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Erasmus+ Project

Learn Deep Project

Cooperation Partnerships in Vocational Education and Training

2023-1-TR01-KA220-VET-000150804

CAPTURING THE KNOW-HOW OF PROFESSIONALS IN CONSTRUCTION USING ONLINE LEARNING

Social Courses

https://www.civilengknowhow.com/

Erasmus+ Project

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1 Introduction

The construction industry has traditionally been defined by its technical rigour, engineering precision, and physical outcomes. For decades, civil engineering education has understandably prioritized "hard skills"—structural analysis, material science, and project scheduling. However, as the global construction landscape evolves into a complex network of multinational joint ventures, diverse stakeholder groups, and heightened ethical responsibilities, the definition of a competent engineer is shifting. Technical proficiency alone is no longer sufficient to navigate the modern built environment.

This Intellectual Output, titled "Social Aspects of Construction Management," addresses this critical paradigm shift. It is designed to bridge the gap between technical engineering education and the human-centric realities of the industry. Construction projects are not merely about erecting structures; they are intensely social endeavors involving negotiation, leadership, ethical decision-making, and legal compliance. A failure in communication or an ethical oversight can be just as detrimental to a project's success as a structural calculation error.

The modules curated under this "Social Courses" framework aim to equip future professionals with the essential "soft skills" required to thrive in Industry 4.0. The curriculum covers three fundamental pillars:

Ethics and Professional Integrity: From general ethical principles to the specific NSPE Code of Ethics, these modules instill a strong moral compass, preparing students to face the complex dilemmas inherent in tendering, quality control, and public safety.

Communication and Cultural Intelligence: In an era of globalized construction, the ability to manage cross-cultural teams and resolve conflicts is paramount. The courses on Communication, Conflict Management, and Cross-Cultural Management provide the tools necessary to lead diverse teams effectively, particularly in international joint ventures.

Legal and Social Responsibility: Understanding the legal framework, including Labor Law and Occupational Health and Safety (OHS), is framed not just as a regulatory requirement but as a social duty to protect the workforce.

By integrating these social competencies into the technical curriculum, this output aims to produce "T-shaped" professionals: engineers who possess deep technical depth but also the broad social breadth necessary to lead, communicate, and act ethically in a rapidly changing world. This holistic approach ensures that the next generation of construction managers is prepared not just to build projects, but to build trust, teams, and sustainable communities.

For more information about the project, please visit its official website:

https://www.civilengknowhow.com/

MOODLE platform:
https://lms.civilengknowhow.com/

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DISCOVER THE KNOW-HOW OF CONSTRUCTION PROFESSIONALS
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Basic Economics

Selected aspects of construction work cost calculation

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Co-funded by the European Union

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Basic information on cost estimate documentation

Investment process – all conceptual, legal, design, construction and other activities related to the construction of a new building.

Investment cycle – time of implementation of the above activities.

Basic information on cost estimate documentation

Investment process:

Stage I - investment preparation

Phase 1 - pre-design studies and analyses
Phase 2 – pre-design documentation
Phase 3 - design

Stage II - investment preparation

Phase 4 - construction works
Phase 5 - assembly of machines and devices
Phase 6 – start-up and trial operation.

The importance of cost estimate documentation in the investment process

Cost estimate – a document specifying the monetary value of structures or construction works, calculated according to established methods.

The importance of cost estimate documentation in the investment process

The most important functions of cost estimates are:

- Cost estimation function
- Pricing function
- Outlay function
- Settlement function

The importance of cost estimate documentation in the investment process

The cost estimate is:

- the basis for:
  - assessing the feasibility and profitability of the investment,
  - selecting the variant to be implemented,
  - developing a method of financing the investment,
  - concluding agreements with contractors,
  - developing a project of technology and organization of works,
  - a construction financing program,
  - cost and progress control of works.
- a tool for controlling expenses.

Price basis for cost estimate calculation

There are two basic methods of cost estimation:

- detailed method,
- simplified method.

Price basis for cost estimate calculation

In the detailed method, we base our calculations on material inputs, which are the material basis for calculations, and on unit prices of production factors.

Unit prices of production factors are labor rates, equipment labor rates, and

Price basis for cost estimate calculation

The simplified method is not based on the analysis of material costs.

In this method, the basis for the price calculation of the cost estimate are unit prices of works or objects depending on the adopted level of aggregation of works.

There are basically four levels of aggregation of works, and therefore four levels of unit prices:

- **basic works** - degree of integration as in the Catalogs of material outlays,
- **integrated works** (assortments of works),
- **integrated elements** (elements of objects),
- **objects** - degree of integration corresponding to the definition of a construction object.

Cost estimation using the detailed calculation method

The detailed calculation consists in calculating the estimated price of the facility or construction works as the sum of the products of the number of established bills of quantities, unit material outlays and their prices, and the added indirect costs and profit, considering the goods and services tax (VAT) - according to the formula:

$$C_k = \Sigma L * (n * c + K_{pj} + Z_j) + P_v$$

or

$$C_k = \Sigma (L * n * c) + K_p + Z + P_v$$

where:

Ck - denotes the cost estimate price,

L - denotes the number of established bill of quantities,

n - denotes unit material costs: labor - nr, materials - nm, equipment and means of technological transport - ns,

Cost estimation using the detailed calculation method

$C_k = \Sigma\ L * (n * c + K_{pj} + Z_j) + P_v$

or

$C_k = \Sigma\ (L * n * c) + K_p + Z + P_v$

where:

c - denotes unit prices of production factors, including hourly cost estimate labor rate - Cr, unit prices of material purchases (i.e. unit prices of material purchases together with their purchase costs) - Cmn, unit prices of machine-hours of equipment and means of technological transport - Cs,

n * c - means direct costs per unit of measurement calculated according to the formula:

Cost estimation using the detailed calculation method

$$n * c = n_r * C_r + \Sigma\, n_m * C_m + M_{pj} + \Sigma\, n_s * C_s$$

where:

Mpj – means the cost of auxiliary materials per unit of measurement,

Kpj – means indirect costs per unit of measurement,

Kp – means indirect costs,

Zj – means the imputed profit per unit of measurement,

Z – means the imputed profit,

Pv – means the tax on goods and services (VAT).

Cost estimation using the simplified calculation method

Simplified calculation consists in calculating the estimate price of objects or construction works, as the sum of the products of appropriately established bill of quantities and unit prices, considering the value added tax (VAT) - according to the formula:

$$C_k = \Sigma L * C_j + P_v$$

where:
Ck - denotes the estimate price,
L - denotes the number of established bill of quantities,
Cj - denotes the unit prices for established bill of quantities,
Pv - denotes the value added tax (VAT), charged in accordance with the applicable regulations.

Catalogue of material outlays

Catalogues of material outlays are lists of quantitative standards relating to the specifications and quantities of material costs needed to complete the planned elements or construction works.

Catalogue of material outlays - example

No.	Base	Description	Um	Outlays	Uc	L	M	E
1	Catalogue of material outlays 2-02, vol. 0203-01	Concrete foundation footings with a volume of up to 0.5 m^3 Dimensions: ……. **-L-** Workers 7.83 o-h/m^3 * 19.53 EUR/o-h **-M-** Plain concrete made of natural aggregate 1.015 * 240 EUR/m^3 Round wood for construction props 0.006 * 415 EUR/m^3 Edged softwood boards, 19-25 mm thick, class III 0.023 * 465 EUR/m^3 Edged softwood boards, thickness 28-45 mm, class III 0.013 * 625 EUR/m^3 Round construction nails 0.61 kg/m^3 * 6.50 EUR/kg **-E-** Means of transport 0.11 m-h/ m^3 * 37.00 EUR/m-h						

Machine hour: m-h

Operating hour: o-h

Uc – Unit cost

L – labor

M – materials

E – equipment

Um – Units of measurement

Catalogue of material outlays - example

No.	Base	Description	Um	Outlays	Uc [EUR/m^3]	L [EUR]	M [EUR]	E [EUR]
1	Catalogue of material outlays 2-02, vol. 0203-01	Concrete foundation footings with a volume of up to 0.5 m^3 Dimensions: **80 m^3**						
		-L- Workers 7.83 o-h/m^3 * 19.53 EUR/o-h	o-h	7,83*80=626,40	12233,59/80=152,92	626,40*19,53=12233,59		
		-M- Plain concrete made of natural aggregate 1.015 * 240 EUR/m^3	m^3	1,015*80=81,20	19488/80=243,60		81,20*240=19488,00	
		Round wood for construction props 0.006 * 415 EUR/m^3	m^3	0,006*80=0,48	199,20/80=2,49		0,48*415=199,20	
		Edged softwood boards, 19-25 mm thick, class III 0.023 * 465 EUR/m^3	m^3	0,023*80=1,84	855,60/80=10,70		1,84*465=855,60	
		Edged softwood boards, thickness 28-45 mm, class III 0.013 * 625 EUR/m^3	m^3	0,013*80=1,04	650/80=8,12		1,04*625=650,00	
		Round construction nails 0.61 kg/m^3 * 6.50 EUR/kg	kg	0,61*80=48,80	317,20/80=3,96		48,80*6,50=317,20	
		-E- Means of transport 0.11 m-h/ m^3 * 37.00 EUR/m-h	m-h	0,11*80=8,80	325,60/80=4,07			8,80*37=325,60

Cost estimation using the simplified calculation method

Unit prices for the purposes of preparing a cost estimate using the simplified method can also be established through **bilateral negotiations** between the ordering party and the contractor. This form of establishing unit prices is possible in the case of a non-tender (direct) mode of commissioning works.

Bill of Quantities

Definition – a study including:

- a list of planned works in the technological order of their execution,
- a short description of the planned works with the required technical parameters of the works,
- a detailed list of basic and auxiliary works paid for in the price of a given work or an indication of the basis for establishing such a list (e.g., the number of the relevant technical specification).

Types of remuneration for a contractor in construction

- Lump-sum remuneration
- Cost estimate remunaration

Price from the contractor's point of view

- The amount for which the contractor is willing to sell the works performed;
- It should ensure:
  - that the contract is obtained,
  - the profitability of production.

BIM 5D

BIM 5D = Design (3D) + Schedule (4D) + Cost

5D software links each building component (walls, floors, beams, etc.) to cost data. When the design changes, costs adjust automatically. This helps teams make informed choices without delays.

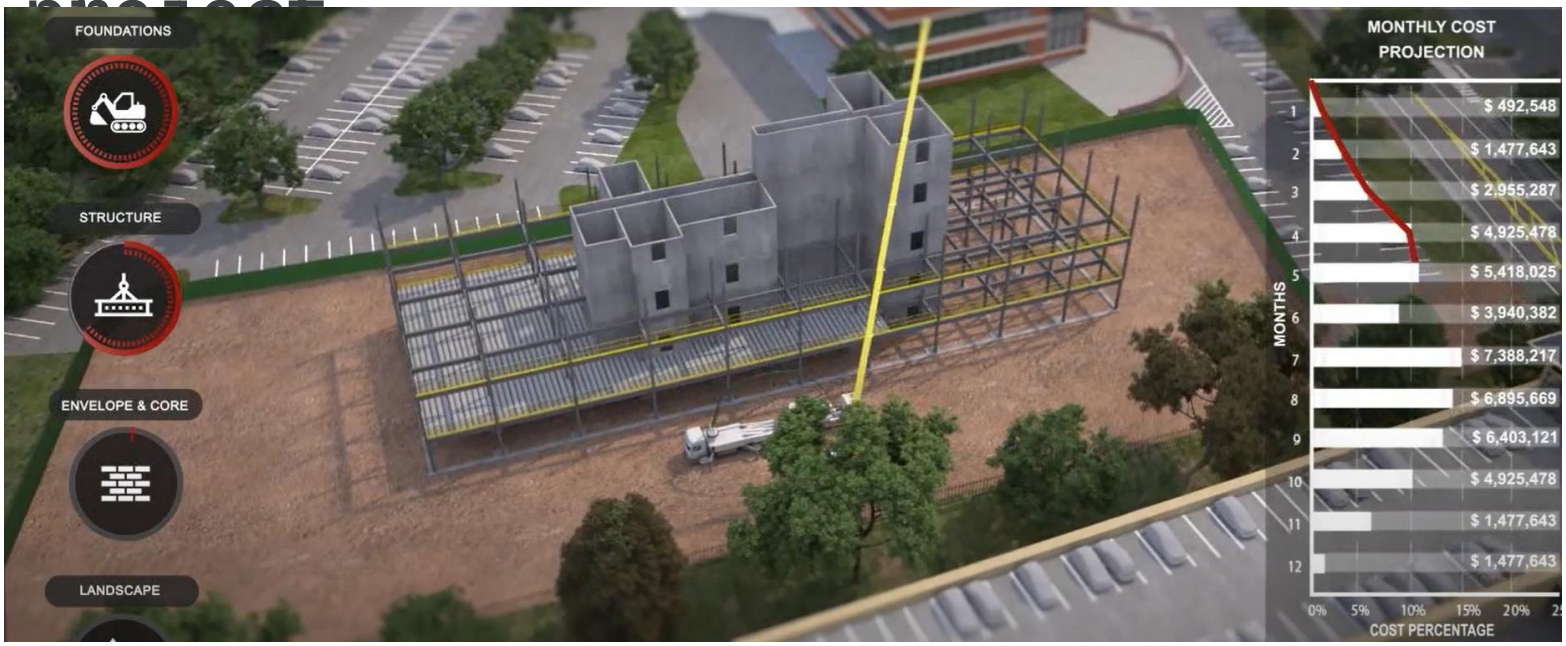
BIM 5D

Total costs after the 1st month of the project.

Source: V5D Youtube

BIM 5D

Total costs after 4 months of the project



Source: V5D Youtube

BIM 5D

Total costs after 10 months of the project

Source: V5D Youtube

Why should BIM 5D be used?

1. Faster & More Accurate Cost Estimation;
2. Better Project Planning
3. Real-Time Budget Updates
4. Improved Collaboration
5. Streamlined Procurement & Bidding

Thank You for Your attention.

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Benefit/Cost Analysis

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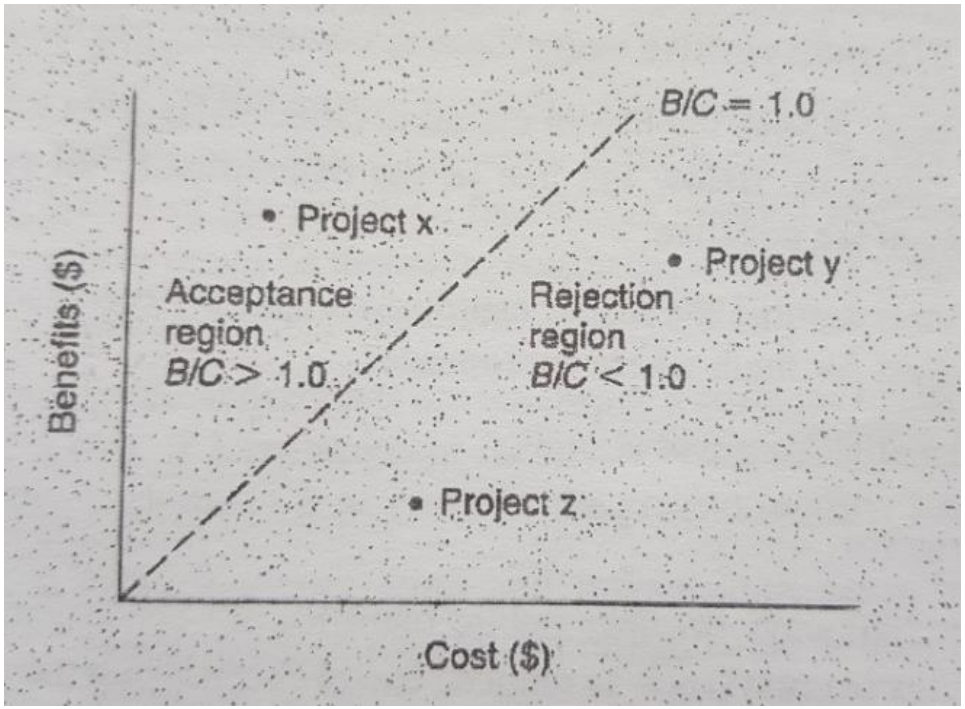
Google Scholar:
https://scholar.google.com/citations?user=Ohagqy4AAAAJ&hl=tr&oi=ao

Benefit/Cost Analysis

The method consists of comparing the ‘equivalent net worth’ of the benefits to the ‘equivalent net worth’ of the costs, expressed as a benefit to cost (B/C) ratio. Usually the NAW is used, although the NFW or NPW can also be used.

For an investment to be acceptable, the B/C ratio should be greater than 1.0 (see figure).



Benefit/Cost Analysis

A common practice among mutually exclusive projects is to find the B/C for each of the competing projects and select the one with the highest B/C ratio. While this usually yields a valid ranking, in some cases it may lead to erroneous selections, as the following example illustrates.

Example 1

Using B/C ratio method, find the best alternative (i=7%)

	X	Y	Z
Annual benefit ($)	375,000	460,000	500,000
Annual cost ($)	150,000	200,000	250,000

Benefit/Cost Analysis

B/C ratio for each alternative is calculated below:

	X	Y	Z
Annual benefit ($)	375,000	460,000	500,000
Annual cost ($)	150,000	200,000	250,000
B/C ratio	2.5	2.3	2.0

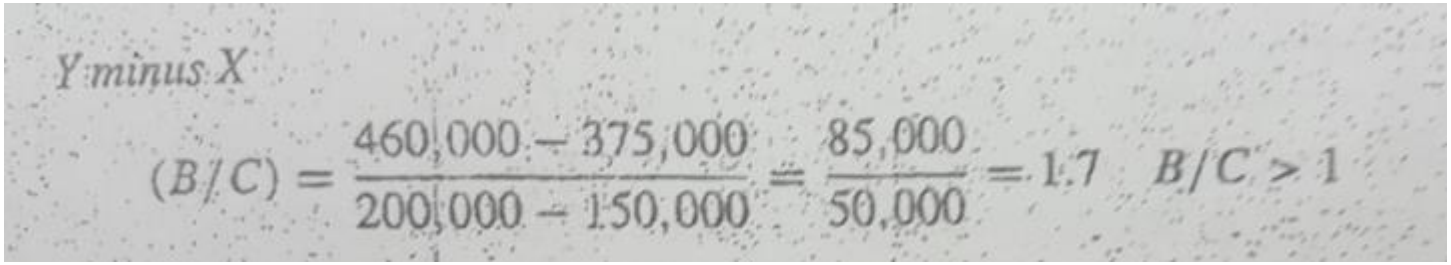
Alternative X appears the best because it has the highest B/C ratio. However, if the NAW of the costs is simply subtracted from the NAW of the benefits the following results are obtained:

	X	Y	Z
Annual benefits ($)	375,000	460,000	500,000
Annual costs ($)	150,000	200,000	250,000
Net annual worth ($)	225,000	260,000	250,000

Benefit/Cost Analysis

Examining the resulting NAW values, it is evident that alternative Y has the higher NAW at 260,000 per year. This NAW İS 35,000/yr higher than X, however, the cost of Y is 50,000/yr higher than that of X. The question then arises, ‘Does the extra 35,000/yr of NAW justify the additional 50,000/yr cost of Y?

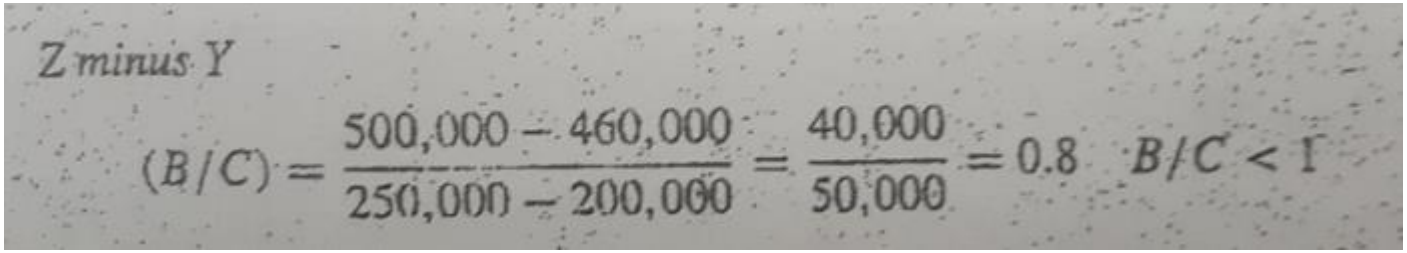
To answer this question, an incremental B/C ratio is found (which is analogous to the incremental rate of return of Chapter 11), beginning with the lower cost pair Y – X. The incremental B/C ratio is determined by subtracting lower cost X from the next higher cost Y as follows:



Benefit/Cost Analysis

Each additional dollar invested in alternative Y over X yields a benefit of $1.70. Therefore, Y is preferred over X, and we eliminate X.

Then compare current candidate Y to the next higher cost alternative Z as follows:



Each additional dollar invested in alternative Z over Y yields a benefit of $0.80. Therefore, Y is preferred over Z, and we eliminate Z.

Select Y.

Y is a better alternative even though it has a lower B/C ratio than X.

B/C Ratios

User Benefits

When new highways or other public facilities are constructed, the user usually enjoys some savings in costs (such as reduced travel costs) when the new facility is compared to the existing one. These savings may occur due to less time required to travel a certain distance (less congestion, fewer stops or delays at traffic signals, shorter route, etc.), lower fuel consumption, less wear, fewer accidents, or other similar reasons. Savings of this type are determined by estimating the **total annual cost to the users for the present facility** (this cost is designated U_p) and subtracting from it the **total annual cost to the same number of users for the future facility** (designated U_f). Thus the **net user benefit,** designated U_n, is calculated as $U_n = U_p - U_f$. If the net costs to users of the future facility are less, the resulting U_n will be positive. The terms $(U_p - U_f)$ and U_n both designate *net* user benefits and are used interchangeably.

B/C Ratios

Owner's Costs

Owner's costs are divided into two categories: (1) capital costs, and (2) maintenance costs.

1. Capital costs are usually considered as the construction, acquisition, or other costs of investing rather than operating and maintaining a facility. If a replacement facility is being considered, the question arises of how to handle the present value of the existing facility. The present value is the cash salvage value that would be received now if the existing facility were sold or demolished. If the existing facility is maintained in place, this cash value is left invested in the existing facility. Therefore the capital cost of the existing facility is the cash salvage value. The cost of the proposed facility is *not* reduced by the worth (salvage value) of the existing facility, since the value of the existing facility is an owner's asset that can be freely kept or spent like cash or any other asset. To handle the sign notation, the following terms are defined.

B/C Ratios

C_f = Equivalent capital cost of proposed (future) facility, usually expressed on an annualized basis.

C_p = Equivalent capital worth of the existing facility (present salvage value), usually expressed on an annualized basis. This is the value that either can be received in cash or left invested in the existing facility.

$C_n = C_f - C_p$ = *Net* capital cost of replacing the present facility with the future facility. Note that if the worth of the present facility is greater than the cost of the proposed facility (an unusual situation), the net capital cost could be negative. Normally, using this chapter's sign convention, *Cn* will be positive.

2. Operation and maintenance costs are the owner's costs for operating and maintaining the facility (O & M). If a replacement facility is being considered, its O & M costs may be more, or less, than the O & M costs for the present facility. Thus, let us define

M_f = Equivalent operating and maintenance costs of the future (proposed) facility, usually expressed as an annual (or annual equivalent) cost.

M_p = Equivalent operating and maintenance costs of the present (existing) facility, expressed in the same terms as M_f.

$M_n = M_f - M_p$ = *Net* operating and maintenance cost of the proposed facility over the present facility. *Mn* may be either positive or negative.

Methods for Calculating B/C Ratios

The two most common approaches to computing the B/C ratio are known as (1) The conventional B/C, and (2) the modified B/C method.

$$\text{conventional } B/C = \frac{\text{net savings to users}}{\text{owner's net capital cost} + \text{owner's net operating and maintenance cost}} = \frac{U_n}{C_n + M_n} = \frac{B_n}{C_n + M_n}$$

$$\text{modified } B/C = \frac{U_n - M_n}{C_n} = \frac{B_n - M_n}{C_n}$$

Example 2

Find the conventional B/C for alternate routes X and Y proposed to replace an existing route between two points; $i = 8$ percent, $n = 20$ years.

	Existing route	Proposed route X	Proposed route Y
Construction cost ($)	0	100,000	100,000
Annual equivalent to construction cost $A = \$100{,}000\underbrace{(A/P, 8\%, 20)}_{0.1019}$	0	$ 10,190	$ 10,190
Estimated user's cost ($/yr)	200,000	165,000	195,000
Owner's operating and maintenance costs ($/yr)	250,000	270,000	240,000

Example 2

In this example, there is an existing route, and two alternative routes X and Y. The alternative routes will be compared to the existing route. Note that benefit and cost should have the same time values (PW, AW, or FW). AW method is used in this example. Therefore, construction cost is converted to annual.

User' cost for existing route is 200,000/yr. For alternative X, user's cost is 165,000/yr. This means that users will save 35,000/yr if X is used. This amount will be taken as a benefit. Route X compared to existing route:

$$\frac{U_p - U_f}{(C_f - C_p) + (M_f - M_p)} = \frac{200{,}000 - 165{,}000}{(10{,}190 - 0) + (270{,}000 - 250{,}000)}$$

$$= \frac{35{,}000}{30{,}190} = \underline{\underline{1.16}}$$

Example 2

Route Y compared to existing route:

$$\frac{U_p - U_f}{(C_f - C_p) + (M_f - M_p)} = \frac{200{,}000 - 195{,}000}{(10{,}190 - 0) + (240{,}000 - 250{,}000)}$$

$$= \frac{5{,}000}{190} = \underline{\underline{26.32}}$$

Based on the results, a 1 dollar investment yields a 26.32 dollar return for alternative Y when compared to the existing route.

Example 2

By comparison, the modified B/C yields the following results.

Route X:

$$\text{modified } B/C = \frac{(U_p - U_f) - (M_f - M_p)}{C_f - C_p}$$

$$= \frac{(200{,}000 - 165{,}000) - (270{,}000 - 250{,}000)}{10{,}190 - 0}$$

$$= \frac{15{,}000}{10{,}190} = \underline{\underline{1.47}}$$

Route Y:

$$\text{modified } B/C = \frac{(200{,}000 - 195{,}000) - (240{,}000 - 250{,}000)}{10{,}190 - 0} = \frac{15{,}000}{10{,}190}$$

$$= \underline{\underline{1.47}}$$

Thus with identical capital investment, the annual savings for routes X and route Y are identical at $4,810 per year, yet the conventional B/C ratio yields B/C of 1.16 for X and 26.32 for Y. The modified B/C ratio on the other hand yields B/C ratios of 1.47 in each case. *This and similar comparisons indicate that the modified B/C method usually yields more consistent results.*

Based on the results, modified B/C ratios are 1.47 in each case.

At the end, in this example, we do not select an alternative as modified B/C ratios are the same. However, if we consider both conventional and modified methods, one might select alternative route Y.

Example 3

An engineering firm is considering five different small computers to aid the firm in running complicated and repetitive calculations. Analysis of the various machines, when applied to the firm's business, indicates the following cash flow information (MARR = 12%).

	G	H	F	I	J
First cost ($) (*P*)	18,000	22,500	25,000	28,400	32,000
Annual net income ($)	3,800	4,800	5,000	6,000	6,600
Useful life (yr)	8	8	8	8	8

Using incremental B/C method, which alternative should be selected?

Example 3

Benefit and cost should have the same time values (PW, AW, or FW). PW method is used in this example. Therefore, annual net income is converted to present value. Moreover, the B/C ratios for each alternative are shown below (eg. alternative G; B/C = 18,877/18,000 = 1.04)

	G	H	F	I	J
First cost ($) ($P$)	18,000	22,500	25,000	28,400	32,000
Annual net income ($)	3,800	4,800	5,000	6,000	6,600
Useful life (yr)	8	8	8	8	8
Present worth of benefits ($) $P_B = A(P/A, 12\%, 8)$	18,877	23,845	24,838	29,806	32,787
B/C	1.04	1.06	0.99	1.05	1.02

Example 3

Since H has the highest B/C ratio, one might be tempted to select H, but that would be wrong. At this point the only conclusion that can be made is to eliminate F because its B/C ratio is less than 1.0.

To solve the problem, each incremental B/C ratio must be determined. The alternatives should be listed according to their first cost as: G H I J

Pairwise comparisons will be made using incremental B/C method:

H–G:

$$\frac{\Delta B}{\Delta C} = \frac{23,845 - 18,877}{22,500 - 18,000} = \frac{4,698}{4,500} = \underline{\underline{1.10}}$$

Since B/C > 1.0, eliminate lower cost alternative G.

Example 3

I–H:

$$\frac{\Delta B}{\Delta C} = \frac{29{,}806 - 23{,}845}{28{,}400 - 22{,}500} = \frac{5{,}981}{5{,}900} = \underline{1.01}$$

Since B/C > 1.0, eliminate lower cost alternative H.

J–I:

$$\frac{\Delta B}{\Delta C} = \frac{32{,}787 - 29{,}806}{32{,}000 - 28{,}400} = \frac{2{,}981}{3{,}600} = \underline{0.83}$$

Since B/C < 1.0, eliminate higher cost alternative J.

Select Alternative I.

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Communication and Conflict Management in Construction Industry

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Co-funded by the European Union

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Communication in the Construction Process

The Concept of Communication

The word 'communication' comes from the Latin 'communicare' and means:

to seek, to do something together, to unite, to share, to inform, to consult, to discuss.

- Communication is a dynamic exchange of information among all parties involved in a construction project.
- It includes both formal documentation and informal conversations.
- Effective communication impacts the quality, timeliness, and safety of project execution.

Importance of Communication in Construction

- Clear communication of expectations
- Prompt problem-solving
- Clear decision-making
- Regular progress reporting
- Minimizing conflicts
- Working towards a shared goal.

Forms of Communication on Site:

• Verbal: quick, daily exchange of information

• Written: construction logbook, reports

• Visual: signs, safety instructions.

All forms are crucial for safety and work organization.

- Communication is a dynamic process of information exchange between the investor, designers, site manager, contractors, supervising inspector, and others.
- It plays a key role from planning through execution to operation.
- It enables the sharing of expectations, problem-solving, and decision-making.

Effective and Modern Communication

Communication competences:

- Means clear, understandable, and timely information exchange, quick response to issues, clear decisions, and regular progress reporting.
- The ability to listen and express thoughts constructively supports cooperation, reduces misunderstandings, and helps achieve goals.
- The site manager should listen to the team.
- Good communication builds trust and a cooperative atmosphere.

Modern Means of Communication:

- Smartphones, tablets, emails, and platforms – gaining importance though less common in construction than in other sectors.
- Site communication must be precise, structured, and adapted to field conditions.
- Its quality affects the success of the project.

Communication and Management:

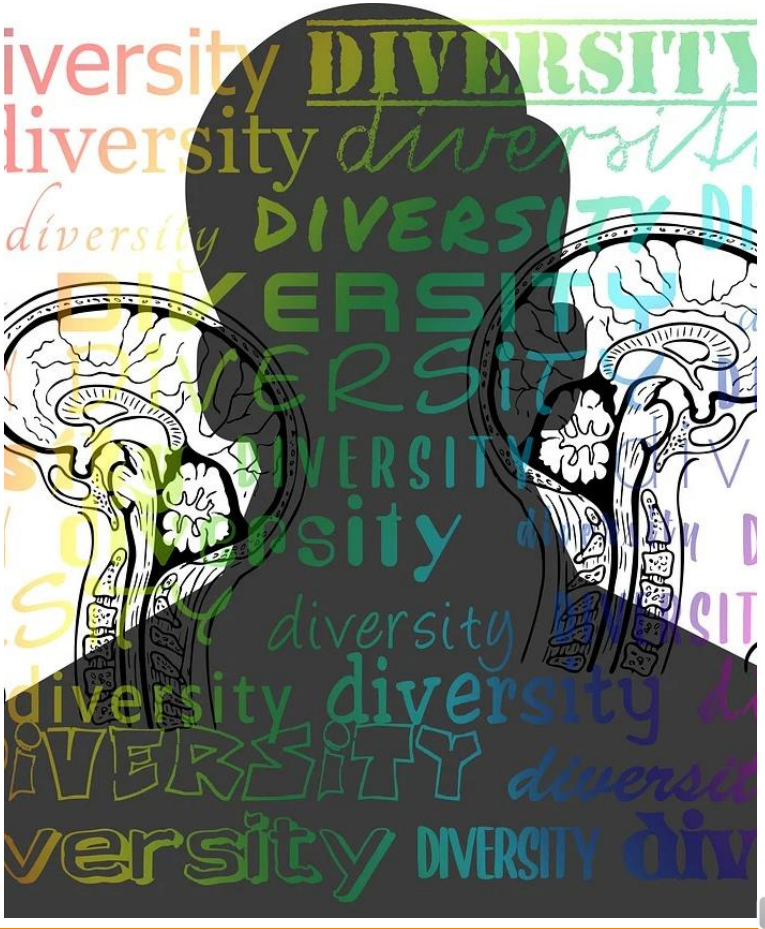
- Two-way communication
- Fast decision-making
- Documenting conversations.

Intercultural Communication

- Working with people from different countries
- Cultural differences in communication styles
- Impact of globalization
- Ethical and cultural challenges.

Cultural Differences and Communication

- Collectivist vs individualist cultures
- Language and communication barriers
- Work style and hierarchy
- Importance of empathy and openness.



Communication in Multicultural Environments

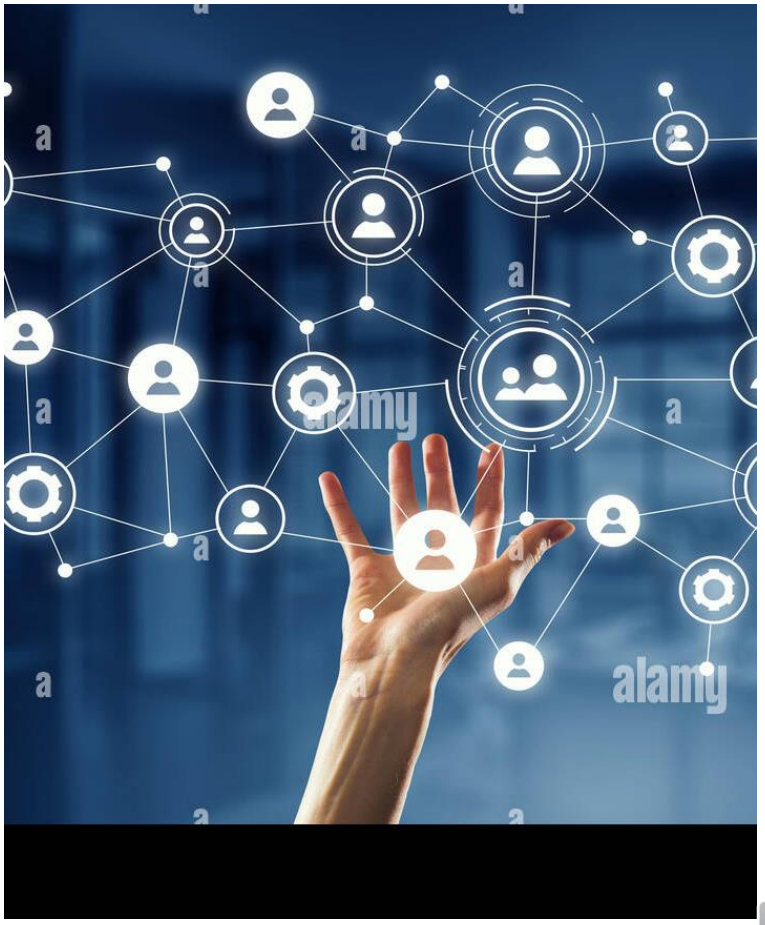
- Complexity and risk of misunderstandings
- Social norms, language, non-verbal communication
- Understanding intent and cultural context.

Managing Intercultural Project Teams

- Challenges and potential of diversity
- Need for intercultural competence among leaders
- Technologies supporting remote collaboration.

Future of Communication

- Intercultural training programs
- Professional communication strategies
- Digitalization and new technologies
- Organizational culture based on respect.



Challenges in Intercultural Communication

- Language barriers
- Different communication and authority styles
- Work pace and stress
- Lack of intercultural leadership training.

Conflict Management in the Construction Industry

Nature of Conflicts

Conflicts are inevitable in construction.

They result from the complexity of processes, number of participants, and time and cost pressure.

Causes of Conflicts:

- inaccurate documentation,
- design changes,
- unclear contracts,
- lack of procedures,
- poor communication.

Types of Conflicts:

- technical, organizational, legal, financial, interpersonal and from interpretation differences in documentation.

Types of Conflicts

Technical conflicts:

- arise from design errors, unclear documentation and differences in interpreting standards.

Organizational conflicts:

- problems with scheduling, work coordination, overloading and unclear division of responsibilities.

Legal conflicts:

- disputes due to contract terms, scope of work, penalties, deadlines, acceptance and payments.

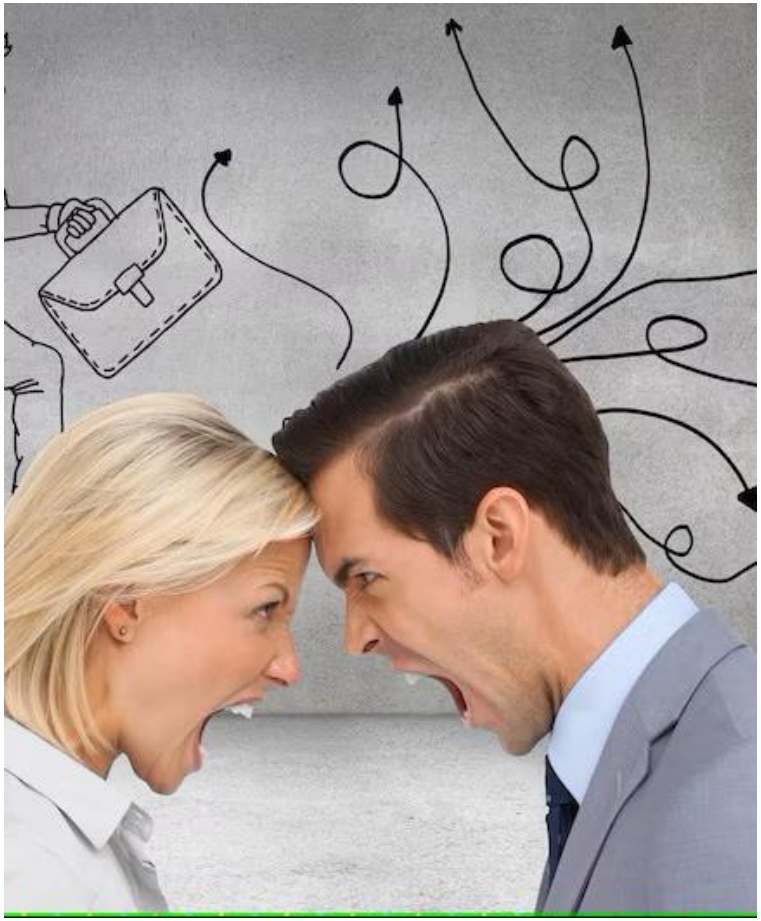
Financial conflicts:

- delays in payments, costs of extra work and shifting of financial responsibility.

Interpersonal Conflicts

- Tensions from differences in character,
- Communication styles,
- Stress,
- Pressure of time.

Conflict Management



Conflict Resolution:

- requires understanding,
- dialogue,
- and compromise.

Mediation and good organizational culture help.

Role of the Site Manager:

- early conflict detection,
- setting rules,
- preventing crises.

Not about winning but rebuilding trust and effective cooperation.

Conflicts can be an opportunity for improvements if properly managed.

Mobbing

- A special form of interpersonal conflict.
- Long term, systematic harassment.
- Causes stress, depression, burnout, and lowers efficiency.

Typical Mistakes Made by Project and Construction Managers

Most common mistakes made by Project Managers

- Lack of willingness to Learn and acquire knowledge
- Design errors
- Poor work organization
- Embedding low-quality materials, reduce durability, and may endanger structural safety
- Execution mistakes, caused by lack of experience, haste, or negligence, affects aesthetics and functionality buildings
- Lack of technical supervision during the implementation of the investment
- Negligence in enforcing occupational health and safety regulations
- Lack of proper communication between participants in the construction process.

Most common mistakes made by Construction Managers

- Frequent absence from the construction site and insufficient supervision of construction works
- Improper maintenance of construction documentation
- Lack of proper organization of work on the construction site
- Downplaying occupational health and safety regulations on the construction site
- Poor communication with other participants of the construction process
- Lack of knowledge of current construction law regulations or their incorrect interpretation
- Psychological mistakes.

The main Consequences of Mistakes

- Delays in the completion of works
- Overruns in the investment budget
- Lack of care for the appropriate quality of works performed, failure to enforce standards of execution leads to serious construction defects, complaints and high costs.
- Lack of appropriate communication and coordination of the work of the design and implementation team
- Violations of construction law regulations, technical standards or provisions of the construction works contract
- Loss of reputation, trust of investors and co-workers.

Conclusions

- In the era of globalization and cultural plurality, effective and culturally sensitive communication within both construction sites and multinational teams is an indispensable management instrument, aiding in the reduction of interpersonal conflicts and the promotion of collaborative synergies.
- Ethical leadership and soft skills competence, especially among those in managerial positions, are pivotal determinants of project excellence, social legitimacy, organizational reputation, and the enduring success of construction enterprises within a highly competitive sector.

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Ethical Principles in the Construction Industry

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Ethical Principles in the Construction Industry

What are Ethical Principles?

- Ethical principles refer to the set of values that define standards of moral conduct. They form the foundation of what is considered morally right.
- Professions of public trust require not only competence, but as well adherence to the highest ethical standards.
- Ethical codes are based on the principle of the common good.
- Ethics and social responsibility are key aspects of the work of a site or project manager.

Professional Ethics in Construction

Modern ethical standards in construction are built on values such as honesty, responsibility, and respect – both for people and the environment.

At the core lies professional integrity, reflected in diligent performance, compliance with legal regulations, and loyalty toward clients, colleagues, and business partners.

Ethical conduct also includes:

- Transparency,
- Safety,
- Environmental responsibility,
- Respect for human dignity.

Ethics Corporate Level – Corporate Governance

Corporate Governance – Key Principles

Corporate governance refers to a framework of principles, procedures, and mechanisms that guide the management and oversight of a company.

Key elements:

- Transparent management & oversight
- Clear roles: owners, board, stakeholders
- Accountability of decision-makers
- Ethics & legal compliance
- Equal shareholder rights.

Benefits:

- Builds trust
- Reduces abuse & corruption
- Boosts efficiency & enterprise value.

Ethics in Business and Construction

Ethics = moral compass in business.

Construction ethics under pressure:

- Little training
- New, unregulated companies
- Greed & high conflict rates.

Ethics applies to all:
Business serves both society & the environment.

Business and ethics were once considered incompatible

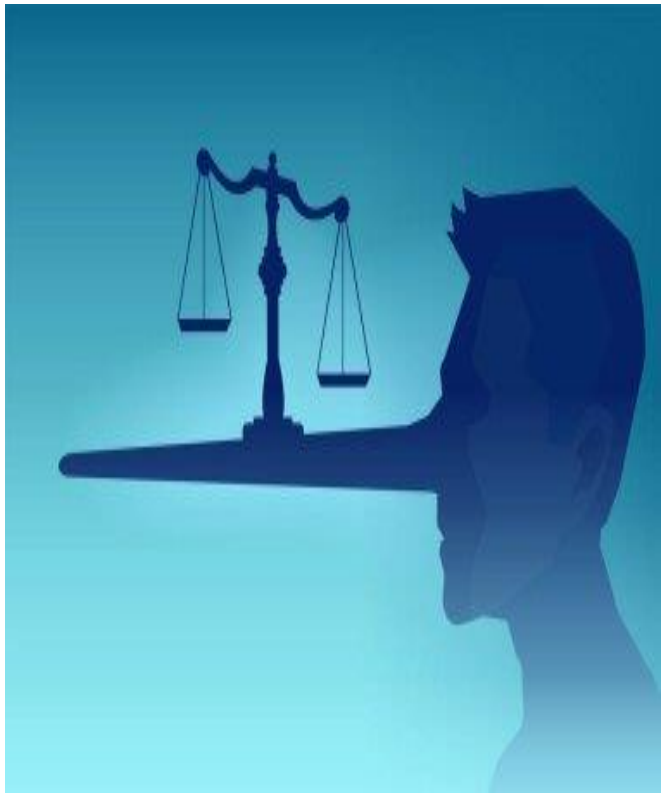
- Ethics are now seen as integral to business practices
- Business serves society and the environment, not just individuals.

Unethical Practices in Construction

Common issues:

- Hiding errors
- Inflated bids & fake costs
- False progress reports
- Misleading clients
- Conflicts of interest

- Bribery vs. gift-giving – blurry line
- Fraud – deception for unfair gain
- Negligence – harm by carelessness.



Other Unethical Practices

- Breach of trust
- Negligence of duties
- Financial fraud
- Whistle-blowing.

Compliance and Value Management in Construction

What is Compliance?

- Compliance with local and international law
- Fair treatment of partners and employees
- Establishment of an organizational unit for compliance, with an advisory and preventive function
- Training of employees in resolving ethical dilemmas
- Compliance with regulations concerning occupational safety, health and environmental protection.

Ethical Foundations of Business

- Legal compliance as a basis for actions
- Values influence the nature of business decisions
- Ethics and value management are core to responsibility
- Define the company's identity and direction
- Foundation of organizational culture
- Examples: honesty, responsibility, trust, respect
- Should be practiced, not just declared.

Benefits of Value Management

- Building trust with clients and partners
- Preventing reputational crises
- Strengthening employee loyalty
- Easier value-aligned decision making
- Responsible and trusted organization
- Sustainable growth and long-term success
- Conscious development of organizational culture
- Compliance is the foundation – values build advantage.

Professional Ethics in the Construction Industry

Professionalism and Ethics

Profession:

- A job requiring knowledge and qualifications.
- Professionalism = competence, responsibility, ethics.
- Foundation of trust in professional relationships.

Ethics:

- System of moral Principles.
- Influences everyday decisions of individuals and Groups.
- Crucial in business decision making.

Ethical Decisions in Construction

- Considering the well-being of clients, employees, and the environment
- Not solely focused on profit maximization
- Importance of conscience and personal integrity of the decision-maker.

Ethics in Practice:

- Honest communication with clients
- Fair tendering and avoiding corruption
- Ensuring worker and environmental safety
- Compliance with industry standards and contracts.

Professional Ethics in Construction Industry

- Set of principles and moral values
- Applies to engineers, designers, contractors, etc.
- Protects public interest and ensures project sustainability

The Essence of Professional Ethics

Honesty and Integrity:

- Transparency of costs and technical capabilities
- Avoiding information concealment
- Adherence to quality standards.

Professional Responsibility:

- Awareness of decision consequences
- Preventing irregularities
- Responding to threats and misconduct.

The Essence of Professional Ethics

Respect and Collaboration:

- Decent working conditions and fair pay
- Honesty with partners and local communities
- Considering the impact of projects on the surroundings.

Respect for the Environment:

- Sustainable development and eco-technologies
- Reducing waste and resource usage
- Thinking about long-term consequences.

Continuous Professional Development:

- Knowledge and understanding of regulations
- Updating knowledge and sharing experience
- Humility and willingness to Learn.

Unethical Behaviors in the Construction Industry

Corruption and Unfair Competition:

- Bribes, rigged tenders
- Abuses in contract awarding
- Distortion of free market principles.

Illegal Employment:

- Lack of insurance and social security
- Hiring without contracts and foreign workers
- Loss of employee rights.

Technical Violations:

- Inferior quality of materials and workmanship
- Cost-cutting at the expense of safety
- Risk of construction disasters.

Unethical Behaviors in the Construction Industry

Collusion and Fraud:

- Agreements restricting competition
- Falsifying documentation and hiding costs
- Deceiving investors.

Lack of Transparency and Law Violations:

- Hiding real costs and issues
- Unauthorized construction, environmental damage
- Ignoring environmental and building standards.

Conclusions

- Professional ethics represent a fundamental pillar of responsible and competent practice within the construction industry. Core elements include integrity, transparency, prioritization of safety in construction activities, environmental responsibility, and fostering respectful and effective information exchange among all stakeholders involved in the investment process across all phases of project delivery.
- Ethical leadership and soft skills competence, especially among those in managerial positions, are pivotal determinants of project excellence, social legitimacy, organizational reputation, and the enduring success of construction enterprises within a highly competitive sector.

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ERASMUS+ KA220-COOPERATION PARTNERSHIPS IN VET
DISCOVER THE KNOW-HOW OF CONSTRUCTION PROFESSIONALS
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Financial Management In The Construction Industry

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Why Construction Finance is Unique?

- Capital Intensity: Requires massive upfront investment before revenue begins.
- Project Duration: Long-term cycles increase exposure to market volatility.
- High Risk: Subject to weather, regulatory changes, and material price hikes.
- Asset Specificity: Capital is locked into a physical location and structure.

The Financial Lifecycle of a Project

- Pre-Development: Design, feasibility, and land acquisition costs.
- Construction Phase: High cash outflow for labor, materials, and equipment.
- Operational/Sales Phase: Debt retirement and profit realization through sales or leasing.
- Exit Strategy: Refinancing or full project handover.

Key Financial Indicators I: Net Present Value (NPV)

Definition: The value of all future cash flows (positive and negative) over the entire life of an investment discounted to the present.

Rule: Accept the project if NPV > 0.

Key Financial Indicators II: IRR & Payback Period

- Internal Rate of Return (IRR): The discount rate that makes the NPV of all cash flows equal to zero.
- Payback Period: The time required to recover the initial investment from net cash inflows.
- Profitability Index (PI): Ratio of payoff to investment.

Capital Structure: Equity vs. Debt

- Equity: Internal funds, partner contributions (Low risk, high cost of capital).
- Debt: Commercial loans, bonds (Fixed repayment, interest tax shields).
- Optimal Mix: Finding the leverage that minimizes the Weighted Average Cost of Capital (WACC).

Global Trends: Sustainable Finance

- Green Bonds: Specifically for eco-friendly construction.
- ESG Criteria: Environmental, Social, and Governance ratings influencing loan eligibility.
- Impact Investing: Financing projects with social or environmental benefits.

Macroeconomics in Türkiye

- Inflation Impact: Rapidly increasing "Hard Costs" (Concrete, Steel).
- Currency Volatility: Sensitivity of imported material prices to USD/TRY and EUR/TRY.
- Interest Rates: Effect on mortgage availability and developer borrowing costs.

Legal & Regulatory Framework (Türkiye)

- Turkish Commercial Code: Governing corporate financial responsibility.
- Consumer Protection Law (No. 6502): Strict regulations on pre-sales.
- Building Inspection Fees: Compulsory financial costs in the project budget.

Traditional Banking Sources

- Construction Loans: Tranche-based disbursements based on site progress.
- Letters of Guarantee: Essential for bidding and contract security.
- Bridge Loans: Short-term financing to cover immediate cash needs.

Real Estate Investment Trusts (GYO)

- Public Listing: Raising capital from the stock market.
- Tax Transparency: Exemption from corporate tax in Türkiye.
- Liquidity: Turning illiquid real estate into tradable shares.

Real Estate Investment Funds (REIF / GYF)

- Asset Pooling: Institutional and individual investors pooling capital.
- Professional Management: Portfolio managed by licensed asset managers.
- Exit Strategy: Capital gains and rental income distribution.

The Land-Share

- Definition: Contractor builds on the owner's land in exchange for a share of the units.
- Financial Benefit: Zero initial cost for land acquisition.
- Risk: Shared ownership and potential legal disputes.

Pre-Sales as Finance

- Customer as Financier: Using buyer installments to fund the skeleton and finishing.
- Discount Strategy: Lower prices at the start to ensure rapid cash flow.
- Legal Protections: Building completion insurance or bank guarantees required.

The Barter System

- Supply Chain Financing: Paying material suppliers (e.g., ceramics, elevators) with apartments.
- Liquidity Relief: Conserving cash for wages and taxes while moving inventory.
- Common Usage: High in mid-sized Turkish residential projects

Revenue Sharing

- Mechanism: Contractor and landowner share the total cash revenue from sales.
- Preferred By: Public entities and large private landowners.
- Alignment: Aligns interests of both parties toward the highest possible sale price

Case Study: 5-Story Residential Project

- Location: Zonguldak (Standard Urban Plot).
- Configuration: 10 Residential Units (2 per floor).
- Floor Area: 20m2 per unit.
- Total Construction Area: Approx. 1500 m2 (including common areas).

5-Story Project: Cost Breakdown

- Hard Costs (65%): Excavation, concrete, steel, labor, finishing.
- Soft Costs (15%): Architecture, engineering, permits, insurance.
- Land Cost: 0 (Assuming Land-Share at 40% share).
- Marketing & Admin (10%): Commissions and site management.
- Contingency (10%): Buffer for inflation and unforeseen costs.

Financing Mix for the Case Study

- 20% Equity: Initial mobilization and foundation.
- 50% Pre-sales: Funding the structure and finishing stages.
- 20% Barter: Paying subcontractors for specialized work.
- 10% Credit: Short-term bank loan for final landscape and handover.

Cash Flow Timeline (5-Story Project)

- Months 1-3: High outflow (Permits, Excavation, Foundation).
- Months 4-10: Steady outflow (Skeleton and Masonry).
- Months 8-15: Inflow begins (Sales installments).
- Month 18: Project completion and final debt settlement.

Urban Transformation Benefits

- Subsidized Interest: State-supported low rates for rebuilding risky structures.
- Tax Exemptions: No title deed fees, notary fees, or municipal fees.
- VAT Advantage: 1% KDV (VAT) for residential units in specific transformational areas.

Financial Risk Management

- Hedging: Fixing material prices through advance payments.
- Sensitivity Analysis: Calculating the "Stress Point" if prices increase by 20%.
- Insurance: "All-Risk" insurance and "Building Completion Insurance."

Future Trends: BIM 5D & Digital Finance

- BIM 5D: Real-time synchronization of 3D design, schedule (4D), and cost (5D).
- Blockchain: Smart contracts for automated subcontractor payments.
- AI Analytics: Predictive modeling for future material price trends.

CONCLUSION & STRATEGIC TAKEAWAYS

- Financial Engineering as a Core Competency: Construction management is as much about managing cash flows and capital structures as it is about managing site operations.
- The "Turkish Model" Resilience: Local financing Land-Share, Pre-Sale, and Barter, provide vital liquidity and risk-sharing mechanisms that sustain the mid-sized residential sector.
- Synchronization is Key: Success in a 5-story residential project depends on the precise alignment of construction progress with sales installments to avoid liquidity gaps.
- Digital Transformation: The shift toward BIM 5D and AI-driven cost estimation is essential for navigating market volatility and ensuring financial transparency.
- Final Synthesis: Financial health is the primary "load-bearing" element of a project; without a solid fiscal foundation, even the most advanced structural designs cannot be realized.

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Labor Law & OHS In The Construction Industry

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Legal Foundation (Law No. 4857 & 6331)

- Labor Law (No. 4857): Governs the relationship between workers and employers (wages, leave, contracts).
- OHS Law (No. 6331): Specifically focuses on preventing workplace accidents and occupational diseases.
- Hierarchy: Safety regulations on site take precedence to protect the most basic right: The Right to Life.

Employment Contracts in Construction

- Fixed-Term: Common for project-based work (e.g., "until the completion of the rough construction").
- Indefinite-Term: Standard ongoing employment.
- Written Requirement: Contracts for one year or more must be in writing.

Working Hours & The 45-Hour Rule

- Standard Week: Maximum 45 hours per week.
- Daily Limit: Cannot exceed 11 hours in a single day.
- Night Work: In construction, night shifts are limited to 7.5 hours for safety reasons.

Overtime

- Definition: Any work exceeding 45 hours per week.
- Compensation: Hourly rate increased by 50% (Hourly x 1.5).
- Annual Limit: Maximum 270 hours of overtime per year.
- Consent: Workers must provide written consent for overtime at the start of each year.

Mandatory Rest Periods

- Daily Rest: 15 mins (up to 4 hours), 30 mins (up to 7.5 hours), 60 mins (over 7.5 hours).
- Weekly Rest: At least 24 consecutive hours of rest every week (usually Sunday).
- Inter-shift Rest: At least 11 hours of rest between two working days.

Wage Protection & Deductions

- Timely Payment: Wages must be paid into the bank account by the 20th of the month.
- Fines: Employers can only deduct wages for disciplinary reasons if stated in the contract (max 2 days per month).
- Minimum Wage: It is illegal to pay below the government-mandated floor.

Annual Paid Leave

- 1–5 years seniority: 14 working days.
- 5–15 years seniority: 20 working days.
- 15+ years seniority: 26 working days.

Occupational Health & Safety (OHS) Fundamentals

- Hazard Class: Construction is categorized as "Very Hazardous".
- The Goal: Proactive prevention rather than reactive compensation.
- Risk Assessment: Must be updated every 2 years or after any major change/accident.

Employer's Core Obligations

- Provide all necessary Personal Protective Equipment (PPE) free of charge.
- Conduct mandatory OHS training (16 hours for very hazardous class).
- Maintain first aid, fire fighting, and evacuation plans.
- Ensure regular health surveillance of all workers.

Employer's Core Obligations

- Strictly use the provided PPE (Helmets, harnesses, boots).
- Follow safety instructions and training protocols.
- Immediately report "Near Miss" incidents.
- Do not endanger themselves or colleagues through negligence.

The Right to Refrain from Work

- Legal Basis: Article 13 of Law No. 6331.
- Condition: If there is a "serious and imminent danger" that cannot be avoided.
- Process: Notify the OHS committee/employer. The worker stays in a safe area while receiving full pay until the danger is removed.

Subcontractor Relations

- Joint Liability: The main contractor is jointly responsible for the subcontractor’s workers' wages, SGK, and OHS.
- Collusion: Subcontractors cannot be used for the "core business" simply to lower costs; they must provide specialized expertise.

Occupational Accidents

- Definition: Any incident occurring at the workplace or during work-related travel that causes physical or mental harm.
- Reporting: Must be reported to SGK within 3 business days.
- Immediate Action: First aid, scene preservation, and investigation.

Occupational Diseases

- Common in Construction: Silicosis (dust), hearing loss (noise), musculoskeletal disorders (heavy lifting).
- Prevention: Dust suppression, noise barriers, and ergonomic training.

Termination with Just Cause

- Article 24 (Worker's Right): Health risks, immoral behavior by the employer, or non-payment of wages.
- Article 25 (Employer's Right): Gross negligence (e.g., refusing to wear a harness), absenteeism, or theft.

Severance Pay

- Eligibility: Minimum 1 year of service.
- Calculation: One month's gross salary for every year worked.
- Condition: Not applicable if the worker resigns (except for military service, retirement, or "just cause") or is fired for gross misconduct

Administrative & Criminal Liabilities

- Fines: Heavy administrative fines for missing safety equipment or training.
- Criminal Case: In the event of death or injury, the Employer, Project Manager, and OHS Specialist may face imprisonment for negligence.

Training & Certification

- Vocational Training: Workers in "Very Hazardous" jobs must have a professional certificate.
- OHS Training Frequency: Must be repeated every year for the "Very Hazardous" class.

Health Surveillance

- Pre-employment: "Fit for work" report is mandatory.
- Periodic: Every year for construction workers.
- Specifics: Audiometry (hearing), X-rays (lungs), and blood tests for chemical exposure.

Women and Youth in Construction

- Prohibition: Children under 18 cannot be employed in heavy/dangerous construction work.
- Female Workers: Specific restrictions on underground/underwater work and night shifts during pregnancy.

Dispute Resolution (Mediation)

- Mandatory Mediation: Before filing a lawsuit for wages or severance, parties must meet with a mediator.
- Timeline: Usually resolved within 3-4 weeks, avoiding years of court litigation.

Conclusion: Strategic Takeaways

- Safety is a Contract: Knowing the law protects your life and your livelihood.
- Documentation is Key: If it isn't written down (training, PPE delivery, inspections), it didn't happen.
- Final Word: A safe site is a productive site. Rights and safety are non-negotiable.

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NSPE Code of Ethics for Engineers

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Eskişehir Technical University

Co-funded by the European Union

ESKİŞEHİR TEKNİK ÜNİVERSİTESİ
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What is Ethics and Morality?

Ethos (Greek) and Mores (Latin) are terms having to do with "custom," "habit," and "behavior.

The word 'ethics' is commonly used interchangeably with 'morality', and sometimes is used more narrowly to mean the moral principles of a particular tradition, group, or individual.

What is Morality?

morality can be defined as:

* a system of rules for guiding human conduct, and principles for evaluating those rules.

What is Ethics?

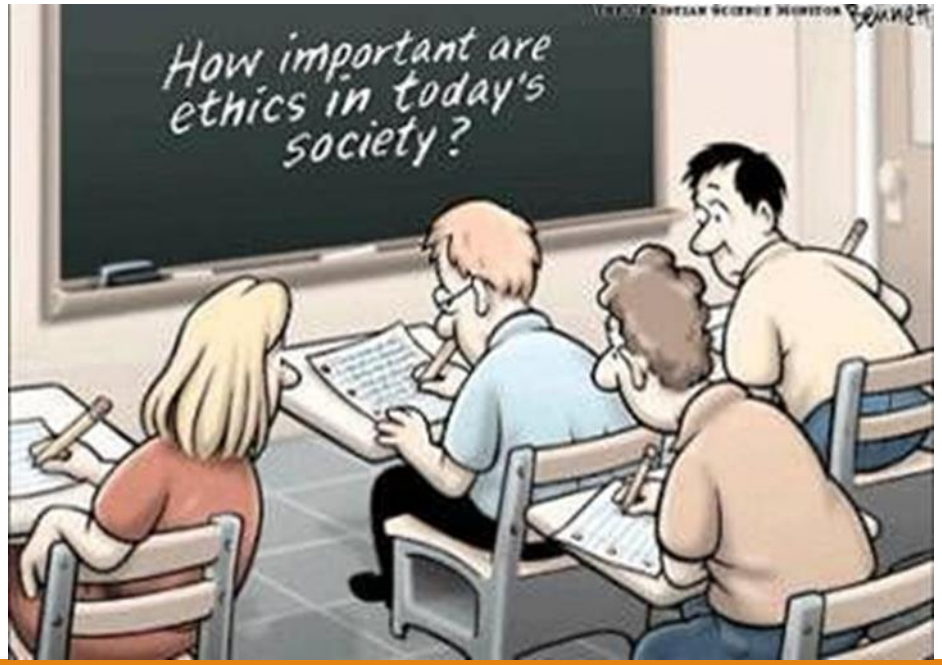
*rules and ideas for human behavior. They tell us what we ought to do.
*a code or system of rules defining moral behavior for a particular society.
*the study of how the choices are made, i.e. "ethics is the study of morality"
*the philosophy of morals or the standard of character set by any nation or race

Professional Ethics

The application of principles and standards accepted by professionals in the workplace.

Engineering Ethics

The study of the moral issues and decisions confronting individuals and organizations engaged in engineering.



No matter how competent or how successful you are as an engineer, your professional life is over, once you get involved in an ethical scandal

As professions become more specialised, ethical issues also become more specialized

Professional societies have increased efforts to establish ethical codes to guide members

Code of Ethics

It is used in the sense of ethical rules or principles.

Most technical societies have written codes of ethics.

As professionals, engineers have a code of ethics.

Engineering Code of Ethics

*Guidelines and principles for evaluation of ethical conflicts

*Not laws but often basis for laws

*Developed for most engineering disciplines

*Formally accepted by professional engineers

Engineering Code of Ethics

*Codes of ethics are not a law

*Ethical behavior is not always protected by law

*Many companies realize that ethical behavior is essential for their long term prosperit

Professional Societies and Codes of Ethics

*Provide a common agreed-upon standard for professional contact

*Do not provide new ethical principles but incorporate a lot of what is found in common morality

*Various Engineering Societies have their own code of ethics

Engineering Societies and Codes of Ethics

*Subject to interpretation by different individuals arriving at different conclusions for the same ethical dilemma

*Very useful for students when applied to case studies where the students can determine what was/should have been the appropriate course of action

*Are subject to revision periodically, reflecting new attitudes in the human condition

Codes of Ethics Commonly Hold

*Engineers and technologists have a duty to hold the health and safety of the public as a primary concern. Usually the first cannon of any code.

*Other duties are summarized in order of importance with most important first e.g. Safety is more important than conflict of interest.

Limitations of Codes of Ethics

1. Codes are restricted to general and vague wording. They cannot be straightaway applied to all situations. It is impossible to foresee the full range of moral problems that can arise in a complex profession like engg.

2. It is easy for different clauses of codes to come into conflict with each other. Usually codes provide no guidance as to which clause should have priority in those cases, creating moral dilemmas.

3. They cannot serve as the final moral authority for professional conduct.

4. The current codes are by no means perfect but are definitely steps in the right direction.

Code of Ethics for Engineers

*National Society of Professional Engineers (NSPE) Codes

*American Society of Civil Engineers (ASCE) Codes

*Japan Society of Civil Engineers

*TMMOB (Türk Mühendis ve Mimar Odaları Birliği) Mesleki Davranış İlkeleri

NSPE Code of Ethics for Engineers

National Society of Professional Engineers®

Code of Ethics for Engineers

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.
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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.
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2. Engineers shall at all times strive to serve the public interest.
   a. Engineers shall seek opportunities 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 shall endeavor to extend public knowledge and appreciation of engineering and its achievements.
   d. Engineers shall strive to adhere to the principles of sustainable development[1] in order to protect the environment for future generations.
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.
   b. Engineers 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.
   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 seminars.

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.

As Revised January 2006

"By order of the United States District Court for the District of Columbia, former Section 11(c) of the NSPE Code of Ethics prohibiting competitive bidding, and all policy statements, opinions, rulings or other guidelines interpreting its scope, have been rescinded as unlawfully interfering with the legal right of engineers, protected under the antitrust laws, to provide price information to prospective clients; accordingly, nothing contained in the NSPE Code of Ethics, policy statements, opinions, rulings or other guidelines prohibits the submission of price quotations or competitive bids for engineering services at any time or in any amount."

Statement by NSPE Executive Committee

In order to correct misunderstandings which have been indicated in some instances since the issuance of the Supreme Court decision and the entry of the Final Judgment, it is noted that in its decision of April 25, 1978, the Supreme Court of the United States declared: "The Sherman Act does not require competitive bidding."

It is further noted that as made clear in the Supreme Court decision:

1. Engineers and firms may individually refuse to bid for engineering services.
2. Clients are not required to seek bids for engineering services.
3. Federal, state, and local laws governing procedures to procure engineering services are not affected, and remain in full force and effect.
4. State societies and local chapters are free to actively and aggressively seek legislation for professional selection and negotiation procedures by public agencies.
5. State registration board rules of professional conduct, including rules prohibiting competitive bidding for engineering services, are not affected and remain in full force and effect. State registration boards with authority to adopt rules of professional conduct may adopt rules governing procedures to obtain engineering services.
6. As noted by the Supreme Court, "nothing in the judgment prevents NSPE and its members from attempting to influence governmental action . . ."

Note: In regard to the question of application of the Code to corporations vis-a-vis real persons, business form or type should not negate nor influence conformance of individuals to the Code. The Code deals with professional services, which services must be performed by real persons. Real persons in turn establish and implement policies within business structures. The Code is clearly written to apply to the Engineer, and it is incumbent on members of NSPE to endeavor to live up to its provisions. This applies to all pertinent sections of the Code.

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NSPE Code of Ethics for Engineers
III. Professional Obligations

4. Engineers shall not disclose, without consent, confidential information concerning the business affairs or technical processes of any present or former employer 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.

NSPE Code of Ethics for Engineers
III. Professional Obligations

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.

NSPE Code of Ethics for Engineers
III. Professional Obligations

6. Engineers shall not attempt to obtain employment or advancement by untruthfully criticizing other engineers.

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.

NSPE Code of Ethics for Engineers
III. Professional Obligations

7. Engineers shall not attempt to injure or falsely the professional reputation of other engineers. Engineers who believe others are guilty of unethical 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.
b. Engineers 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.

NSPE Code of Ethics for Engineers
III. Professional Obligations

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.

NSPE Code of Ethics for Engineers
III. Professional Obligations

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.
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 seminars.

NSPE Code of Ethics for Engineers
Board of Ethical Review Cases

The NSPE has established the NSPE Board of Ethical Review to interpret its ethical rules. Engineers, government officials or members of the public who find themselves in a dilemma can apply to this board anonymously, describing the case they have encountered. Professional engineers, selected from different regions, serve as committee members. They examine and discuss the cases brought before them in light of the ethical rules. Following this process, the committee issues a written report explaining the case, indicating any ethical rule violations, answering questions related to the matter, and reaching a conclusion.

NSPE Code of Ethics for Engineers
Board of Ethical Review Cases

Ethics case reports written since 2000 are available on the NSPE website (https://www.nspe.org/career-growth/ethics/board-ethical-review-case) to serve as examples for the public and engineers.

Case reports can be used as examples in legal proceedings and for demonstration purposes in academic settings.

NSPE Code of Ethics for Engineers

Board of Ethical Review Cases

Case No. 24-5

https://www.nspe.org/career-growth/ethics/board-ethical-review-case

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Case No. 24-5

NSPE NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

BOARD of ETHICAL REVIEW

Sustainable Development and Resilient Infrastructure

Case No. 24-5

Facts

Engineer K, a licensed professional engineer, is hired by the City to design a new flood control system to protect a rapidly growing urban area that has experienced increasingly severe flooding. The City has policies in place to develop new infrastructure projects with resiliency due to climate change in mind. The project's goal is to create a resilient infrastructure that balances immediate protection needs with long-term sustainability.

During the initial design phase, Engineer K identifies two potential approaches, both of which could be successfully designed and implemented:

Traditional Approach: Build a concrete floodwall system to provide immediate protection at a relatively low cost. While effective in the short term, the floodwall system has a high carbon footprint, is prone to deterioration, and may require significant repairs or upgrades within 15 years. Further, the system does not provide for expandability should future flooding risk expand or increase and would require complete demolition and rebuilding if the capacity proved insufficient in the future.

Sustainable Approach: Develop a green infrastructure system incorporating wetland restoration and other biodynamic controls. This approach would mitigate flooding while enhancing local biodiversity and reducing carbon emissions. Further, the natural aspects of this approach could readily be expanded if additional capacity is necessary should future flooding risk expand or increase. However, the initial cost is significantly higher than the traditional approach and the system requires several years to fully mature before offering optimal protection.

As part of the project development process, the City directed Engineer K to hold stakeholder meetings to gather feedback on the project. During stakeholder meetings, some commentors expressed a preference for the Traditional Approach due to its lower upfront cost and faster implementation timeline. However, other community and environmental organizations advocated for the Sustainable Approach, citing its long-term environmental and social benefits. Engineer K personally believes the Sustainable Approach aligns better with both City policies and the engineer's professional obligation to promote sustainability and resilience, but recognizes competing priorities of cost, urgency, and long-term impact.

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While working on the report and gathering necessary information, Engineer K discovers that the Traditional Approach could disproportionately impact a nearby underserved community by diverting floodwaters to their neighborhood under low-probability but high-volume conditions — particularly if the design capacity of the Traditional Approach is breached. Engineer K presents all available information about both the Traditional Approach and the Sustainable Approach, including the risks and benefits of each approach to the City's leadership during a City Council meeting.

The City's leadership decides not to address the identified floodwater issue with the Traditional Approach, ultimately concluding that any action to mitigate the impact on this community would delay the project further and reinforcing the low probability of such conditions occurring. The City approves the Traditional Approach and Engineer K proceeds to work on its implementation.

Questions

1. Engineer K personally believes the Sustainable Approach is better. Should Engineer K have only presented information about the Sustainable Approach?
2. Does Engineer K have any ethical obligations after the City approves the Traditional Approach?

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Code of Ethics References:

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

I.4 Engineers shall act for each employer as a faithful agent or trustee.

II.3.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.

II.5.b Engineers shall not offer, give, solicit or receive, either directly or indirectly, any contribution to influence the award of a contract by a public authority, or which may reasonably be construed by the public as having the effect or intent of influencing the awarding of a contract

III.1.b Engineers shall advise their clients or employers when they believe a project will not be successful.

III.1.f Engineers shall treat all persons with dignity, respect, fairness, and without discrimination.

III.2.a Engineers 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.

III.2.d Engineers are encouraged to adhere to the principles of sustainable development.

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BER CASE REFERENCES:

BER Case 65-9; BER Case 73-9; BER Case 15-12; BER Case 21-7; BER Case 22-10

Discussion

The Board of Ethical Review (BER) begin this discussion by reviewing the Fundamental Canons of the NSPE Code of Ethics (Code). Engineer K is hired by the City with a specific task in mind—design a new flood control system to protect a rapidly growing urban area; the goal of the completed system will be to protect the public health, safety, and welfare. Engineer K, as a professional engineer, has an obligation to the City to act as a faithful agent or trustee. We will explore the distinction between an agent and trustee with a somewhat simplified description:

· If the City hires Engineer K and tells them what to do, then Engineer K is acting as the City's agent—Engineer K should do what the city instructs them to do.

· If the City hires Engineer K and gives them discretion in how to complete a task, Engineer K is acting as a trustee — the City trusts that Engineer K will do the job as if they were doing it themselves.

During the design phase, the City trusts Engineer K to develop a design. What should be included in the design is where the analysis of the Code is required. Certainly, the system should be functional; any non-functional design brings into play the obligation to advise a client or employer if a project will not be successful under Code section III.1.b. When reporting about their design, Engineer K shall be objective and truthful in their professional reports, statements, or testimony. Per Code section II.3.a, they "shall include all relevant and pertinent information in such reports . . . ." Under Code section III.1.f, professional engineers shall treat all persons with dignity, respect, fairness, and without discrimination, and under Code section III.2.d, they are encouraged to adhere to the principles of sustainable development.

The BER have referenced multiple Code citations, and there are others that could be added to the list. Generally, Engineer K should use all of their knowledge and ability to study the problem, develop solutions, and recommend to the City the option (or options) they believe are best. Engineer K has identified two options for the City to consider—the traditional approach and the sustainable approach. Each should be presented completely, and the advantages and disadvantages of each should be included.

The BER reviewed an analogous situation in BER Case 21-7, where an engineer was asked to prepare a report discussing replacement of a fossil-fueled electric generation facility with a system of solar panels. If a system of stand-alone solar panels is selected, the chance of power system unreliability may be increased. The discussion of this case noted the ethical objective of an informed policy and project decision making process; the engineer in BER Case 21-7 was obliged to include information about the potential for rolling blackouts if a reliable

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generation alternative was not selected. The additional cost to make the solar panel system more reliable by supplementing it with battery storage should be included in the engineer's report.

BER Case 22-10 also dealt with sustainability and the tradeoffs between traditional systems (in this case lawn irrigation) and sustainable options. BER Case 22-10's discussion noted that Engineer Intern Wasser (an important player in BER Case 22-10) "could be in a unique position to meaningfully serve the client – and his company. By introducing and offering sustainable alternatives . . . , Wasser . . . can harmonize [Code sections] I.4 and III.2.d." Engineers should take the opportunity to educate clients. In closing the discussion of BER Case 22-10, the BER concluded:

As was noted, engineers shall act for each employer or client as faithful agents or trustees, but are encouraged to adhere to the principles of sustainable development. It is not enough to simply look at the situation and conclude an engineer's obligation to the client/ employer takes precedence over the sustainable development principles. This case helps to illustrate that endeavoring to integrate all code of ethics provisions when developing a solution is critical. Suggesting sustainable options for an irrigation system as a means to resolving the ethical tension presented in this case is a path the BER endorses. Furthermore, suggesting sustainable options will inform the client; refusing to perform the task, or quitting, will not.

The BER next turns to how Engineer K should address disproportionate impact. BER Case 15-12 discusses the tradeoffs involved with routing a highway. Certainly, highway routing concerns and disparate impact have been discussed at depth in the media, and there are several additional BER cases that discuss highway routing (BER Cases 65-9 and 73-9). The take aways from these cases are there is not necessarily one correct answer, and that engineers should be creative when looking at solutions. In BER Case 15-12, the engineer was encouraged to think beyond the binary of tearing down the farmhouse or finding another highway route — could the farmhouse be relocated?

This type of creative thinking is incumbent on Engineer K and their team when considering the impact of floodwaters on the underserved community. For example, analysis of whether some combination of the traditional approach (with a quick solution to the flooding problems) be used with sustainable provisions in the underserved community to mitigate the risk if a portion of the traditional system does not work.

Ultimately, Engineer K will present the design alternatives to the City decision makers so they can make a choice. Once the decision is made, Engineer K should act as a faithful agent and follow the decision made by City officials. These officials serve at the will of the people and are ultimately accountable to the people for their decisions. Engineer K should respect that accountability and not be motivated by self-interest in a sustainable solution if the City decides against it. In fact, an effort to influence the award of a contract by a public authority would be a violation of Code section II.5.b.

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Conclusions:

1. Engineer K should present both approaches to the City if Engineer K believes both are viable solutions.
2. Because Engineer K has entered into a contract to design the new flood water control system, Engineer K has an ethical obligation to act as a faithful agent or trustee. Engineer K is ethically obligated to fulfill their contractual obligations to the City and continue to design the Traditional Approach as approved by the City.

NOTE: The NSPE Board of Ethical Review considers ethical cases involving either real or hypothetical matters submitted to it from NSPE members, other engineers, public officials, and members of the public. The BER reviews each case in the context of the NSPE Code of Ethics and earlier BER opinions. The facts contained in each case do not necessarily represent all of the pertinent facts submitted to or reviewed by the BER and shall not be considered a direct evaluation of any real matter that may have been submitted.

Each opinion is intended as guidance to individual practicing engineers, students, and the public. In regard to the question of application of the NSPE Code of Ethics to engineering organizations (e.g., corporations, partnerships, sole proprietorships, government agencies, and university engineering departments), the specific business form or type should not negate nor detract from the conformance of individuals to the Code. The NSPE Code deals with professional services, which must be performed by real persons. Real persons in turn establish and implement policies within business structures.

To submit fact patterns for potential BER consideration for a future BER case, please email ethics@nspe.org. NSPE does not commit that BER will provide an analysis of every fact pattern submitted to NSPE.

References

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