LIFE-CYCLE COSTING (LCC) IN TRANSPORT PROJECTS

Presentation for BBL

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September 7, 2022

The Concept

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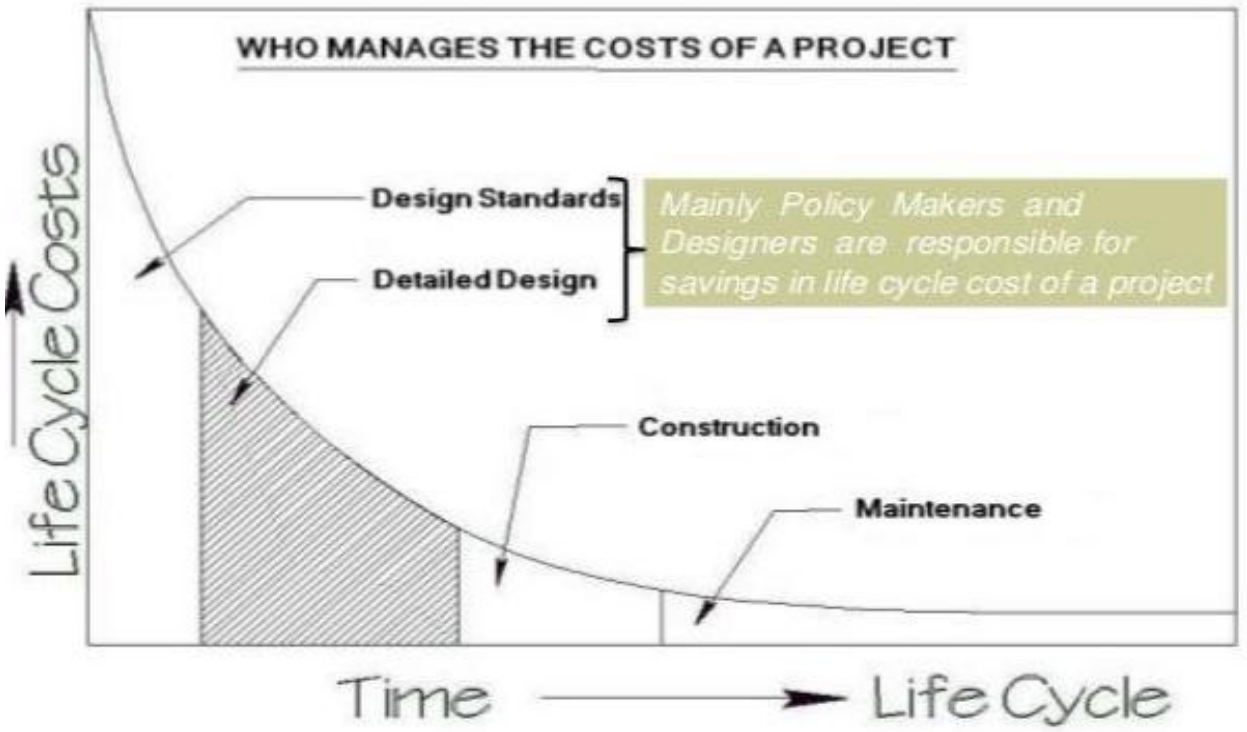
What is Life Cycle Costing (LCC)?

"The life cycle cost of an item is the sum of all funds expended in support of the item from its conception and fabrication through its operation to the end of its useful life" (White and Ostwald, 1976).

- According to World Bank Procurement Guidance, evaluation of bid/proposal costs may include an assessment of life cycle costs.

- The principle of **Value-For-Money (VFM)** does not necessarily mean selecting the lowest price, but rather the lowest total cost of ownership over the useful life of an asset.



Life cycle costs of a project

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LCC in various contract types

- Transition in LCC responsibilities and opportunities from the **client** to **contractor** as the contract type moves from Item-Rate through Engineering Procurement and Construction (EPC) to Public-Private-Partnership (PPP).

- However, scope for design innovation/options may be limited, depending upon the level of detail specified in the Employers' design requirements for EPC and PPP contracts.

- Also, these contracts cannot address Employer's risks such as availability of Right of Way.

Contractor's responsibility for overall O&M increases

EPC + maintenance type contracts or PPP concessions are considered synonymous to "LCC" based contracts as they attempt to optimize capex and O&M costs over the project life cycle and transfer time and cost overrun risks…

Relationship between the life of the asset and contract duration is critical.

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Case Study – WB-funded Tamil Nadu Road Sector Projects

LCC through the lens of TNRSP II vs TNRSP

- This case study looks at life cycle costing through the lens of the World Bank funded Second Tamil Nadu Road Sector Project (TNRSP II) (approved 2003), vs Tamil Nadu Road Sector Project (TNRSP) (approved 2015).

TNRSP –

Traditional item-rate contracts

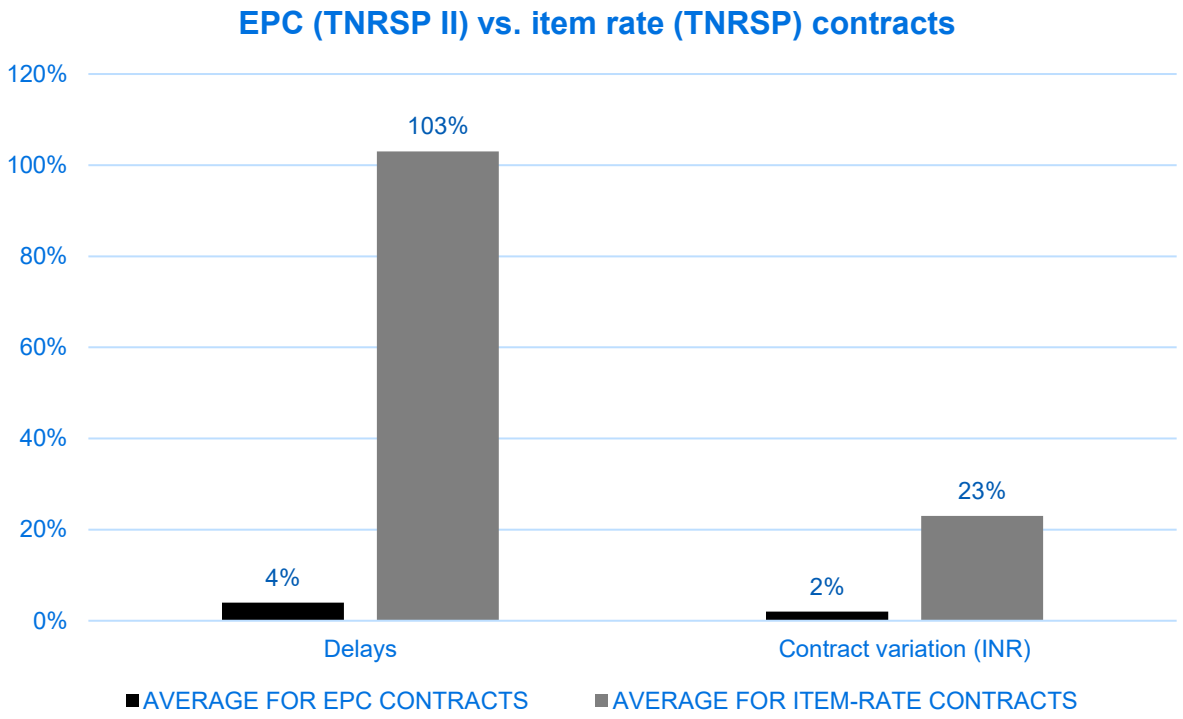
- were prone to high transaction costs
- offered limited scope for harnessing economies of scale/technology
- contained few incentives for containing time and cost overruns or optimizing life cycle costs.

TNRSP II –

EPC + maintenance type contracts or PPP concessions

- construction and maintenance responsibilities clubbed under a single contract.
- major risks related to design and utility relocation transferred to the contractor and payments linked to outcomes, thereby providing stronger incentives for quality, better services, efficiency, cost optimization.
- similar objectives sought to be achieved through performance based multi-year maintenance contracts.

EPC contracts (TNRSP II) vs. item rate contracts (TNRSP) – performance on key metrics



Note: Increases (overruns) are shown as +ve, decreases (savings) are -ve

- EPC contracts (with inbuilt maintenance) had much **lower** –
  - time overruns (4 percent for EPC vs 103 percent for item-rate) and
  - contract cost variation (Rs. 27 million or 2 percent under EPC vs. Rs. 471 million or 23 percent under item-rate contracts).

- This brings out the **efficiency gains** from the use of EPC contracts (with inbuilt maintenance) i.e. Life Cycle approach.

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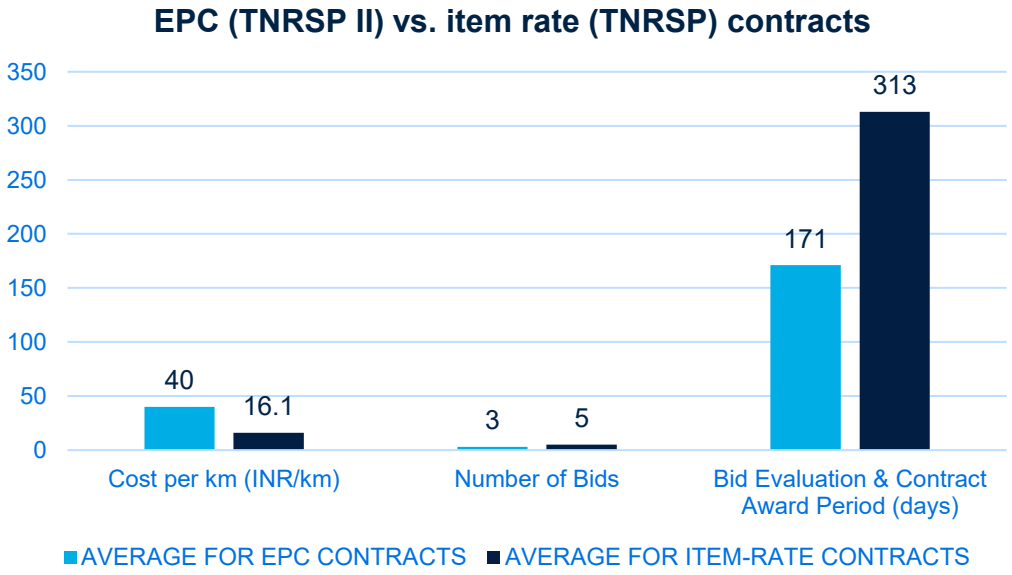
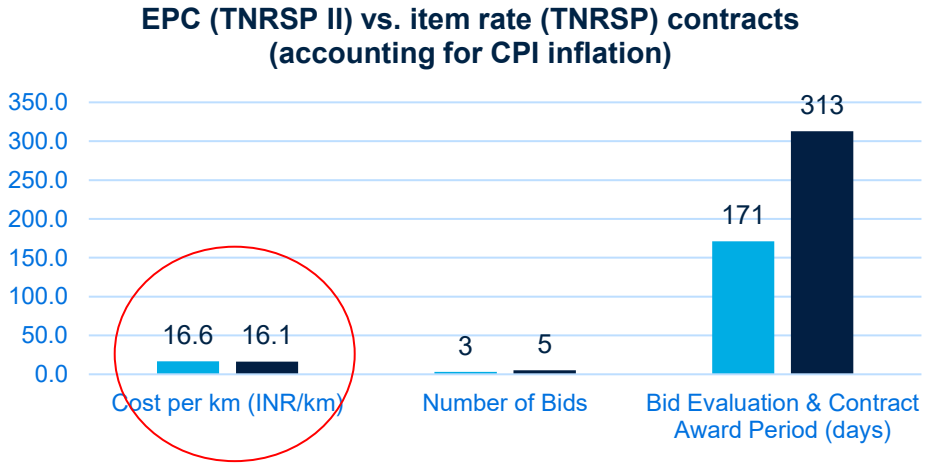
EPC contracts (TNRSP II) vs. item rate contracts (TNRSP) – performance on key metrics





Source for CPI: The World Bank Data Bank

- EPC contracts on average –
  - received **fewer bids** - may be due to fewer qualified bidders for EPC works.
  - had a **lower bid evaluation and contract award period**, possibly because the Employer had more experience in efficiently handling the bidding process, and lack of a rate analysis for lump-sum EPC bids.
  - Had higher average per km costs than item-rate:
    - Additional risks under EPC format.
    - Market unfamiliar with EPC format.
    - Addition of 5-year maintenance raises EPC costs slightly.
    - The difference in number of bids between the two types of contracts.
    - The item-rate contracts were awarded some years before most of the EPC contracts.
  - Average costs per km is similar after discounting cost based on an estimate of CPI inflation

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Performance of PPP contract under TNRSP II (70.2 km, 1 contract)

PPP No.	Road	Km	Contract Price & Cost/km (INR. Mn.)[1]		Cost/time overruns	Physical Progress (%)	Financial Progress[2] (%)
			Contract price	Cost/km	(%)		
02	Four laning of Oddanchatram-Dharapuram-Avinashipalayam section of SH-37	70.2	9,472.3	135	Completed 3 months ahead of schedule	99.1	99.1

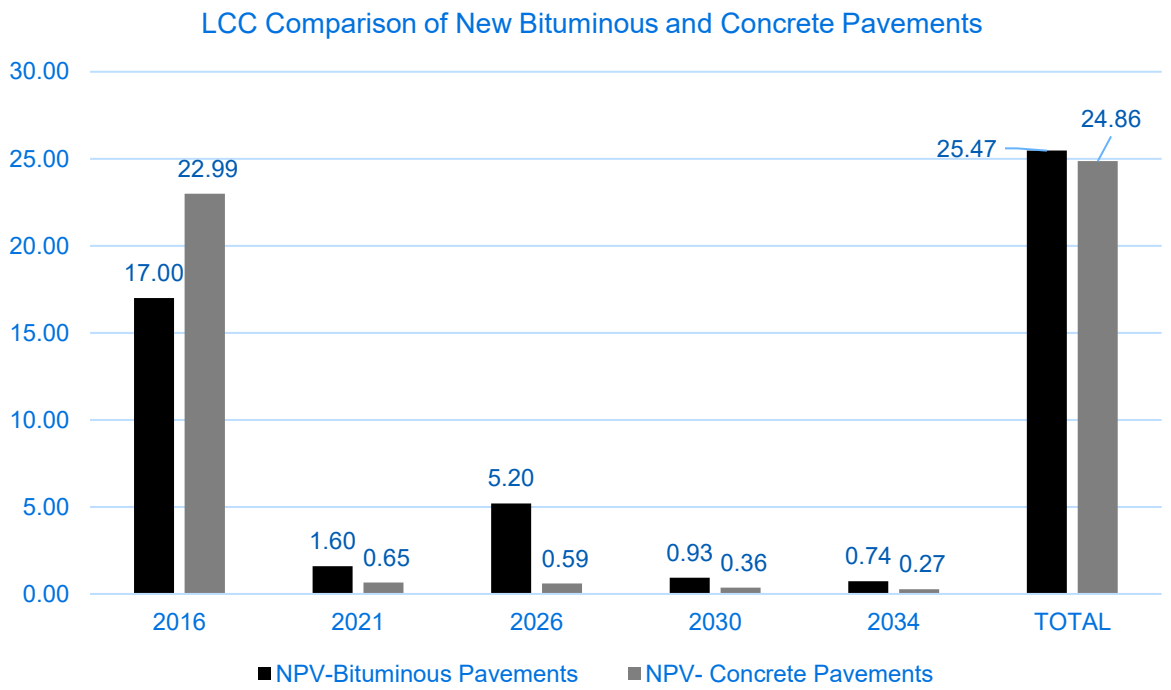
- Experience of the proposed three PPP contracts was mixed: one of the proposed contracts was completed ahead of schedule but it was not possible to attract viable bidders for the other two contracts.

- The state recognized the advantages of the PPP contract delivery model and would investigate the factors that determine their success or failure based on experience under the project and elsewhere.

Bituminous or concrete pavements?

How does LCC affect the choice between bituminous (flexible) and concrete (rigid) pavement construction and bituminous and concrete overlays?

- A 2017 study published in the International Journal of Innovative Science and Research Technology found:
  - Construction cost of concrete pavement (Rs. 22.9 million) is significantly higher than of bituminous pavements (Rs. 16.9 million).
  - LCC of bituminous pavements (Rs. 25.5 million) was about 2.4 percent higher than that of concrete pavements (Rs. 25 million).
- The analysis concluded that **concrete pavements** have higher economic benefits than **bituminous pavements** despite their higher initial cost.



Source: [1]

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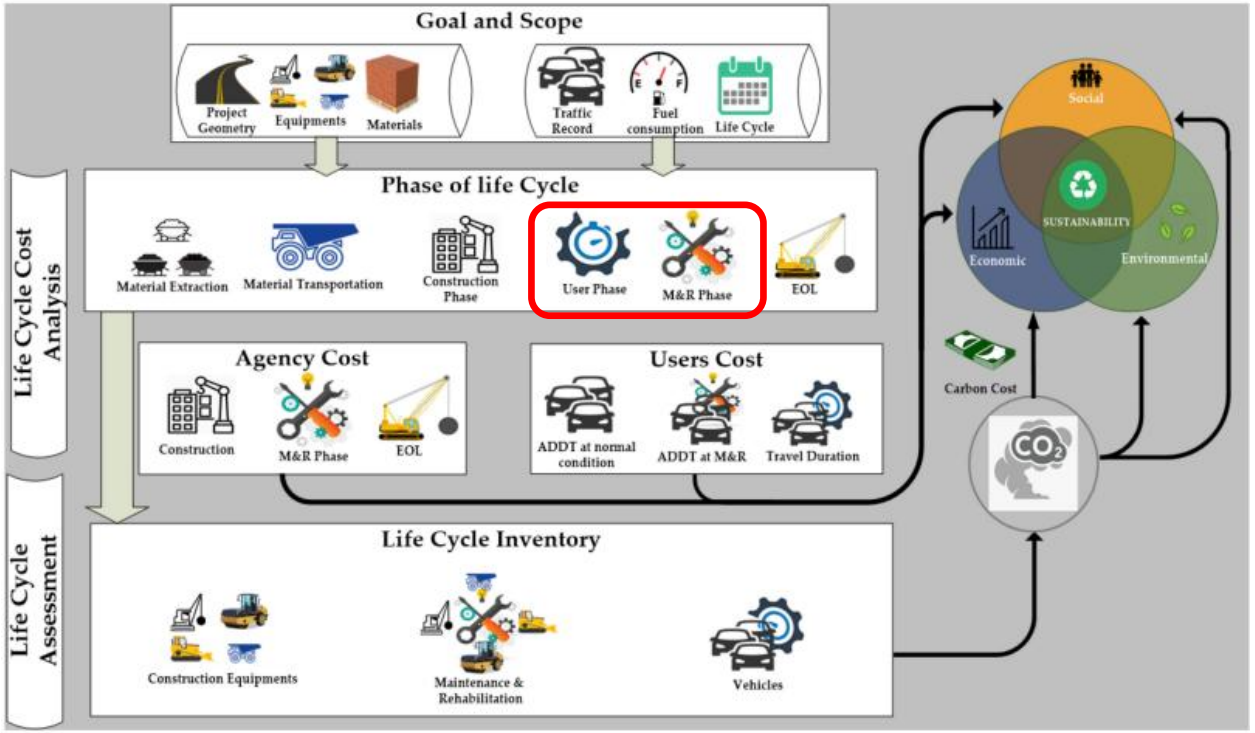
Design/Technology/Contract type options to decrease LCC and reduce Overall Carbon Emission

To what extent does carbon-accounting alter the LCC calculations?

- Essential that the environmental costs of pavement projects is assessed, and that carbon assessment is added to the calculation to better guide policy.
- A case study was conducted to incorporate the environmental cost in life cycle costing.
  - An integrated Life Cycle Assessment and Life Cycle Cost Analysis took costs and impact for pavement construction, maintenance and rehabilitation and user phases.
  - Found that the different phases of the life cycle of a project affect the economy, social life, and environment at different levels. The **user phase** had the highest cost and impact followed by **Maintenance & Rehabilitation (M&R).**



Source: [2]

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Challenges and Recommendations

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Challenges

- On item-rate contracts, the onus on defining LCC solutions lies with the client and their design consultants.

- In EPC (with inbuilt maintenance) and PPP contracts there is a **clear financial incentive** for contractors to present a longer-term solution and these are thus more amenable to concepts of LCC and VFM.

- Cost comparisons to compare like with like can be difficult, but are essential to convince clients of the benefits of LCC

Need for breaking the old mindset for awarding contracts on lowest bid price basis.

Way forward?

- The **Detailed Project Report (DPR) phase** is critical for determining life cycle costs and potential value saving/engineering concepts that can be applied – but these must also be reflected in client requirements.

- Time to consider **gradual introduction of concepts of green and sustainable procurement** (such as the Green Procurement Principle (GPP) and Sustainable Procurement Principle (SPP)) into civil works procurement for sustainable highways in India?

- Recent introduction of **rated evaluation criteria** (where quality aspects are given weight during bid evaluation) may help in adoption of LCC as well as GPP/SPP.

References

1. Life Cycle Cost Analysis of Flexible Pavements and Rigid Pavements in Urban Areas, International Journal of Innovative Science and Research Technology, Shirole Pratik Ashok and Patil Ashwini R., Volume 2, Issue 6, June – 2017
2. Alaloul, W.S.; Altaf, M.; Musarat, M.A.; Faisal Javed, F.; Mosavi, A. Systematic Review of Life Cycle Assessment and Life Cycle Cost Analysis for Pavement and a Case Study. Sustainability 2021, 13, 4377. https://doi.org/10.3390/su13084377
3. Heidari, Mohammad & Heravi, Gholamreza & Nezhadpour Esmaeeli, Asghar. (2020). Integrating life-cycle assessment and life-cycle cost analysis to select sustainable pavement: A probabilistic model using managerial flexibilities. Journal of Cleaner Production. 254. 120046. 10.1016/j.jclepro.2020.120046
4. Consulting Services for Value Engineering Program for National Highway Design and Construction, Final Project Report October 2018, Prepared for Ministry for Road Transport & Highways, India by TRL
5. Climate-based protectionism: Green public procurement can incentivize public sector to eliminate polluting tech, August 2021, Fostering industry transition through green public procurement: A “How to” guide for the cement & steel sectors, June 2021, Sustainable/Green Public Procurement, CERC- ENVIS Resource Partner, 2020, Sustainable Public Procurement in India: Selection of priority products and Preliminary Market Assessment, December 2019, Green public procurement (GPP) of construction and building materials, December 2014, Public Procurement In India, Engagement with Sustainability Concerns in Public Procurement in India: Why and How, August 2013

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