapter.

(6) "All Structural Components" shall mean each structural element necessary to the complete load path of the structure.

(7) No later than 90 days prior to December 31, 2023, the Board shall review and amend, modify, or sunset this rule if it determines this rule creates barriers to entry for private business competition, is duplicative, outdated, obsolete, overly burdensome, or imposes excessive costs. Failure by the Board to act in accordance with this provision will result in the expiration of this rule on December 31, 2023.

Rule: 61G15-35.003 Qualification Program for Special Inspectors of Threshold Buildings and Special Inspectors of Threshold Buildings (Limited).

- Effective Date: 3/28/2021, 4/5/2022

- Summary: Substantial updates to rule language and established an additional certification which went into effect 3/28/2021. Later, the rule was again updated to clarify new versus existing buildings, experience, etc. which went into effect 4/5/2022. A summary of the revisions is provided below. We recommend reading the rule in its entirety here:

https://www.flrules.org/gateway/RuleNo.asp?title=RESPONSIBILITY%20RULES%20OF%20PROFESSIONAL%20ENGINEERS%20PROVIDING%20THRESHOLD%20BUILDING%20INSPECTION&ID=61G15-35.003

- You must have proof of licensure in good standing in Florida, three years of experience performing structural field inspections in the new construction of Threshold Buildings, and two years of experience in the design of all structural components of new threshold buildings to qualify as a Special Inspector of Threshold Buildings. Structural design/inspection refers to all aspects of the building under construction. Licensed engineers that mainly do structural field inspections must have five years of experience performing them on the new construction of Threshold Buildings and possess the certifications identified in 61G15-35.004(2)(f) when applying. The Engineer of Record must prepare the threshold ("special") inspection plan.

For S.I. Certification, only design and inspection experience for new buildings is credible. The Board establishes Special Inspectors (Limited) certification. When licensed as an S.I. (Limited), you may serve as the inspector for projects involving non-substantial repair for existing Threshold buildings.

You may not inspect new construction sites or repairs with substantial structural damage unless certified as a Special Inspector of Threshold Buildings.

To qualify as a Threshold Inspector (Limited), you must have proof of professional engineering licensure in good standing in Florida, with the principal practice being structural engineering. You must also have three years of experience performing structural field

inspections on Threshold Buildings and two years of experience in the structural design of repairs to components of Threshold Buildings. Licensed engineers that mainly do structural field inspections must have five years of experience performing inspections on Threshold Buildings and possess the certifications listed in 61G15-35.004(2)(f), Florida Administrative Code when applying.

On the application, you must specify whether your experience is from new construction or repair of existing threshold buildings. Work unrelated to design or inspection of construction projects or not performed during a 40-hour week in full-time employment as an engineer will not count toward credit.

Applications for Special Inspectors of Threshold Buildings (Limited) can be obtained from the Board office or downloaded at https://www.flrules.org/Gateway/reference.asp?No=Ref-14136.

The Board will notify the engineer of rejections or updates.

Part 3: Revisions to F.S. Chapters 455 & 471

1. Chapter: 455 Business and Professional Regulation: General Provisions.

Section 455.02 Licensure of members of the Armed Forces in good standing and their spouses or surviving spouses with administrative boards or programs.

- Effective Date: 7/1/2022

- Summary: During the 2022 Session, Senate Bill (SB) 562 was approved by the Governor on 6/9/2022 and amends s. 455.02, F.S.; requiring the Department of Business and Professional Regulation to expedite professional license applications submitted by spouses of active duty members of the Armed Forces of the United States.

- Text added to paragraph (d) of subsection (3): *(d) The department shall expedite all applications submitted by a spouse of an active duty member of the Armed Forces of the United States pursuant to this subsection and shall issue a license within 7 days after receipt of a complete application that includes all required documentation under subparagraphs (a)1.-4.*

2. Chapter: 471 Engineering.

Section 471.055 Structural Engineering Recognition Program for Professional Engineers.

- Effective Date: 7/1/2022

- Summary: During the 2022 Session, House Bill (HB) 375 was approved by the Governor on 4/27/2022 and establishes the Structural Engineering Recognition Program for Professional Engineers; requires Board of Professional Engineers to recognize licensed professional engineer who has successfully passed specified examination; provides requirements for application & recognition; prohibits fee for such application or for recognition; authorizes professional engineer recognized by program to identify such recognition in her or his professional practice & marketing & advertising materials.

- (1) The board shall establish the Structural Engineering Recognition Program for Professional Engineers to recognize professional engineers who specialize in structural engineering and have gone above and beyond the required minimum professional engineer licensing standards. The board shall establish minimum requirements to receive recognition through the program. The board must recognize any licensed professional engineer who has successfully passed the National Council of Examiners for Engineering and Surveying Structural Engineering 16-hour PE Structural examination or any other examination approved by the board. In addition, the board may recognize any licensed professional engineer who specializes in structural engineering based on alternative criteria determined by the board.

(2) Upon application to the board, a professional engineer who has the minimum program requirements shall be recognized as a professional engineer who has gone above and beyond in the field of structural engineering. The board may not collect a fee for such application or for recognition by the program.

(3) A professional engineer who is recognized by the program may identify such recognition in her or his professional practice, including in marketing and advertising materials.

(4) Recognition by the program is not required for a professional engineer to practice structural engineering.

(5) The board shall adopt rules to implement this section.

Part 4: Resources

- **Florida Administrative Code, Chapter 61G15**, Board of Professional Engineers
  https://www.flrules.org/gateway/Division.asp?DivID=267

- **Florida Senate**
  https://www.flsenate.gov/

- **Florida House of Representatives**
  https://www.myfloridahouse.gov/

- **Florida Statutes, Title XXXII, Chapter 455**, "Business and Professional Regulation: General Provisions"
  http://www.leg.state.fl.us/Statutes/index.cfm?App_mode=Display_Statute&URL=0400-0499/0455/0455ContentsIndex.html&StatuteYear=2021&Title=%2D%3E2021%2D%3EChapter%2455

- **Florida Statutes, Title XXXII, Chapter 471**, "Engineering"
  http://www.leg.state.fl.us/Statutes/index.cfm?App_mode=Display_Statute&URL=0400-0499/0471/0471ContentsIndex.html&StatuteYear=2021&Title=%2D%3E2021%2D%3EChapter%20471

- **Florida Administrative Weekly**
  https://www.flrules.org/gateway/Division.asp?DivID=267

- **Laws of Florida – State Library and Archives of Florida**
  http://laws.flrules.org node?field_list_year_nid=5234

ETHICS FOR FLORIDA ENGINEERS

COURSE DESCRIPTION

This course satisfies the Ethics continuing education requirement for professional engineers licensed in the state of Florida. The distance learning interactive format covers a brief overview of ethics, the National Society of Professional Engineers (NSPE) steps to ethical engineering decisions, and the NSPE Code of Ethics for Engineers.

In order to complete the activity, you must read through the material and answer the self-assessment questions immediately following.

COURSE OBJECTIVE

The purpose of this course is to provide professional engineers licensed in Florida with the fundamentals they need to adhere to the Code of Ethics for Engineers. Upon completion, learners will have an understanding of the Code of Ethics and the application of professional ethics to decision making.

Completion of this course
satisfies Florida's

1 HOUR

requirement in Ethics

Provider Approval:

AdvanCE is an approved Florida Board of Professional Engineers Continuing Education Provider: Provider #0009318

FACULTY

Bart Ciambella P.E., M.B.A.

COURSE TOPICS

- Overview
- Steps to Ethical Engineering Decisions
- NSPE Code of Ethics for Engineers
- Resources

Overview

What is ethics?

Professional Ethics is a set of standards defined by the professional community which provides a guide for behavior that is expected from the professional.

Why study ethics?

The purpose of study is to familiarize oneself to the professional standards that apply to your profession. These standards vary from state to state, organizations, country and culture. Registration laws incorporate ethics with varying detail, so that what is stated in one jurisdiction may not be stated in another. Knowing the differences will help you grow professionally.

Why practice ethics?

Violating the professional standards of behavior can have financial and legal consequences. List the consequences of unethical behavior.

Steps to Ethical Engineering Decisions

There are nine steps to ethical engineering decisions:

1. Stop and Think

a. Stop with the hustle and bustle and quietly reflect on the situation.

b. Stop and review relative information about the situation

c. Stop and take a step back to look at the big picture.

d. Think if the situation will result in losing employment, a client or worse.

e. Think if there are similar situations other engineers have encountered.

f. Understand why this situation has presented itself to you.

g. Who benefits and who gets penalized from the situation?

2. Clarify goals

a. Clarify if this is an ethical or legal situation or both.

b. What is the most desired outcome:

i. Obtaining a contract

ii. Looking good for self-promotion

iii. Increase income

iv. Prestige

v. Peace and quiet

3. Determine facts known and unknown

a. From reviewing the relative information on the situation are there missing facts that can be researched?

b. Are there reliable resources that can be consulted

c. Are there legal resources that would shed light on the situation

d. Are there ethical resources that can be researched

4. Develop options

a.Identify the alternate approaches

b. Outline the options

5. Consider foreseeable results of options

a. From the tabulated options are there risks that can be applied to each

b. Are there benefits

c. Consider a simple scoring system to help highlight the best option

d. Are you being honest with yourself

6. Refer to the NSPE Ethics Resources

a. NSPE Code of Ethics

b. NSPE Board of Ethical Review Cases (over 500 situations)

7. Refer to state registration law for guidance

a. Review the specific registration law of your home state.

b. Review the specific registration law of the state where the project is located.

8. Consult with respected staff or outside professionals

a. Discuss the situation with trusted professionals

b. Discuss the situation with the legal council of the state boards

c. Discuss the situation with a close friend or relative

d. Discuss the situation with a Professional Society executive of NSPE or State or Chapter Society.

9. Decide the course of action and take it

a. After going through the eight steps above, a clear picture of what is expected from a professional in the situation will become clear. In the most professional way act on the decision.

b. Professionally and respectfully decline the assignment.

c. Refer the work to another professional who will not be placed in the same situation.

d. Inform the authorities if necessary

Code of Ethics Preamble

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

I. Fundamental Canons

Engineers, in the fulfillment of their professional duties, shall:

1. Hold paramount the safety, health, and welfare of the public.

2. Perform services only in areas of their competence.

3. Issue public statements only in an objective and truthful manner.

4. Act for each employer or client as faithful agents or trustees.

5. Avoid deceptive acts.

6. Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

II. Rules of Practice

1. Engineers shall hold paramount the safety, health, and welfare of the public.

a. If engineers' judgment is overruled under circumstances that endanger life or property, they shall

notify their employer or client and such other authority as may be appropriate.

b. Engineers shall approve only those engineering documents that are in conformity with applicable standards.

c. Engineers shall not reveal facts, data, or information without the prior consent of the client or employer except as authorized or required by law or this Code.

d. Engineers shall not permit the use of their name or associate in business ventures with any person or firm that they believe is engaged in fraudulent or dishonest enterprise.

e. Engineers shall not aid or abet the unlawful practice of engineering by a person or firm.

f. Engineers having knowledge of any alleged violation of this Code shall report thereon to appropriate professional bodies and, when relevant, also to public authorities, and cooperate with the proper authorities in furnishing such information or assistance as may be required.

2. Engineers shall perform services only in the areas of their competence.

a. Engineers shall undertake assignments only when qualified by education or experience in the specific technical fields involved.

b. Engineers shall not affix their signatures to any plans or documents dealing with subject matter in which they lack competence, nor to any plan or document not prepared under their direction and control.

c. Engineers may accept assignments and assume responsibility for coordination of an entire project and sign and seal the engineering documents for the entire project, provided that each technical segment is signed and sealed only by the qualified engineers who prepared the segment.

3. Engineers shall issue public statements only in an objective and truthful manner.

a. Engineers shall be objective and truthful in professional reports, statements, or testimony. They shall include all relevant and pertinent information in such reports, statements, or testimony, which should bear the date indicating when it was current.

b. Engineers may express publicly technical opinions that are founded upon knowledge of the facts and competence in the subject matter.

c. Engineers shall issue no statements, criticisms, or arguments on technical matters that are inspired or paid for by interested parties, unless they have prefaced their comments by explicitly identifying the interested parties on whose behalf they are speaking, and by revealing the existence of any interest the engineers may have in the matters.

4. Engineers shall act for each employer or client as faithful agents or trustees.

a. Engineers shall disclose all known or potential conflicts of interest that could influence or appear to influence their judgment or the quality of their services.

b. Engineers shall not accept compensation, financial or otherwise, from more than one party for services on the same project, or for services pertaining to the same project, unless the circumstances are fully disclosed and agreed to by all interested parties.

c. Engineers shall not solicit or accept financial or other valuable consideration, directly or indirectly, from outside agents in connection with the work for which they are responsible.

d. Engineers in public service as members, advisors, or employees of a governmental or quasi-governmental body or department shall not participate in decisions with respect to services solicited or provided by them or their organizations in private or public engineering practice.

e. Engineers shall not solicit or accept a contract from a governmental body on which a principal or officer of their organization serves as a member.

5. Engineers shall avoid deceptive acts.

a. Engineers shall not falsify their qualifications or permit misrepresentation of their or their associates' qualifications. They shall not misrepresent or exaggerate their responsibility in or for the subject matter of prior assignments. Brochures or other presentations incident to the solicitation of employment shall not misrepresent pertinent facts concerning employers, employees, associates, joint venturers, or past accomplishments.

b. Engineers shall not offer, give, solicit, or receive, either directly or indirectly, any contribution to influence the award of a contract by public authority, or which may be reasonably construed by the public as having the effect or intent of influencing the awarding of a contract. They shall not offer any gift or other valuable consideration in order to secure work. They shall not pay a commission, percentage, or brokerage fee in order to secure work, except to a bona fide employee or bona fide established commercial or marketing agencies retained by them.

III. Professional Obligations

1. Engineers shall be guided in all their relations by the highest standards of honesty and integrity.

a. Engineers shall acknowledge their errors and shall not distort or alter the facts.

b. Engineers shall advise their clients or employers when they believe a project will not be successful.

c. Engineers shall not accept outside employment to the detriment of their regular work or interest. Before accepting any outside engineering employment, they will notify their employers.

d. Engineers shall not attempt to attract an engineer from another employer by false or misleading pretenses.

e. Engineers shall not promote their own interest at the expense of the dignity and integrity of the profession.

f. Engineers shall treat all persons with dignity, respect, fairness, and without discrimination.

2. Engineers shall at all times strive to serve the public interest.

aEngineers are encouraged to participate in civic affairs; career guidance for youths; and work for the advancement of the safety, health, and well-being of their community.

b. Engineers shall not complete, sign, or seal plans and/or specifications that are not

in conformity with applicable engineering standards. If the client or employer insists on such unprofessional conduct, they shall notify the proper authorities and withdraw from further service on the project.

c. Engineers are encouraged to extend public knowledge and appreciation of engineering and its achievements.

d.Engineers are encouraged to adhere to the principles of sustainable development1 in order to protect the environment for future generations.

e. Engineers shall continue their professional development throughout their careers and should keep current in their specialty fields by engaging in professional practice, participating in continuing education courses, reading in the technical literature, and attending professional meetings and seminar.

3. Engineers shall avoid all conduct or practice that deceives the public.

a. Engineers shall avoid the use of statements containing a material misrepresentation of fact or omitting a material fact.

b. Consistent with the foregoing, engineers may advertise for recruitment of personnel.

c. Consistent with the foregoing, engineers may prepare articles for the lay or technical press, but such articles shall not imply credit to the author for work performed by others.

4. Engineers shall not disclose, without consent, confidential information concerning the business affairs or technical processes of any present or former client or employer, or public body on which they serve.

a. Engineers shall not, without the consent of all interested parties, promote or arrange for new employment or practice in connection with a specific project for which the engineer has gained particular and specialized knowledge.

b. Engineers shall not, without the consent of all interested parties, participate in or represent an adversary interest in connection with a specific project or proceeding in which the engineer has gained particular specialized knowledge on behalf of a former client or employer.

5. Engineers shall not be influenced in their professional duties by conflicting interests.

a. Engineers shall not accept financial or other considerations, including free engineering designs, from material or equipment suppliers for specifying their product.

b. Engineers shall not accept commissions or allowances, directly or indirectly, from contractors or other parties dealing with clients or employers of the engineer in connection with work for which the engineer is responsible.

6. Engineers shall not attempt to obtain employment or advancement or professional engagements by untruthfully criticizing other engineers, or by other improper or questionable methods.

a. Engineers shall not request, propose, or accept a commission on a contingent basis under circumstances in which their judgment may be compromised.

b. Engineers in salaried positions shall accept part-time engineering work only to the extent consistent with policies of the employer and in accordance with ethical considerations.

c. Engineers shall not, without consent, use equipment, supplies, laboratory, or office facilities of an employer to carry on outside private practice.

7. Engineers shall not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice, or employment of other engineers. Engineers who believe others are guilty of unethical or illegal practice shall present such information to the proper authority for action.

a. Engineers in private practice shall not review the work of another engineer for the same client, except with the knowledge of such engineer, or unless the connection of such engineer with the work has been terminated.

bEngineers in governmental, industrial, or educational employ are entitled to review and evaluate the work of other engineers when so required by their employment duties.

c. Engineers in sales or industrial employ are entitled to make engineering comparisons of represented products with products of other suppliers.

8. Engineers shall accept personal responsibility for their professional activities, provided, however, that engineers may seek indemnification for services arising out of their practice for other than gross negligence, where the engineer's interests cannot otherwise be protected.

a. Engineers shall conform with state registration laws in the practice of engineering.

b. Engineers shall not use association with a nonengineer, a corporation, or partnership as a "cloak" for unethical acts.

9. Engineers shall give credit for engineering work to those to whom credit is due, and will recognize the proprietary interests of others.

a. Engineers shall, whenever possible, name the person or persons who may be individually responsible for designs, inventions, writings, or other accomplishments.

b. Engineers using designs supplied by a client recognize that the designs remain the property of the client and may not be duplicated by the engineer for others without express permission.

c. Engineers, before undertaking work for others in connection with which the engineer may make improvements, plans, designs, inventions, or other records that may justify copyrights or patents, should enter into a positive agreement regarding ownership.

d. Engineers' designs, data, records, and notes referring exclusively to an employer's work are the employer's property. The employer should indemnify the engineer for use of the information for any purpose other than the original purpose.

Footnote 1 "Sustainable development" is the challenge of meeting human needs for natural resources, industrial products, energy, food, transportation, shelter, and effective waste management while conserving and protecting environmental quality and the natural resource base essential for future development.

Resources

- Florida Board of Professional Engineers: https://fbpe.org/
- National Society of Professional Engineers: https://www.nspe.org/
- Online Ethics Center for Engineering and Science: https://onlineethics.org/use-materials-oec

INTRODUCTION TO PROJECT MANAGEMENT FOR PROFESSIONAL ENGINEERS

COURSE DESCRIPTION

In this course, professional engineers will explore the essential principles of project management tailored specifically to the engineering field. This course covers the strategic management of engineering projects, focusing on achieving goals within the constraints of time, budget, and quality.

By the end of this course, engineers will be equipped with the knowledge and tools necessary to efficiently manage projects, mitigate risks, and exceed stakeholder expectations.

COURSE OBJECTIVE

The objective of this course is to equip licensed professional engineers with the foundational knowledge and practical skills required to effectively manage engineering projects from initiation to completion. Participants will learn to apply project management principles tailored to the engineering context, ensuring that projects are delivered on time, within budget, and to the required quality standards while effectively managing risks and stakeholder expectations.

FACULTY

Bart Ciambella P.E., M.B.A.

Completion of this course
satisfies Florida's

3 HOURS

general CE requirements

Provider Approval:

AdvanCE is an approved Florida Board of Professional Engineers Continuing Education Provider: Provider #0009318

LEARNING OBJECTIVES

1. Define the core components of project management and their relevance to engineering projects.
2. Develop a project charter that clearly outlines objectives, scope, and stakeholder roles.
3. Apply time management techniques, such as Gantt Charts and Critical Path Methods, to optimize project schedules.
4. Implement cost management strategies to ensure project completion within budgetary constraints.
5. Utilize risk management tools to proactively identify, assess, and mitigate potential project risks.

Project management in engineering is a multifaceted discipline that requires a strategic approach to navigate complex challenges and achieve successful outcomes. It is the backbone that supports the successful execution of engineering projects, ensuring that they meet defined goals within constraints such as time, budget, and quality.

Engineering projects can be executed efficiently and effectively. The ultimate goal is to deliver results that meet or exceed stakeholder expectations, within the defined constraints. Effective project management not only ensures the successful completion of individual projects but also contributes to the overall growth and success of the organization.

PROJECT MANAGEMENT FUNDAMENTALS

Definition and Importance

Project Management is "coordinating and controlling tasks to meet defined objectives, deadlines, and budgets". Effective project management is a crucial component in business operations, driving optimal outcomes in several important categories such as risk management, improved outcomes for deliverables, and better budget adherence; another crucial area is client satisfaction

What is a Project Life Cycle?

- Initiating
- Planning
- Executing
- Monitoring and Controlling
- Closing

Project Initiation

The purpose of Project Initiation is to define the task at a high level. Activities include developing a project charter, identifying stakeholders, and conducting a feasibility study. The desired outcome of the Initiation phase is to achieve approval to proceed with the project.

Project Charter is a formal document that authorizes the initiation of a project and outlines its objectives, scope, stakeholders. It also states the key elements necessary for its execution, and serves as a reference point throughout the project's lifecycle. The Charter is essential for aligning stakeholders and team members. Key components typically found in a project charter are:

1. Title
2. Purpose and Objectives
3. Scope
4. Deliverables
5. Stakeholders
6. Manager
7. Budget
8. Timeline
9. Risks
10. Approval and Authorization

Identifying Stakeholders is a crucial aspect of Project Initiation. A stakeholder in a project is any individual, team, group, or outside organization that has an interest in or is affected by the project's outcomes. Stakeholders can influence or be influenced by the project and its execution. Their participation and impact may vary based on their roles and interests.

Conducting a Feasibility Study is another way to ensure you have a successful Project Initiation. A feasibility study is a comprehensive evaluation used to determine whether a proposed project is viable, cost-effective, and achievable. It assists organizations in making well-informed decisions and addressing potential risks before committing substantial resources.

Risk Management is a vital component of the initiation phase. Identifying and assessing risks is crucial because it enables organizations to detect potential issues early, make informed decisions, and minimize the impact of potential problems. By understanding risks, organizations can better manage costs, enhance planning, and improve resilience. This proactive approach also builds stakeholder confidence by showing a commitment to effective risk management and problem-solving.

Many methods to assess risks are in use today. Each of these methods help identify potential issues, evaluate their impact, and develop strategies to manage them effectively. Some commonly used methods are:

Risk Breakdown Structure (RBS)
This chart of risk categories, arranged by severity and likelihood of occurrence, resembles a family tree and helps identify and spot potential pitfalls.

Risk Register
Many companies prefer to use the Risk Register, a document that lists all identified risks, their characteristics, and their potential impact.

Qualitative Risk Analysis
This project within the project involves assessing the probability and impact of risks based on subjective judgment and prior experience.

Quantitative Risk Analysis
Provides a more detailed analysis of risks, including potential financial impacts and scheduling effects, using statistical methods and data.

SWOT Analysis
SWOT helps identify risks by analyzing how external factors could impact the project's success by examining internal strengths and weaknesses, and external opportunities and threats related to the project.

Failure Mode and Effects Analysis (FMEA)
FEMA is a systematic approach to identify potential failure modes and their effects on the project.

Delphi Technique
This is a structured process for collecting and aggregating expert opinions through multiple rounds of questioning; it helps the stakeholders reach a consensus on the likelihood and impact of risks by leveraging the collective expertise of a panel.

These methods can be used individually

or in combination to thoroughly assess risks, enabling better planning and management strategies to mitigate potential issues.

Project Planning

In the Project Planning stage, stakeholders with clearly defined roles develop a detailed roadmap leading to project execution. Activities include creating a shareable project plan, defining scope, setting objectives, allocating resources, and establishing timelines. Several key components at this phase are:

1. Scope Management: Scope Management involves defining and controlling what is included and excluded in a project. It ensures that all necessary work is completed while avoiding scope creep, which is the uncontrolled expansion of project boundaries.

2. Defining Project Scope: Effective scope management helps ensure that project goals are met and resources are used efficiently. A Work Breakdown Structure (WBS) is a hierarchical decomposition of a project's total scope into smaller, more manageable components. It organizes and defines the project's deliverables and work elements, breaking them down into tasks and subtasks. The WBS helps in planning, scheduling, and assigning responsibilities, ensuring all aspects of the project are covered and facilitating effective project management.

3. Time Management: One of the most important influences on a project's success is skillful time management. Time is the ultimate unrenewable resource, as Benjamin Franklin once said, "Lost time is never found again." Wasted time can destroy an otherwise well planned project.

Gantt Chart

A Gantt Chart is a visual project management tool that displays the project schedule over time. It uses horizontal bars to represent tasks or activities, showing their start and end dates, duration, and progress. Gantt charts help in tracking project timelines and overall progress, allowing for easy visualization of how tasks overlap and their respective deadlines. These are especially useful for teams with visual learners.

Critical Path Method (CPM)

The Critical Path Method (CPM) is a project management technique used to identify the longest sequence of dependent tasks that determine the project's minimum duration. It involves mapping out all project tasks, their requirements, and durations to find the critical path, or is the sequence that dictates the project's completion date. CPM helps in prioritizing tasks, managing scheduling constraints, and focusing on activities that impact the project's timeline.

Scrum

If the project calls for a time management tool that emphasizes collaboration and accountability, Scrum is the answer. This time management method utilizes iterative cycles called sprints, typically lasting two to four weeks, during which a cross-functional team works to deliver a final product. Scrum emphasizes collaboration, flexibility, and continuous improvement through regular meetings like daily stand-ups, sprint planning, and retrospectives.

Kanban

Visual teams and organizations prefer Kanban. Kanban is a visual workflow management method that aims to improve efficiency by visualizing tasks and work stages. Key principles and elements of Kanban include visualizing workflow through boards and limiting work in progress to maintain efficient task completion. Kanban encourages continuous improvement through clear process policies and collaborative feedback loops, fostering a culture of experimentation and adaptive evolution.

Cost Management

Cost management is another important aspect of a project to consider while planning. Cost management is crucial because it ensures that a project is completed within its budget. Effective cost management helps in planning and controlling project expenditures, predicting future financial needs, and allocating resources efficiently. By managing costs, organizations can make informed financial decisions and maintain financial stability throughout the project lifecycle. Some cost control measures to consider are:

- Budgeting: Establishing a detailed budget that outlines projected costs for all project activities and resources.

- Cost Tracking: Monitoring actual expenses against the budget to identify deviations and manage spending in real-time.

- Earned Value Management (EVM): Analyzing project performance by comparing the planned progress and budget with actual progress and costs to assess cost efficiency and performance.

- Variance Analysis: Assessing the difference between budgeted and actual costs to understand cost overruns or savings and take corrective actions.

- Cost Forecasting: Predicting future costs based on current expenditure trends and project progress to anticipate potential budget issues.

- Change Control: Implementing procedures to manage and evaluate changes to the project scope or budget, ensuring that any alterations are approved and properly funded.

- Resource Optimization: Efficiently allocating and using resources to reduce waste and control costs through better procurement practices or resource scheduling.
- Cost-Benefit Analysis: Evaluating the costs of various project options against their benefits to ensure cost-effective decision-making.

These methods help in maintaining control over project finances, ensuring that projects are completed within budget and financial resources are used effectively.

Quality Management

Quality planning and assurance are critical components of project management. This is what ensures deliverables meet specified standards and stakeholder expectations. Quality assurance focuses on systematically monitoring and evaluating processes to ensure compliance with these criteria. Various tools and techniques for quality control are used, including statistical methods like control charts and process capability analysis. These help to identify deviations and ensure consistent product quality. Additionally, techniques such as root cause analysis and failure mode and effects analysis (FMEA) are used to address and prevent defects by understanding their underlying causes. Together, these practices and tools contribute to delivering high-quality outcomes and enhancing overall project success.

Project Execution

During Project execution, the project plan is put into action. The team works to complete the tasks defined in the planning phase. During this phase, resources are allocated and deliverables are produced according to the project schedule. The project manager's role is to coordinate team members, manage communications, and ensure that the work is progressing as planned. Project Execution also involves managing stakeholder expectations and handling any issues or changes that arise. Regular status meetings and updates help keep the team aligned and focused on achieving project objectives. Successful execution requires effective leadership, diligent management of resources and time, and clear communication.

Resource Management

Human resource planning is a vital aspect of project management that involves identifying and organizing the necessary personnel to achieve project objectives efficiently. It encompasses forecasting staffing needs, defining roles and responsibilities, and ensuring that the right skills are available at the right times. Managing project teams involves not only recruiting and allocating these resources but also fostering a collaborative and productive work environment. Effective management includes motivating team members, resolving conflicts through clear communication and support. By integrating human resource planning with team management practices, project managers can optimize team performance, enhance project outcomes, and adapt to changes and challenges throughout the project lifecycle.

Communication Management

Effective communication strategies are essential for the success of any project, as they ensure that information is accurately and efficiently exchanged among team members, stakeholders, and other relevant parties. These strategies involve establishing clear channels and protocols for communication, selecting appropriate tools and platforms, and tailoring messages to the audience's needs and preferences. Some of these strategies are:

- Regular Status Updates: Provide consistent and scheduled updates on project progress, milestones, and any changes. This keeps all stakeholders informed and aligned with the project's current status and upcoming steps.

- Scheduled Meetings: Organize routine meetings, such as weekly team check-ins or monthly stakeholder reviews, to discuss progress, address concerns, and align on objectives. This fosters ongoing dialogue and ensures issues are addressed promptly.

- Clear Documentation: Create and maintain comprehensive project documentation, including plans, reports, and decisions. This provides a reference point for team members and stakeholders and ensures that everyone has access to accurate and up-to-date information.

- Feedback Channels: Implement several methods for receiving and addressing feedback from team members and stakeholders. This encourages open communication, helps identify and resolve issues early, and improves project outcomes based on input from all involved.

- Active Listening: Engage actively with team members and stakeholders by listening to their concerns and suggestions. Actively listening is more than merely waiting to respond; actively listening requires leaning forward, maintaining eye contact, and validating concerns. When delivering a different opinion or outright disagreement, an active listener will lead with an area of commonality, using the connector 'and' instead of 'but.' This demonstrates respect, helps in understanding different perspectives, and fosters a collaborative environment where issues can be resolved effectively.

Monitoring and Controlling

The fourth phase in project management is where the project's progress is tracked to ensure it stays on course with the planned objectives. This phase involves regularly measuring performance with Key Performance Indicators and Earned Value Management. Monitoring and Controlling also involves managing and measuring change in the midst of a project, and the importance of having structures in place to implement as needed. Key activities include tracking project schedules, budgets, and scope to prevent deviations. By continuously monitoring and adjusting, project managers can address issues early, minimizing risks and ensuring the project remains aligned with its goals. Effective monitoring and controlling is essential for delivering a successful project that meets stakeholder expectations.

Performance Measurement

Key Performance Indicators (KPIs) are essential metrics used to evaluate and track

the success of a project or organization in achieving its strategic objectives. KPIs provide measurable data that helps stakeholders understand how well a project is performing against predefined goals. They can cover various aspects such as project timelines, budget adherence, quality, and customer satisfaction. By setting clear, relevant KPIs, organizations can monitor progress, identify areas for improvement, and make data-driven decisions. Effective use of KPIs enables better alignment of project activities with organizational goals, enhances accountability, and supports continuous improvement efforts.

Earned Value Management (EVM) is a project management technique that provides a comprehensive framework for assessing project performance and progress. It integrates scope, cost, and schedule to evaluate how much work has been completed compared to what was planned. EVM calculates key metrics such as Earned Value (EV), Planned Value (PV), and Actual Cost (AC) to determine variances and performance indices, such as Cost Performance Index (CPI) and Schedule Performance Index (SPI). By comparing these metrics, EVM helps project managers identify deviations from the plan, forecast future performance, and make informed decisions to keep the project on track. This systematic approach enhances the ability to manage budgets, schedules, and project risks effectively, contributing to overall project success.

Change Management

A good project manager handles change management by being proactive, employing clear communication, and engaging buy-in from all stakeholders. They employ a structured approach to address alterations. They also update project plans, schedules, and budgets as necessary, while communicating the changes and their implications to the team. Implementing a formal change control process helps in tracking and managing changes systematically, ensuring that adjustments are made efficiently and transparently. By managing change effectively, project managers minimize disruptions, maintain alignment with project goals, and enhance overall project success.

Risk Monitoring

Ongoing risk assessment involves regularly reviewing and updating the project's risk register to identify new risks and reassess existing ones. Being proactive is key. This includes conducting periodic risk evaluations and involving stakeholders to gain diverse perspectives on potential issues. Specific activities might include risk audits, trend analysis, and risk reviews during project milestones. Mitigation strategies involve creating detailed action plans to address identified risks.

For example, if a risk of delayed supplier deliveries is identified, a mitigation strategy might include establishing alternative suppliers or increasing inventory levels as a buffer. Other strategies could involve developing contingency plans for high-impact risks, such as allocating additional resources or revising project schedules to accommodate potential delays. By implementing these tailored strategies and continuously monitoring their effectiveness, project managers can proactively manage risks and adapt to changes, ensuring the project's success.

Project Closing

Effective project closing is crucial for capturing valuable insights, ensuring stakeholder satisfaction, and paving the way for future project success. It is the final phase where all activities are wrapped up and the project is formally completed. Deliverables are handed over, teams document lessons learned, and post project reviews are conducted. These important pieces of project closing increase quality assurance for future endeavors.

Deliverable Verification

Deliverable Verification ensures that project deliverables meet the specified requirements before they are accepted by the client or stakeholder. This involves checking that each deliverable has been completed according to the project's scope and quality standards. Activities typically include reviewing, testing, and inspecting the deliverables to confirm they meet the agreed specifications.

Final Project Documentation

Final Project Documentation is a complete set of records compiled at the end of a project. It includes detailed information about project activities, deliverables, and outcomes, such as project plans, reports, change logs, and relevant correspondence. This documentation helps evaluate project performance, provides insights for future projects, and ensures all contractual obligations are met. It also captures lessons learned and recommendations for improvements.

Document Lessons Learned

To document lessons learned effectively, start by creating a detailed post-project review report that summarizes successes, challenges, and recommendations. Hold workshops or meetings to gather insights from the team and use surveys to collect feedback from stakeholders. Implement project management software to organize and share lessons learned, and set up a centralized knowledge database for easy retrieval and future reference.

Conduct a Post-Project Review

A post-project review involves several key steps. Begin by gathering all relevant project documentation and scheduling a review session with stakeholders and team members. During the session, evaluate project goals, timelines, budget, deliverable quality, and team performance. Document lessons learned by analyzing what worked, what didn't, and how challenges were addressed. Develop actionable recommendations, assign responsibilities, and set deadlines. Summarize these findings in a report, distribute it to relevant parties, and schedule follow-up meetings to track the implementation of recommendations and their effects on future projects.

THE ROLE OF TECHNOLOGY IN PROJECT MANAGEMENT

In today's engineering world, technology plays a key role in improving how projects are planned, managed, and completed. Advanced digital tools are transforming everything from scheduling and resource allocation to risk management and communication. These tools make it easier to track project timelines, manage resources, and ensure that everything stays on budget. By automating tasks and providing real-time updates, technology helps keep projects on track and ensures that the right resources are available when needed. Understanding how to use these tools effectively is essential in achieving successful outcomes in engineering projects.

Technology in Enhanced Planning and Scheduling

Resource management using technology involves optimizing the allocation and utilization of resources through advanced digital tools. These tools enable real-time tracking of resource availability, project timelines, and budget constraints, allowing managers to make informed decisions swiftly. Automated systems streamline the scheduling process, ensuring that resources are assigned efficiently based on project needs and priorities. Data analytics provide insights into resource performance, highlighting areas for improvement and forecasting future requirements. This technological approach enhances transparency, reduces waste, and improves overall project efficiency by ensuring that the right resources are available at the right time.

Technology in Resource Management

Resource management using technology focuses on optimizing resource allocation and utilization through advanced digital tools. These tools allow for real-time tracking of resource availability, project timelines, and budget constraints, enabling managers to make informed decisions. Automated systems streamline scheduling, ensuring efficient resource assignment based on project needs. This technological approach enhances transparency, minimizes waste, and boosts overall project efficiency.

Technology in Risk Management

Advanced risk management software offers features for identifying, analyzing, and mitigating risks. These tools help organizations identify, assess, and mitigate risks in cybersecurity, physical security, and compliance. These platforms allow users to conduct assessments, automate workflows, and generate detailed reports to ensure regulatory compliance.

Technology in Budget and Cost Control

Project management technology provides tools for planning, scheduling, and controlling large-scale projects. Its features typically include portfolio management, resource management, risk analysis, and collaboration tools, all aimed at enhancing project visibility, decision-making, and overall project success.

Technology Improved Communication and Collaboration

Project management software tools enhance communication and collaboration by providing a centralized platform where team members can share information, update project statuses, and collaborate in real-time. These tools typically include task management features that allow for assigning tasks, setting deadlines, and tracking progress, ensuring everyone knows their responsibilities. Integrated messaging systems and chat rooms facilitate instant communication and quick decision-making, while centralized document sharing enables seamless collaboration on files. Discussion boards allow for topic-specific conversations, brainstorming, and feedback. Automated notifications keep everyone informed about updates and important changes. Built-in or integrated video conferencing supports virtual meetings, enhancing remote collaboration. Real-time activity feeds provide visibility into recent updates, and shared calendars ensure awareness of key dates and milestones. Many include visual dashboards displaying key metrics.

Technology Assisted Data Analysis and Reporting

Data analysis software enables users to process, visualize, and interpret large sets of data efficiently. These tools offer features such as statistical analysis, predictive modeling, and data visualization to uncover patterns, trends, and insights. By transforming raw data into actionable information, data analysis software helps organizations make informed decisions and drive strategic initiatives.

Technology in Task Automation

Task animation software allows users to visually represent and manage workflows by creating dynamic, animated diagrams of tasks and processes. It helps in illustrating task sequences and progress in a visually engaging way. By animating tasks, users can better track project progression, identify bottlenecks, and enhance overall project planning and communication.

Technology and Document Management

Effective document management is facilitated by platforms that ensure all project-related documents. The software keeps all documents organized, accessible, and secure, enabling efficient version control and document sharing. It provides features like version control, secure sharing, and indexing to streamline document handling and is another way to improve overall workflow.

Technology and Quality Management

Quality management tools are designed to ensure that products and services meet standards and specifications. They provide features for tracking defects and managing quality control processes. By implementing these tools, organizations can enhance product quality, and reduce errors, which increases customer satisfaction.

Technology and Enhanced Stakeholder Engagement

Technology facilitates better stakeholder engagement through features that allow for real-time updates, feedback loops, and transparent communication. This ensures that all

stakeholders are informed and can contribute to the project's success.

Technology's Role in Security and Compliance

Project management software often includes robust security features to protect sensitive project data. Compliance tools ensure that projects adhere to industry regulations and standards, reducing the risk of legal issues.

Technology and software are integral to modern project management, offering tools and features that enhance planning, execution, and monitoring of projects. They provide project managers with the capabilities to handle complex projects efficiently, ensuring successful outcomes and continuous improvement (ResearchGate, 2024).

ETHICAL CONSIDERATIONS IN PROJECT MANAGEMENT

Ethical considerations are integral to project management. They guide decision-making and actions to align with broader organizational values and societal expectations. Ethical considerations in project management are vital for ensuring the integrity and success of a project. These considerations include honesty, transparency, and fairness in all project activities. Project managers must uphold ethical standards by accurately reporting project status, avoiding conflicts of interest, and making decisions that are in the best interest of all stakeholders.

Ethical behavior involves respecting confidentiality, protecting sensitive information, and adhering to legal and regulatory requirements. It also requires fair treatment of team members, avoiding discriminatory practices, and fostering an inclusive work environment. Ethical considerations also extend to environmental and social responsibilities, ensuring that projects do not harm the environment or adversely affect communities. Addressing these issues proactively helps in preventing legal disputes, improving stakeholder satisfaction, and achieving long-term project success.

THE IMPORTANCE OF LEADERSHIP AND TEAM DYNAMICS

In the complex world of project management, success hinges not only on technical expertise and planning but also on the strength of leadership and the dynamics within the team. Leadership plays a critical role in guiding a project from inception to completion, influencing how effectively a team collaborates, overcomes challenges, and meets its objectives. At the same time, the dynamics within the team—how members interact, communicate, and work together—can significantly impact the overall performance and outcome of the project. This section explores the vital importance of leadership and team dynamics in project management, examining how these elements contribute to the achievement of project goals and the creation of a cohesive, motivated, and high-performing team.

Decision Making

A good leader requires strong decision-making skills to effectively guide their team and achieve project goals. These skills are crucial for navigating challenges and making choices that align with the team's objectives and overall strategy. By making well-informed decisions, leaders can address problems promptly and steer the project in the right direction. Efficient decision-making also helps in the optimal allocation of resources, ensuring that time, money, and effort are used wisely. Leaders who excel in decision-making build trust and confidence within their team, as members rely on their judgment to handle uncertainties. This trust fosters a positive work environment, encouraging collaboration and commitment. Furthermore, effective decision-making supports innovation by allowing the entire team to explore new ideas and solutions. Leaders who consistently make sound decisions contribute to the team's success and drive organizational growth. The ability to make quick, yet thoughtful decisions also helps maintain project momentum and prevents delays. Overall, strong decision-making skills are essential for maintaining leadership effectiveness and achieving long-term success.

Fostering Open Communication

Leadership is the cornerstone of successful team dynamics, acting as the guiding force that steers a team towards achieving its goals. Effective leadership is not just about giving orders or setting a vision; it is about understanding the unique strengths and weaknesses of each team member and leveraging these to create a cohesive and high-performing group. A strong leader knows how to build trust within the team, fostering an environment where members feel valued, respected, and motivated to contribute their best efforts. Trust is the foundation upon which all successful team dynamics are built, and without it, even the most talented groups can struggle to perform. Leaders who actively listen, communicate transparently, and show empathy are more likely to gain the trust and loyalty of their team members, setting the stage for collaboration and mutual support.

Recognizing Team Member Needs

Effective leadership involves recognizing and addressing the individual needs of team members. This requires a deep understanding of what motivates each person, as well as a commitment to providing the resources and support they need to succeed. Leaders who take the time to understand their team members' goals, challenges, and preferred working styles can tailor their approach to better meet these needs, ultimately enhancing overall team performance. By aligning individual motivations with the team's objectives, leaders can inspire a sense of purpose and commitment that drives the entire group forward. In this way, leadership is not just about directing the team; it is about empowering each member to contribute to their fullest potential.

Setting Vision and Goals

Vision and goal setting are crucial in leadership as they provide a clear direction for the team, guiding their efforts and decisions. A well-defined vision inspires and motivates team members, giving them a sense of purpose and alignment with the

organization's objectives. When leaders set specific, measurable goals for their vision, the vision turns into actionable steps, helping the team stay focused and organized. Goals offer a framework for assessing progress and performance, allowing leaders to make informed adjustments as needed. Establishing both short-term and long-term goals helps in tracking incremental achievements and maintaining momentum. Vision and goal setting also facilitate effective resource allocation, ensuring that efforts are directed towards the most impactful areas. By articulating a compelling vision, leaders can rally the team around shared objectives and foster a sense of commitment. Clear goals create accountability, as team members understand their roles and responsibilities in achieving the broader vision. Additionally, a strong vision helps leaders navigate challenges and maintain resilience, keeping the team oriented towards their ultimate purpose. Overall, vision and goal setting are fundamental to successful leadership, driving team performance and organizational growth.

Building Morale

Vision and goal setting are crucial in leadership as they provide a clear direction for the team, guiding their efforts and decisions. A well-defined vision inspires and motivates team members, giving them a sense of purpose and alignment with the organization's objectives. Setting specific, measurable goals translates the vision into actionable steps, helping the team stay focused and organized. Goals offer a framework for assessing progress and performance, allowing leaders to make informed adjustments as needed. Establishing both short-term and long-term goals helps in tracking incremental achievements and maintaining momentum. Vision and goal setting also facilitate effective resource allocation, ensuring that efforts are directed towards the most impactful areas. By articulating a compelling vision, leaders can rally the team around shared objectives and foster a sense of commitment. Clear goals create accountability, as team members understand their roles and responsibilities in achieving the broader vision. Additionally, a strong vision helps leaders navigate challenges and maintain resilience, keeping the team oriented towards their ultimate purpose. Overall, vision and goal setting are fundamental to successful leadership, driving team performance and organizational growth.

Resolving Conflicts

In any team, conflicts are inevitable. Strong project managers resolve conflicts within teams by addressing issues proactively, maintaining open communication, and fostering a collaborative environment.

When team members disagree on how to approach a task, an effective project manager facilitates a discussion where each party can voice their concerns and suggestions. By listening carefully and acknowledging each viewpoint, the project manager can guide the team towards a consensus or compromise that aligns with project goals.

Tension can arise due to perceived uneven workload distribution. A skilled project manager will assess the situation, identify any imbalance, and redistribute tasks if necessary. They might also implement regular check-ins to monitor workload and adjust as needed, preventing future conflicts.

When personality clashes arise, a great project manager acts as a mediator. If two team members have conflicting working styles, the project manager could set clear expectations, create opportunities for the team to bond, and encourage mutual respect.

In cases where conflict escalates, the project manager may involve human resources or external mediation. By handling conflicts promptly and effectively, great project managers maintain team cohesion, ensuring that the project stays on track and is completed successfully.

Forming Trust

Good leaders in project management build trust by consistently demonstrating reliability, transparency, and empathy. They follow through on commitments, setting an example for the team by meeting deadlines and delivering quality work. Transparency is key; effective leaders communicate openly about project goals, challenges, and expectations, ensuring that all team members are informed and aligned. This openness fosters an environment where team members feel secure in voicing their ideas and concerns.

Empathy also plays a crucial role in trust-building as well. Leaders who take the time to understand the individual needs and perspectives of their team members create a supportive environment where everyone feels valued. They actively listen, show appreciation for contributions, and address any issues fairly and promptly. By consistently demonstrating these behaviors, leaders earn the respect and confidence of their team, laying the foundation for strong, collaborative relationships that are essential for project success.

Leveraging Diverse Skills

Strong leaders leverage diverse skills by recognizing and harnessing the unique strengths of each team member to enhance overall project outcomes. They start by thoroughly understanding the individual expertise and capabilities within their team, identifying how these can best be applied to different aspects of the project. By aligning tasks with team members' specific skills and interests, leaders ensure that each person is working in an area where they can excel and contribute most effectively.

These leaders also foster an inclusive environment where diverse perspectives are encouraged and valued. They facilitate collaboration by bringing together team members with complementary skills to tackle complex problems, leading to innovative solutions that might not emerge from a more homogenous group. Empowering leaders also provide opportunities for cross-training and professional development, allowing team members to expand their skills and contribute in new ways. This strategic utilization of diverse talents not only strengthens the team

but also drives the success of the project.

Defining Clear Roles

Good leaders in project management clearly define skills by first thoroughly understanding the specific competencies required for each role within the project. They assess the team's collective and individual abilities, identifying both strengths and areas for development. By clearly communicating the skills needed for each task or responsibility, leaders set clear expectations and provide guidance on how team members can best contribute to the project's success.

These leaders also establish clear criteria for performance, making it easy for team members to understand what is expected of them and how their skills align with the project's goals. Through regular feedback and performance reviews, they help team members refine their skills and grow professionally. Additionally, good leaders encourage continuous learning and development, offering resources and opportunities for team members to acquire new skills that will enhance their contributions. This approach not only clarifies roles but also fosters a culture of growth and excellence within the team.

Developing High Emotional Intelligence

Effective leaders develop high emotional intelligence (EQ) by practicing self-awareness, empathy, and effective communication. They start by reflecting on their own emotions, understanding how their feelings impact their decisions and interactions with the team. This self-awareness allows them to manage their emotions effectively, especially under pressure, maintaining a calm and composed demeanor that sets a positive tone for the team.

Empathy is an important key aspect of high EQ, and good leaders cultivate it by actively listening to their team members, seeking to understand their perspectives, concerns, and motivations. This empathetic approach helps them build stronger relationships and address issues in a way that resonates with the team.

These leaders focus on clear and open communication, ensuring that their messages are not only understood but also considerate of the emotional impact on others. By consistently practicing these behaviors, good leaders enhance their EQ, which in turn strengthens team dynamics and overall project success.

Monitoring Team Progress

Great project managers monitor team progress by setting clear expectations, using effective tools, and maintaining regular communication. Here are five concrete examples:

1. Setting Milestones and Deadlines: A great project manager establishes specific milestones and deadlines at the beginning of a project. If a software development team is working on a new feature, the project manager might set a milestone for the completion of the design phase within the first two weeks. By breaking down the project into smaller, manageable tasks with clear deadlines, the project manager can easily track progress and identify any delays early on.

2. Using Project Management Software: Tools help project managers monitor progress in real time. If a marketing team is working on a campaign, the project manager can assign tasks within the software, track who's responsible for what, and see how close the team is to completion. This allows the project manager to quickly spot any bottlenecks and address them.

3. Conducting Regular Check-ins: Weekly or bi-weekly meetings allow the project manager to check in on each team member's progress. For example, during a stand-up meeting, team members can briefly update the group on what they've accomplished, what they're working on, and any challenges they're facing. This keeps everyone aligned and provides the project manager with a clear picture of where the team stands.

4. Implementing a Feedback Loop: Continuous feedback is essential for monitoring progress. If a team member completes a task, a great project manager reviews the work promptly and provides constructive feedback. For example, in a content creation project, the project manager might review drafts and suggest revisions before the final submission. This ensures that the work meets the project's standards and keeps the team on track.

5. Tracking Key Performance Indicators (KPIs): The exceptional project manager sets KPIs for critical milestones. These include design completion, prototype development, or testing phases. For example, the KPI might be the percentage of tasks completed by a specific deadline. Monitoring these KPIs ensures the project stays on schedule.

KPIs related to defect rates, error frequency, or rework levels help the manager maintain quality standards. If the defect rate exceeds the target KPI, it signals a need for process improvement or additional quality checks.

A truly forward thinking project manager uses KPIs in resource allocation, budget management, and risk management as well.

KPIs like resource allocation efficiency or labor hours per task measure how effectively resources are being used. An engineering project manager monitors these KPIs to ensure that team members are neither overworked nor underutilized.

Budget Management: KPIs such as cost variance or budget adherence track financial performance. The project manager uses these KPIs to monitor expenditures and ensure the project stays within budget.

Risk Management: The manager might set KPIs for the number of identified risks or the effectiveness of mitigation strategies. Tracking these KPIs helps in managing uncertainties and minimizing potential project disruptions.

These strategies enable great project managers to keep their teams on track, ensuring timely and successful project completion.

ADAPTABILITY AND FLEXIBILITY IN MANAGING PROJECTS

Engineering projects are often full of uncertainties. From unexpected resource shortages to sudden changes in client requirements, project managers must be prepared to face challenges that can disrupt even the best-laid plans. This is why flexibility and adaptability are so important in project management. Being able to adjust plans, timelines, and resources quickly allows project managers to keep projects on track, even when unexpected obstacles arise. Adaptability helps project managers navigate these challenges effectively, ensuring that projects move forward smoothly despite the uncertainties.

Navigating Uncertainties

One of the primary reasons flexibility and adaptability are essential in project management is their role in navigating uncertainty. Projects often involve complex variables and dependencies, which can lead to unforeseen challenges. These could range from resource shortages, technological failures, or changes in client requirements, to global events like economic downturns or pandemics. Rigid adherence to the original plan can be detrimental when circumstances shift. Flexibility allows project managers to pivot and adjust their plans, timelines, and resource allocations in response to new developments.

For instance, if a key supplier suddenly becomes unavailable, a flexible project manager can quickly identify alternative sources or modify the project scope to accommodate the change without compromising the overall objectives. This adaptability minimizes the impact of risks and helps keep the project on track. By fostering a culture of flexibility within the team, project managers can encourage creative problem-solving. Team members will then proactively contribute solutions to emerging issues.

Engaging in Iterative Problem-Solving

Engineering projects are inherently complex, often presenting challenges that cannot be solved with a single, straightforward solution. These projects require a dynamic approach, where solutions are developed through a process of continuous testing, evaluation, and refinement. This iterative problem-solving process is crucial for addressing the multifaceted issues that arise during the lifecycle of a project. Adaptable project managers are particularly adept at navigating this iterative process, as they understand that achieving the best outcomes often requires flexibility, creativity, and a willingness to embrace change.

Adaptable project managers foster a problem-solving mindset within their teams by encouraging an environment where creativity and innovation are not just welcomed but actively promoted. They recognize that the most effective solutions often emerge from a collaborative effort, where diverse perspectives and ideas are brought together. By empowering team members to think critically and explore multiple avenues for solving a problem, these managers cultivate a culture of innovation. This approach not only leads to more effective solutions but also enhances the team's overall problem-solving capabilities, enabling them to tackle future challenges more effectively.

Iterative problem-solving involves a cycle of testing and refinement, where initial solutions are continuously improved based on feedback and new information. Adaptable project managers support this process by providing the necessary resources and flexibility for their teams to experiment and refine their ideas. They understand that early versions of a solution may not be perfect, but through repeated cycles of testing, analysis, and adjustment, the team can develop a more robust and effective outcome. This approach reduces the risk of project failure and increases the likelihood of delivering a solution that meets or exceeds the project's objectives.

Engineering projects often involve complex problems that require iterative solutions. Adaptable project managers encourage a problem-solving mindset among team members, fostering creativity and innovation. They support iterative testing and refinement of solutions to achieve optimal outcomes.

Engaging in Continuous Improvement

Adaptability is a key driver in fostering a culture of continuous improvement within project teams. Adaptable project managers understand that no project is without its challenges and learning opportunities, and they actively encourage their teams to view each project as a chance to grow and refine their processes. By promoting an environment where feedback is not only welcomed but sought after, these managers create a space where team members feel empowered to share their insights and experiences. This openness to feedback, combined with the willingness to implement lessons learned, allows teams to identify areas for enhancement and make incremental improvements over time.

Adaptable project managers emphasize the importance of post-project reviews as a critical component of continuous improvement. They ensure that these reviews are thorough and constructive, focusing on what worked well, what didn't, and how processes can be optimized for future projects. This iterative approach to improvement helps teams build on their successes while addressing any shortcomings, leading to more efficient and effective project execution over time.

Performing Risk Management Assessments

Flexible project management is closely tied to the implementation of robust risk management practices. In a dynamic project environment, project managers must remain vigilant in identifying potential risks that could threaten the project's success. This proactive approach involves anticipating various scenarios that could arise during the project lifecycle, from resource shortages to technical challenges or unexpected market changes. By developing contingency plans in advance,

adaptable project managers ensure that their teams are prepared to respond quickly and effectively to these risks if they materialize.

Flexibility in project management allows for continuous monitoring and adaptation as risks evolve. Project managers can adjust strategies and resource allocations in real-time, responding to emerging threats and minimizing their impact on the project. This ongoing risk management process not only helps to safeguard the project's objectives but also enhances the team's resilience and ability to navigate uncertainty, ultimately contributing to the overall success of the project.

Embracing Innovation

Adaptability in project management plays a pivotal role in fostering an environment where innovation thrives. When project managers prioritize adaptability, they create a culture that encourages teams to embrace new ideas and explore uncharted territories. This openness to change empowers team members to think creatively and propose innovative solutions without fear of failure. In such an environment, team members are more likely to experiment with novel approaches and cutting-edge technologies, knowing that their contributions are valued and supported.

By actively promoting and nurturing this mindset, adaptable project managers help drive projects forward in ways that might not have been possible with a more rigid approach. This willingness to innovate can lead to breakthroughs that significantly enhance the quality, efficiency, and impact of the project. Ultimately, adaptability not only facilitates the adoption of new ideas but also ensures that projects remain dynamic, forward-thinking, and capable of evolving in response to emerging challenges and opportunities.

Enhancing Team Dynamics

Flexibility and adaptability also play a critical role in enhancing team dynamics. A project team is typically composed of individuals with diverse skills, backgrounds, and working styles. As the project progresses, team members may encounter various interpersonal challenges or conflicts. A flexible leader is better equipped to manage these dynamics, adapting leadership styles and communication approaches to suit the needs of the team.

For example, some team members may prefer more structured guidance, while others thrive with autonomy. An adaptable project manager recognizes these differences and tailors their approach accordingly, ensuring that each team member is motivated and engaged. This adaptability extends to conflict resolution as well, where a flexible leader can mediate disputes by understanding and accommodating the perspectives of all parties involved.

Additionally, as projects evolve, so do the roles and responsibilities within the team. A project manager who can adapt to these changes by redistributing tasks or reshaping team structures ensures that the team remains cohesive and productive. This adaptability fosters a positive working environment, where team members feel supported and valued, leading to higher morale and better overall performance.

Improving Decision-Making

Effective decision-making is at the heart of successful project management, and flexibility is a key component of this process. In a dynamic project environment, decisions often need to be made quickly and with incomplete information. A flexible project manager is able to assess the situation, weigh the available options, and make informed decisions that align with the project's objectives, even when conditions are uncertain.

Adaptability also allows project managers to revisit and revise decisions as new information becomes available. This iterative approach to decision-making is particularly important in agile project management, where continuous improvement and responsiveness to change are core principles. By remaining open to new data and perspectives, adaptable project managers can refine their strategies, making adjustments that optimize project outcomes.

Flexibility in decision-making also enables project managers to balance short-term needs with long-term goals. For example, a project may require immediate changes to meet a tight deadline, but an adaptable manager will also consider how these changes might impact the project's future phases. This holistic view ensures that decisions are not just reactive, but also strategic, supporting the project's overall success.

Delivering Successful Project Outcomes

Ultimately, the importance of flexibility and adaptability in project management is reflected in the successful delivery of project outcomes. Projects that are managed with a rigid, inflexible approach are more likely to encounter significant delays, budget overruns, or even failure. In contrast, projects led by adaptable managers who can respond to changes and challenges are more likely to achieve their objectives, even in the face of adversity.

Flexibility allows project managers to navigate the complexities of modern project environments, where change is constant and unpredictability is the norm. By adapting to new circumstances, project managers can maintain momentum, ensuring that the project continues to move forward, even when obstacles arise. This adaptability is particularly important in industries characterized by rapid technological advancement, where the ability to pivot quickly can mean the difference between success and obsolescence.

Moreover, flexibility and adaptability contribute to long-term project success by fostering continuous improvement. Project managers who embrace change are more likely to implement lessons learned from previous projects, making adjustments that enhance future performance. This iterative approach not only improves the chances of success for the current project but also builds the organization's

overall project management capabilities.

Understanding and Responding to Crisis Management

In times of crisis or unexpected challenges, the role of an adaptable project manager becomes even more critical. These leaders are characterized by their ability to maintain composure and provide steady guidance to their teams, even when faced with uncertainty and high-pressure situations. A crisis can disrupt the usual flow of a project, creating confusion, fear, and hesitation among team members. However, an adaptable project manager knows how to navigate these turbulent waters by quickly assessing the situation, identifying the most immediate threats, and prioritizing tasks that need urgent attention. This ability to swiftly evaluate the crisis allows them to make informed decisions without delay, which is crucial in preventing the situation from escalating further.

Moreover, adaptable project managers excel in rallying their teams around common goals during a crisis. They recognize that in such times, clear communication and strong leadership are paramount. By articulating a clear vision of how the team will overcome the crisis, these managers instill confidence and a sense of purpose in their team members. This collective focus on shared objectives helps to mitigate the disarray that a crisis can cause, enabling the team to continue working effectively, even under challenging circumstances.

Another critical aspect of adaptability in crisis management is the ability to remain flexible with plans and strategies. Projects rarely proceed exactly as planned, and crises can derail even the most carefully laid-out strategies. An adaptable project manager is prepared to pivot, adjust project scopes, reallocate resources, and alter timelines as necessary to keep the project on course. They understand that rigid adherence to the original plan may not be feasible and that the ability to adapt and change course is essential for survival in the face of adversity.

Great leaders play a key role in managing the emotional and psychological impacts of a crisis on their team members. By maintaining a calm and composed demeanor, they help reduce anxiety and stress within the team, creating a more stable working environment. This emotional resilience, combined with their strategic adaptability, enables them to lead their teams through crises more effectively, ensuring that the project continues to move forward despite the challenges. Ultimately, the ability to understand and respond to crisis management with adaptability is a hallmark of effective project leadership, ensuring that projects are not only completed successfully but also that teams emerge stronger and more resilient from the experience.

CONCLUSION

Reflecting on the journey to becoming an engineering project manager entails considering the pivotal moments and motivations that guide you. Some have a passion for overseeing complex projects and driving them to successful completion. Others are inspired by the opportunity to contribute to groundbreaking engineering solutions, pushing the boundaries of innovation. Some are drawn to the strategic dimensions of project management, recognizing its profound impact on efficiency and productivity. Regardless of the underlying motivation, maintaining a commitment to excellence is crucial, ensuring exemplary leadership and expertise in every project undertaken.

In this course, we reviewed the steps in project management: initiation, planning, execution, monitoring and controlling, and closing. Each step includes key components essential for the success of any engineering project. We discussed the importance of technology, ethical considerations, and the hallmarks of leadership and team dynamics. Additionally, we highlighted why project managers must excel in adaptability and flexibility.

QUESTIONS FOR REVIEW

1. **Time Management**
   a. Which time management strategies are best for my organization and team (Gantt Chart, CBM, Scrum, Kanban), and why?

2. **Budget Management**
   a. Which aspect of budget management is most challenging for me and my team?
   b. How can I as a project manager improve in this area?

3. **Feedback**
   a. How do I deliver feedback to my team members?
   b. How is feedback received?
   c. Do I see continual improvement from team members?

4. **Communication Management**
   a. Who are my internal and external stakeholders?
   b. How are they identified?
   c. What are my communication practices with stakeholders?
   d. How can my communication with stakeholders improve?
   e. What feedback about my communication have I received, and how has that informed my communication strategies?

5. **Leadership**
   a. What traits of leadership do you feel you possess?
   b. Which traits do you feel you had when you became an engineer?
   c. What traits have you learned from people in leadership roles?
   d. How has participating in a mentor program helped you learn or teach about leadership skills?
   e. Describe the leadership traits you have encountered in recent positions.
   f. Which leadership traits do you feel would be the most difficult to master? Why?

6. **Adaptability and Flexibility**
   a. Which aspects of adaptability and flexibility do you possess?
   b. When in your professional life did you need to display adaptability to guarantee success of a project?
   c. What are some roadblocks to being flexible in project management?
   d. In which area do you see more difficulty showing flexibility, time management or budget management? How would you as a project manager handle challenges in these areas?

7. **Ethical Considerations**
   a. Which ethical consideration in project management do you feel is most important? Are they all equally important?
   b. What are some consequences of not considering ethics in project management?

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BLOCKCHAIN FUNDAMENTALS FOR ENGINEERS: BRIDGING TRADITIONAL PROTOCOLS AND DIGITAL INNOVATION

COURSE DESCRIPTION

The distance learning interactive format explores how professional engineers can incorporate blockchain technology to create efficiencies and decrease costs across a range of functions. The course will cover the basics of blockchain, important blockchain features, and possible outcomes of combining blockchain with professional engineering.

In order to complete the activity, you must read through the material and answer the self-assessment questions immediately following.

COURSE OBJECTIVE

The purpose of this course is to provide professional engineers with a basic understanding of blockchain technology, blockchain protocols similar to professional engineer protocols, and possible outcomes of integrating professional engineering and blockchain technology.

FACULTY

Bart Ciambella P.E., M.B.A.

Jordan Blough M.B.A.

Completion of this course
satisfies Florida's

3 HOURS

general CE requirements

Provider Approval:

AdvanCE is an approved Florida Board of Professional Engineers Continuing Education Provider: Provider #0009318

COURSE TOPICS

- Introduction
- What is Blockchain and a brief history of Bitcoin
- The Consensus Mechanism
- Cryptography and the Hidden Asset of Blockchain
- The Time Keeping Aspect of Blockchain
- Combining Blockchain and Professional Engineering
- Conclusion
- Resources

Introduction

Blockchain is considered a revolutionary technology by many people around the world. Today, its applications are being tested throughout the world for not only crypto transactions, but also for data storage, security, and contracts.

One of the most exciting implications of Blockchain technology has been the proposal of web 3.0, which could ostensibly revolutionize the internet. For all that Blockchain promises to do, it seems that it will impact all the different sectors associated traditionally with engineering. These include electronics, banking, insurance, and the internet-related sectors around the world.

The US system for licensure of professional engineers (Professional Engineering Protocol) with its own model law, is effective in bridging the capitalization gap—i.e., that long period of time between money flowing to a product or structure and the time that project produces revenue. Within this capitalization gap, the engineer's stamp holds the asset in suspension during the design and construction phases, serving as a proxy for the finished project on the accounting balance sheet. Upon closer comparison, there appears to be significant functional similarities between the mechanics of the Professional Engineering Protocol and the mechanics of Blockchain Protocol for achieving security, consensus among stakeholders, and validation of transactions. Professional engineering licensure has proven effective for over 100 years, but few people are aware of the role that PEs play in an economic system. Today, the institution of professional engineering is struggling for an interface with the digital world.

This makes Blockchain one of the most promising and in-demand topics that could have a substantial impact for years to come. All in all, it seems as if Blockchain will leave no industry unimpacted.

What is Blockchain and a Brief History of Bitcoin

Bitcoin: The First Blockchain

Bitcoin is the world's first cryptocurrency; created after the economic crisis of 2008 known as the Great Recession. Its creator/s Satoshi Nakamoto, who to this day remains in secret, designed it so that individuals could take control of their finances without the interference of the big banks or the government.

Blockchain is basically a data transfer system that was built by the creators of Bitcoin to send and receive Bitcoin. Blockchain is a 'decentralized ledger system' meaning Blockchain doesn't just transfer Bitcoin between two people, it also keeps a ledger of each transaction.

In addition, Blockchain tracks and records every single transaction that has ever taken place. As far as the storage of these transactions is concerned, it is stored on thousands, perhaps hundreds of thousands of computers.

The storage here is made up of blocks; As blocks fill up, new ones are added, and a 'chain' is formed. There is no sole source of the record making Blockchain an incredibly secure system as well.

Blockchain also provides transparency into the transactions that have taken place. This ensures that while money may potentially be stolen from people during transactions, it can always be tracked.

There are many Blockchains around the world today due to the influx of cryptocurrencies. Each cryptocurrency runs on a different Blockchain. However, Blockchain isn't confined to cryptocurrencies anymore because of its use as a data transfer and storage system. Hence, it can be used to store or transfer any type of data. Today, private companies and governments have begun using it for different purposes.

What is the Decentralized Ledger?

Blockchains can best be described as decentralized ledgers. This means several nodes or machines hold the record of that Blockchain, in turn, making it incredibly secure. If a record is altered on one node or machine, the others can detect it immediately. This prevents a rogue node from corrupting the entire set of data.

New Cryptocurrencies and the Evolution of Blockchain

After the establishment of Bitcoin, hundreds of other cryptocurrencies have been introduced. Some have the exact same function as Bitcoin, while others have different purposes altogether.

The ubiquity of cryptocurrencies and their slow, but inevitable acceptance by major companies and financial institutions has led to draw interest from consumers, hedge fund investors, as well as various financial gurus.

Forks and New Currencies

Since cryptocurrencies are all open source, they are open to mimicry and copying. Due to their open source nature, they rely on their communities to maintain and develop the underlying code.

A fork happens whenever a community makes a change to the blockchain's protocol, or basic set of rules. When this happens, the chain splits — producing a second blockchain that shares all of its history with the original chain but is headed off in a new direction.

There are 2 types of forks:

Soft Fork

Think of a soft fork as a software upgrade for the blockchain. As long as it's adopted by all users, it becomes a currency's new set of standards.

Soft forks are used to bring new features or functions, typically at the programming level, to both Bitcoin and Ethereum. Because the end result is a single blockchain, the changes are backward-compatible with the pre-fork blocks.

Hard Fork

A hard fork happens when the code changes so much that the latest version is no longer backward-compatible with earlier blocks. In this scenario, the blockchain splits in two: the original blockchain and latest version that follows the new set of rules.

This creates an entirely new cryptocurrency and is the source of many well-known coins. Cryptocurrencies like Bitcoin Cash and Bitcoin Gold evolved out of the original Bitcoin blockchain via a hard fork.

The Implications of Blockchain and Web 3.0

It's been a few years since we've been hearing about the birth of a new internet (Web 3.0), and a few more since Bitcoin and cryptocurrencies. Even though several of these concepts seem the same, they are not.

We called the first known version of the internet Web 1.0. An access-free, instant, but static network we could tag as a read-only Content Distribution Network (CDN). Here, users did a little more than consume content posted by a few publishers in a client-server architecture. HTML code, banners, and web forms flooded the not-so-easy-to-read network.

Web 2.0 followed about ten years later with the birth of blogging, social media, and e-commerce that revolutionized social interactions. Dynamic content, web applications, cloud services, XML, RSS, and a new internet that allowed users and communities to collaborate with each other. On-demand reading and writing of content was finally a reality.

Just ten years ago, Web 2.0 gave way to the next stage; a semantic internet that improves the required web technologies to create, share, and connect content through data analysis, based on the ability to understand the meaning of words, in place of keywords or numbers. A new internet that enables a ubiquitous, omnichannel strategy with interconnected applications and devices, 3D graphics, live-streaming, mobile apps, artificial intelligence, blockchain technology, and digital money. Welcome to Web 3.0: an Internet where we can create content, share it, and execute agreements: welcome to the read, write, & execute universe!

Blockchain technology is a record of transactions and information organized in blocks in a peer-to-peer network. The blocks are linked together in a single list, called a chain, by means of a cryptographic hash making the records impossible to modify by creating a secure data structure.

All parties involved in verifying a transaction, as well as a considerable number of third parties, maintain a full copy of the blockchain, creating a robust and distributed network.

Blockchain technology was introduced by scientists Stuart Haber and W. Scott Stornetta in 1991 but became mainstream 17 years later with the birth of the Bitcoin cryptocurrency and its White Paper publication titled "Bitcoin: A Peer-to-Peer Electronic Cash System ". The paper was published under the pseudonym of Satoshi Nakamoto in 2008.

Blockchain is particularly valuable in increasing the level of trust among network participants because it provides cryptographic evidence about a set of transactions. Given the use of these types of cryptographic proofs, they're awfully expensive to produce but easy for other network participants to verify - any attempt at tampering is evident. This feature removes the need for a central body to monitor and govern the information flow. The self-executing protocol guarantees the information integrity and compliance using predefined business rules.

This fast-evolving technology has already captured the interest of VC investors. In 2015, The Economist published an article where they referred to blockchain technology as a "trust machine". Since that moment, a large set of organizations have been exploring the technology that delivers trust, transparency, and helps to reduce operating costs in a wide variety of industries.

Bitcoin was the first, but definitely not the last one. After a frenzied start followed by a steady innovation growth, the cryptocurrency market skyrocketed in 2017, appreciating by 1,200%. Nowadays, there are several hundred other cryptocurrencies in circulation with a total market capitalization circa 279 Bn USD (according to CoinMarketCap) while several more are currently being developed.

Nevertheless, blockchain technology capabilities enable many more applications other than cryptocurrencies: it allows the digital representation, aka tokenization of financial instruments such as bonds, stocks, or derivatives, the traceability of goods in a value chain, document notarization, and much more.

In the short but dynamic history of this nascent technology, two different industries are portrayed: cryptocurrencies and blockchain technology.

The same way the internet shaped the world by allowing democratic access to information, blockchain is paving the road for how people and organizations set new business rules and exchange assets in this new Web 3.0.

The Consensus Mechanism

The Byzantine General's Dilemma

The Byzantine Generals Problem is a game theory problem, which describes the difficulty decentralized parties have in arriving at a consensus without relying on a trusted central party. In a network where no member can verify the identity of other members, how can members collectively agree on a certain truth?

The game theory analogy behind the Byzantine Generals Problem focuses on several generals besieging Byzantium. They have surrounded the city, but they must collectively decide when to attack. If all generals attack at the same time, they will win, but if they attack at contrasting times, they will lose.

The generals have no secure communication

channels with one another because any messages they send or receive may have been intercepted or deceptively sent by Byzantium's defenders.

Only decentralized systems face the Byzantine Generals problem, as they have no reliable source of information and no way of verifying the information they receive from other members of the network. In centralized systems, an authority is trusted to publish true information and prevent false or fraudulent information from being spread throughout the network. This problem is solved by the consensus mechanism.

Consensus Mechanisms

A consensus mechanism is a system that cryptocurrencies like Bitcoin and Ethereum use to validate the authenticity of transactions and maintain the security of the underlying blockchain. This system ensures that all legitimate transactions are recorded on the blockchain and that each copy of the blockchain contains valid transactions.

Proof of Work

Proof of work (PoW) describes a system that requires a fair, but feasible amount of effort in order to deter frivolous or malicious uses of computing power, such as sending spam emails or launching denial of service attacks.

The concept was subsequently adapted to securing digital money by Hal Finney in 2004 through the idea of "reusable proof of work" using the SHA-256 hashing algorithm.

Following its introduction in 2009, Bitcoin became the first widely adopted application of Finney's PoW concept (Finney was also the recipient of the first bitcoin transaction).

Proof of Stake

Proof-of-stake is a cryptocurrency consensus mechanism for processing transactions and creating new blocks in a blockchain. Proof-of-stake (POS) was created as an alternative to Proof-of-work. While PoW mechanisms require miners to solve cryptographic puzzles, PoS mechanisms require validators to simply hold and stake tokens.

Delegated Proof of Stake

Delegated Proof of Stake (DPoS) is a popular evolution of the PoS concept, whereby users of the network vote and elect delegates to validate the next block. Delegates are also called witnesses or block producers. Using DPoS, you can vote on delegates by pooling your tokens into a staking pool and linking those to a particular delegate.

You do not physically transfer your tokens to another wallet, but instead utilize a staking service provider to stake your tokens in a staking pool.

Proof of Authority

Proof-Of-Authority (PoA) is a consensus method that gives a small and designated number of blockchain actors the power to validate transactions or interactions with the network and to update its distributed registry.

Proof of History

Proof of History is a sequence of computation that can provide a way to cryptographically verify passage of time between two events. It uses a cryptographically secure function written so that output cannot be predicted from the input and must be completely executed to generate the output.

Proof of Capacity

Proof-of-capacity currencies rely on a computer's available hard drive storage space for a decentralized block verification and generation process.

Proof of Activity

The proof-of-activity consensus mechanism is a hybrid of proof-of-stake and proof-of-work in which the miner seeks to utilize the best of both systems.

Proof of Burn

With proof-of-burn, miners drive consensus by periodically burning coins; a process of permanently deleting or eliminating that specific coin from circulation. This validates new transactions while preventing inflation.

The Caveats of the Consensus Mechanism

Given Bitcoin's success, it's no surprise that its protocol should have attracted imitators, some of whom have sought to refine it, and others to overhaul it entirely. Nevertheless, it's ironic that there is a lack of, well, consensus when it comes to consensus mechanisms. Which option constitutes the most stable and efficient solution? It depends on who you ask.

- Proof of work has received some criticism over the last few years. A major talking point is centered around its energy and resource requirements: the computational power needed for miners to solve complex mathematical puzzles ahead of their peers is huge.
- Proof of stake has been criticized for giving power to a centralized group of hoarders. Some argue that affluent coin holders are more likely to mint blocks, leading to centralization, while others express alarm at the new attack vectors it introduces, including sybil attacks.
- For delegated proof of stake, although the protocol is less energy-consuming, it veers towards centralization, due to the fact that the decisions lay in the hands of a small core of holders.
- Although not technically a consensus mechanism, Proof of History plays a critical role in enabling network participants to reach consensus on time by using a Verifiable Delay Function, thereby avoiding "the longest chain" rule.

Cryptography and the Hidden Asset of Blockchain

Multi-Key Cryptography is the Basis of Blockchain Security

Public Keys

A public key is a cryptographic code that allows users to receive cryptocurrencies into their accounts. The public key and the private key are the tools required to ensure the security of the crypto economy.

When a user initiates his or her first

transaction with bitcoin or altcoins, a unique pair of a public key and a private key gets created. Each of the keys consist of a long string of alphanumeric characters that help keep a user's holdings secure in the digital ecosystem.

Private Keys

A private key is a secure code that enables the holder to make cryptocurrency transactions and prove ownership of their holdings. Bitcoin keys specifically feature a 256-bit string displayed as a combination of letters and numbers. It's stored within your crypto wallet, enabling you to access your Bitcoin whenever you need to.

Crypto Wallets

A crypto wallet allows you to send, receive, view, and spend cryptocurrency. The wallet is also where your keys (both private and public) live, giving you secure access to any crypto you own. There are various kinds of crypto wallets: simple hosted crypto wallets - where a platform looks after your private key for you. Non-custodial wallets - where you control your private keys with no third-party involvement at all. There are also hardware wallets – in this instance, your keys are stored offline, which some people deem more secure. Though different, they all share one common feature - they're used for storing your crypto keys.

Encryption and the Benefits for Data Storage and Transfers

Cryptography is key to the security of the blockchain ledger. Each transaction is recorded on the blockchain using encrypted data. Each user can access their own information to buy and sell crypto securely, using their public and private keys.

With cryptographic hashing, blockchains record root hashes with each transaction securely coded within them. If someone tries to tamper with data from any part of the blockchain, the change will result in a completely different hash at the root hash.

By comparing that root hash to the root hash on their own computer, other users can see that the data is compromised.

Cryptographic hashing allows limitless transactions to be recorded securely across the network. Since multiple transactions can combine into one hash, blockchains can continue growing at scale.

Cryptographic hashing is irreversible so that no one can undo transactions. This process keeps them safe from any adversarial action and ensures that all users can rely on the accuracy of the digital ledger.

Transparency and Security at the Same Time

Blockchain makes data open/transparent in a way that has not existed in financial systems in the past. This is one of the main reasons blockchain supporters believe it could be used as the new standard for transparency.

How exactly is data made transparent on the blockchain? Network participants have the ability to access holdings and transactions of public addresses using a block explorer. This is used to search the blocks of a blockchain, their contents, and their relevant details.

In the case of cybersecurity, decentralized threat data can be made accessible. While some may argue that in-depth analyses and reports provide sufficient confidence that the security solutions are performing as they're supposed to, bias may come into play due to the companies paying for the analysis reports, certifications, and other benefits.

With blockchain, any bias can be eliminated thanks to this transparency. A second benefit is added trust for major players in countries with strict regulations (PCI-DSS compliance, EU's GDPR law, HIPAA Security Rule for the healthcare industry, and others). Cybersecurity laws can benefit significantly if threat data is decentralized or recorded on the blockchain. For some players, major fines may be imposed if the utmost security standards are not met.

For example, Singapore passed the Cybersecurity Act of 2018 - a high-stake bill that has the potential to implicate major sectors of the city-state, including the government, if its mandates are breached. Critical Information Infrastructure (CII) operators may face up to$100,000 USD or jail time of up to two years in the event of a breach. With blockchain, auditors can verify that these bodies are adhering to the clauses of the laws and filling the security requirements by tracing and verifying the attacks.

The Time Keeping Aspect of Blockchain

Blockchain-based Timestamping is the process of recording data on a blockchain to prove that it existed at a specific date and time.

Blockchain-based Timestamping services are an innovative way for businesses to provide proof of existence for their documents. It is also used by organizations for tracking legal contracts, patents, and other vital records.

Security by Timestamp

A timestamp record is a digital signature of the sender or receiver on a document, which can be verified against public key infrastructure (PKI).

Blockchain-based timestamping is a system to verify data and assign a time or date of creation for digital documents or events. In the simplest form, the timestamp is a string of characters that uniquely identifies the document or event and indicates when it was created.

Blockchains are decentralized systems that record data in blocks on a ledger. The blocks contain information on transactions between users on the blockchain platform. Each block must have a unique identifier. The hash function provides this identifier by converting an input value to an output value with a fixed number of digits or bits.

Timestamping Benefits

Blockchain-based timestamps have several key benefits:

- They are more reliable and secure, as they cannot be changed or removed once published to the ledger.
- Blockchain is decentralized, which minimizes the possibility of tampering by any one party.
- Timestamps can be viewed entirely transparently if desired.

A straightforward way to compare traditional timestamping to blockchain-based timestamping is to look at the example of a manufacturing company. Ordinarily, a manufacturing company tracks the different steps in the manufacturing process on their own centralized servers.

Here, data can be lost, corrupted or manipulated, potentially leading to mistrust in the timestamps. On the other hand, with its decentralized, distributed networks, blockchain secures encrypted data at the source in a way that can't be altered. With secure, immutable, transparent data comes trust, and that's where the ultimate benefit lies.

Successful Blockchain Projects

Kodak's Blockchain Docment Management Project

The platform, launched under the name Kodak Services for Business, is intended for businesses and governments to store and manage sensitive documents. Kodak Document Management Platform relies on blockchain to provide efficiency and security, according to the company.

The company also claims that the blockchain platform will lead to 20-40% cost savings through automated workflows and decreased human management of content, information, and documents.

SKU Chain

US blockchain company Skuchain has partnered with Japanese tech giant NTT Data to build a blockchain platform for supply chain and logistics management. The solution, which combines blockchain technology with internet of things (IoT) innovations such as radio-frequency identification (RFID), has already been trialed in Japan's manufacturing sector, where it has been successfully used to improve supply chain efficiency. The solution is being jointly marketed by Skuchain and NTT Data in Japan.

Skuchain and NTT Data are also working with companies in Japan to use the supply chain platform to offer inventory financing offered through the blockchain platform – a key part of Skuchain's offering in other industry sectors such as food and agribusiness.

Skuchain is also in the process of implementing a supplier financing program based on its blockchain technology with one of Japan's premier automotive manufacturers, with the California tech company set to make big strides in the Asian supply chain space this year.

At the crux of the product is blockchain-enabled track and trace technology, which helps manufacturers with complex supply chains ensure that products are traceable at every node. By harnessing IoT, such as RFID, it means factory workers don't have to go through the arduous process of scanning each pallet of goods to ensure it is there. RFID tech allows for goods to be scanned on a collective basis, using mobile phones effectively saving an extensive amount of time.

Combining Blockchain and Professional Engineering

A 2016 white paper from the National Society of Professional Engineers' Financial Technologies Task Force explored the opportunities of professional engineers involvement in blockchain technologies and how the Professional Engineering Protocol, the basis for the licensure system in the United States, and the technology may intersect. The following excerpts are taken from the National Society of Professional Engineers "Blockchain Technology: Implications and Opportunities for Professional Engineers" and can be found in full at nspe.org.

Professional Engineering as a Financial Institution

The professional engineer's fundamental ethical obligation is to hold paramount the public safety, health, and welfare. But in practice, this includes the insurers and banks that assure the public welfare. The Professional Engineering Protocol allows public and private industry to span the capitalization gap—that is, the time gap between the initiation of investment and the delivery of revenue from that investment—in order to borrow money against future revenues. As noted earlier, the US system for licensure of professional engineers (Professional Engineering Protocol) with its own model law, is effective in bridging the capitalization gap—i.e., that long period of time between money flowing to a product or structure and the time that project produces revenue. Within this capitalization gap, the PE stamp holds the asset in suspension during the design and construction phases, serving as a proxy for the finished project on a balance sheet. The Professional Engineering Protocol, in fact, achieves this through many of the same security features as the three tricks of blockchain technology.

1. Professional engineers endure a peer-review process in obtaining and maintaining their license. Examinations qualify the engineers, and a revocable license establishes an incentive to high integrity.
2. Professional engineers use a common science and language of mathematics as the public key and problem solution as the private key, effectively encoding their judgments. An engineer recognizes the information of another engineer and can validate the integrity of a packet of information.
3. The professional engineer's stamp acts to finalize a transaction to an indelible legal ledger that memorializes monetary value and title to property.

The continued similarities between the goals of blockchain protocol and the Professional Engineering Protocol are remarkable, thus demonstrating that blockchain ideas are not

new and there is nothing to fear. Blockchains may, in fact, be more compatible to existing institutions than previously considered.

Perhaps then, an effective blockchain can be constructed combining components of the physical and the digital domains to achieve the high tolerance for ambiguity that humans provide while also providing the speed, accuracy, and scalability of computer networks.

For example:

- Instead of a computer modeling a fake network of Byzantine generals, a network of real "generals" can be assembled from a group of licensed engineers to model a computer network.
- Instead of a solution to a trivial puzzle as a means of generating a digital token, the solution to a real life puzzle can also be used to generate a digital token.
- Instead of a hashing program that generates a cryptographic key, a professional engineer's stamp could be used as the algorithm to hash cryptographic keys that are authorized to open and close contracts on the blockchain.

As long as each component of the blockchain ecosystem is insurable, the entire system would remain insurable. There would otherwise be no limit to the number of blockchains that can exist nor the number or combination of analog and digital components that can be mixed as long as the tokens, in the end, can clear accounts.

Oracle Contracts

A "smart contract" is a decision that is executed by a computer algorithm on a blockchain. For example, if condition A and condition B are triggered, then payment C is executed. An adjudicated smart contract is a smart contract whose execution is contingent on a physical observation or judgment by a reliable witness. The adjudicator would essentially flip the switch that allows the computer to follow a path of logic to, say, approve the next step in a sequence of events; assign, limit, or transfer liability; shift insurance coverage; establish responsible charge; or initiate a payment from a bank, bond, insurance claim, or contingency fund. If there is a problem or suspected corruption, the entire trail can be audited to forensic standards.

An oracle contract is an adjudicated contract with the added requirement that the adjudicator is deemed the most appropriate person to be performing the adjudication. The additional requirement means that a method is required to establish the most appropriate adjudicator—and that method must likewise be insurable. The oracle must make decisions in physical space—not simply assess digital data. The oracle must be able to be present in time and space, determine causation of an event, and deal with significant ambiguity in relation to the facts being observed. The validity of the oracle is what established tangibility, therefore, money and property. Securing the pool of decentralized oracles would be essential to insurability of such contracts on a blockchain

Banks and insurance companies depend on engineers to verify the design, materials, processes, components, and performance of all subjects that they finance. In general, the construction process consists of a long and complicated series of events that all must be contracted, negotiated, ordered in time, and verified in a secure manner while also triggering payments to stakeholders. These events are tied together by critical path methodology. All actuarial data used to insure any number of insurable conditions at some point touches the professional engineering stamp. A structure cannot be occupied without the PE stamp, a car cannot be insured without safe roads and bridges, and municipal projects cannot be capitalized without professional engineers.

The Professional Engineering Protocol is therefore the best model to start on blockchain because it is already codified in law and proven to be insurable. It will be essential to broaden the breadth and depth of the oracle pool as blockchain implementation advances to include non licensed engineers and other makers of useful things, however, the insurability requirements must remain in order for the global blockchain experiment to be ultimately successful.

The Real Value of Engineering

A recent study by the Federal Reserve Bank of San Francisco estimates that each dollar spent on infrastructure results in a $2 increase in GDP (GSP). Arguably, the GDP is a poor measure of economic activity that does not reflect distribution, multiyear impact, cumulative properties, or intangible assets. For example, a bridge that connects two communities may cost $100 million to create and maintain but may deliver a billion hours of increased productivity to a community over the 100-year lifespan of the bridge. Society can then invest surplus productivity on such things as art, education, civic activity, raising families, and more engineering. In general, citizens in their community reinvest surplus productivity.

The economic benefit of technological change is difficult to measure. However, in 1957 a study by Robert Solow concluded that between 1909 and 1949, the annual rate of technological change of 1.5% resulted in 90% of the increase in output per capita attributed to that same period. Today such things are complicated to measure, however IHS Inc. published a report that finds that an estimated $3 trillion of additional value has been added to the global gross domestic product, plus another $9 trillion of indirect value in the last 20 years, due to the pace of innovation predicted by Moore's Law. Moore's law simply relates to computer processing speed doubling every 18 months—a fractional proxy for engineering value!

Many engineers now cite conditions where "data engines" may override engineering opinion in many technical and financial decisions such as property valuation, energy policy, land use, infrastructure priorities, resource allocation, and risk management. The 2008 financial crisis was a data problem, not a human productivity problem— the difference between the

virtual value of mortgages and the physical value of the asset could not be reconciled in fact. The crisis was precipitated because there was no way to reconcile a virtual asset such as collateralized debt obligations with the physical world of structures and utility. Data is fast and cheap but its value is quickly lost without qualified human observation.

Engineering Contracts

Typical construction contracts, such as those published by the American Institute of Architects and the Engineers Joint Contract Documents Committee, provide a framework for the engineer-client interface to engineering projects. EJCDC's Standard General Conditions of the Construction Contract (C-700), as an example, lays out a long series of requirements that multiple parties need to fulfill in a specific order and within a specific time period. Each may be supplied faster, securely, and more indelibly if filed to a blockchain.

In general, the construction management consists of a long and complicated series of events that all must be contracted, negotiated, ordered, and verified in a secure manner. They are tied together by critical path methodology that is not unlike a blockchain. From the installation of a window wrap in a high-rise residential facility to publishing a flight manifest of a cargo aircraft on a tight schedule, such events can be validated instantaneously and adjudicated on the blockchain by the engineer of record (which is also on the blockchain). The output may be instantly distributed— by a set of pre-programmed rules—to banks, insurance companies, and ground workers—in consensus and without error. Reporting discrepancies, establishing prior art for innovative means and methods, and releasing document revisions, schedule changes, change orders, material orders, or returns are viable applications of blockchain. The engineer would essentially flip the switch that allows the computer to follow an interdependent path of logic.

By flattening the hierarchy and removing bottlenecks, projects can eliminate failure points; compress execution time; reduce volatility; integrate data; and reduce opportunities for fraud, negligence, incompetence, and breach of contract. Engineer- adjudicated contracts can be associated with project milestones and tracked on a master plan for quantity, quality, and chronological order. This data may be combined with the maintenance plan, future renovations, fiscal history, mortgages, loans, valuations, and ultimately the replacement of the project.

Project Lifecycle

In the old days of the automotive industry, the adage held that a new car would lose 25% of its value as soon as it drove off the dealer's lot. Selling a used car was limited to the local classifieds and how much the buyer had in their bank account. Odometer fraud was rampant. In 1984 a computer engineer started CarFax, which brought to the market, by fax machine, a registry of lifecycle events based on public data that could impact the value for a particular vehicle identification number. Since then, the variability in car values has diminished substantially. Carfax has greatly reduced the risk of vehicle pricing while protecting subsequent owners from bad actors and those conditions that undermine the value of the asset. Carfax enables buyers, banks, and insurance companies to accurately identify risk exposures, determine the probability there will be a loss, and determine the consequences of a loss should it occur. Under the leadership of HSI Inc., CarFax is currently introducing a service allowing car owners to track their maintenance records as well. Bruce Cahan, a consulting professor at Stanford's Civil & Environmental Engineering Department in the School of Engineering, is leading a project that accumulates lifecycle data and quality-of-life measures for construction projects using blockchain technology to reduce the volatility in pricing, maintenance, fiscal history, and therefore, property valuation.

During the lifecycle of a building, the design and construction records become part of a total set of documents that describe the asset. These include the property plat, maintenance documents, purchase contracts, insurance contracts, refinance documents, acquisition documents, leases and subleases, mortgages, and documents related to renovations, modifications, and ultimately the building's demolition and replacement. Real estate agents, insurance brokers, escrow services, police, government regulators, vendors, and occupants interact with the structure. Each and every interaction with the building requires some form of contractual agreement and subsequent payout associated with that event. This rich history, or lack of it, can add or subtract value from the property. Today, all of this value is largely invisible, undocumented, and disassociated from the asset.

Keeping track of all this data is prohibitively expensive with current database structures. Using the aviation industry as a comparison, a huge percentage of the costs in aviation is directly associated with documentation, certification, and information control of the aircraft history, performance, and related support infrastructure. The consequences of aviation failures can be devastating, so when an aircraft becomes disassociated from its data; such as operating in a foreign country, or installing counterfeit (uncertified) parts, it can no longer be financed or insured. The value of a $50 million passenger jet may plummet to scrap metal values simply for lack of data. As Cahan states, "The asset becomes the keeper of its own information."

Conclusion

The consortia between engineering and insurance already exist and their impact on the cost of capital is abundantly clear. To formalize this in blockchain programming is not a radical position by any means. What is unique about this proposal is that insurance and engineering should be at the forefront of blockchain development, building the bridge that spans the capitalization gap upon which everyone else can travel.

The current path of blockchain deployment,

dominated by banks, venture capital, and decentralized autonomous organizations, may not be sufficient in delivering the highest and best use for this important technology within the existing framework.

The market incentive and corresponding regulatory overreach in attempting to control blockchains will only have the effect of recentralizing databases rather than decentralizing databases—this is what happened to NAFTA. Regulatory arbitrage may serve only to increase volatility and inequality and not decrease it.

The superior method for so-called "controlling" blockchain technology would be through hybrid application of digital and physical proofing mechanisms that are individually insurable so that infinite combinations would still result in easily insurable enterprise. Reinsurance could then provide the ultimate umbrella, diversifying away remaining risk. Unique combinations of such components assigned by entrepreneurs, adjudicated by engineers, and underwritten by banks and insurance companies could yield new business methods to meet the technical needs of our future at a very low cost of capital. Smart contracts related to physical events must be adjudicated by persons most qualified to do so. For large technology and infrastructure projects, those persons should be licensed professional engineers who flip the switches on the blockchain. Oracle contracts are important and useful only to the degree that the oracles themselves are qualified and decentralized by objective means. The oracle pools may be decentralized through algorithms that convert résumés to cryptography in a manner that secures asset nodes and property titles. Real-world problems can be used as proof-of-work for the puzzles that power blockchains and their associated currency. Cryptocurrencies would no longer be just digital tokens best suited for speculation, rather, they could represent real human productivity achieving generalized reciprocity in real money exchanges.

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