Business Models and Contracting Structures for Electric Buses - Practices and Lessons

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Why is a Business Model relevant for E-buses?

E Buses operations is a collection of systems, requiring multiple stakeholders to work together

Transit System ➔ Stations and Terminals ➔ Depots and Maintenance ➔ Transit Agency

Batteries and BMS ➔ Control systems & Motor ➔ Fully Built Bus ➔ Bus OEM

Charging System ➔ Charging Management ➔ Step Down Transformers ➔ Energy Solution Provider (ESP)

Grid ➔ HT Supply ➔ Energy Utility

Further, E Buses have comparable TCO, but have high upfront costs versus lower operating costs, requiring upfront capital

The complexities necessitate an viable, incentivised contractual arrangements, several of which are possible.
Global E Bus Business Models – India

**Business Models in India**

**Model 1: Outright Purchase Model**
- Supplies Bus, Charger and Battery to the STU.
- STU owns the bus, operation and maintenance.
- Business model adopted by few cities like Kolkata, Indore, Jaipur, Guwahati, and Jammu under FAME I.
- Many difficulties in deployment and operations.

**Model 2: Gross Cost Contract**
- Investors, OEMs, and ESPs own the STU.
- STU pays a fixed price per km to the Consortium for O&M.
- Mandated model under FAME II.
- More than 3000 e-buses have been procured out of which 900 e-buses are operational.

**Model 3: Utility Provider Led Model**
- EU and energy provider own the STU.
- STU pays for O&M.
- Experimented by NTPC in Andaman Nicobar.

**Predominant Model in India is Gross Cost Contract (GCC).**
Pooled Procurement of 5450 Buses in India

Convergence Energy Services Ltd. (CESL), a PSU under Ministry of Power has selected the operator for procurement, operation and maintenance of 5450 E-buses in 5 Indian cities – Availing the incentives available under FAME II.

**Why Pooled Procurement?**
To homogenise and aggregate demand

**Business Model Used**
Gross Cost Contract

**Contract Period**
12 Years (with 10 lakh assured km)

**Outcome of Pooled Procurement**
TATA Motors won the tender in all Categories

<table>
<thead>
<tr>
<th>Type of Bus</th>
<th>Rate (Rs/Km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 m Low Floor AC</td>
<td>47.49</td>
</tr>
<tr>
<td>12 m Low Floor Non-AC</td>
<td>43.49</td>
</tr>
<tr>
<td>12 m Std. Floor Non-AC</td>
<td>44.99</td>
</tr>
<tr>
<td>9 m Std. Floor AC</td>
<td>41.45</td>
</tr>
<tr>
<td>9 m Std. Floor Non-AC</td>
<td>39.21</td>
</tr>
</tbody>
</table>

**Advantages**

**Economies of Scale**

Lowest Ever price was discovered

Aggregation of demand and centralised procurement seems to have provided better economics. However, merits of common specification and service conditions are yet to be proven.
Global E Bus Business Models - Shenzen

KEY TAKEAWAYS

- The 3e warranty system takes complete care of the vehicles till the end of its lifetime.
- Partnership among operators, manufacturers, financial organizations and charging companies significantly reduced the technology uncertainty and spread the cost burden.

Source: Case Study: Electric buses in Shenzhen, China, 2020 by Zeyuan Song, Yingqi Liu, Hongwei Gao, Suxiu Li

Note: 3e System includes battery, electric motor, and controller
Global E Bus Business Models - Santiago, Chile

KEY TAKEAWAYS

- The new system seeks to split the ownership and operation of assets by having fleet suppliers and bus operators, while the transport authority manages depots.
- Maintenance costs have significantly reduced due to the involvement of manufacturers.

Adopted from: ZEBRA: From pilot to scale - Lessons from electric bus deployments in Santiago de Chile, 2020 by Sebastián Galarza, Transport & Energy Sector Lead, CMM Chile
Region Stockholm, Region Skåne and Region Västra Götaland

**Stockholm**

- **Trafikförvaltningen**
  - PO
  - Ownership of Bus and Chargers
  - Operation
  - Maintenance
  - Development of Depots

- **PTA**
  - Remuneration based on ridership
  - Ownership of all Depots

**Skane**

- **Skånetrafiken**
  - PO
  - Ownership of Bus, Chargers + Charging Infra
  - Operation
  - Maintenance
  - Ownership and Development of Depots

- **PTA**
  - Remuneration based on ridership

**Vasta Gotaland**

- **Västtrafik**
  - PO
  - Ownership of Bus, Chargers + Charging Infra
  - Operation
  - Maintenance
  - Ownership of Few depots + Land for charging Infra setup

- **PTA**
  - Land for Charging Infra.

**Note:** Charging facilities are operated and maintained by the operator itself.

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**KEY TAKEAWAYS**

Variety of models in the same country shows that models may need to be tweaked according to local context.

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*Adopted from: Electric buses for Swedish public transport services, 2019 by Anna-Cecilia Lundström, Matilda Ninasdotter Holmström, Erik Torstensson and Matilda Eriksson.*
## Comparative Matrix – International Case Cities

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Activity</th>
<th>Country</th>
<th>City / Region</th>
<th>China</th>
<th>Chile</th>
<th>Sweden</th>
<th>Västra Götaland</th>
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</thead>
<tbody>
<tr>
<td></td>
<td><strong>E-buses</strong></td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>Ownership of buses</td>
<td>FC</td>
<td>FC</td>
<td>PO</td>
<td>PO</td>
<td>PO</td>
<td></td>
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<td>2</td>
<td>Funding For Procurement</td>
<td>FC</td>
<td>FC</td>
<td>PO</td>
<td>PO</td>
<td>G</td>
<td></td>
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<tr>
<td>3</td>
<td>Supply of Buses</td>
<td>VM (Through Lessee)</td>
<td>VM</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Bus Operational Services</td>
<td>G + PO</td>
<td>G + PO</td>
<td>PO</td>
<td>PO</td>
<td>PO</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Bus Maintenance Services</td>
<td>G + PO</td>
<td>VM</td>
<td>PO</td>
<td>PO</td>
<td>PO</td>
<td></td>
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<tr>
<td></td>
<td><strong>Battery</strong></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Ownership of Battery</td>
<td>PO</td>
<td>FC</td>
<td>PO</td>
<td>PO</td>
<td>PO</td>
<td></td>
</tr>
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<td>Supply of Batteries</td>
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<td>VM (Through</td>
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<td>ND</td>
<td>ND</td>
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<tr>
<td>3</td>
<td>Regular Maintenance of Battery</td>
<td>PO</td>
<td>VM</td>
<td>PO</td>
<td>PO</td>
<td>PO</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Systematic tracking of Battery Usage</td>
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<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
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<tr>
<td>5</td>
<td>Replacement of Battery</td>
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<td>ND</td>
<td>ND</td>
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<td>6</td>
<td>Disposal and Recycling of battery</td>
<td>PO</td>
<td>VM</td>
<td>ND</td>
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<tr>
<td></td>
<td><strong>Charging Infrastructure</strong></td>
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<tr>
<td>1</td>
<td>Ownership of Charging Infra.</td>
<td>CSP (Gets Rent)</td>
<td>FC</td>
<td>G</td>
<td>G + PO</td>
<td>G + PO</td>
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<tr>
<td>2</td>
<td>Land Acquisition for Charging Infra.</td>
<td>G</td>
<td>ND</td>
<td>G</td>
<td>G</td>
<td>G</td>
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<tr>
<td>3</td>
<td>Supply of Chargers</td>
<td>VM (Through ESP)</td>
<td>VM (Through ESP)</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
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<td>CSP</td>
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<td>Charging Infra. Service Provisions</td>
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<tr>
<td>6</td>
<td>Charging Infra. Management</td>
<td>CSP</td>
<td>FC</td>
<td>PO</td>
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<tr>
<td>7</td>
<td>Electricity Provision for Charging Infra.</td>
<td>G</td>
<td>ND</td>
<td>ND</td>
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<tr>
<td></td>
<td><strong>Staff Requirement</strong></td>
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</tr>
<tr>
<td>1</td>
<td>Staff needed for Operation</td>
<td>VM</td>
<td>VM</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Staff Needed for Maintenance</td>
<td>VM</td>
<td>VM</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td></td>
</tr>
</tbody>
</table>

### Legend
- **Government (G)**
- **Finance Company (FC)**
- **Private Parties (PO)**
- **Charging Service Provider (CSP)**
- **Partnership (G + PO)**
- **Vehicle Manufacturer (VM)**
- **Not Discussed (ND)**
E-Bus Business Models Across the Globe

Inclined towards Unbundling and Outsourcing
Criteria for Selection of E-Bus Business Model

Selection Criteria
1. Does it address Performance Risk of Buses?
2. Assures Effective Use of Existing Resources?
3. Aligned to timing and quantum of available funds?
4. Is the Contract easy to manage?
5. Is the Market for suppliers and Service Providers sufficiently evolved?

Risks to be mitigated
1. Technology Risk
2. Operations Risk
3. System Maintenance Risk
4. Support Infrastructure Development Risk
5. Labour relationship Risk
6. Funding Risk
7. Contract Management Risk

- Risk of managing new technology in absence of inhouse capacity
- Availability of skilled and trained driving manpower is very crucial for e-bus operations
- Each system components i.e EV drivetrain, batteries, charging infra, electric infra requires different skill sets and expertise.
- Performance of Charging Infrastructure and availability of HT power
- E-buses may replace existing buses hence the existing manpower needs to be used.
- Availability of upfront capital subsidy OR periodic funding
- Inhouse capacity is required for management of complex contracts compared to goods procurement.
Summarizing Lessons from Global Experience

Mandatory OEM Participation

To reduce technological and Operational Risk

Strong Contractual Arrangements

Multiple stakeholders are involved, hence the responsibilities to be defined clearly and risk to be passed on to the party best able to bear it

Warranty for Battery and Drivetrain

To mitigate the battery risk as it is about 40% of the bus cost
Thank You

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