EPC -v- EPCM
## EPC –v- EPCM Timetable

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 mins</td>
<td>EPC –v- EPCM</td>
</tr>
<tr>
<td>2 mins</td>
<td>EPC or EPCM?</td>
</tr>
<tr>
<td>20 mins</td>
<td>Engineering for EPC &amp; EPCM</td>
</tr>
<tr>
<td>10 mins</td>
<td>Procurement Strategies for EPC &amp; EPCM</td>
</tr>
<tr>
<td>10 mins</td>
<td>Construction for EPC &amp; EPCM</td>
</tr>
<tr>
<td>5 mins</td>
<td>Cost Control for EPC and EPCM</td>
</tr>
<tr>
<td>5 mins</td>
<td>Disputes for EPC &amp; EPCM</td>
</tr>
<tr>
<td>10 mins</td>
<td>Advantages and Disadvantages of EPC</td>
</tr>
<tr>
<td>10 mins</td>
<td>Advantages and Disadvantages of EPCM</td>
</tr>
<tr>
<td>5 mins</td>
<td>Conclusion</td>
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<tr>
<td></td>
<td>Questions &amp; Answers</td>
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</tbody>
</table>
EPC –v- EPCM

The purpose of this presentation is to consider the following:

- EPC which is an abbreviation for Engineering (E), Procurement (P), and Construction (C) and

- EPCM which is abbreviation for Engineering (E), Procurement and Construction Management (CM);

- consider the advantages and disadvantages of EPC and EPCM

- understand the pitfalls of EPC and EPCM
The major EPC/EPCM forms of contract are as follows:

- FIDIC Silver Book
- Orgalime Turnkey Contract
- ICC Turnkey Task Force
- ENAA
- ICE 7th Edition
- ECC 3rd Edition
- MDB Harmonised
EPCM Standard Forms of Contract

No standard forms of contract
EPC - definition

"procurement by the owner of a major construction project via a fixed price, lump sum turnkey route"
The EPC Contractor is considered to be an expert in this form of contracting and this is onerous in international construction projects and must provide:

- a project that is ‘fit for purpose’
- Engineering and design is to a unique standard
- not carry out wilful misconduct
- not be grossly negligent
Typical EPC arrangement
EPCM - definition

....”an EPCM contract is a professional services contract which has a radically different risk allocation”

Worlds Apart: EPC and EPCM Contracts
Risk issues and allocation

Phil Loots and Nick Henchie
EPCM Contractor

The EPCM Contractor is different to the EPC Contractor and his duties are carried out to a standard of ‘reasonable skill and care’ which is lower than ‘fit for purpose’ and covers:

- performance of design work
- preparation of budget cost estimate
- preparation of programme and estimated duration
- managing procurement and administration of trade contractors
- coordination of design and construction
- wilful misconduct and gross negligence are main causes of breach
Typical EPCM arrangement
Typical Allocation of Risk for Construction Projects

- **Construction Management (EPCM)**
  - Client assumes Risk
  - 100%

- **Traditional**
  - Balanced
  - 50%-50%

- **EPC**
  - Contractor assumes Risk
  - 10%-90%

- **Design and Build**
  - Moves towards Contractor
  - 25%-75%

**Conclusion:** EPC transfers the majority of risk to the contractor
Basic Engineering (FEED)

Basic engineering is a term commonly used to define concept design and is commonly known in EPC and EPCM projects as front-end engineering & design (FEED)

- The FEED is normally a separate contract to the EPC and executed on agreed rates and prices.

- The end of FEED is the start point of the EPC which is executed on the basis of lump sum or reimbursable cost
EPC/EPCM – FEED & Detailed Design

Client consents
- Exploration and access
- Client requirements
- Environmental plan

Engineering
- Basic engineering
- Detailed engineering
- Material requisitions
- IFC drawings and specifications
- Engineering support to construction

Procurement
- Procurement plan
- Contract information
- Material purchasing
- Material delivery

Construction
- Construction plan
- Construction plan for support facilities
- Permit to work
- Construction of support facilities
- Construction of the project

Controls
- Change control
- Monitor engineering
- Update budget and schedule
- Progress and cost reporting

Pre operational testing
- Full production
FEED phases, characteristics and potential outcomes

<table>
<thead>
<tr>
<th>Business Planning</th>
<th>Phases</th>
<th>Start-up and Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Conceptual Study – Define Project Options</td>
<td>Feasibility Study – Select Most Viable Option</td>
</tr>
</tbody>
</table>

**Characteristics:**
- Core to project planning
- Progressive, gated approach
- Ensures quality definition of the project and the resources required

**Outcomes:**
- Excellent operability
- Faster project cycle times
- Enhanced safety
- Capital effectiveness
- Improved quality
- Skilled resources
Quality of FEED

BS 7000 states that properly verified and validated design leads to cost effective construction

However:

- The definition of FEED varies from project to project and sectors
- The slide to follow illustrates the effects of a FEED that lacks proper verification and validation
Results of a Deficient FEED

Actual vs. Planned:
- Actual: 478,230
- Planned: 0
Results of a Deficient FEED
Results of a Deficient FEED

- Planned: 0, 200,000, 400,000, 600,000, 800,000, 1,000,000, 1,200,000, 1,400,000
- Actual: 478,230, 840,000, 1,280,000
EPC/EPCM – Synopsis of Risk

Engineering Procurement and Construction (EPC)
- High risk for CONTRACTOR and expensive for OWNER

Engineering Procurement and Construction Management (EPCM)
- High risk for OWNER, less cost and less onerous for the CONTRACTOR
- EPCM Contractor is responsible design, procurement of materials and management
- Professional service as opposed to a party to the contract

EPC/EPCM mix
- Bespoke form of CONTRACT, complicated and difficult to make workable
For either EPC or EPCM to work and especially for PROCUREMENT to be effective there must be good cooperation and communication between Owner and Contractor.

A key part of EPCM is the effective letting of packages in conjunction with the FEED.

Effective procurement FOR EITHER EPC or EPCM must have a defined strategy to deal with issues related to:

- Contract and commercial
- Integration
- Contract Management

The slides to follow reveal some of the issues that arise and potential solutions.
Procurement strategy

**Issue**

Fast track procurement

Driven by lack of planning and understanding of equipment & vendor supply chain and end to end logistics timeframes

**Solution**

- Improved early market engagement
- Proactive and robust procurement planning
- Active management of inputs
Contract and commercial structure

**Issue**

**EPC v EPCM decision-making**

often driven by past poor experience of one or other and can shape contract strategy without testing/validation

**Solution**

- Adopt approach that aligns procurement, contract and commercial model with client/project objectives
- Consider developing a outcome/performance driven commercial model
- Consider ability to co-operate/collaborate with EPCM contractor
Integrated process

**Issue**

Poor integration between engineering and project controls and procurement functions

**Solution**

- Planning that addresses integration of functions (linking outputs with inputs)
- Improved definition of engineering deliverables and estimation/alignment of man hours
- Procurement process and governance that aligns with engineering progression and project controls

Step 1: FEED / Concept
Step 2: Detail Design
Step 3: Procure
Step 4: Schedule
Step 5: Construction
Step 6: Commissioning and operation

Integrated Procurement/Engineering/Project Controls Process

$ Time

Revenue Costs
Contract management

Issue
Contractor non-compliant with client management and project process

Solution
Integration of owner policies and standards, functions and inclusion of process requirements e.g. Project Controls reporting, cost, financial, schedule within contract

Step 1
FEED / Concept

Step 2
Detail Design

Step 3
Procure

Step 4
Schedule

Step 5
Construction

Step 6
Commissioning and operation

Revenue
Costs

Time

$
82 tons of steel shipped to site... wrong earth quake design by Contractor
Conclusion

Communication, cooperation and a defined strategy are essential tools in ensuring successful procurement for either EPC or EPCM
Construction EPC & EPCM
EPC/EPCM – Network and Programme Management

**Client consents**
- Exploration and access
- Client requirements
- Environmental plan

**Basic engineering**
- Project release for construction

**Detailed engineering**
- IFC drawings and specifications
- Engineering support to construction

**Engineering**
- Basic engineering
- Detailed engineering

**Procurement**
- Procurement plan
- Contract information
- Material requisitions
- Material purchasing
- Material delivery

**Construction**
- Construction plan
- Construction plan for support facilities
- Permit to work
- Construction of support facilities
- Construction of the project

**Controls**
- Change control
- Monitor engineering
- Update budget and schedule
- Progress and cost reporting

Pre operational testing → Full production
Construction and Programme Risks

EPC

CONTRACTOR is responsible for the programme, coordinates all interested parties and is responsible for completion on time

EPCM

CONTRACTOR is responsible for coordinating the schedule and safety during construction
EPC/EPCM Construction and Programme Responsibilities

EPC Contractor is responsible for the construction programme and any culpable delays result in liquidated damages.

EPCM Contractor is responsible for:

- managing the coordination of trade contractors
- design and procurement
- development and agreement of an overall programme

EPCM projects are prone to difficulties when deficient FEED and late design changes are encountered.
## Deficient FEED

### Deficient FEED and Programme Consequences

<table>
<thead>
<tr>
<th>Root causes</th>
<th>Programme Consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of trained operatives and poor engineering</td>
<td>Construction planning breaks down and leads to delay</td>
</tr>
<tr>
<td>Lack of information and records</td>
<td>Reliance upon wrong information leads to over payment and incorrect scheduling</td>
</tr>
<tr>
<td>Late changes to the FEED</td>
<td>Delay and disruption to the progress of construction leading to claims and disputes</td>
</tr>
</tbody>
</table>
EPC/EPCM Deficient FEED, Late Changes and Delay

EPCM projects are prone to difficulties when deficient FEED and late design changes are encountered.

The slides to follow demonstrate how a deficient FFED causes late design changes and results in prolongation.
Deficient FEED leads to late changes and delay
Deficient FEED leads to late changes and delay
Deficient FEED leads to late changes and delay
It is now becoming common to mix EPC and EPCM responsibilities on major projects.

This is complex and difficult to manage and the slides to follow demonstrate this statement.
Mixing EPC and EPCM Construction Risks

<table>
<thead>
<tr>
<th>WBS</th>
<th>Description</th>
<th>EPC Scope</th>
<th>EP(CM) Scope</th>
<th>AACH Self Perform</th>
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<tbody>
<tr>
<td>1000</td>
<td>General</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2310</td>
<td>Primary Crusher and Ore Transport</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2370</td>
<td>Utility Installation</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>3410</td>
<td>Slurry Holding Tanks</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>3430</td>
<td>Slurry Pipeline</td>
<td>X</td>
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<tr>
<td>3450</td>
<td>Choke Stations</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>3470</td>
<td>Slurry Vent/Drain Stations</td>
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<tr>
<td>3525</td>
<td>Ore Transport Tunnel</td>
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<tr>
<td>3535</td>
<td>Ore Conveying</td>
<td></td>
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</tr>
<tr>
<td>4215</td>
<td>Ore Stockpile</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4225</td>
<td>Grinding</td>
<td>X</td>
<td></td>
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<tr>
<td>4235</td>
<td>Pebble Crushing</td>
<td>X</td>
<td></td>
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<td>4266</td>
<td>Ore Pulp Thickening</td>
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<tr>
<td>4275</td>
<td>Lime Plant</td>
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<tr>
<td>4281</td>
<td>Confluencia Site Preparation (early works)</td>
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<tr>
<td>4281</td>
<td>Confluencia Site Preparation</td>
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<tr>
<td>4282</td>
<td>Common Services-Confluencia</td>
<td>X</td>
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<tr>
<td>4295</td>
<td>Confluencia Access Road</td>
<td>X</td>
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<tr>
<td>4460</td>
<td>Las Tórtolas Site Preparation</td>
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<tr>
<td>4470</td>
<td>Service Buildings</td>
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<td>4510</td>
<td>Primary Flotation</td>
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<tr>
<td>4520</td>
<td>Molybdenum Plant</td>
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<td>4530</td>
<td>Cleaner Flotation &amp; Regrind</td>
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<td>4540</td>
<td>Thickening/Filtration/Concentrate Storage</td>
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<td>Flotation General</td>
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<td>4550</td>
<td>Lime/Reagents Plant</td>
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<td></td>
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<td>4820</td>
<td>Tailings Transport</td>
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<td>X</td>
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<tr>
<td>4830</td>
<td>Tailings Classification/Distribution</td>
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<td>4840</td>
<td>Tailings Reclaim Water</td>
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<tr>
<td>4850</td>
<td>Tailings Dam Modification</td>
<td>X</td>
<td></td>
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<tr>
<td>4920</td>
<td>Tailings Thickener</td>
<td>X</td>
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<td>5120</td>
<td>Fresh Water Supply to Los Bronces (from Riecillos)</td>
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<td>Reclaim Water Supply to Los Bronces</td>
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<td>6230</td>
<td>S/E Polpaico, Expansion</td>
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<td>6231</td>
<td>S/E Las Tórtolas, Expansion</td>
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<td>6232</td>
<td>PL 220kV Polpaico-Las Tórtolas 2</td>
<td>X</td>
<td></td>
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<tr>
<td>6233</td>
<td>S/E Las Tórtolas 2</td>
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<td>6234</td>
<td>PL 35/25kV Las Tórtolas-Bombas 2,3,4</td>
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<td>6235</td>
<td>PL 220kV Polpaico-Maitenes</td>
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<td>6240</td>
<td>PL 220kV Las Tórtolas2-Confluencia</td>
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<tr>
<td>6245</td>
<td>Confluencia Main Substation (Sub)</td>
<td>X</td>
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<tr>
<td>6245</td>
<td>Confluencia Main Substation (Harmonic filter)</td>
<td>X</td>
<td></td>
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<tr>
<td>6246</td>
<td>PL 220 kV Maitenes-Confluencia</td>
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</tbody>
</table>
Typical mix of EPC & EPCM Construction Risk

- SAG Mill EPC
- Mine EPCM
  - Tunnel from mine to grinder EPCM
    - El = +3000m
  - El = +3000m
- Molybdenum plant EPC
  - 55KM pipeline to plant EPC
    - El = +800m
Summary

In both EPC and EPCM projects the programme is an essential tool to carry out effective construction

EPC Contractor is responsible for the construction programme

EPCM Contractor is responsible for the design and procurement programme

EPCM trade contractors are responsible for the construction programme

EPCM programme relationships results in difficulties in settling delay claims
Cost Control

EPC Contractors are paid by means of a lump sum or reimbursable cost

This provides certainty to the Owner as long as the FEED is properly verified and validated

EPCM Contractors are paid by means of a professional fee and target cost

This process does not provide certainty because the FEED is not fully developed for procurement and there is a high risk of late changes
Owner Claims

EPC Contractors are ‘turnkey contractors’ and if they are late the contract provides certainty for the Owner by means of liquidated damages for delayed completion.

EPCM Contractor is a professional role and if they are in breach the recourse is a claim for negligence and which is difficult to prove and uncertain.

Both EPC and EPCM forms of contract have a common cause of claim i.e. a deficient FEED, which can cause disputes.
Deficient FEED and Disputes

A deficient FEED creates:

- excessive post contract changes to scope (variations)
- variations create additional administration
- variations create additional work
- variations create additional cost
- variations cause a breakdown in planning
- All the above lead to claims, potential disputes and delay
Variations

Step 1: FEED / Concept
Step 2: Detail Design
Step 3: Procure
Step 4: Schedule
Step 5: Construction
Step 6: Commissioning and operation

Time

Delay

Poor project set up and planning
Imprecise contract / specification programming issues
Claims / variations leading to Delay
Lack of funding

Delays

Project funding concerns

Financial Arrangements
EPC poor engineering control

Step 1 FEED / Concept
Step 2 Detail Design
Step 3 Procure
Step 4 Schedule
Step 5 Construction
Step 6 Commissioning and operation

Time

Delay

Poor engineering

Claims and variations lead to Delay
Lack of administration

Delay

Step 1: FEED / Concept
Step 2: Detail Design
Step 3: Procure
Step 4: Schedule
Step 5: Construction
Step 6: Commissioning and operation

Time

Poor administration

Contractor’s claims, un agreed variations lead to Delay
Conclusion

A deficient FEED creates variations together with Owner and Contractor tension which leads to a breakdown in job planning.

Excessive variations can lead to disputes and delay.
Advantages and Disadvantages

EPC
EPC Advantages – 1. Single Point Responsibility

**Engineering**
Contractor’s risk and responsible for all vendor design and field engineering

**Procurement**
The purchasing of resources and materials are contractor’s risk as is inflation and escalation

**Construction**
Field engineering and constructability and functionality is contractors risk

**Single Point Responsibility**
1. Single Point
2. Certainty
3. Quality
4. Legal
# EPC Advantages – 2. Certainty in respect of time and cost

## Engineering

Contractor’s risk to complete design and field engineering where time is of the essence and cost is a lump sum. Owner controls variations to the lump sum.

## Procurement

Placement of orders in good time is driven by Engineering. Thus the purchasing of resources and materials are contractor’s risk as is inflation and escalation.

## Construction

Construction being completed on time is driven by Engineering and Procurement and if the contractor is late then liquidated damages are applied.

---

**Certainty in respect of time and cost**

1. Single Point
2. Certainty
3. Quality
4. Legal

---

*Turner & Townsend*
EPC Advantages – 3. Quality is standard of ‘fit for purpose’

<table>
<thead>
<tr>
<th>Engineering</th>
<th>Procurement</th>
<th>Construction</th>
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</thead>
<tbody>
<tr>
<td>Design warranties</td>
<td>Design warranties</td>
<td>Design warranties</td>
</tr>
<tr>
<td>protect the owner</td>
<td>protect the owner</td>
<td>and performance bond</td>
</tr>
<tr>
<td>with regard to</td>
<td>with regard to</td>
<td>protect the owner</td>
</tr>
<tr>
<td>quality</td>
<td>quality</td>
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</tbody>
</table>

Quality of design and work

1. Single Point
2. Certainty
3. Quality
4. Legal

Turner & Townsend
## EPC Advantages – 4. Legal

<table>
<thead>
<tr>
<th>Engineering</th>
<th>Procurement</th>
<th>Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Legal</strong> fees tend to be lower because owner negotiates one contract with the EPC contractor, thus single point for any dispute</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Legal

1. Single Point
2. Certainty
3. Quality
4. Legal
EPC Disadvantages – 1. Precise and accurate owner requirements

Owner must clearly specify requirements

1. Precise and accurate owner requirements

1. Requirements
2. Variations
3. Cost
4. Financing
EPC Disadvantages – 2. Variations

Owner ordered variations are expensive and can delay completion

1. Requirements
2. Variations
3. Cost
4. Financing
## EPC Disadvantages – 3. Cost

<table>
<thead>
<tr>
<th>Engineering</th>
<th>Procurement</th>
<th>Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tends to be costly because of the imbalance in risk</td>
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</tbody>
</table>

### Cost

1. Requirements
2. Variations
3. Cost
4. Financing

---

**Turner & Townsend**
EPC Disadvantages – 4. Cost

Tends to be costly because of the imbalance in risk
Advantages and Disadvantages

EPCM
### EPCM Advantages – 1. Earlier commencement

<table>
<thead>
<tr>
<th>Engineering</th>
<th>Procurement</th>
<th>Construction Management</th>
</tr>
</thead>
</table>

The owner’s requirements do not have to be as precise and accurate and the cost of post contract changes is managed by the EPCM contractor on behalf of the owner.
The owner’s requirements do not have to be as precise and accurate and the cost of post contract changes is managed by the EPCM contractor on behalf of the owner.
The cost is lower because the owner’s requirements do not have to be as precise and accurate and the cost of post contract changes is managed by the EPCM contractor on behalf of the owner. The risk is then spread across multiple trade contracts which again provides a lower overall construction cost.
EPCM Advantages – 4. Control

The owner has more control over the whole process and ultimately with time and cost.
EPCM Disadvantages – 1. Owner bears the greater risk

Engineering

Owner bears the greater risk

Capped professional indemnity insurance for design

Construction manager errors are owner errors and cost

Defects are difficult to attribute

Procurement

Construction Management

Owner bears the greater risk
EPCM Disadvantages – 2. Greater uncertainty with time and cost

**Engineering**

- Owner bears the greater risk
- Capped professional indemnity insurance for design
- Construction manager errors are owner errors and cost
- Defects are difficult to attribute
- Delay and disruption and associated costs are difficult to attribute

**Procurement**

**Construction Management**

Greater uncertainty with time and cost

1. Risk
2. Uncertainty
3. Concept
4. Legal
EPCM Disadvantages – 3. Concept design not fully verified and validated

**Owner bears the risk for design development**

Value Engineering can be expensive

Construction manager errors are capped by professional insurance indemnity

Defects are difficult to attribute

Delay and disruption and associated costs of post contract changes are difficult to attribute in both time and cost
EPCM Disadvantages – 4. Legal

- **Multiple contract drafting**
  - Multiple disputes
  - Drafting errors and law of contract can be difficult to impose

<table>
<thead>
<tr>
<th>Engineering</th>
<th>Procurement</th>
<th>Construction Management</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>1 Risk</th>
<th>2 Uncertainty</th>
<th>3 Concept</th>
<th>4 Legal</th>
</tr>
</thead>
</table>
Conclusion

EPC or EPCM?
Conclusion

EPC and an EPCM are two different forms of contract

Mixing EPC and EPCM is to be avoided

EPC is the transfer of risk to the Contractor at a high cost to the Owner

EPCM places more risk on the Owner with a lower cost

Properly verified and validated FEED provides cost effective EPC and EPCM