INFRASTRUCTURE COST MANAGEMENT: OVERVIEW, TREND AND FUTURE DIRECTION

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AGENDA

- ✓ Infrastructures
- ✓ The Concept of Cost management
- ✓ The story/history
- ✓ Cost management in:
  - Buildings
  - Civil engineering projects
  - Oil and gas
- ✓ Current trends
  - Pre-contract
  - Post contract
- ✓ Future direction
  - Sustainable buildings
  - ICMS Costing template
- ✓ Challenges
- ✓ Conclusion/recommendations

INFRASTRUCTURES

- Infrastructure defined
- Examples (energy, transportation, Heavy, M&E, Buildings, mining)
- The world faces social and economic problems due to the dearth of adequate modern infrastructures
- The Gaps

- **Why? (**Rapid urbanization, increasing population size and economic growth)
- **Where we are:**
  - Wide deficits gap vs dwindling economic resources

- QS response
  - Effective utilization of scarce resources

COST MANAGEMENT

❑What is cost in construction?

❑The understanding of cost management varies

➢Estimating, budgeting, control

➢Cost Estimating, budgeting, control and resource allocation

➢Cost management is industry specific

However, in construction, cost management refers to activities associated with cost estimation and control

❑Global recognition

➢generally low visibility

➢Practices under different naming:

QS, Cost managers, commercial managers, cost engineering

Cost Mgt → **Cost estimation** → **Cost control**

WHAT IT IS AND PURPOSE

❑What we do in cost management

➢The management of cost-related processes from project conception to demolition

➢Planning, estimating, budgeting, financing, funding, managing and controlling cost

❑Purpose

➢ provide the economic justification for project expenditures and

➢for planning the funding

❑Are economic justifications being realised?

➢May be no; project across sectors lack economic justifications

THE STORY

Time-honoured profession of over 170 years old

Napoleonic and Post war: settlement by fair valuation based on measurement after completion of the works'.

Measurers & tradesmen engaged to compile cost of resources used in site from 1875

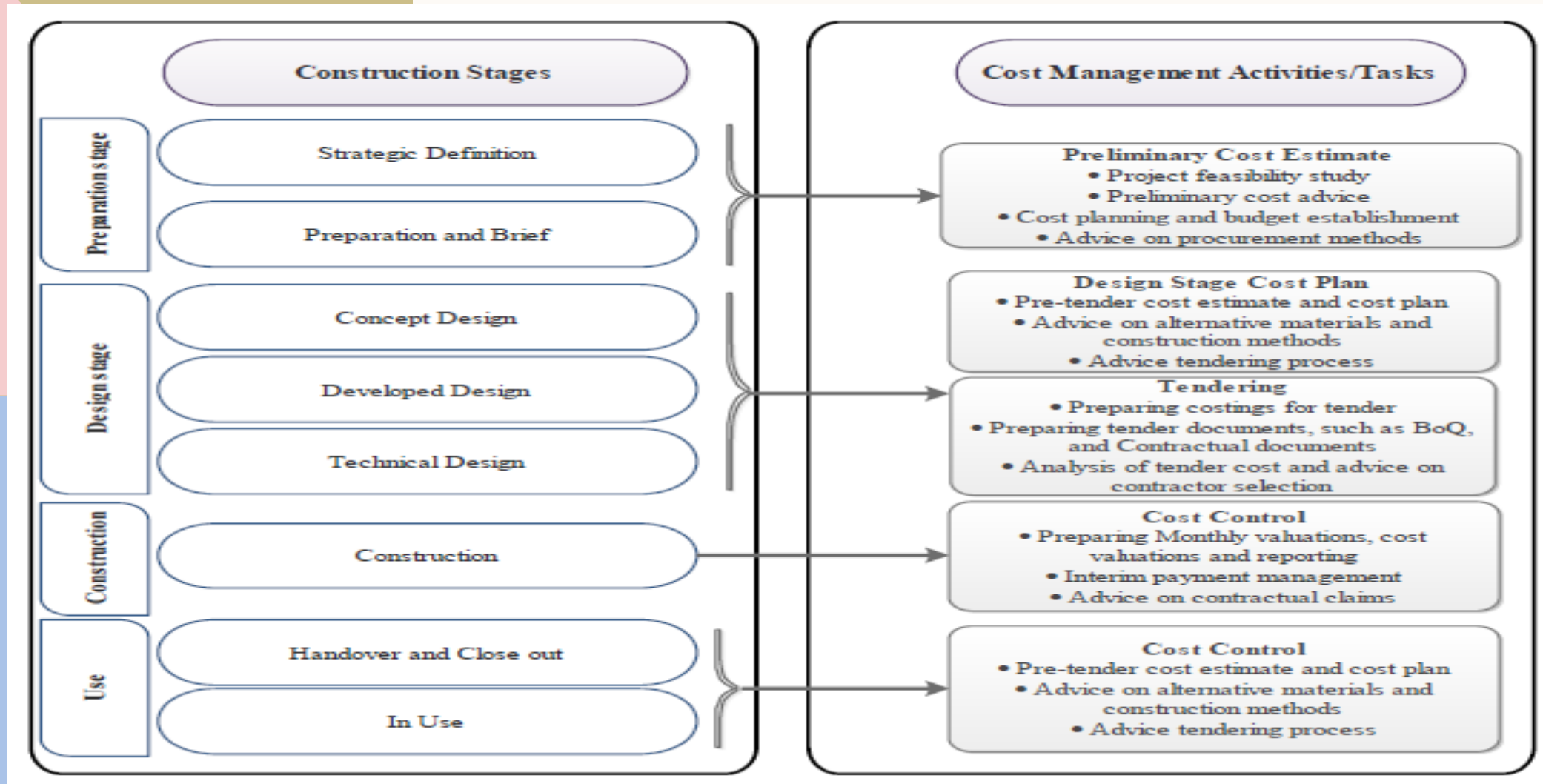
Established QS; Sir Henry Hunt (1820)

Modern quantity surveying in 1834 after architect spliced to form RIBA

COST MANAGEMENT IN BUILDING

- The estimate develops from preliminary design using cost/GFA, preliminary cost plan or approximate quantities

- The cost plan provides more detailed estimate based on the functional unit of the project (elements).
- The elemental cost plan is cost checked against the pre-determined cost limit, and where required, comparative cost estimate of alternatives alternative designs is prepared
- At detailed design stage to **cost check** the fully develop design agrees with pre-determined budget.
- Analytical estimating is further prepared to determine the pre-tender estimate used as criteria for bid selection during the tendering.
- Post contract, emphasis shift to cost control that is, ensuring project expenditures are within budget and pre-agreed cost framework.


Construction Stages
Preparation stage
Strategic Definition
Preparation and Brief
Design stage
Concept Design
Developed Design
Technical Design
Construction
Construction
Use
Handover and Close out
In Use
Cost Management Activities/Tasks
Preliminary Cost Estimate
• Project feasibility study
• Preliminary cost advice
• Cost planning and budget establishment
• Advice on procurement methods
Design Stage Cost Plan
• Pre-tender cost estimate and cost plan
• Advice on alternative materials and construction methods
• Advice tendering process
Tendering
• Preparing costings for tender
• Preparing tender documents, such as BoQ, and Contractual documents
• Analysis of tender cost and advice on contractor selection
Cost Control
• Preparing Monthly valuations, cost valuations and reporting
• Interim payment management
• Advice on contractual claims
Cost Control
• Pre-tender cost estimate and cost plan
• Advice on alternative materials and construction methods
• Advice tendering process

COST MANAGEMENT IN CIVIL ENGINEERING WORKS (ROADS)

- The estimate develops as desktop study base on total length and features (e.g., bridge) using **cost/KM + appurtenances**
- Preliminary cost plan from preliminary design is develop from approximate quantities
- The cost plan allocates the budget to five elements (sections):
  - General item (mainly specified requirements)
  - Earthworks
  - Drains and Culverts
  - Bridges (if any)
  - Surfacing
- The **approximate quantities** are used as **shopping lists (BEME)** for contractor's selection
- Post contract, less of cost control but detailed measurement and evaluation

ISSUES IN CIVIL ENGINEERING WORKS

CM in road works	Less **QS involvement** pre-contract
	Less cost control; post contract (as quantities are not fixed)
	Contracts are reviewed regularly
	Contract document **not standardized** but based engineers perceptions
	Project overheads are fixed (specified requirements) and contractor's requirements (contractual and MRC not prioritized)

OIL AND GAS

- **Post-contract administration applies**
- **CM practices are highly advanced and benchmarked**

- Practice as cost engineering, cost controllers and estimators; open to all(notably certified), dominated by engineers but QS are relevant
- Preliminary estimates are prepared but analytical estimate are developed from full design requiring manufacturing and fabrication
- Rates and markups are regulated by statutory body
- In major installations (e.g., refineries); main contractors are manufacturers and equipment cost could be up to 70% of total project costs
- Civil works, mechanical piping and instrumentation are sub-let and managed centrally using in-house team or consultants

BUILDING SERVICES

Services are estimate to account to 40-60% of the total capital cost of construction and could be

Budgeting for building services evolves a cost per gross floor area; given as provisional sums

Another vastly used cost estimating practice is to secure sub-contractor and suppliers prices.

Cost managers often make adjustment to account market conditions, local variations as well as plant and equipment

Cost estimation can also progress using bills of quantities, however, the use of bills of quantities is limited to fully developed design

Post-contract administration, interim valuation, re-measurement, financial reporting, contractual claims management, agreeing and preparing final accounts

CURRENT TRENDS IN COST MANAGEMENT

➢ Improving accuracies	Re-engineering cost estimating (Order of cost estimating and cost planning)
➢ Standardization of practice for universality	Construction quantities and work procurement (less of BoQs and universal standardization of documents)
➢ Progressive Cost performance measurement	Modern cost management tools and techniques
	Standardization of maintenance, operation cost planning and procurement
➢ digitalization	Digitalization of cost management processes

CURRENT PRACTICE- PRE-CONTRACT

Work estimate	Building works + MC preliminaries + MC profit and overhead
Project & design team fees estimate	Project & design team fees + Work Estimate = Base estimate
Other development fees	Development fees + Work Estimate + design fees = Base estimate
Risk allowance	Design risk, construction risk, employer change risk, employer other risks = Cost LIMIT I
Inflation estimate	Tender and construction inflation = Cost Limit II

CURRENT - POST-CONTRACT

Modern cost management tools	Brief notes
Cost-value reconciliation	CVR illustrates the company's profitability level by bringing together the established cost and values.
Earned value system (analysis)	Integrated project cost and schedule control that gives their trend variances
Financial/cost report	Cost reports provide progress information that is used to assess project performance against set
Cost performance assessment	Tools for monitoring work schedules, financial budgets, work inspection, and feedbacks are used by Clients, consultants, and contractors to monitor cost performance.
Target costing	Cost limit is set which cannot be exceeded
Activity-based costing	Projected are costed based on the scheduled activities
Value engineering	Evaluating and eliminating any potential threat to cost performance
Cost models (regression models	
Monte Carlo simulations	
Work-breakdown structure	
Lifecycle costing	

FUTURE DIRECTION

Thinking CM as activities dealing with:

- ***cost finding,***
- ***forecasting,***
- ***planning,***
- ***developing and***
- ***analysis of project processes and control.***

❑Fundamentally, a new understanding of cost management and QS services

➢Away from cost estimating and control to:

❑*With this thinking, CM is*

➢*Commercial management to the contractor, funders and clients*

➢*Cost engineering, cost controlling to oil and gas stakeholders*

➢*Contract and project management to the clients*

➢*Cost consultancy and financial management to clients and designers*

❑*QS is a professional construction cost, contract and procurement manager*

SUSTAINABILITY SUSTAINABLE BUILDINGS

- Costing for SB outweighs estimating the cost of building to the costing the implications of the building and construction operations to the environment.
- Sustainability optioneering in design, achieving sustainability value in procurement
- CM of SB gravitates as measuring, costing and valuing green
- Greenness adheres to theory of practice; requisite practice in a region underscore what the is considered green features
- Green technologies are Building applied (add-ons) and Building integrated
- Effective CM, requires the knowledge of sustainability drivers and green features the design can implement to achieve this goal
- Cost advice is based on lifecycle cost analysis
- not an arbitrary percentage or lump sum addition

SUSTAINABLE BUILDINGS CONTD.

❑Pay considerate attention to:

❑ **sustainable features,**

❑**cost of construction site waste management,**

❑levels of local employment and skills,

❑traffic and transport implications for embodied carbons.

❑In retrofit projects; use **pre-demolition audit** to optimise recycling, save costs; minimize dumpsite and carbon footprint (sustainability point)

❑During planning, clearly **define the sustainability goal** of the project basing on its direct **relationship with cost and green cost premium**

❑Scale-up **VE skills** to save costs and improve greening goal through design optioneering

❑Cost is given as **indicative cost/area for low or zero carbon technologies,** materials and other features

❑**Avoid lump sums, and identify those features or sustainability issues in the tender report**

ICMS

- **Two major requirements** are added to infrastructure cost management **additional risk register in BESMM4**
  - Whole life costing analysis
  - Carbon emission considerations

Class F - Insitu concrete

Section	Description	Unit	Quantity	All-in unit (£)	CO_2 (kg)	Capital cost (£)	Carbon cost (kg)
F2	Provision of concrete: Designed mix						
	Ordinary cement to BS EN 197						
F4.1.3.02	Grade C10; 20mm aggregate	m^3	0.0	97.04	267.12	0.00	0.00
F4.1.3.04	Grade C20; 20mm aggregate	m^3	0.0	105.4	335.59	0.00	0.00
F4.1.3.06	Grade C30; 20mm aggregate	m^3	148.4	113.52	399.94	16842.39	59337.10
	Sulphate resisting cement to BS 4027						
F5	Placing of concrete: Mass						
F5.1	Blinding						
F5.1.1.02	Thickness < 150mm	m^3	27.0	27.26	5.9	736.02	159.30
F5.1.2.02	Thickness < 300mm	m^3	0.0	25.97	5.62	0.00	0.00
F5.2	Bases, footings, pile caps and ground slabs						
F5.2.1.02	Thickness < 500mm	m^3	0.0	18.18	3.93	0.00	0.00
F5.2.2.02	Thickness > 500mm	m^3	0.0	18.18	3.93	0.00	0.00
F5.4	Walls						
F5.4.3	Thickness < 500mm	m^3	0.0	20.78	4.49	0.00	0.00
F5.8	Thrust blocks						
F5.8.2.01	Thickness > 1200mm	m^3	0.0	38.95	8.43	0.00	0.00
F6	Placing of concrete: Reinforced						
F6.2	Bases, footings, pile caps and ground slabs						
F6.2.2	Thickness < 500mm	m^3	15.8	24.67	5.34	388.55	84.11
F6.2.4	Thickness > 500mm	m^3	15.8	19.47	4.21	306.65	66.31
F6.3	Suspended slabs						
F6.3.2	Thickness < 300mm	m^3	108.7	28.56	6.18	3103.76	671.61
F6.3.4	Thickness > 300mm	m^3	8.2	25.97	5.62	212.69	46.03

DIGITAL TECHNOLOGIES

- BIM (Schematic BIM, design BIM and as-built BIM) automated measurement, facilitates estimating and tracks projects during construction; suffice for estimating, cost control and final account
- BIM tools (3D, Laser scanning, RFID and camera)
- Augmented and virtual reality
- Mobil technologies
- IoTs
- Artificial intelligence and machine learning
- Drones and robotics
- Cyber security and blockchain
- Big data analytics
- Construction software and data eco-system

CHALLENGES

- Project complexity (construction duration, diverse activities etc.)
- Dearth of innovation in cost management processes
- Reliance on cost and time performance makes CM static
- Fragmented industry and discontinuity of projects
- **Accuracy bias**
- **Tedious tasks**
- **Time pressure**
- **Dearth of Standards and their application**
- **Poor reputation, low visibility of profession and identity crisis**
- **Changes in procurement methods**
- **Modern construction methods**

CONCLUSION AND RECOMMENDATIONS

- ❑Cost management is not static as perceived, practice and paraded
- ❑Time and events are modifying its activities; professionals in this field must grow with the trend

Recommendations/Strategies

- ❑Inclusive thinking, paradigm shift and cost as system thinking
- ❑Wider collaboration
- ❑Integrated project delivery
- ❑Technological innovations (BIM) (difficulty, quackery and accuracies failures)
- ❑Quality design information
- ❑Big data analytics (developing models and pattern to ease CM tasks and operation)
- ❑Institutional frameworks

THANK YOU

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