CV4011 Project Planning and Management
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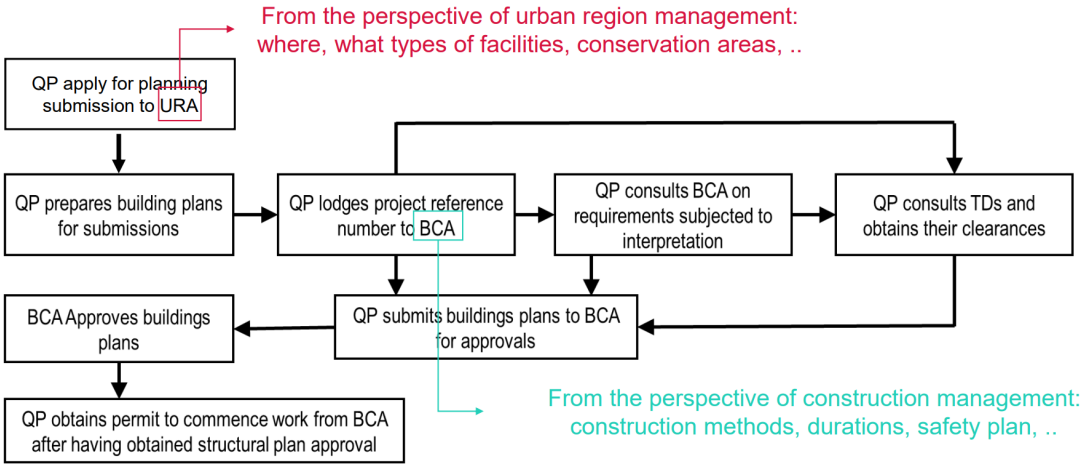
CV4011 AY 2023-2024 Semester 1 Finals Questions

1.

a) *List the main approvals required before physical construction works can commence, and their respective issuance parties, Briefly elaborate on the key focus and purpose of these approvals.*

Building Control Act - Building Plan Submission Process



TDs: Technical departments such as NEA, PUB, LTA, and FSSD
Name of the approval/permit: Written Permission
Authority for issuance of the approval/permit: BCA for structural plan approvals, URA for land use planning approval

b) *Er. ZYX is a Professional Engineer and a Qualified Person for an ongoing construction project. He just came back from a two-week overseas vacation. This vacation is approved by Senior Management and for the works during his vacation period, Er. ZYX had approached his colleague, Er. PQR to assist to oversee Er. ZYX's works. And, Er. PQR agreed to assist.*

However, Er. PQR is very busy and did not pay too much attention to Er. ZYX's project, and some works were not done in accordance to the regulations and resulted in some additional works. Er. ZYX is only aware of the incident after he came back from vacation.

Discuss the responsibilities, obligations, and duties of the Er. ZYX and Er. PQR with regards to Code of Professional Conduct and Ethics in the case above.

In Singapore, professional engineers are bound by a Code of Professional Conduct and Ethics that outlines their responsibilities, obligations, and duties.

Table A1 - Respective responsibilities, obligations, and duties of Er. ZYX and Er. PQR and the relevant clauses specific to the Singapore's Code of Professional Conduct and Ethics

Engineer	Er. ZYX	Er. PQR
Responsibilities, obligations, and duties	**Oversight and Supervision**: As a Professional Engineer and the Qualified Person for the construction project, Er. ZYX has a duty to oversee and supervise the project. This responsibility is not relinquished even during approved vacations. Despite being on vacation, Er. ZYX is accountable for the project's progress and compliance. **Delegation and Communication**: While it is acceptable for Er. ZYX to delegate responsibilities during his absence, he remains responsible for ensuring proper communication with the colleague taking over. Clear instructions, guidelines, and expectations should have been provided to Er. PQR to ensure that the works are carried out in accordance with regulations. **Mitigation and Oversight**: Er. ZYX should have implemented measures to mitigate risks during his absence. Regular check-ins, progress updates, and a mechanism for Er. ZYX to be alerted to any issues should have been established.	**Professional Competence**: Er. PQR has a professional obligation to exercise due care and diligence in carrying out the delegated responsibilities. Even if Er. PQR was busy, Er. PQR should have ensured that the necessary attention was given to the project, and proper protocols were followed. **Adherence to Regulations**: Er. PQR must adhere to the relevant regulations and standards in executing the tasks. Any deviation should be promptly addressed or escalated to Er. ZYX. **Communication**: Er. PQR has a duty to communicate any challenges, deviations, or issues encountered during the oversight of Er. ZYX's works. Timely communication would allow Er. ZYX to address concerns remotely or make arrangements for the necessary corrections.
Code of Professional Conduct and Ethics (Singapore)	a. Engineers in Singapore are expected to ***uphold the highest standards of integrity, competence, and professionalism***. b. They are required to ***comply with relevant laws and regulations***, and to ***safeguard public health, safety, and welfare***. c. Engineers must ***maintain their professional knowledge and skills*** and ensure that those under their supervision are also ***competent***. d. ***Clear communication and documentation of engineering decisions*** and actions are essential.	

In summary, both Er. ZYX and Er. PQR shares the responsibility for the project's outcomes. Er. ZYX should have ensured proper delegation and oversight mechanisms, while Er. PQR should have fulfilled his duties diligently and communicated effectively. The incident highlights the importance of clear communication, competence, and adherence to professional standards in engineering practices.

c) *Your company, a Main Contractor firm, is currently tendering a construction project of 2 blocks of 36-storey residential buildings. You are assigned by your boss to compile the tender documents for submission and give him a brief after the compilation.*

   Discuss and elaborate on the information that you will be looking for, where you plan to get it, and the different parties or your colleague that you would like to speak to with regards to the above task. Explain your reason for doing so.

Compiling tender documents for a construction project, especially one involving 2 blocks of 36-storey residential buildings, is a crucial task that requires comprehensive information gathering. In the context of Singapore, where regulations, standards, and procedures may be unique, it's essential to ensure that the tender documents are accurate, complete, and compliant. The breakdown of the relevant information required as follows:

Project Specifications and Requirements:
- Source: Review the project brief provided by the client or the relevant government agency.
- Reason: Understanding the client's requirements, specifications, and expectations is fundamental to tailoring the tender documents accordingly.

Regulatory Compliance and Building Codes:
- Source: Refer to the Building and Construction Authority (BCA) guidelines, codes of practice, and relevant regulations.
- Reason: Ensuring compliance with local building codes is essential for obtaining necessary approvals and avoiding legal issues during and after construction.

Site Information and Conditions:
- Source: Conduct site visits, speak to surveyors, and obtain topographical surveys and geotechnical reports.
- Reason: Accurate information about the site conditions is crucial for planning construction activities, estimating costs, and managing potential risks.

Cost Estimation and Budgeting:
- Source: Collaborate with quantity surveyors and cost estimators to determine the project's overall cost.

- Reason: Accurate cost estimation is essential for preparing a competitive tender and ensuring that the project remains financially viable.

Construction Methodology and Timeline:
- Source: Consult with the project managers and construction engineers to develop an appropriate construction methodology and timeline.
- Reason: Having a clear construction plan is crucial for demonstrating competence and reliability in the tender documents.

Subcontractor and Supplier Information:
- Source: Contact potential subcontractors and suppliers to gather quotes and availability.
- Reason: Understanding the market rates and availability of subcontractors and suppliers is vital for accurately pricing the project.

Legal and Contractual Considerations:
- Source: Consult with legal advisors to ensure that the tender documents include all necessary contractual clauses and meet legal standards.
- Reason: Mitigating legal risks and ensuring a fair and transparent contractual framework is critical for the success of the project.

Health and Safety Plans:
- Source: Work with health and safety professionals to develop comprehensive health and safety plans.
- Reason: Safety is a top priority in construction projects, and having robust health and safety plans is essential for compliance and risk management.

Environmental Impact Assessment:
- Source: Engage environmental consultants to conduct an environmental impact assessment if required.
- Reason: Ensuring compliance with environmental regulations and addressing potential environmental impacts is crucial for project approval.

Stakeholder Engagement:
- Source: Communicate with local authorities, community representatives, and other relevant stakeholders.
- Reason: Building positive relationships with stakeholders can contribute to the success of the project and help address any concerns or issues proactively.

After compiling the tender documents, I would provide a brief to my boss, highlighting key aspects such as compliance with regulations, accurate cost estimation, comprehensive project planning, and risk mitigation strategies. This briefing would serve to ensure that the tender submission aligns with the company's capabilities and meets the client's expectations.

2. An engineer intends to apply the line of balance (LOB) method to schedule the construction of 88 identical MRT piers in a project. The project owner has stipulated a target build rate of 6 piers per week. In scheduling the work, the project site will be allowed to work 8 hours per day and 5 days per week with a minimum buffer of 3 days between operations. The man-hours required for one pier (M) and the optimum team size (Q) for the construction operations are given in Table Q2 The construction sequence is in the order of operation A followed by B then Operation C.

Table Q2

Operation	Man-hours required (M)	Optimum team size (Q)
A	410	5
B	700	9
C	430	7

Note:

i. Use up to the nearest two decimal points in your calculation.
ii. For the final answer in project duration in days, round up to the nearest integer.

a. Calculate values required to construct a line of balance schedule for the above project. Indicate the overall project duration.

2a)

Target number of units, N	88	units
Target Output Rate, R	6	units / week
Minimum Buffer, B	3	days
Number of Workdays per week, d	5	days
Number of Work Hours per day, h	8	hours

A -> B -> C

Definition	Manhours required	Optimum Men per Gang	Theoretical Gang Size at chosen output	Actual Gang Size	Actual Output Rate	Activity Duration for 1 unit	Time start on first unit to start of last unit
Activity	**M**	**Q**	**G = RM/hd**	**g**	**U = gR/G**	**T = M/Qh**	**S = (N-1)d/U**
A	410	5	61.50	60	5.85	10.25	74.31
B	700	9	105.00	99	5.66	9.72	76.89
B' [For part b(i)]	700	9	105.00	90	5.14	9.72	84.58
C	430	7	64.50	63	5.86	7.68	74.23

Unit	**A_S**	**A_F**	**B_S**	**B_F**	**C_S**	**C_F**
1	0.00	10.25	13.25	22.97	28.64	36.32
88	74.31	84.56	90.14	99.87	102.87	110.54

Buffer at Start	13.25	-	25.97	-
End	90.14	-	100.20	-
Buffer at End	87.56	-	102.87	-
Start	10.67	-	28.64	-

Project Duration = 111 days

b. If the sub-contractor of operation B can only supply 90 workers to the project, and that operation A and C are carried out based on manpower calculated in part (a).
i. Under the above circumstances, what would be the new project schedule?

bi)

Unit	**A_S**	**A_F**	**B_S**	**B_F**	**C_S**	**C_F**
1	0.00	10.25	13.25	22.97	36.33	44.01
88	74.31	84.56	97.83	107.56	110.56	118.23

Buffer at Start	13.25		25.97
End	97.83		100.20
Buffer at End	87.56		110.56
Start	2.98		36.33

Project Duration = 119 days

ii. If, after 45 days from the project start, the number of workers for operation B can be increased to the same rate as operation C, what would be the new project duration?

bii)

For Activity B		Remarks
B_S	13.25	
At day 65, number of units N' completed at U = 4.71		With 9 gangs of 90 men
S'	51.75	Use 65 - B_S
N'	54.22857143	Use S' = (N'-1)d/U
At day 65 onwards, U' of B based on U of C	5.86	U' of B = U of C
Therefore, remaining number of units completed at U' = 5.86	33.77142857	Use total N - N'
New S' for remaining 33.77 number of units to be completed at U' = 5.86	27.95975057	Use S = (N'-1)d/U'
Total number of days to complete B	102.68	Use [(65) days + (S' at U = 5.86) days + (One period of B) days] to complete operation)
Activity B will complete in 103 days.		

For Activity C		Remarks
C_S at day 65	77.72	Use [(65) days + (One period of B) days + (3) days of buffer] for start of C for unit 54.23
Remaning S for C	27.95975057	Use S = (N'-1)d/Uc
Total number of days to complete C	113.36	Use [(77.72) days + (Remaining S for C) days + (One period of C) days] to complete operation)
Activity C will complete in 114 days.		
Project Duration = 114 days		

Note: Formulae for LOB, G = RM/h, T = M/Qh, S = (N-1)d/U

3.

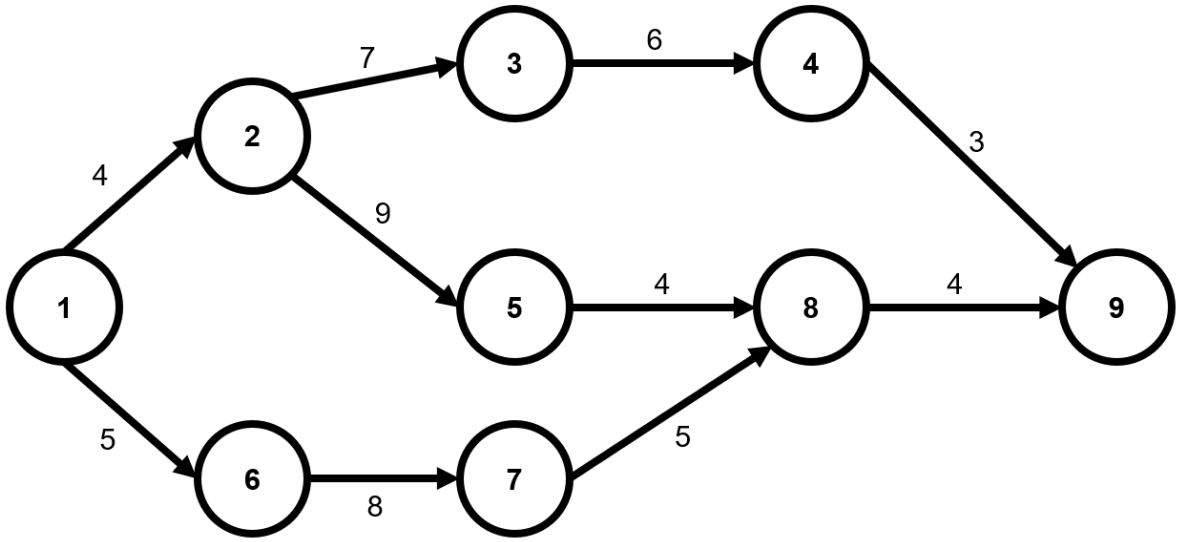
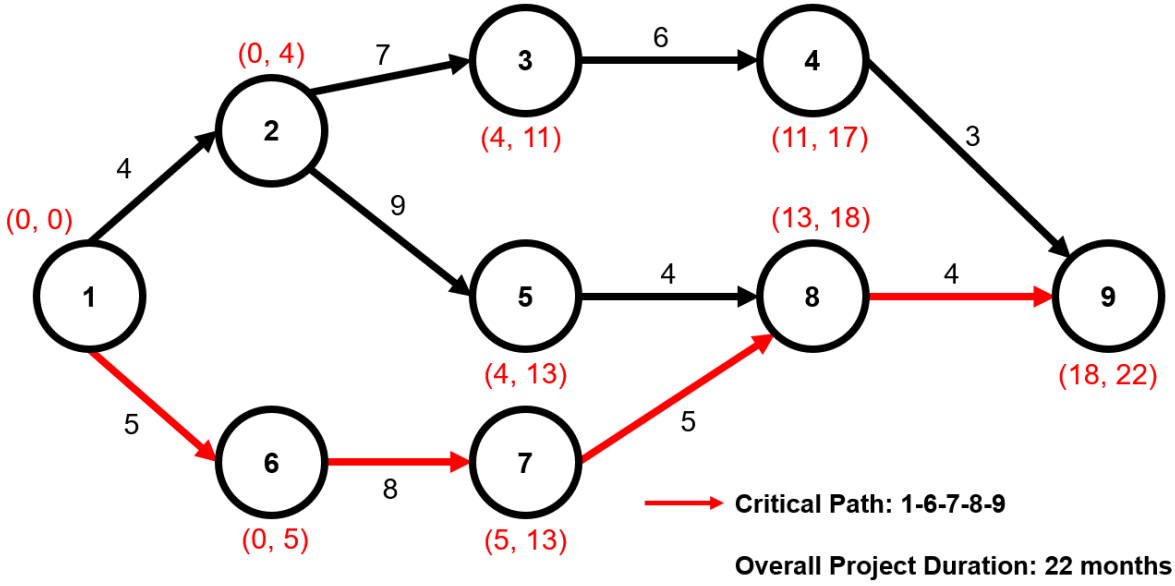


Figure Q3 Project Network Diagram

a. *Figure Q3 shows a network diagram for a construction project with duration indicated in months, Please calculate the Early Start and Early Finish for all activities, advise the critical path and project duration.*



b. *Table Q3 below shows the budgeted cost for the list of for the same project indicated in Q3(a). Progress at the end of Month 15 is also listed in the table. From the information provided, perform earned value analysis and answer the following questions.*

Table Q3 - Project Activities, budget, and actual completion

Activity	Budget Cost, $1,000 (k)	Actual Progress at Month 15, (%)	Actual cost incurred till Month 15, $1,000 (k)
1-2	40	100	42
1-6	50	100	50
2-3	80	100	76
2-5	100	80	90
3-4	60	50	29
4-6	30	0	-
5-8	35	50	20
6-7	120	90	112
7-8	45	0	-
8-9	55	0	-

i) Calculate BCWP for all activities at the end of Month 15, and briefly review and comment on the overall project performance.

bi)

	Budget	Progress	ACWP	BCWP	CPI	Remarks
Activity	**Budget Cost, $1,000 (k)**	**Actual Progress at Month 15, (%)**	**Actual cost incurred till Month 15, $1,000 (k)**	**Budgeted Cost Work Performed, $1,000 (k)**	**Cost Performance Index = BCWP/ACWP**	**Comments**
1-2	40	100	42	40	0.95	Over budget
1-6	50	100	50	50	1.00	Same as budget
2-3	80	100	76	80	1.05	Under budget
2-5	100	80	90	80	0.89	Over budget
3-4	60	50	29	30	1.03	Under budget
4-9	30	0	-	0	-	N/A
5-8	35	50	20	17.5	0.88	Over budget
6-7	120	90	112	108	0.96	Over budget
7-8	45	0	-	0	-	N/A
8-9	55	0	-	0	-	N/A
		Total	**419**	**405.5**		

Overall Cost Performance Index	**0.97**
Project is slightly over budget with overall CPI = 0.97 with spending of $13.5k more than that of the budgeted cost	

ii) Estimate the project cost at completion, if

- *the cost trend continue remaining works*
- *remaining works are performed within budget*

bii)

Two ways for the calculation of EAC (Estimated Cost At Completion)

1. EAC = BAC/CPI
This formula is used when the original estimation is met without any deviation. It is always good for a project manager if he or she is maintaining the CPI and SPI.

2. EAC = ACWP + (BAC - EV)
This formula is used when the current deviation with the original estimation is thought to be different in the future. It is generally ACWP plus the remaining value of the work to perform.

Choose method 1 for part (bii)

	Budget	Progress	ACWP		Remarks
Activity	**Budget Cost, $1,000 (k)**	**Actual Progress at Month 15, (%)**	**Actual cost incurred till Month 15,**	**Actual cost incurred till Month 22, $1,000 (k)**	**Comments**
1-2	40	100	42	42	Cost trend continue remaining works
1-6	50	100	50	50	Cost trend continue remaining works
2-3	80	100	76	80	Cost trend continue remaining works
2-5	100	80	90	112.5	Cost trend continue remaining works
3-4	60	50	29	58	Cost trend continue remaining works
4-9	30	0	-	30	Remaining works are performed within budget
5-8	35	50	20	40	Cost trend continue remaining works
6-7	120	90	112	124.44	Cost trend continue remaining works
7-8	45	0	-	45	Remaining works are performed within budget
8-9	55	0	-	55	Remaining works are performed within budget
			Total	**636.94**	***The project cost at completion would be $636.94k***

iii) What is the overall cost target for remaining works should the project cost at completion be kept within the original budget?

biii)

	Budget	Progress	ACWP @ 15	ACWP @ 22	Remarks
Activity	**Budget Cost, $1,000 (k)**	**Actual Progress at Month 15, (%)**	**Actual cost incurred till Month 15, $1,000 (k)**	**Actual cost incurred till Month 22, $1,000 (k)**	**Comments**
1-2	40	100	42	42	Cost trend continue remaining works
1-6	50	100	50	50	Cost trend continue remaining works
2-3	80	100	76	80	Cost trend continue remaining works
2-5	100	80	90	112.5	Cost trend continue remaining works
3-4	60	50	29	58	Cost trend continue remaining works
4-9	30	0	-	30	Remaining works are performed within budget
5-8	35	50	20	40	Cost trend continue remaining works
6-7	120	90	112	124.44	Cost trend continue remaining works
7-8	45	0	-	45	Remaining works are performed within budget
8-9	55	0	-	55	Remaining works are performed within budget
Total	**615**		**419**	**636.94**	***The project cost at completion would be $636.94k***

Total Budget Cost to Month 22	**615**	
Total Actual Cost to Month 15	**419**	
Cost Target for remaining works	**196**	***The overall cost target for remaining works is $196k.***

4.

a) *Compare and contrast an agreement with a contract, highlighting their similarities and differences.*

In the construction industry, agreements are often made during the initial stages of project discussions and may include preliminary understandings or letters of intent. However, when the parties intend to create a legally binding relationship with detailed terms and conditions, they typically formalise the arrangement into a construction contract. Construction contracts are usually detailed, formal documents that outline the scope of work, specifications, payment terms, timelines, dispute resolution mechanisms, and other critical aspects of the construction project. Table A4 distinguishes the similarities and differences between agreements and contracts.

Type	**Agreement**	**Contract**
Similarities		
1. Mutual Understanding	Both involve a mutual understanding or meeting of the minds between two or more parties.	Like agreements, contracts require a mutual agreement between parties involved.
2. Legal Intent	Both are intended to have legal consequences, implying that the parties intend to be bound by the terms.	A contract is a specific type of agreement that is legally enforceable, reinforcing the legal intent.
3. Offer and Acceptance	Involves an offer by one party and an acceptance by another, establishing the basis for the agreement.	Contracts typically include elements of offer and acceptance, contributing to the formation of a legally binding relationship.
4. Consideration	Both may involve consideration, which refers to something of value exchanged between the parties.	Consideration is a fundamental element of contracts, representing the bargained-for exchange that gives each party a legal benefit or causes a legal detriment.
Differences		
1. Enforceability	Not all agreements are legally enforceable. Some are social or moral agreements without legal consequences.	Contracts, by definition, are legally enforceable. Breach of contract can lead to legal remedies.

2. Formality	May be informal and can even be oral in some cases, depending on the nature of the agreement.	Contracts often require more formality, and some types, especially in the construction industry, may need to be in writing to be enforceable (e.g., contracts for the sale of land).
3. Specificity and Details	Can be broad and may lack specific details.	Contracts are typically more detailed, specifying terms, conditions, responsibilities, and other crucial elements with precision.
4. Intention to Create Legal Regulations	The intention to create legal relations may be implied or inferred based on the circumstances.	Contracts explicitly state the intention to create legal relations, reinforcing the enforceability of the agreement.
5. Complexity	Can be simple and straightforward, covering basic terms.	Construction contracts, in particular, tend to be complex, involving detailed provisions related to scope, payment, timelines, dispute resolution, and more.
6. Statutory Requirements	Generally subject to fewer statutory requirements.	Construction contracts, in particular, may be subject to specific statutory regulations and requirements, adding a layer of complexity and compliance.

In summary, while an agreement is a broader term encompassing a mutual understanding between parties, a contract is a more specific and legally binding agreement with detailed terms and conditions. Construction contracts, within the context of the construction industry, represent a specialised form of agreements tailored to the complexities and requirements of construction projects.

b) *Discuss the pros and cons of using the following types of construction contracts:*
- *Unit Price Contracts*
- *Lump Sum Contracts*
- *Cost Plus Contracts*

Type of Contract	Pros	Cons
Unit Price	**Flexibility**: Unit price contracts offer flexibility as they allow adjustments to the quantity of work required. This is beneficial when the project scope is uncertain or subject to change. **Transparency**: The unit price contract provides transparency because it breaks down the costs of each unit of work. This transparency can help in avoiding disputes and ensures that the owner pays for the actual work performed. **Quick Start**: Projects can start quickly as unit price contracts are often used when the design is not complete. This enables construction to begin while the design is still being finalised	**Estimation Challenges**: Estimating the total project cost can be challenging as the final quantity of work may not be known until the project progresses. This can lead to cost overruns or underruns. **Potential for Disputes**: Disputes may arise over the quantities and unit prices, especially if there are disagreements about the actual quantities of work performed or the unit prices applied.
Lump Sum	**Certainty of Cost**: Lump sum contracts provide a fixed price for the entire project, offering the owner certainty about the total cost. This can be advantageous for budgeting and financial planning. **Reduced Owner Involvement**: Owners have less involvement in the day-to-day construction activities as the contractor is responsible for managing costs and	**Limited Flexibility**: Changes to the scope of work can be challenging and may result in change orders, potentially increasing costs and causing delays. **Risk Transfer**: The contractor bears the risk of unforeseen conditions or changes in the project, which may lead to a higher initial contract price to account for these risks.

	project execution within the fixed budget. **Clear Scope**: Since the scope of work is well-defined in lump sum contracts, there is less room for ambiguity or disputes related to the scope of work.	
Cost Plus	**Flexibility and Adaptability**: Cost plus contracts offer flexibility for changes in project scope. They allow for adjustments to the contract as the project progresses, making them suitable for projects with evolving requirements. **Transparent Costs**: The owner has visibility into the actual costs incurred, as the contractor provides detailed records of expenses. This transparency can foster trust between the parties. **Encourages Efficiency**: Since the contractor is reimbursed for actual costs and may receive a percentage fee on top, there is an incentive for the contractor to find cost-effective solutions and manage the project efficiently.	**Cost Uncertainty**: Owners may face uncertainty regarding the final project cost, as it depends on the actual costs incurred during construction. This uncertainty can be a disadvantage for owners with strict budget constraints. **Potential for Disputes**: Disputes may arise over what costs are reasonable and necessary, especially if there are disagreements about the contractor's expenses or the percentage fee charged.

In conclusion, the choice of construction contract type depends on the project's specific characteristics, level of design completion, and the risk tolerance of the parties involved. Each type has its advantages and disadvantages, and the selection should align with the project's goals and requirements.

c) What is the importance of value engineering (VE) for the construction project owner? Typically when should VE start for the contractor?

Value Engineering (VE) holds significant importance for construction project owners by providing a systematic approach to ***optimise functionality, quality, and performance*** while ***minimising costs***. This process contributes to ***effective cost control throughout the project life cycle, enhances overall project value, and mitigates potential risks***. By identifying and implementing cost-saving opportunities early, VE ***promotes stakeholder satisfaction***, including investors, end-users, and the community. Additionally, it ***supports sustainability initiatives*** by integrating environmentally responsible practices into the project.

Contractors should ***initiate the VE process as early as possible***, particularly in the pre-construction and design development phases. Collaboration with designers and engineers is crucial during this period to identify opportunities for cost savings and efficiency improvements. The most effective application of VE occurs when ***contractors actively engage in continuous monitoring throughout the project***, ensuring that potential value improvements are identified and incorporated into the construction process. Overall, early and ongoing involvement in the VE process ***allows contractors to optimise costs while maintaining project objectives***, contributing to the success of the construction project.

d) Why is it important to have a change order in construction projects?

Change orders are crucial in construction projects due to ***their role in formalising modifications to the original project scope, specifications, and contract terms***. They provide a ***transparent and documented process*** for addressing unforeseen circumstances, design changes, or client requests. Change orders ***contribute to contractual clarity*** by ensuring that both the client and the contractor understand the agreed-upon modifications, helping prevent disputes. Additionally, they ***enable adjustments to project costs, support effective risk management, offer legal protection in case of disputes, and contribute to project control by aligning changes with project objectives***. Through facilitating communication, documentation, and schedule management, change orders play a vital role in ***maintaining project integrity, managing uncertainties, and ensuring the successful completion of construction projects***.

Comments for CV4011:

1. Take time to practise the relevant past year final papers.
2. Important concepts such as ES, EF, LOB, and topics on costing should be focused on during revision.
3. Listen to Professor David Chew for his part on contracts management and attend tutorials.
4. Link for the summary of notes for CV4011 prepared by myself:

https://docs.google.com/document/d/1krLWfVGWZg3p_2I4r8sxZbdbbIO9xFSkrwPiZhgPyLY/edit?usp=sharing

5. Past year exam solutions prepared by myself for cross reference/additional support materials for your preparation:

CV4011 AY 2022-2023 Semester 1 Finals Questions:

https://docs.google.com/document/d/1yRh9uDp28N8YJ0DjzYKX0vqN30oGGQu61x__5dsPpAg/edit?usp=sharing

CV4011 AY 2021-2022 Semester 1 Finals Questions:

https://docs.google.com/document/d/1O6TJwXvghjlZW5pU_wBhGBzmdbYpvrzt-flR53x3_2o/edit?usp=sharing

NANYANG TECHNOLOGICAL UNIVERSITY

SEMESTER 1 EXAMINATION 2023-2024

CV4011 PROJECT PLANNING AND MANAGEMENT

November / December 2023 **Time Allowed: 2 hours**

INSTRUCTIONS

1. This paper contains **FOUR (4)** questions and comprises **FOUR (4)** pages.
2. Answer **ALL** questions.
3. All questions carry equal marks.
4. This is a Closed-Book Examination.
5. All answers must be written in the Answer Book provided. Answer each question beginning on a **FRESH** page of the Answer Book.

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1. (a) List the main approvals required before physical construction works can commence, and their respective issuance parties. Briefly elaborate on the key focus and purpose of these approvals.

(8 Marks)

(b) Er. ZYX a Professional Engineer and Qualified Person for an ongoing construction project. He just came back from a two-week oversea vacations. This vacation is approved by Senior Management and for the works during his vacation period, Er. ZYX have approached his colleague, Er. PQR to assist to oversee Er. ZYX's works. And, Er. PQR agreed to assist.

However, Er. PQR is very busy and did not pay too much attention on Er. ZYX's project, and some works are not done in accordance to the regulations and results in some additional works. Er. ZYX is only aware of the incident after he came back from vacation.

Discuss on the responsibilities, obligations and duties of the Er. ZYX and Er. PQR with regards to Code of Professional Conduct and Ethics in the case above.

(5 Marks)

(c) Your company, a Main Contractor firm, is currently tendering a construction project of 2 blocks of 36-storey residential project. You are assigned by your boss to compile the tender documents for submission and give him a brief after the compilation.

Discuss and elaborate on information that you will be looking for, where you plan to get it, and the different parties or your colleague that you would like to speak to with regards to above task. Explain your reason for doing so.

(12 Marks)

2. An engineer intends to apply the line of balance (LOB) method to schedule the construction of 88 identical MRT piers in a project. The project owner has stipulated a target build rate of 6 piers per week. In scheduling the work, the project site will be allowed to work 8 hours per day and 5 days per week with a minimum buffer of 3 days between operations. The man-hours required on one pier (M) and the optimum team size (Q) for the construction operations are given in Table Q2. The construction sequence is in the order of operation A followed by B then Operation C.

Table Q2

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C	430	7

Note:

i. Use up to nearest two decimal point in your calculation.
ii. For final answer in project duration in days, round up to nearest integer.

(a) Calculate values required to construct a line of balance schedule for the above project. Indicate the overall project duration.

(12 Marks)

(b) If the sub-contractor of operation B can only supply 90 workers to the project, and that operation A and C are carried out based on manpower calculated in part (a).

(i) Under above circumstances, what would be the new project schedule?

(ii) If, after 65 days from project start, the number of workers for operation B can be increased to the same rate as per Operation C, what would be the new project duration?

(13 Marks)

Note: Formulae for LOB, G = RM/hd, T=M/Qh, S=(N-1)d/U

3. (a) Figure Q3 shows a network diagram for a construction project with duration indicated in months. Please calculate Early Start and Early Finish for all activities, advise the critical path project duration.

(7 Marks)

Note: Question No. 3 continues on Page 3.

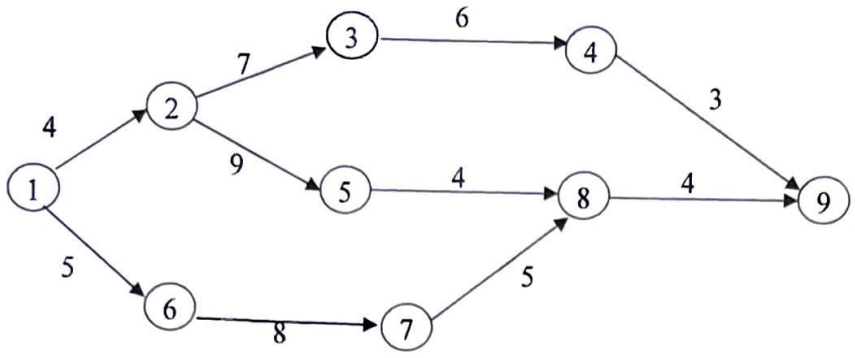

Figure Q3 Project Network Diagram

(b) Table Q3 below shows budgeted cost for the list of for the same project indicated in Q3(a). Progress at end of Month 15 is also listed in the table. From the information provided, perform earn value analysis and answer the following questions.

(i) Calculate BCWP for all activities at end of Month 15, and briefly review and comments the overall project performance.

(10 Marks)

(ii) Estimate the project cost at completion, if
- the cost trend continue remaining works
- remaining works are performed within budget

(4 Marks)

(iii) What is the overall cost target for remaining works should the project cost at completion is to be kept within the original budget.

(4 Marks)

Table Q3. Project activities, budget and actual completion

Activity	Budgeted Cost, $1,000 (k)	Actual Progress at Month 15, (%)	Actual cost incurred till Month 15, $1,000 (k)
1-2	40	100	42
1-6	50	100	50
2-3	80	100	76
2-5	100	80	90
3-4	60	50	29
4-9	30	0	-
5-8	35	50	20
6-7	120	90	112
7-8	45	0	-
8-9	55	0	-

4. (a) Compare and contrast an agreement with a contract, highlighting their similarities and differences.

(7 Marks)

(b) Discuss the pros and cons of using the following types of construction contracts:

- Unit Price Contracts
- Lump Sum Contracts
- Cost Plus Contracts

(9 Marks)

(c) What is the importance of value engineering (VE) for the construction project owner? Typically when should VE start for the contractor?

(5 Marks)

(d) Why is it important to have a change order in construction projects?

(4 Marks)

END OF PAPER