
Module 4D16 CONSTRUCTION MANAGEMENT - SOLUTIONS

Question 1

(a)

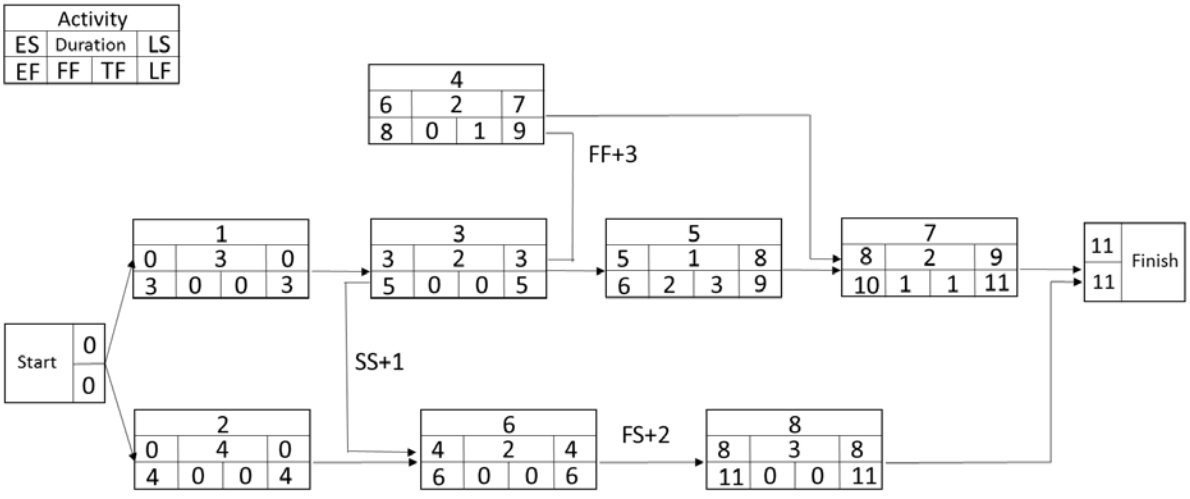
Free Float: The amount of time that an activity can be delayed before it impacts the start of any succeeding activity. It is computed as the smallest link lag value of all link lines that occur immediately after the activity.

Total Float: The amount of time that an activity can be delayed before it impacts the completion date of the project. The total float of any activity is most frequently determined as being the difference between the late finish and early finish (or late start and early start) of the activity. More generally, it can determined as the sum of the total float of the following activity and the associated link lag value. If more than one activity follows the smallest sum value is determined to be the total float.

Lag: The amount of time that exists between the early finish of an activity and the early start of a specified succeeding activity.

Critical Path: the sequence of schedule activities that have no float and determine the duration of the project. [20%]

(b)(i) & (b)(ii)



Critical paths: 1-3-6-8 & 2-6-8 [40%]

Question 1 (cont.)

(c)

Day	1	2	3	4	5	6	7	8	9	10	11
Cycle 0							4(2)	4(2)			
	1(3)	1(3)	1(3)	3(3)	3(3)	5(4)			7(3)	7(3)	
	2(2)	2(2)	2(2)	2(2)	6(2)	6(2)			8(2)	8(2)	8(2)
Resource	5	5	5	5	5	6	2	2	5	5	2
Cycle1							4(2)	4(2)			
	1(3)	1(3)	1(3)	3(3)	3(3)	5(4)				7(3)	7(3)
	2(2)	2(2)	2(2)	2(2)	6(2)	6(2)			8(2)	8(2)	8(2)
Resource	5	5	5	5	5	6	2	2	2	5	5
Cycle 2							4(2)	4(2)			
	1(3)	1(3)	1(3)	3(3)	3(3)		5(4)			7(3)	7(3)
	2(2)	2(2)	2(2)	2(2)	6(2)	6(2)			8(2)	8(2)	8(2)
Resource	5	5	5	5	5	2	6	2	2	5	5

Backward Pass Calculation

[Start of cycle 1]
Day 11
IF(7,1)=3*(5-2-(3*1))=0 Adopt this

[Start of cycle 2]
Day 9
IF(5,1)=4*(6-2-(4*1))=0 Adopt this
IF(5,2)=4*(2-2-(4*1))=-16

Forward Pass Calculation

If you calculate the forward pass for Activity 5 and 7 you will find again IF=0 which means that there is no improvement, but it does schedule the activity earlier so as to give greater flexibility to the overall network. Thus the overall network remains the same.

[40%]

Question 2

(a) Cash flow analysis consists of a detailed examination of the disbursement of funds and the receipt of revenues. There are two major reasons for conducting a cash-flow analysis. First, cash flow analysis reveals if surplus funds are available during a project or if a negative cash position will occur during construction. The second purpose is to help establish the appropriate markup to apply on a bid. [15%]

(b) For cash-flow analysis, the type of ownership does not substantially alter the result. Use of company-owned equipment that is managed through an internal "separate company" would affect the cash flow of individual projects exactly the same as if the equipment was rented from an outside company. In other words, it would most likely be a monthly cash withdrawal for the "lease" of the equipment. [15%]

(c) Delay causes higher overhead costs through longer work period and due to labour cost increases. During delays in a project, equipment will also be locked-in for a longer period. This means that the company has to pay more rent in the case where the company rents the equipment and thus the expenses will increase. In the case where equipment is owned, delays may cause problems to another project where the equipment was scheduled to be used; this will cause delays to the other project and thus more expenses for the company. [20%]

(d)

Activities	Cost		Duration (days)		Crash cost/Unit Time (£/day)	Maximum Crash Allowed (day)
	Crash	Normal	Crash	Normal		
A	£4000	£3600	3	5	200	2
B	£6400	£5500	7	10	300	3
C	£6900	£6300	7	8	600	1
D	£4900	£4700	3	5	100	2
E	£2400	£2050	8	10	175	2
F	£1400	£1200	6	7	200	1
Sum		**£23350**				

Question 2 (cont).

(d)(cont.)

Step	Paths	Duration	Activities Crashed	Project Duration after Crash	Crash Cost (£)	Cumulative Direct Cost (£)	Corresponding Indirect Cost (£)	Cumulative Total Cost (£)
0	A-C-D-F A-B-F A-E-F	25 22 22		25 22 22	0	23350	5000	28350
1	A-C-D-F A-B-F A-E-F	25 22 22	D by 2 days	23 22 22	200	23550	4600	28150
2	A-C-D-F A-B-F A-E-F	23 22 22	C by 1 day	22 22 22	600	24150	4400	28550
3	A-C-D-F A-B-F A-E-F	43 40 43	F by 1 day	21 21 21	200	24350	4200	28550
4	A-C-D-F A-B-F A-E-F	41 38 41	A by 2 dayS	19 19 19	400	24750	3800	28550

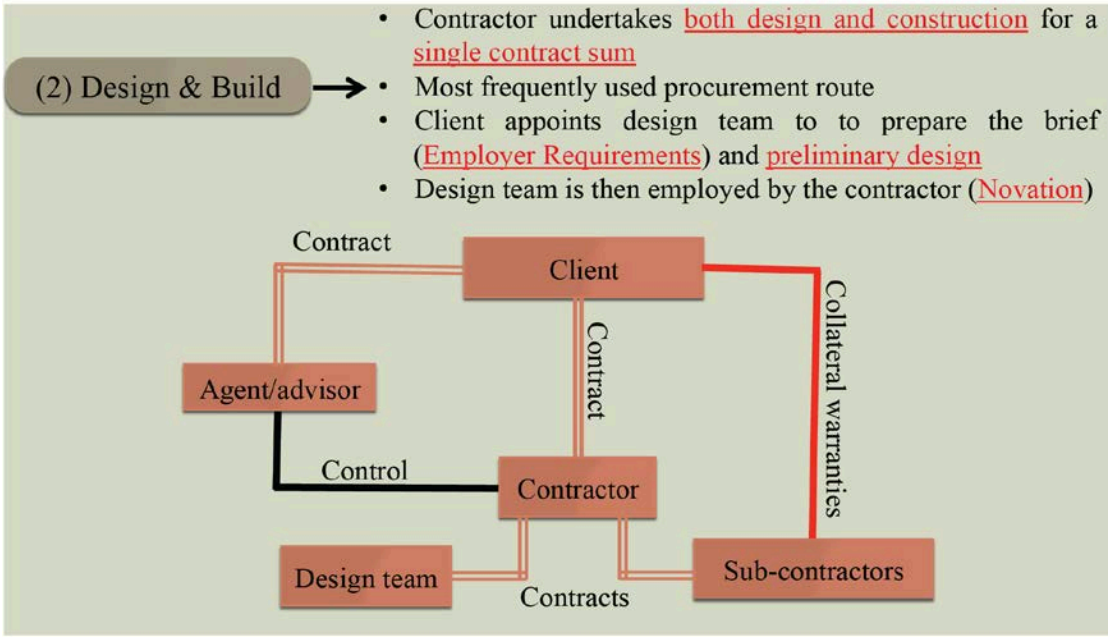
When duration is 23 days, the minimum overall cost is £28,150.

[50%]

Question 3

(a) The aim of a good procurement strategy is to achieve the optimum balance of risk, control and funding for a project.
The choice of a particular procurement strategy largely depends on a client's required balance of cost, quality and time risks. [15%]

(b)



[35%]

(c)

- Keep equipment in operation
- Prevent loss of skilled workers/managers
- Firm prestige (marketing)
    - Projects of national importance
    - Unusual, difficult projects
- Maintain relationship with an owner
    - Usually for a high profit margin

[15%]

Question 3 (cont.)

(d) - Mean value of V=1.06
- 1 known competitor and 2 unknown competitors
- Estimated cost: £2 million
- Corrected cost: £2,12 million
- The "average competitor" is used to simulate 2 unknown competitors
- Number of projects = 30

R	Comp A #	"average"
1.00	0	0
1.02	1	1
1.04	3	3
1.06	5	5
1.08	10	10
1.10	7	7
1.12	3	3
1.14	1	1

For all competitors:

b/c	P_A	P_{av}	P_{av}	P_{all}	Expected Profit (million)
1.00	1.00	1.00	1.00	1.00	0.00
1.02	0.97	0.97	0.97	0.90	0.04
1.04	**0.87**	**0.87**	**0.87**	**0.65**	**0.05**
1.06	0.70	0.70	0.70	0.34	0.04
1.08	0.37	0.37	0.37	0.05	0.01
1.10	0.13	0.13	0.13	0.00	0.00
1.12	0.03	0.03	0.03	0.00	0.00
1.14	0.00	0.00	0.00	0.00	0.00

Markup = corrected cost x (R-1) = £0.08 million

[35%]

Question 4

(a) There are moral reasons, financial reasons and legal reasons. The students are expected to talk about each one of these in some detail, based on the material their lecture notes. [20%]

(b) Health and safety is regulated by the Health and Safety at Work Act 1974. This is an Enabling Act, which allows the Secretary of State to make further laws (regulations) without the need to pass another Act of Parliament. The Health & Safety Executive, established in 2008, performs the function of regulation and enforcement of the Health and Safety at Work act. It serves improvement notices, prohibition notices and can also prosecute offenders. It oversees over 200 regulations and also the Approved Code of Practice (ACOP). [10%]

(c) Employers (1) must carry out risk assessments to eliminate or reduce risks. Employers with five or more employees need to record the significant findings of a risk assessment (2) Are required to make arrangements for implementing the health and safety measures identified as necessary by risk assessments (3) Are required to monitor and review those arrangements (4) Are required to appoint people with sufficient knowledge, skills, experience and training to help them to implement these arrangements (5) Are required to set up emergency procedures and provide information about them to employees [20%]

(d) Clients' duties include:

- Appoint a CDM co-ordinator
- Appoint a principal contractor
- Provide pre-construction information to CDM co-ordinator
- Make sure that the construction phase does not start unless there are suitable welfare facilities and a construction phase plan in place

Principal Contractors' duties include:

- Plan, manage and monitor construction phase
- Prepare, develop and implement a written plan and site rules before construction begins)
- Give sub-contractors relevant parts of the plan
- Make sure suitable welfare facilities are provided throughout construction
- Ensure all workers have site inductions and required training
- Secure the site

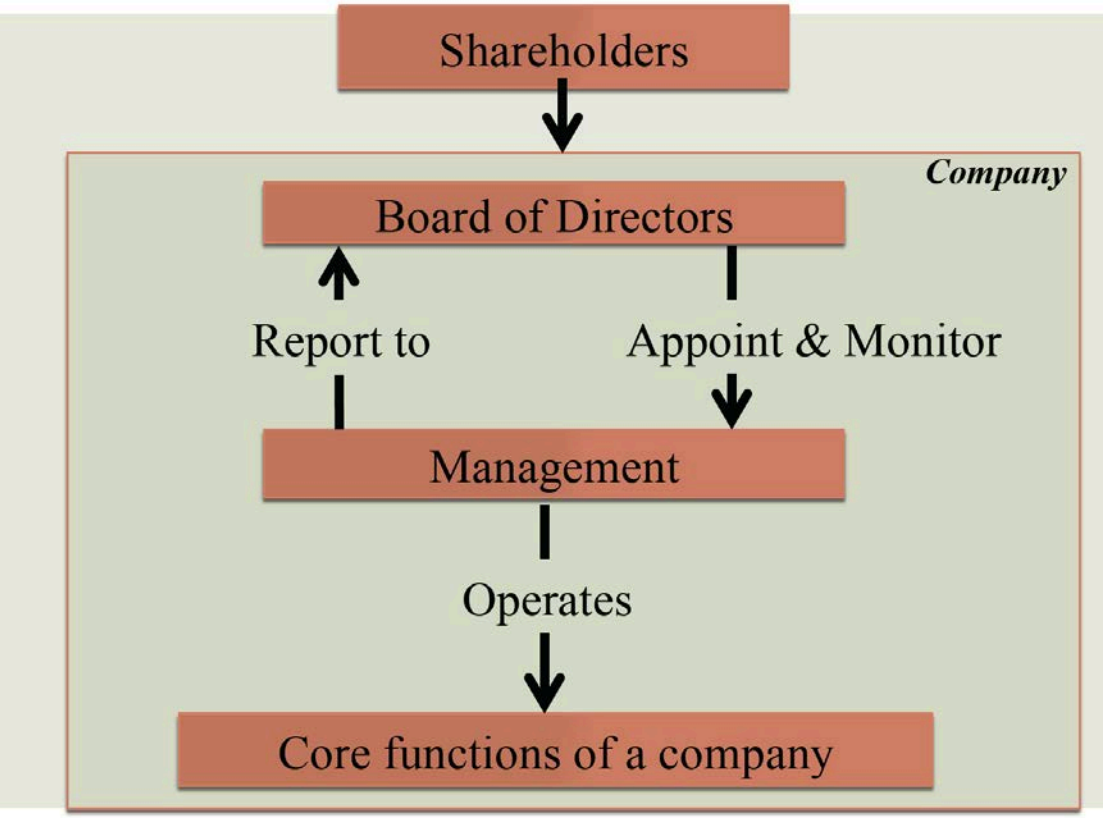
[30%]

(e) The MS describes the sequences of operations for safe working that will ensure health and safety during the performance of a task. They are not a requirement of the CDM Regulations but are identified by HSE as one way of satisfying the requirements of the regulations. The risk assessment is required under the construction phase health and safety plan. [20%]

Question 5

(a) The two parts are (1) Corporate Governance: these are the processes by which companies are controlled and directed and (2) Corporate Finance which concerns the money raising options of the incorporators.

In the UK, we follow the Anglo-American model of corporate governance which (1) has a strong emphasis on the interest of shareholders, (2) with a single-tiered Board of Directors that is normally dominated by non-executive directors elected by shareholders and (3) the non-executive directors are expected to outnumber the executive directors.



[30%]

Question 5 (cont.)

(b) He main business types are (1) Sole traders (2) Limited companies (private and public) and (3) Business Partnerships (limited partnerships and limited liability partnerships)

The students are then expected to talk about the tax implications for each of the business types above. This is discussed in detail in the lectures. [30%]

(c) Statutory accounts must include:

(1) A balance sheet - value of everything the company owns and is owed on the last day of the financial year

(2) A profit and loss account - the company's sales, running costs and the profit or loss it has made over the financial year

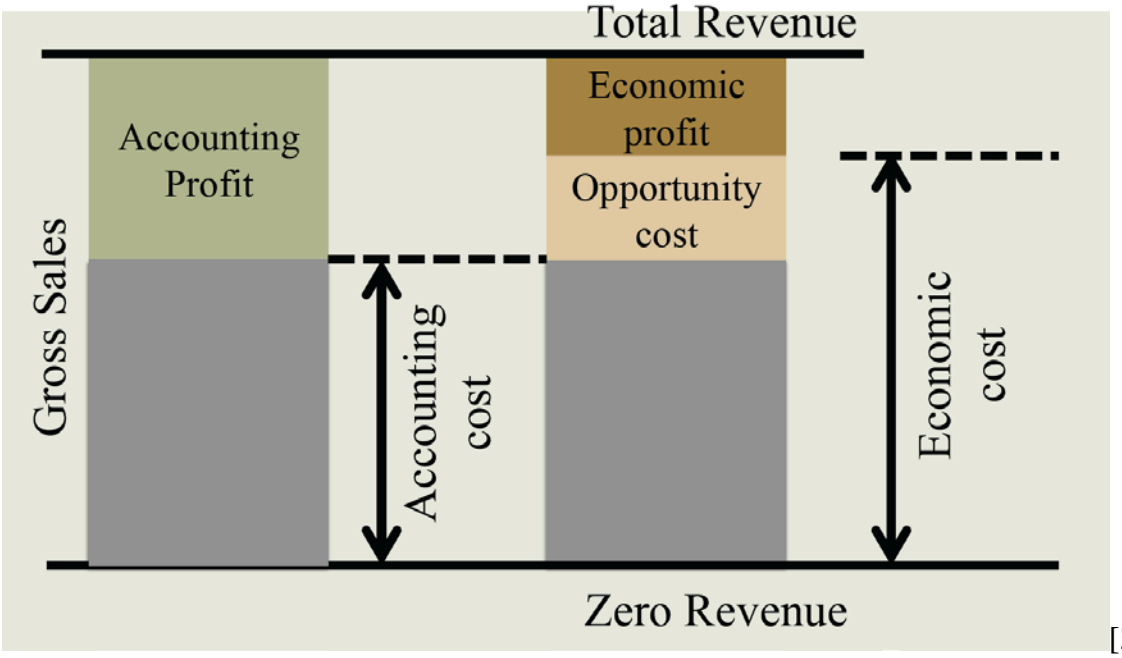
(3) An auditor's report - this depends on the size of your company

(4) A director must sign the balance sheet and their name must be printed on it

[20%]

(d) Construction Economics is concerned with the allocation of scare resources. At its simplest level, economics is the science of choice.

The economic cost is made up of the accounting cost and the opportunity cost. The students are then expected to define what the opportunity cost is.



[20%]

4D16 Assessor's comments

Question 1

This was a popular question. It was reasonably well answered by most candidates. Part (a) asked them to provide 4 short answers and help set out their thinking process for part (b); the definition of free float and lag was answered incorrectly by only a few of the students. Part (b) asked them to lay out a network diagram and calculate its parameters. About half the students made mistakes on this; some due to a lack of understanding of free float, and some due to a lack of understanding of the relationships between activities. Part (c) asked students to level resources. A few did not remember how to do this at all, and many others only partially remembered the process. A few got it 100% right. A few run out of time.

Question 2

Question 2 had 4 parts. It was not a popular question, and when answered, it was not answered well. The first 3 parts were theory questions that expected the students to show an understanding of cash flow analysis, the reasons it is conducted, and the factors that affect it. Some of the answers showed superficial understanding of the subject. The 4th part asked candidates to perform a time-cost trade-off analysis. Some of the answers indicated a lack of understanding, while other mistakes involved simple oversights or numerical mistakes.

Question 3

This was a popular question with 70% of the students attempting it. Part (a) asked the students to explain the aims of a good procurement strategy and hence explain how clients could choose a particular procurement route over others. This was answered well by most of the students. Part (b) tested the students' knowledge of the main features of the Design & Build procurement route and the advantages (and disadvantages) for the clients and the contractors. The students were expected to draw a sketch to explain how the different parties engage in this form of procurement. This part of the question was generally answered well with the exception of the advantages and disadvantages part where a large number of students failed to mention one or two of the main points. Parts (c) and (d) were answered reasonably well by most candidates. Part (c) asked for 4 reasons for bidding on a project other than cost, and most candidates were able to answer it well. Part (d) asked them to calculate the best bid price for a project using probability theory. Again, most students were able to do this correctly. The mistakes were mostly due to numerical errors.

Question 4

This question was very popular but had the lowest average mark by quite some margin. The separate parts of the question related to different aspects of health and safety legislation and implementation in the UK. As these questions were entirely based on material presented in the lecture notes, the solutions were expected to be precise and include all key points highlighted in the lectures. The relatively low marks obtained by many resulted from a propensity for many students to waffle on about generalities relating to health and safety, often repeating similar points in the same answer, rather than focusing on the specific and precise definitions and requirements specified in the notes.

Question 5

This question was made up of four parts. Part (a) tested the students' knowledge about the two parts that UK company law is concerned with; it then asked the students to describe the governance model companies follow in the UK using a sketch. The majority of the students got this correct with only a

couple failing to draw the sketch properly. Part (b) asked the students to name the main business types recognised in the UK and describe the tax implications for each. The majority of the students could name the main business types but a significant number failed to describe the tax implications associates with each. Part (c) asked the students to identify the statutory requirements for companies in the UK. This part of the question was well answered with most of the students getting full marks. Part (d) asked students to define the term Construction Economics and hence explain the term economic cost and hence how it differs from accounting cost. Most of the students answered this part well.