

TRAINING NEEDS ASSESSMENT (TNA) FOR ELECTRIC BUSES IN INDIA



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Need for Training and Execution Process

E-Bus Skill Framework for PTAS

E-Bus Skill levels at PTAs and Training Needs

E-Bus Training Program

NEED FOR TRAINING

Transitions in bus system



Regulatory
CNG, BSIV



Voluntary
ITS, Low floor

Barriers in Transition to e-Bus



Technological



Financial



Institutional



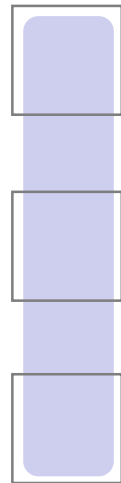
Vehicle/Battery



Operator



Charging Infrastructure



TNA ?

All these transition **require skill upgradation** periodically for **sustainable and longevity** of the system

To understand the requirements, overcome barriers and to smoothen this transition process

STEP-BY-STEP EXECUTION AND OUTCOMES



Design of TNA framework
(functions, sub-functions and activities)

Interaction with relevant **Stakeholders** and **data collection**

Data Analysis and Assessment of STUs
e-Bus skill gap capacities across PTA staff

Recommendation on **Training Needs** for PTA staff across e-Bus life cycle

Prepare training programme and propose training modules for various roles at PTAs

Prepare organization structure and resource requirements (JDs) for PTAs

Outcomes

1

Training needs assessment for e-Buses at PTA

2

Training programme and pilot execution for PTA

3

organization structure and resource requirements for PTA

E-BUS SKILL FRAMEWORK FOR PTA: 7 FUNCTIONS | 28 SUB-FUNCTIONS



Strategy Roadmap and Planning

Technical Specification Design

Procurement

Operations

Repair and Maintenance

Monitoring and Control

Scrapping and Recycling

Need for e-Buses

↓
Size and Technology Selection

↓
Long-term Transition Strategy

↓
Manpower Planning and Staffing

Power Requirement

↓
Range Requirement

↓
Battery Selection and Sizing

↓
Charging and Electrical High Voltage Systems Selection and Sizing

↓
Depot and Terminal Infrastructure Requirements

↓
Spare Parts Specifications

↓
ITMS Specifications

E-Bus Purchase Specification

↓
Contract and Performance Documentation

↓
Stores and Purchases

E-Bus Route Network and Operations Planning

↓
E-Bus, Crew and Chargers Scheduling

↓
E-Bus Driving

E-Bus Charging

↓
Preventive Maintenance, Breakdown Repairs and Overhauling

↓
Batteries & BMS

↓
Thermal Management System of Batteries

↓
Electronics, Sensors, Wiring, Fuses etc.

↓
Motors, Drive, Controllers and Regenerative Braking

↓
E-Bus Charging

↓
Air Conditioning

ITMS and MIS

End-of-Life Definition

↓
Scrap Disposal and Tracking

SUPPLY AND DEMAND SIDE STAKEHOLDERS INTERACTION AND DATA COLLECTION

Data Collection

Supply-side (Online)

51

Survey Responses

PTAs (In-person)

48

Survey Responses

04

PTAs visits

Personnel's across all Hierarchies

Top Management
Senior Management
Middle Management
Workmen



Shimla-Manali, HRTC

- 75 e-Buses of Olectra and PMI Foton makes
- operating for >2 years
- Under Capex model
- 50 e-Buses sanctioned



Navi Mumbai, NMMT

- 30 e-Buses of JBM make
- Operating for >8 months
- Under Capex model
- 100 e-Buses sanctioned



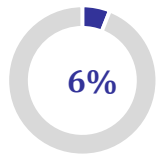
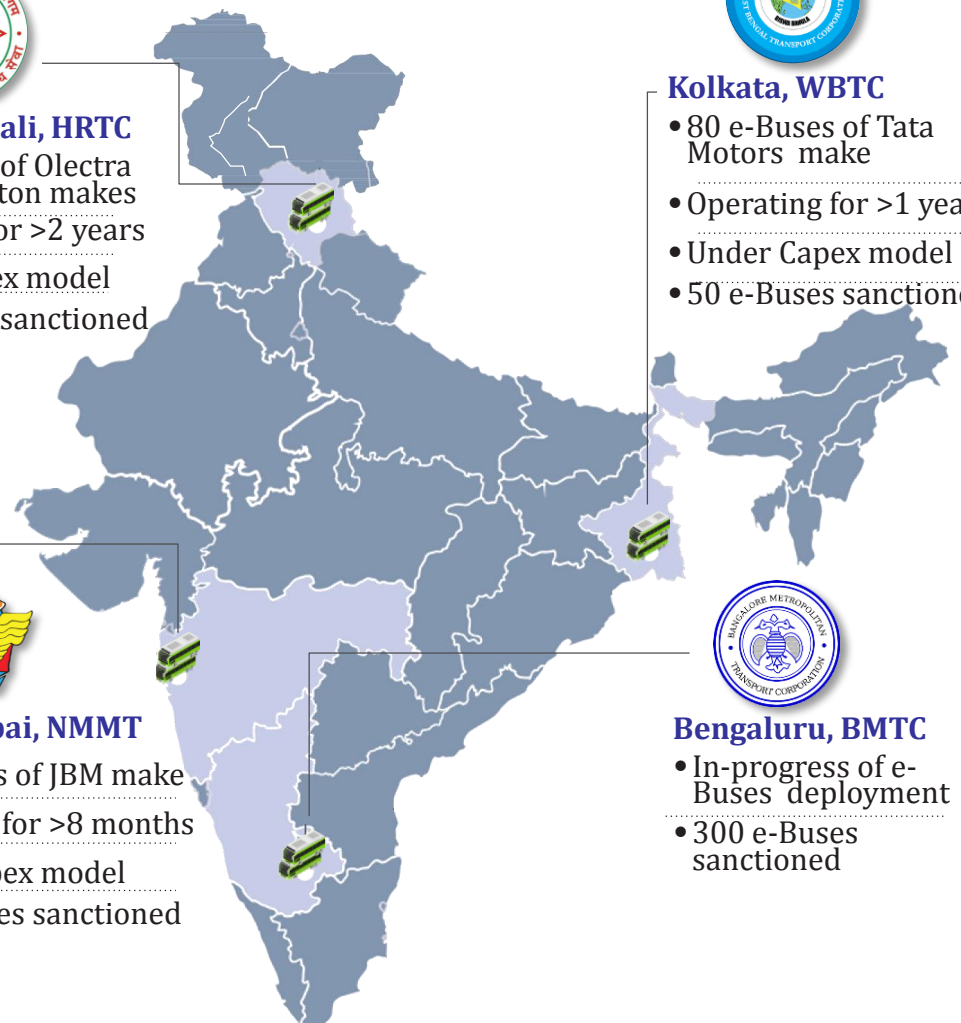
Kolkata, WBTC

- 80 e-Buses of Tata Motors make
- Operating for >1 year
- Under Capex model
- 50 e-Buses sanctioned

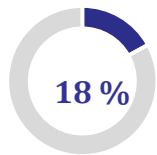


Bengaluru, BMTCL

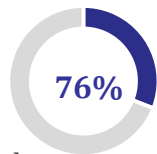
- In-progress of e-Buses deployment
- 300 e-Buses sanctioned



Battery and Charger manufacturers



E-bus Manufacturers



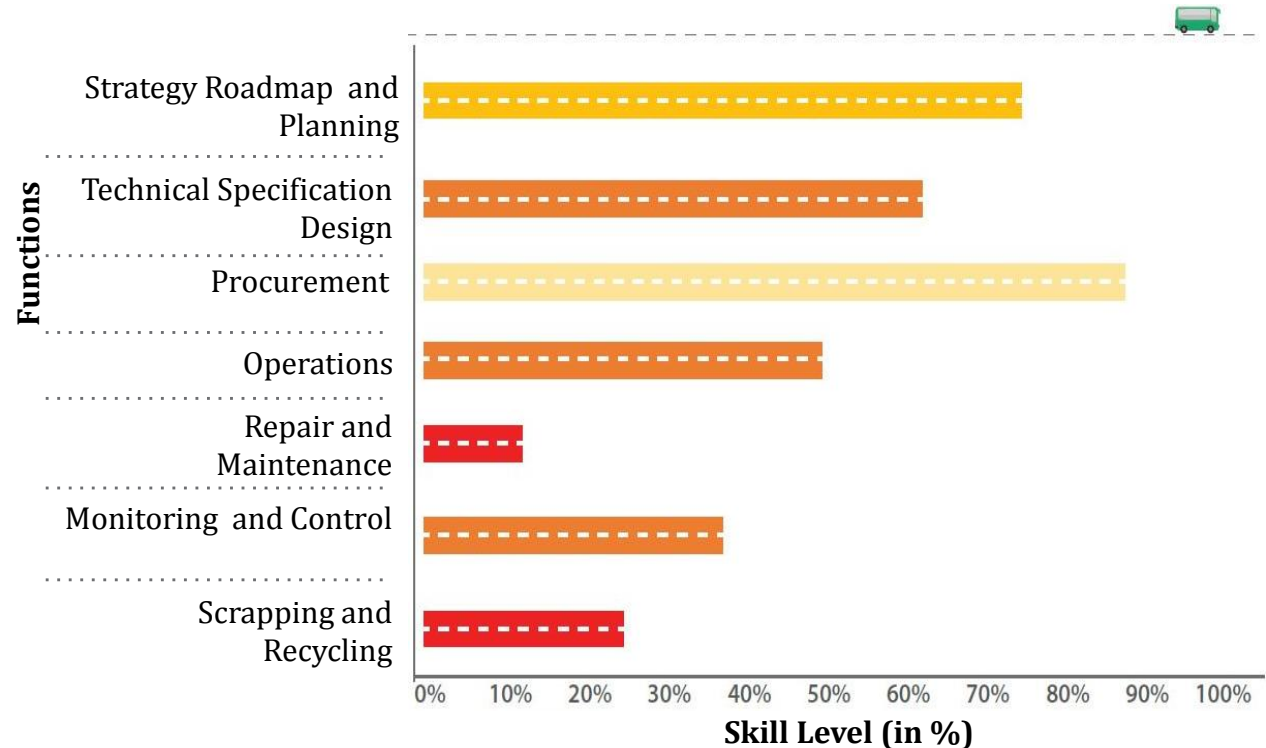
Industry experts

CURRENT SKILL LEVELS AT PTAS

Skill level representation

Colour Code	Current STUs Skill Levels	Level of Training Needs
	High	Low
	Fair	Medium
	Medium	Fair
	Low	High

Overall Skill levels



For 'Procurement' function, STUs have 'High' skill levels

For 'Strategy Roadmap and Planning' function, STUs have 'Fair' skill levels

For 'Technical Specification Design', 'Operations' and 'Monitoring and Control' functions, STUs have 'Medium' skill levels

For 'Repair and Maintenance' and 'Scrapping and Recycling' functions, STUs have 'Low' skill levels

KEY CHALLENGES FACED BY PTAS DUE TO LACK OF SKILLS

1. Strategy Roadmap and planning



- In-sufficient preparations to provide infrastructure to the operator resulting in delay in deployment
- Overall sub-optimal performance

2. Technical specification design



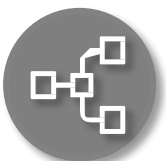
- Sub-optimal choice of battery size and results in operational challenges of not meeting range
- Reduced e-Bus productivity and revenue shortfalls

3. Procurement



- Delayed/ multiple times cancellation of tenders
- Less discovery of optimal price level
- Weaknesses in contract enforcement

4. Operations



- Poor utilization of assets, affects fleet productivity
- Trip loss/ route misses affects customer services
- Schedule disruptions of chargers and e-Buses charging

5. Repair and Maintenance



- Delays in undertaking maintenance activities
- Delays in breakdown repairs
- Higher downtime of e-Buses

6. Monitoring and control



- Failures in obtaining reasons for reduced operational ranges vs. contracted
- Access of data
- Ambiguity in fixing responsibility of ownership between STU, VMs and private operator

7. Scrapping and Recycling



- Lack of clarity on remaining battery life expectancy and its reuse/ recycling procedure

NOTE:

Training needs w.r.t. each of the mentioned functions are elaborated in the upcoming TNA report

TRAINING NEEDS FOR KEY ROLES AT PTAS: 1/2

Top Management and **Senior Management** roles plays an important part across functions ‘Strategy Roadmap and Planning’, ‘Technical Specification Design’ and ‘Procurement’. Their training needs mostly ranges from ‘Medium’ to ‘Fair’, with ‘High’ training needs for few important roles like Head Mechanical Engineering.

Functions	Management level	Senior Management					Middle Management			Workmen		
	Sub-functions	MD/ CMD/ Joint MD	Head Traffic	Head Civil Engineering/ Electrical	Head Mechanical Engineering	Head Stores & Purchase/ Procurement	Head IT/ MIS	Depot Manager	Works/ Maintenance Manager	Supervisor	Driver	STU Technician
Strategy Roadmap and Planning	Need for e-Buses	Medium	Medium	Medium	Medium	Fair	Low	High	High	Low		
	Size and Technology Selection	Medium	Medium	Medium	High	Fair	Low	High	High	Low		
	Long-term Transition Strategy	Fair	Fair	Fair	Fair	Fair	Low	Low	Low			
	Manpower Planning and Staffing	Medium	Medium	Low	Fair	Low	Low	Low	Fair	Fair		
Technical Specification Design	Power Requirement		High	Medium	High	Fair	Low	High	High	Low		
	Range Requirement		High		High	Fair	Low	Fair	Fair	Low		
	Battery Selection and Sizing	Low	Medium	Medium	High	Fair	Low	Low	High	Low		
	Charging and Electrical High Voltage Systems Selection and Sizing	Low	Low	High	High	Fair	Low	Low	High	Low		
	Depot and Terminal Infrastructure Requirements	High	High	High	High	Fair	Low	Fair	Fair	Low		
	Spare Parts Specification				High	Fair		Fair	High	Low		
	ITMS Specification		Fair		High	Fair	High	Low	Low	Low		
Procurement	e-Bus Purchase Specification			Medium	High	High	High	Low	Fair	Low		
	Contract and Performance Documentation		Medium	Medium	High	High	Low		Low			
	Stores and Purchase				High	High	Low	Low	High			

Level of Training Needs  Low  Medium  Fair  High

TRAINING NEEDS FOR KEY ROLES AT PTAS: 2/2

Few select Senior Management, Middle Management and Workmen roles plays an important part across functions 'Operations', Repair and Maintenance', 'Monitoring and Control' and Scrapping and Recycling. Their training needs mostly ranges from 'Fair' to 'High'.









Functions	Management level	Top Management		Senior Management				Middle Management			Workmen	
	Sub-functions	MD/CMD/ Joint MD	Head Traffic	Head Civil Engineering/ Electrical	Head Mechanical Engineering	Head Stores & Purchase/ Procurement	Head IT/ MIS	Depot Manager	Works/ Maintenance Manager	Supervisor	Driver	STU Technician
Operations	Route Network and Operations Planning		Medium		Medium		Fair	Fair	Low			
	e-Bus, Crew and Chargers Scheduling		High		Medium	Low	Fair	Fair	Low		Fair	
	e-Bus Driving		Medium		Medium		High	Low	Low	High		
Repair and Maintenance	e-Bus Charging			Low	Medium	Low	Fair	Fair	High	Fair	Low	Low
	Preventive Maintenance, Breakdown Repairs and Overhauling		Low	Low	High	Low	Fair	Low	High	High		High
	Batteries and BMS		Low	Low	High	Low	Fair	Fair	High	High		High
	Thermal Management System (TMS) of Batteries		Low	Low	High		Fair	Fair	High	High		High
	Motors, Drives, Controllers and Regenerative Braking				High		Low	Fair	High	High		High
	Electronics, Sensors, Wiring, Fuses etc.				High	Low	Low	Fair	High	High		High
	Communications			Low	Low	Medium		High	Fair	High		High
Air Conditioning				Low	Medium		Fair	High	High		High	
Monitoring and Control	ITMS and MIS		Low	Low	High	Low	High	Fair	High			
Scrapping and Recycling	End-of-Life Definition and Tracking		Low	Low	High	High	Low	Low	High	High		Low
	Scrap Disposal			Low	High	High	Low	Low	High			Low

Level of Training Needs  Low  Medium  Fair  High

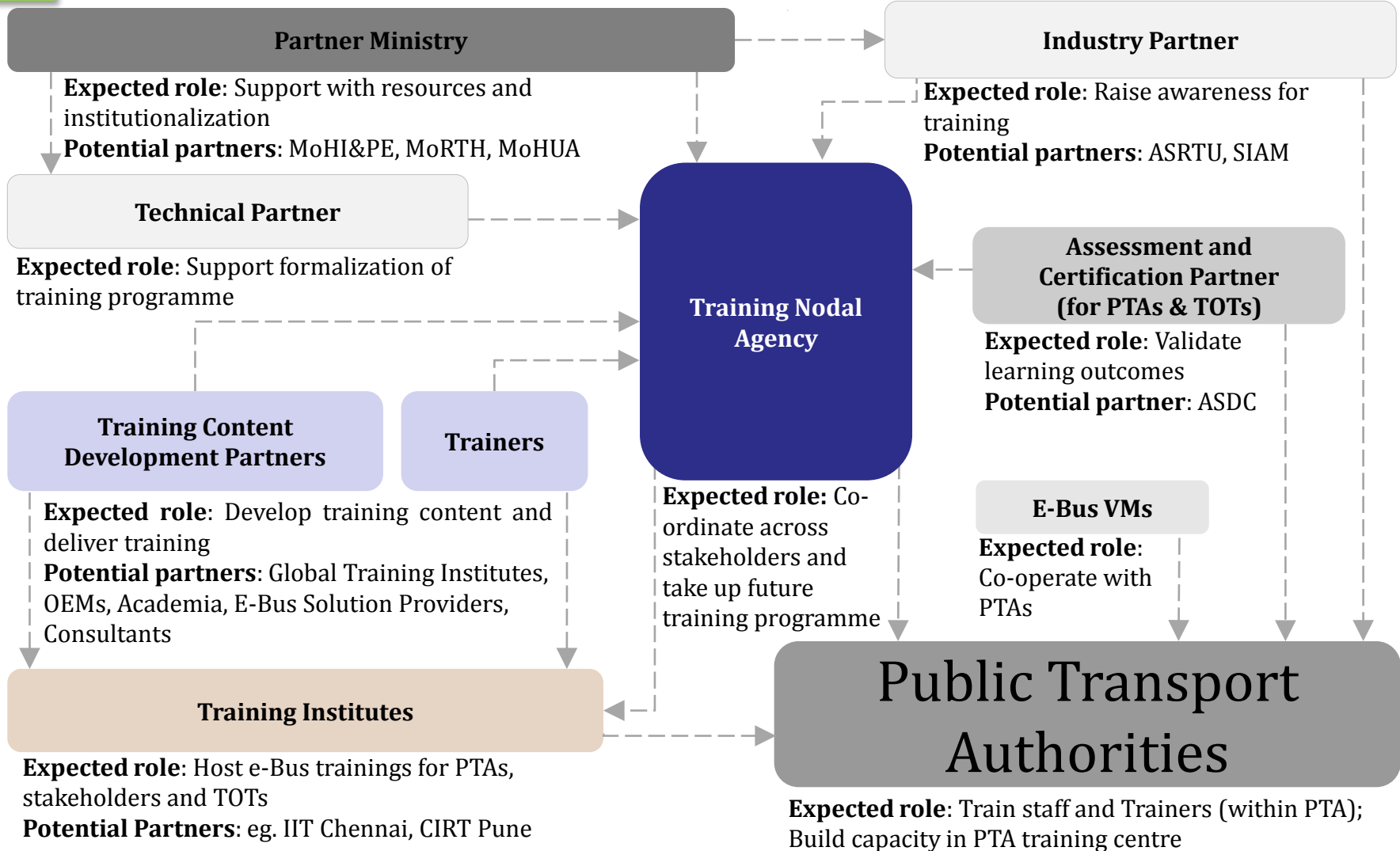
E-BUS TRAINING PROGRAMME MODULES

8 Modules

31 Sub-Modules

							
Fundamentals and Safety	Technology Planning, Specification Design and Selection	Financial Planning and Strategy	Procurement	Operations Planning and Implementation	Monitoring and Control	Repair and Maintenance	End-of-life, Scrapping and Recycling
System Overview and Usage at STUs	Battery Technologies, Sizing and Selection	Life Cycle Cost Benefit Analysis and STU Business Case	Procurement: Purchase Specifications Design	Route Selection, Operations Planning & Scheduling of e-Bus Fleet and Chargers	Performance Monitoring and Evaluation at Depot level	Batteries and BMS Cooling Systems (Bus, Batteries, Motors)	Warranty and End-of-Life Management
Safety and Fire Hazards, SOPs, Prevention and Emergency Handling	Charging Technologies Sizing and Selection	Investments and Financing for different Procurement Models	Procurement: Models and Performance Contract Design	Intelligent Charging and Optimisation	Contract Management and Monitoring Best Practices for PTA	Traction and other Motors, Drive, Controller and Regenerative Braking	e-Bus and Lithium-ion Batteries Scrapping and Recycling
	Charging and Energy Infrastructure Planning	Manpower Planning and Capacity Building	Evaluation, Testing and Inspection Best Practices for PTA	Driver Training	ITMS/MIS Systems for overall e-Bus Fleet, Charging and PTA integration	Electronics and High voltage Electrical Systems	
	Depot Infrastructure and Equipment Planning	Long term Transition Planning from ICE to electric fleet for PTA		Driving Behaviours impact on e-Bus Energy Performance		Chargers and back-end High voltage Electrical Systems	
	Overall System Planning and Optimisation: Scenario Analysis and Trade-offs					On-Board Diagnostics and Communications	
						Overall Preventive Maintenance Planning, Check Lists, Tools, Best Practices	
						Spare Parts & Inventory Planning and Management	

E-BUS TRAINING PROGRAMME STRUCTURE



THANK YOU