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Application Of Value Methodology of Making Electric Vehicle Charging Infrastructure Cost Efficient in India

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Abstract

India's electric vehicle (EV) revolution is gaining momentum, but the high cost of charging infrastructure remains a critical barrier to widespread adoption. This paper presents a structured application of the Value Methodology (VM) to improve the cost efficiency of EV charging infrastructure in India without compromising functionality, quality, or performance. A multidisciplinary team conducted a value study incorporating key VM phases—Information, Function Analysis, Creative, Evaluation, and Development—to examine current infrastructure designs and deployment models.

Using Function Analysis System Technique (FAST) diagrams and life-cycle cost analysis, the team identified high-cost drivers such as land usage, redundant structural elements, and over-specified electrical components. Creative alternatives, including modular station designs, shared grid connections, and integrated solar power systems, were evaluated for feasibility and value improvement. The study resulted in proposed solutions yielding potential cost savings of 25–30%, while maintaining essential performance criteria.

Stakeholder involvement—government bodies, utility providers, OEMs, and end-users—was critical in aligning value objectives and implementation pathways. The study concludes that VM is an effective tool for balancing cost, function, and stakeholder expectations in infrastructure planning. This paper contributes a replicable model for applying VM to large-scale public utility projects in emerging markets, supporting India's broader sustainability and electrification goals.

1. Introduction

India's journey toward a sustainable transport ecosystem is gaining momentum with the adoption of electric vehicles (EVs). One of the key pillars supporting this transformation is the development of Electric Vehicle Charging Infrastructure (EVCI). While the push from the government, market incentives, and increased consumer awareness have contributed to EV adoption, the establishment of a cost-effective, reliable, and scalable EVCI remains a challenge. Cost overruns, inefficient space utilization, and lack of integrated planning are frequently observed in current installations. This case study examines how Value Methodology (VM) was applied to EV charging infrastructure projects in India to reduce costs, enhance value, and support scalability through functional analysis and stakeholder collaboration.

2. Case Study Context

Three cities—Delhi, Pune, and Bengaluru—were chosen for the study based on their diverse deployment models (government-run, public-private partnership, and private-operated). Each site featured existing EV charging infrastructure at different stages of maturity. The primary goal of the case study was to apply VM principles to identify cost inefficiencies and develop value-driven alternatives.

Each city adopted a differing infrastructure development models:

- **Delhi**: Government-led deployment at metro stations and public parking spaces.
- **Pune**: Public-private partnership (PPP) model with municipal and corporate collaboration.
- **Bengaluru**: Privately operated EV charging stations within tech parks and commercial complexes.

These diverse models provided an excellent opportunity to benchmark costs, deployment speed, utilization rates, and stakeholder perspectives under varied regulatory and market conditions.

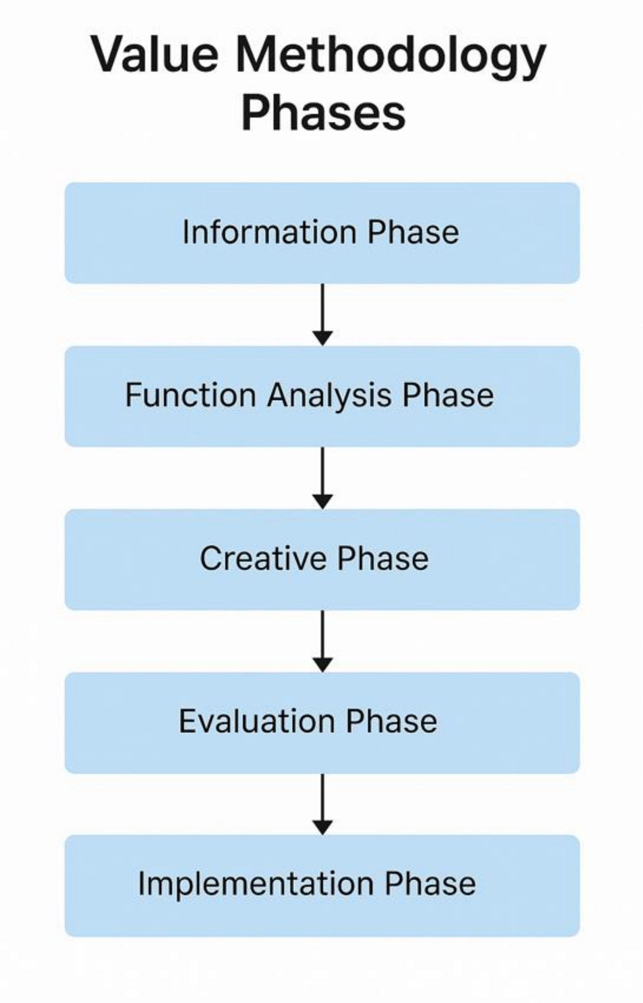
3. Application of Value Methodology

3.1. **Value Study Process**

A multidisciplinary team including stakeholders from engineering, finance, design, and urban planning was constituted. The study followed SAVE International's VM job plan:

- **Information Phase**: Detailed site inspections, technical specs of chargers, and utility bills were reviewed to pinpoint inefficiencies.
- **Function Analysis**: Functions like "Charge EV," "Supply Power," and "Display Status" were analyzed for necessity and value contribution.
- **Creative Phase**: Ideas such as co-located solar charging, mobile charging vans, and lightweight modular structures emerged.
- **Evaluation Phase**: Alternatives were vetted through multi-criteria decision-making techniques.
- **Development Phase**: Actionable plans were created for implementation and piloting.

VM Phase	Activities Conducted
Information	Site surveys, cost breakdowns, stakeholder interviews, usage pattern studies
Function Analysis	FAST diagram creation, essential vs. secondary function mapping
Creative	Brainstorming sessions, benchmarking, ideation workshops
Evaluation	Feasibility analysis, cost-benefit assessments, stakeholder scoring
Development	Detailing of chosen alternatives, pilot planning, implementation strategy



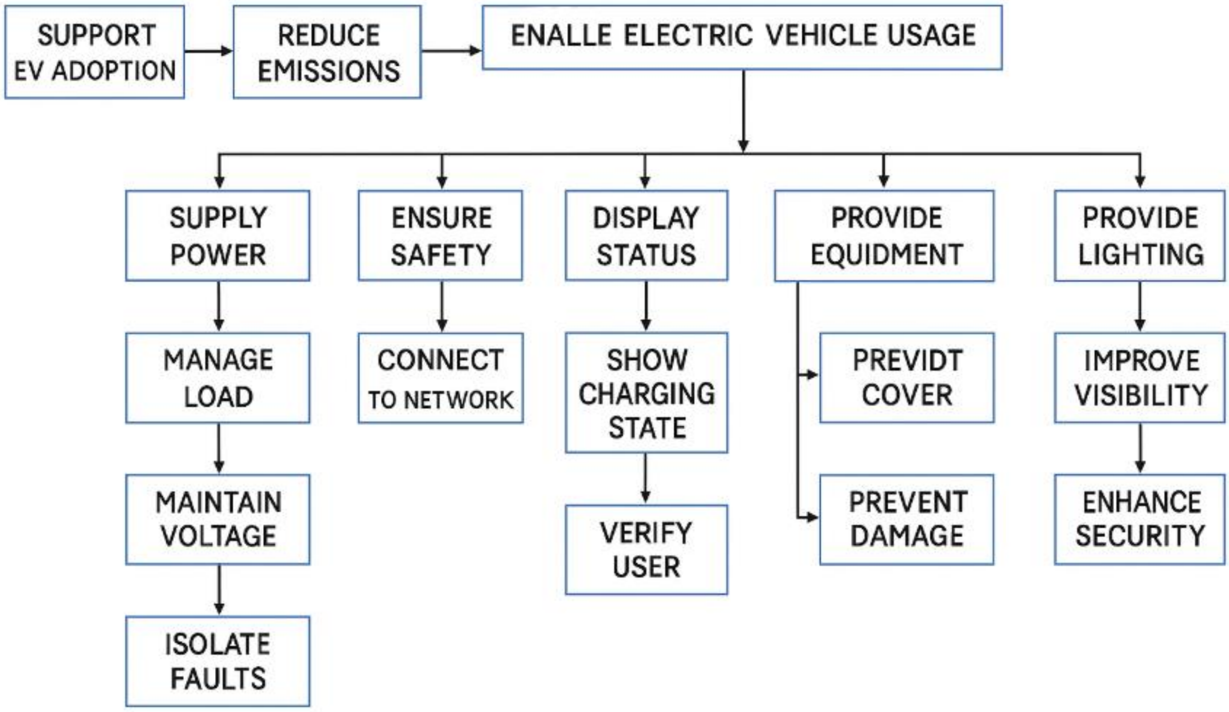
3.2. **Key Functions Identified**

Function Type	Functions
Primary Functions	Charge Electric Vehicle, Supply Power, Ensure Safety
Support Functions	Enable Payment, Display Charging Status, Shelter Equipment, Provide Lighting

- **Primary Functions**: Charge Electric Vehicle, Supply Power, Ensure Safety
- **Support Functions**: Enable Payment, Display Charging Status, Shelter Equipment, Provide Lighting

4. Function Analysis

Using Function Analysis System Technique (FAST), the team visualized the logic behind the infrastructure's design. The FAST diagram helped clarify how each function contributes to the ultimate goal of supporting EV adoption and reducing emissions. The diagram links lower-level operational functions with higher-level policy goals. It clearly distinguishes what is essential from what adds supportive value. A textual FAST diagram is presented below:



5. Cost Drivers and Pain Points

Costs arose from overengineering and site acquisition. Components were often oversized or underused

The VM team identified the following high-cost drivers:

Cost Driver	Description
Land Costs	Expensive leases or acquisition in urban centers
Civil Construction	Overbuilt RCC shelters and infrastructure
Electrical Overspecification	High-capacity panels unused due to low current demand
Underutilized Chargers	Fast chargers placed without matching demand forecasts

6. Creative Alternatives Proposed

Each solution targets a specific cost driver. Ideas were benchmarked for savings and feasibility.

Proposed Alternative	Description	Estimated Savings
Shared Use Agreements	Use existing petrol pumps/mall space	25–30%
Modular Construction	Prefabricated shelters replacing RCC units	40%
Right-Sized Electrical Systems	Scalable load configurations based on projected demand	20%
Solar Integration	Rooftop panels for supplemental/off-peak energy	Long-term ROI
Smart Load Distribution	AI systems to regulate power delivery during peak/off-peak times	Efficiency Gain

7. Evaluation and Feasibility

Evaluation results were compiled using a weighted scoring system based on cost, feasibility, and functionality:

Alternative	Cost Impact	Functional Benefit	Implementation Ease	Total Score (/10)
Shared Use Agreements	High	Moderate	High	8.5
Modular Construction	High	High	Moderate	9.0
Right-Sized Components	Moderate	High	High	8.0
Solar Integration	Moderate	High	Moderate	7.5
Smart Load Distribution	Moderate	High	Low	7.0

8. Implementation and Pilot Results

Pilots were launched in each city:

City	Pilot Initiative Description	Key Outcome
Delhi	Modular units at metro parking	Reduced build time by 40%
Pune	Shared use with public utility land	Eliminated land acquisition costs
Bengaluru	Smart load-managed solar-assisted station at tech parks	15% higher charger utilization

Pilot Summary Chart:

- **Cost Savings**: 25–30% average across all pilots
- **Time-to-Deploy**: Reduced by 35% using modular methods
- **Utilization Rate**: Improved by 20% in optimized locations
- **Stakeholder Engagement**: Increased buy-in and transparency

9. Policy Implications

The case study outcomes indicate the need for supportive policies:

- Encourage VM-led feasibility studies for public infrastructure
- Provide incentives for modular and solar-integrated designs
- Standardize specs to facilitate modular and interoperable solutions
- Simplify land use regulations for shared infrastructure

10. Conclusion

This case study validates the effectiveness of Value Methodology in addressing the cost and efficiency challenges in EV charging infrastructure. By focusing on functions, eliminating unnecessary costs, and fostering collaboration, VM delivered replicable and scalable solutions suitable for India's urban ecosystem. As EV adoption accelerates, VM can be institutionalized as a best practice in infrastructure planning.

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