Presentation to Kochi delegation
Barry HOWE
19th Jan 2016
Alstom: A global leader in the rail industry

Four activities

TRAINS

SYSTEMS*

SERVICES

SIGNALLING

*Including Infrastructure
Agenda

• India

• Sustainability

• Smart Transportation
Alstom in India: The Journey So far

- **First modern Metro sig. contract in India**
  - DMRC, L1 & L2: Train control and Signalling System 43 M€

- **Bangalore Metro** (BMRCL) Sig. Contract with 65 M€

- **Rolling Stock**
  - 42 - 4 car trains: 241 M€

- **Track Work**
  - Ballastless Track, 30 M€

- **Line Extensions**

- **Delivery of the first train set (4 coaches) manufactured at Brazil to Chennai metro**

- **2001**
  - DMRC, L1 & L2: Train control and Signalling System 43 M€

- **2007**
  - DMRC, L1 & L2: Train control and Signalling System 43 M€

- **2009**
  - Bangalore Metro (BMRCL) Sig. Contract with 65 M€

- **2010**
  - Commencement of operations of AT India’s first rolling stock facility for metro rail coaches

- **2012**
  - Delivery of the first train set (4 coaches) manufactured at Brazil to Chennai metro

- **2013**
  - Rollings Stock
  - 42 - 4 car trains: 241 M€

- **2014**
  - High Growth Period
    - EDFC (APL1) 220M€
    - MADHEPURA E- LOCO 3.32Bn€
    - LUCKNOW (RS + SIG) 155M€

- **2015**
  - RS, S&T, PS, RSS – 161Me
  - Trackwork – 33Me

- **2016**

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Presence in India

- More than 1600 Employees in India
- **Corporate & Commercial Centre**: Noida
- **Manufacturing sites**: 2 (Sricity, Coimbatore)
- Systems Engineering & Product Development Centre, Transport Information Solutions (TIS) & Rolling Stock Engineering Centre: Bengaluru

**RS Projects**: Chennai Metro, Kochi Metro, Lucknow Metro

**Other Project Offices**: Delhi, Jaipur, Bangalore, Tundala

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**Other Project Offices**: Delhi, Jaipur, Bangalore, Tundala

**Bengaluru**
- Transport Information Systems [TIS] Site
- Systems design, Application Engineering
- Software Factory

**Coimbatore**
- Transport Components
- Traction Equipment
- Looming of wiring harness
- Audio Frequency Track Circuits and Point Machines

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India Headcount Evolution

- More than 50 m€ investment in India
- Investment in human capital & engineering capabilities bolstered to 1600+ engineering workforce
- 200m€ investment on E Loco with significant ramp up plans on human capital still on the radar
Ongoing projects

Urban Metro

Kochi (KMRL)
- Rolling Stock
- Signalling & Telecom
- Track & Power Supply

Chennai (CMRL)
- Rolling Stock
- Track & Power Supply

Bengaluru (BMRC)
- Signalling

Delhi (DMRC)
- Signalling
- Track work
- Spares

Jaipur (JMRC)
- Signalling

Lucknow (LMRC)
- Rolling Stock
- Signalling

Mainlines
- EDFC – S&T, Infra
- E-Loco-Madhepura

Kochi Metro highlights
- 1st Train delivery on 2nd Jan 2016, Before schedule delivery

Chennai Metro highlights
- 7 Trains in Revenue service
- 33 Trains delivered
## Current Contracts: in Brief

<table>
<thead>
<tr>
<th>Project</th>
<th>Project Value</th>
<th>Deliverables</th>
<th>Start Date</th>
<th>End Date</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-locos</td>
<td>€3.32B</td>
<td>800 locomotive + Maintenance</td>
<td>Sep'15</td>
<td>Jan 2029</td>
<td>Contract Signed</td>
</tr>
<tr>
<td>LUCKNOW METRO</td>
<td>€343M</td>
<td>20 Trains + 22.87km CBTC SIG</td>
<td>Aug 2015</td>
<td>Dec 2018</td>
<td>Design Phase in progress</td>
</tr>
<tr>
<td>CHENNAI METRO</td>
<td>€271m</td>
<td>42 Trains + Track works</td>
<td>Sep'10</td>
<td>Jun'16</td>
<td>@10km in revenue service, 33 trains (9 Lapa, 24 India)</td>
</tr>
<tr>
<td>KOCHI METRO</td>
<td>€161M</td>
<td>25 Trains + CBTC Sig + Tel + 750VDC third rail PS (in four separate contracts)</td>
<td>Oct'15</td>
<td>Dec'17</td>
<td>1st train delivered, two substations commissioned</td>
</tr>
</tbody>
</table>

### Need For Standardisation in Metro Projects

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Metro and LRT rail network – the Indian scenario

- Delhi, Bangalore, Chennai, Jaipur, Mumbai & Kolkata already have operational metro lines. Construction is under way in Kochi, Lucknow, Noida more cities.

- **Massive investment to the tune of 1.3 trillion INR (17.5 Bn€)** required. Possible modes of funding:
  - 100% Central/State Govt. funded (eg: Kolkata metro N-S Line)
  - Combination of govt. funding and loans from multi-lateral agencies.(eg: DMRC)
  - PPP projects with VGF from State Govt (eg: Hyderabad).
  - 100% private (light metros like Rapid Rail Metro in Gurgaon)

- Global majors are setting up local manufacturing facilities to cater to the huge volume and prospects for future growth. Rolling stock is a case in point.
Upcoming Metro Projects

More than 25 prospective new cities has been identified with Urban Metro projects. **LRT /Trams** are going to be the next most preferred mode of Transportation that will address high volume traffic & clean energy solution simultaneously in Tier II cities.

**North India**
- Delhi Metro | LRT
- Chandigarh LRT
- Ludhiana LRT
- Meerut LRT
- Agra LRT
- Kanpur LRT
- Varanasi LRT
- Lucknow Metro
- Greater Noida Metro
- Gurgaon Metro

**East India**
- Kolkata Metro
- Patna LRT
- Guwahati LRT
- Bhubaneshwar LRT

**South India**
- Chennai Metro
- Bangalore Metro
- Kozhikode and Thiruvananthapuram LRT
- Vishakhapatnam LRT
- Vijayawada –Guntur LRT
- Coimbatore LRT
- Tirupati LRT

**West and Central India**
- Mumbai Metro
- Nagpur Metro
- Pune Metro
- Ahmedabad Metro
- Bhopal LRT
- Indore LRT
- Raipur LRT

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In search of the best combination for these promising cities:

**Light Rail transport solution e.g. Axonis**

- Elegant & Easy to insert in Cities
- Fast to design, build, integrate
- Economical to acquire and operate
- Available & non-proprietary
- Safe & Secure
- Low Energy consumption
- Tailor-made to each city’s architecture thanks to Alstom Design & Styling expertise
- Civil works optimisation leading to up to 20% lower cost of construction
- Lowest LCC calculated amongst all modes over life span
- Narrower viaduct width, can be inserted on road median

**Turnkey Projects**

- Reduces its management and coordination team
- Transfers a maximum of risks to the contractor
- Negotiates with only one supplier
- Transfers the interface management to the contractor
- Transfers the global project performance & quality responsibility to the contractor
- Benefits from facilitated transverse innovations proposed by the contractor
- Benefits from a cost and delivery time optimization by the contractor

**LRT/Tram systems** can complement the urban growth of public transport in India in tier 1 and tier 2 cities with cost, planning and environmental benefits

**French transport companies operating in India** have the expertise to develop a LRT/Tram solution using their present knowledge of successfully building and/or operating public transport systems in **India**
AXONIS – An integrated system on turnkey basis meets the specific transport needs of fast growing and densely populated cities

**Civil Work**
- 45 m minimum curve
- Up to 6% slope
- Viaduct (Tunnel possible)
- Depot at grade
- Test Track possible

**Power Supply**
- 750 Vdc power supply
- HESOP 2x1.2 MW or 2MW
- Medium Voltage Network of 22KV

**Track**
- Slab or Plinth concrete
- 3rd rail 750Vdc
- Underneath captation

**Capacity**
- 10000 to 45000 PPHPD

**Rolling Stock**
- 2 to 5 cars train configuration
- Cars size: 18 m x 2.7 m
- 100% motorised
- Front Evacuation Door
- Max speed 80 kph

**Signalling**
- GoA4: UTO / U400
- Driverless
- 70 s headway minimum
- Centralised control center
- Operation supervision
- Communication network (Audio + Video)

**Depot Equipments**
- Bogie wheel reprofiling
- Cleaning
- Lifting
- Shunting vehicle
- Hydraulic & Electrical tooling...

**PSD**
- Full or Medium height

**ILS**
- Spare parts for warranty
- Specific Tooling for sub systems
- Training / Documentation

Quick construction, easy urban insertion and improved life-cycle costs.
TRAMWAYS - Advantages

- **Environment:** Eco friendly mode of transport

- **Safety:** Safer than Buses and Cars

- **Speed:** Average speed higher than Buses stuck in traffic

- **Effectiveness:** More reliable journey time

- **Regularity & continuity of service**

- **City embellishment:** Road upgrading works
What India means to Alstom going forward (both as a market and as a base for export)

India - A very promising market
(To 2020 & Beyond)

Central & State government initiatives | Competitive Advantage | Understanding of the Market

AT Value proposition

ALSTOM has a strong footprint in India having two factories each at Coimbatore & Sricity for manufacturing propulsion systems and metro cars respectively. These were set up in 1968 & 2013 with a capital investment of over INR 300 crores. In addition, two innovation hubs - one for Signalling and one for Rolling Stock Engineering & Design - currently provide employment to over 1000 employees and are well equipped to cater to the immediate and long terms needs of Indian Railways & the Urban Metro market.

The upcoming opportunities in India and Alstom’s investments & establishments offers immense opportunities for realizing the “Make in India” dream of the Hon’ble Prime Minister
Agenda

- India
- Sustainability
- Smart Transportation
Trains designed to reduce environmental impact and optimise lifecycle costs

5 Eco-design priorities

| Energy efficiency | Use of clean and recyclable materials | Noise reduction | Air emission reduction | Easy end-of-life |

Product Use

Manufacturing

Materials

Life-cycle thinking

Maintenance

End of life Recovery / Recycling

⇒ A network of 100 experts (eco-design, acoustics, materials, energy...)
⇒ Eco-design processes, lifecycle assessment tools, environmental product profiles
Rail offer true environment-friendly solutions

- Less energy consumption
- Less CO$_2$ emissions
- Less impact on landscape

High-speed & very high-speed trains
5 times less energy consumption than planes per passenger*

Metro
5 times less emissions than a bus, 7 times less than a car per passenger**

Citadis tram
Full integration in urban landscape
Catenary-less solutions preserving historical authenticity

* In primary energy equivalent
** With an European energy mix and standard occupancy rates

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Alstom offering for energy efficiency and CO2 reduction

High environmental performance rolling-stock

Energy Efficiency Services

Smart Railway Systems

Weight Reduction
Aerodynamics
Insulation
Efficient Traction & auxiliaries
Hybrid Traction
Braking energy recovery & storage
Optimised sleeping modes

Energy Diagnosis
Energy metering
Eco-driving
Re-tractioning & Retrofit for energy efficiency

Addressing existing fleets is key to rail’s contribution in the fight against climate change

Electrification
Reversible electrical substations for braking energy recovery
Driverless metros & ATO

We also provide solutions to reduce air and noise emissions and improve recyclability.
Agenda

- India
- Sustainability
- Smart Transportation
Emergence of Smart is fuelled by changing customer behaviors, evolving market and global trends

Customer & market trends

- Enhanced interconnectedness
  - People, vehicles and infrastructure are increasingly connected (e.g. by real-time data, smartphones)

- Altered consumer behavior
  - People use and share instead of own (share economy)

- Soaring individuality
  - Niche segments arise
  - People strive for autonomy

- Increasing convenience
  - People face more time pressure, while increasing comfort expectations

- Diminishing boundaries
  - New players enter established markets
  - Players increasingly tend to cooperate

Opportunities in Smart Transportation

- Globalization
- Urbanization and growth of megacities
- Demographic change
- Scarcity of resources and climate change
- Technological progress

Global trends
Transportation is becoming Smarter

Traditional Transportation

> Conventional, rather asset-intensive transport modes and services
> Limited view on single element of travel chain – no focus on optimizing the entire customer journey
> Rather "passive administration" instead of disruptive or continuous improvement"

Smart Transportation

> Application of Information & Communications Technologies to the transport industry
> Attract people to use public transport (e.g. through reducing transport time)
> Decrease operation costs
> Intelligent combination of several transport modes and concepts with improved interfaces between modes
> Shifting paradigms towards sustainability and flexibility of service offering
THANK YOU
FOR YOUR ATTENTION
Projects: Chennai Metro Rolling Limited

Rolling Stock

**Scope:** Design, manufacture, supply, testing and commissioning of 42X4 metro cars including training on operation and maintenance

**Main features:**
- Alstom Metropolis Metro Cars.
- Config: DMC+TC+TC+DMC
- 25 kV 3 phase AC IGBT traction, Regenerative braking.
- Stainless steel car-body, Max operating speed: 80 km/h

Track Work

**Scope:** Design and Construction of Track Work in Viaduct, Tunnel, Underground and Depot in Corridors 1 & 2 and supply of all materials including rails, sleepers, turnouts, fastenings etc.

**Main features:**
- Ballast-less Standard Gauge[1435 mm] track
- Total track length – 105 km (48 km elevated, 42 km UG and 15 km in depots)
- Mobile flash-butt welding, high attenuation sleepers
- 29 turnouts in line, 35 in depot
Projects: Delhi Metro Rail Corporation

Signalling Phase 1

**Scope:** Design, manufacture, supply, installation, testing and commissioning of train control and signaling systems for Lines 1 & 2 of Delhi Metro.

**Main features:**

- Total length of 33 km with 28 stations and 2 depots.
- Design headway of 120s (with ATP)
- URBALIS 200 solution for Automatic Train Control with ATP+ATO.
- ICONIS Automatic Train Supervision

Signalling Phase 2

**Scope:** Design, manufacture, supply, installation, testing and commissioning of train control and signaling systems for extension of Lines 1 & 2 of Delhi Metro.

**Main features:**

- Total length of 36.80 km with 27 stations and 1 depot:
  - UG section: 12 km, 10 stations - Elevated section: 27 km, 17 stations
- URBALIS 200 solution for Automatic Train Control including ATO
- ICONIS Automatic Train Supervision
Projects: Delhi Metro Rail Corporation

DMRC L7
Track works

Scope: Supply, Installation, Testing and commissioning of Ballastless Track of Standard Gauge, Part - 1 Corridor of Sections of Lajpat Nagar (Including) - Shiv Vihar (Line - 7) in elevated and underground sections along with Ballasted I Ballastless Tracks in Depot at Vinod Nagar of Delhi MRTS Project of Phase-III

Main features:

• manufacture & supply of materials (except Rails, Turnouts, Scissors X-over, Derailing Switches and special fastenings for turnouts, which shall be supplied by the Employer), verification, delivery, installation, testing, including integrated testing and commissioning, technical support, training of Employer's staff and documentation for a completesystem

• Track length 31 Km elevated and Underground from Lajpat Nagar (including) to Shiv Vihar.

• Depot and workshop facilities at Vinod Nagar Depot.

• 21 Stations.
Project: Bangalore Metro - Signaling

Scope: Design, manufacture, supply, installation, testing and commissioning of an advanced train control and signalling system [Lines 1(E-W) and 2(N-S) of Bangalore Metro]

Main features:
- Total length of 42 km
- Headway of 120s (design) / 150s (operating)
- Design capacity of 40,000 pphpd
- URBALIS 200 solution for Automatic Train Control
- ICONIS Automatic Train Supervision
- 750 VDC 3rd rail
- 41 stations, 2 depots
**Project: Jaipur Metro Signaling**

**Scope:** Design, manufacture, supply, installation, testing and commissioning of train control and signaling systems at Jaipur for Jaipur Metro Rail Project

**Main features:**

- Total length of 9.7 km with 9 stations and 1 depot:
  - Underground section: 0.26 km, 1 stations
  - Elevated section: 9 km, 8 stations
- URBALIS 200 solution for Automatic Train Control including ATP+ATO.
- ICONIS Automatic Train Supervision
Projects: Kochi Metro Rail Limited

**Rolling Stock**

**Scope:** Design, manufacture, supply, testing and commissioning of 25 standard gauge 3-car trains with an option for 25 additional trains.

**Main features:**
- 25 three-car trains, Length: 66.5 m, Width: 2900 mm
- 975 passengers (8p./m^2), 136 seating places
- Max axle load: 16T, Design Speed: 90 km/h
- Electrical braking down to 10 km/h

**CBTC Sig & Tele**

**Scope:** Design, manufacture, supply, installation, testing and commissioning of Urbalis 400 CBTC and of an integrated telecom solution comprising CCTV, Passenger Information, Passenger Announcement.

**Main features:**
- Automatic Train Protection and Automatic Train Operation
- SMARTLOCK 400 Computer-based interlocking
- Point machines and signals, Axle Counter
- Automatic Train Supervision (ATS)
- Maintenance Support System (MSS)
Projects: Kochi Metro Rail Limited

Power Supply System - 3rd Rail & Receiving Sub-Station

**Scope:** Design verification, engineering, manufacture, supply, installation, testing and commissioning of 750 vDC third rail traction electrification, 33kv/415v auxiliary substations, and associated MV, DC cabling & SCADA systems.

**Main features:**

- 110/33kV GIS (Gas Insulated Substation), receiving substations
- Auxiliary Main substation with 33kv/415V Dry Type Transformers
- 750V DC Third Rail Traction Electrification for Total 60 Track KM
- DC Traction Substation with 590-590V dry type rectifier transformer at selective locations & Depot and associated
- DC Switchgears and Cabling
- 33/0.415kV Auxiliary Substations at all the stations and Depot
- SCADA systems for control and Monitoring at OCC and BCC
Projects: Lucknow Metro Rail Corporation

Rolling Stock + CBTC Signalling

**Scope:** DESIGN, MANUFACTURE, SUPPLY, TESTING, COMMISSIONING INCLUDING TRAINING OF 80 NO. STANDARD GAUGE CARS ELECTRICAL MULTIPLE UNITS (EMUS) & TRAIN CONTROL, SIGNALLING SYSTEMS (Communication based train control and signaling system (CBTC))

**Main features:**

- 4 car configuration (DTC-MC-MC-DTC) later expandable to 6 car (DTC-MC-TC-MC-MC-DTC)
- Acceleration: 1.2 m/s² (with 50% motorization)
- 16T Axle load (EL@8p/m2: 340 pax)
- Max. Design Speed: 95 kmph
- Headway - 90 sec (design), 100 sec (operational)
- Stopping Accuracy: ±300 mm for 99.98% of station stops
- Wrong side failure: less than 10-9 per train operating hour for complete system
- SIL: SIL4 for Primary detection, ATP, IXL, Secondary Train detection
Projects: Dedicated Freight Corridor Corporation

Electrification, Signalling & Telecom and Building Works

**Scope:** Design & Build of 2x25kv AC Electrification, S&T of double track mainline railways lines on Lump Sum Basis for Bhaupur-Khurja Section of Eastern Dedicated Freight Corridor

1. **Electrification works:** Design, supply, system quality management, installation, testing incl. integrated testing & comm. of the complete system; 2x25 KV AT System, 5 Traction sub-stations, 6 SPs, 11 SSPs

   OHE – approx. 800 Tkms SCADA- includes interface with SCADA system of adjacent section

2. **Building & Structure including E&M Works –**

   Buildings: Stations, OCC, Staff Qtrs, Maint Depots, Ancillary Bldgs.

   E & M works: Non-Traction Power Supply and distribution system, Electricals in all Bldgs., DG sets, UPS, SCADA/BMS, HVAC, Training

3. **Signalling works:** Automatic Block sig, 11 IXL stations, Track detection – Axle counter, Interlocking for 34 LC gates, Train Management System -SIL 2

4. **Telecom works:** OFC System, Data Networking System, Telephone, Mobile Train Radio Comm., Master Clock, Video Surveillance system, DC Power Supply
**Projects: Electric Locomotives**

**E-Loco Manufacturing & Factory at Madhepura**

**Scope:** Setting up Electric 'Locomotive Factory at Madhepura, Bihar and Long Term Procurement and Maintenance of ELECTRIC LOCOMOTIVES

- Design development manufacture testing supply commissioning of 800, 1676mm Gauge 9000 KW (12000 hp)
- IGBT based 3 phase drive double Bo-Bo locomotive over a period of 11 years
- Maintenance of first 250 loco supplied for 13 years and subsequent 250 locos for 4 years
- Design, finance, construct and operate the Factory suitable for manufacturing and assembly of locomotives per annum
- Design, finance, construct and operate the two depots till end of maintenance period
- Design, finance, construct a township comprising the social and commercial infrastructure