International Public Transport Benchmarking: Learning from others

Ben Condry, Senior Research Associate
RTSC, Imperial College London

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Key elements of the presentation

- Introduction to the RTSC at Imperial College
- History of the benchmarking groups and who participates
- Why operators participate
- How the process works and examples
- Benefits
- Example Key Performance Indicators
- Conclusions – why the benchmarking process has become so useful
Imperial College London and the RTSC

- **Imperial College London**
  - Founded in 1907, now ranked 3rd in Europe
  - Focus: Science, technology, engineering and medicine
  - 14,000 students and 4,000 staff

- **Railway and Transport Strategy Centre (RTSC)**
  - Founded in 1992 with initial funding from British Rail
  - Part of the Centre for Transport Studies in the Department of Civil & Environmental Engineering
  - Benchmarking, operations, economics and policy
  - International team of 20 public transport experts
RTSC history and experience – 19 years of successful worldwide benchmarking projects

1994  Group of Five metros
1996  Community of Metros (CoMET) for large metros
1998  Nova group for medium-sized metros
2004  International Bus Benchmarking Group (IBBG) for large urban bus operators
2010  International Suburban Rail Benchmarking Group (ISBeRG)
2011  American Bus Benchmarking Group (ABBG) for mid-sized bus operators in North America

Significant benefits led to groups being continuous projects: e.g. Hong Kong; New York, London: CoMET members for 19 years, IBBG members for 8 years
CoMET and Nova Metro benchmarking groups
Now 31 metros world-wide, including most of the largest
Group size: Large enough to find diverse practices, small enough to maintain close contact between individuals.
International Bus Benchmarking Group
12 Member Cities, 13 Operators
American Bus Benchmarking Group: 17 Members Across the US in a Wide Range of Urban and Suburban Environments

- C-Tran (Vancouver)
- Lane Transit (Eugene)
- San Joaquin RTD (Stockton)
- Omnitrans (San Bernardino)
- Spokane Transit (Spokane)
- UTA (Salt Lake City)
- C-Tran (Vancouver)
- DART (Des Moines)
- RTA (Dayton)
- RGRTA (Rochester)
- RTA (Dayton)
- NFTA (Buffalo)
- GCRTA (Cleveland)
- RIPTA (Rhode Island)
- Pace (Chicago)
- The T (Fort Worth)
- Capital Metro (Austin)
- PSTA (St. Petersburg)
- LYNX (Orlando)
Why do major transport operators find benchmarking so valuable?

- Public transport essential for cities to function effectively
- Our operators spend over £40bn (70bn AUD) per annum, using scarce public funds
- Growing expectations demand modern, safe, reliable and efficient networks.
- Limited opportunities for operators to gauge performance locally
- Benchmarking is a key tool for operators to see if they are operating optimally, and how to improve

Role of the benchmarking groups:

- analytical work to understand performance
- disseminate and advise organisations on best practice
Many common strategic and technical challenges - Benchmarking has become essential to help address these.

<table>
<thead>
<tr>
<th>Top Strategic Challenges for Metros</th>
<th>0</th>
<th>5</th>
<th>10</th>
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<tbody>
<tr>
<td>Network Expansion</td>
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<td>Government support/funding</td>
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<td>Reducing costs</td>
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<tr>
<td>Operational Improvement and reliability</td>
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<tr>
<td>Employee training/retention/recruitment</td>
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<td>Long-term asset improvement / renewal</td>
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<td>Securing fare increases, revenue, ridership</td>
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<td>New governance framework</td>
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<tr>
<td>Overcrowding / Capacity</td>
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<tr>
<td>Leveraging new technology</td>
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<td>Regional transport plans/ integration</td>
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<tr>
<td>Labour relations / staff ethos</td>
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Technology can help address many challenges: benchmarking helps share experience.
For members, the benchmarking groups are central to proactive, effective continuous improvement.

“Why do others do things differently? Can we learn from them?”

“The Search for Best Practices that Lead to Superior Performance”

- Identify high priority issues and areas for improvement
- Set challenging but achievable performance targets
- Best practice transfer and implementation
- Informed dialogue with stakeholders
- What has worked (or not) elsewhere?
Key principles of the benchmarking groups: Confidentiality, Collaboration, Speed and Independence

- Benchmarking programme owned and steered by the members
- RTSC, Imperial College carries out management and analysis
- Continuous, annual cycle
- Group chair rotated on an annual basis
- Confidentiality to allow full data and information exchange in the groups only
- Complementary to other industry bodies (e.g. UITP)
Key Performance Indicator system - to compare performance and show where to look for best practices

Drill-Down Studies - In-depth research on topics of common interest, to identify best practices, often with Expert Workshops

Website with Online Forum – Transport peers consult with each other, providing quick answers

Two Meetings per Year - typically attended by senior directors
## KPI System

KPI System – measures “whole system” performance based on the Balanced Scorecard

### Growth, Learning & Innovation

- % change Network Size & Passenger Journeys
- % change Operated Capacity km & Car km
- Number of Training Hours / 1000 Staff Hours
- Non-fare Commercial Revenue / Fare Revenue & /Passenger Journey

### Internal Processes

#### Reliability & Availability

- % of Cars Available & Used in Peak Hour
- Car km / hours between Incidents (by category)

#### Efficiency

- Passenger Journeys / Staff + Contractor hours
- Capacity & Car km / Staff + Contractor hours
- Train hours / Driver Hours
- % Employee Absenteeism
- Traction Energy Consumed / Car km
- Total Energy Consumed / Passenger Journey & km

### Financial

- Total Commercial Revenue / Operating Cost
- Operating Cost / Revenue Car km
  - Service Operations Cost / Car km
  - Maintenance Cost / Car km
  - Administrative cost / Car km
- Investment cost / Car km
- Operating Cost / Passenger Journey & km
- Fare Revenue / Passenger Journey & km

### Safety & Security

- Total Fatalities / Passenger Journeys
- Deaths from Suicide / Passenger Journeys
- Deaths from Accidents / Passenger Journeys
- Deaths from Illegal Activity / Passenger Journeys
- Incidences of Crime / Passenger Journeys
- Staff Lost Time through Accidents / Staff Hours

### Customer

#### Capacity Provision & Utilisation

- Capacity km / Route km
- Passenger km / Capacity km

#### Service Quality

- Passenger Hours’ Delay / Passenger Journey
- Passenger Journeys On Time / Passenger Journey
- Trains On Time / Total Trains (scheduled + actual)
- Train Hours Operated / Hours of Train Delay

### Environment

- CO2 per Passenger km
Purpose and use of Key Performance Indicators

- Benchmarking is NOT simply a comparison of data or a creation of league tables

- The structured KPI comparisons are used for:
  - Stimulating productive “why” questions / lines of inquiry
  - Identifying high priority problems, strengths and weaknesses
  - Identifying trends: who has truly improved performance over time and why (up to 19 years of data)?
  - Internal motivation – setting realistic targets for performance
  - Supporting dialogue with Government and other stakeholders
KPIs are just the starting point – the greatest value comes from applying Best Practice learnt from others.
A KPI which describes a lot about benchmarking
Is such disparity in performance real?

Research Challenge: identify and quantify factors within and outside management control that affect reliability

Essential to reach comparability: takes several annual cycles

We apply statistical modelling + deep investigation of operational, technology, engineering and maintenance processes

Are EU metros such poor performers given circumstances?
Modelling: performance often ‘average’ given structural factors

Car km Between Incidents Causing a Delay > 5 Minutes to Service (2011)

As = Asia  Eu = Europe  Am = Americas

Car km (millions)
Line-level econometrics benchmarking of reliability shows the impact of technology and external factors such as asset age.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>% Change Delay incidents</th>
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<tbody>
<tr>
<td>+1 year rolling stock age</td>
<td>+ 0.7-2%</td>
</tr>
<tr>
<td>+1 peak tph</td>
<td>+ 3.5%</td>
</tr>
<tr>
<td>+1 tph practical capacity</td>
<td>- 5%</td>
</tr>
<tr>
<td>Manual &gt; ATO</td>
<td>- 26%</td>
</tr>
<tr>
<td>+10% passenger journeys</td>
<td>+ 3.0%</td>
</tr>
</tbody>
</table>

Almost 500 topics now covered in studies; examples include

**Engineering**
- Rolling Stock Reliability
- Asset Renewal Decision Making

**Operations**
- Investing in Punctuality
- Driver Productivity

**Customers**
- Customer Satisfaction
- Passenger Information

**Financial**
- Fares, Funding and Financing
- Non-Fare Revenue

Drill-Down studies conducted annually by each group

Members select topics of mutual interest
- Reflect key topical issues, and questions raised by KPIs

Members provide data and
- Questionnaires and expert interviews

Imperial College analyses and reports findings and recommendations

Expert “workshops” to share experiences directly

The numerical benchmarking has to be combined with “Best Practice Benchmarking” – Drill-Down Studies
Benchmarking Benefits:
Improved decision-making by learning from the experience of others

- **Asian Metro**: driver productivity study: 10% saved through shift reorganization

- **American Metro**: Review of station cleaning processes following study: 10% productivity gain

- **South American Metro**: $1mp.a. saved on turnstile maintenance as a result of a Forum question.

- **American Metro**: justified move from 2 car-pairs to through gangways: several million £, improving capacity by 10%

- **HK MTR**: best practice in policy used to successfully argue for fare adjustment mechanism

- **ISBeRG Railway** used fleet age information to help make the case for funding of replacement cars
Example: escalator engineering benchmarking: application with high impact

- Research for London Underground (LU) 2009
- Modelling revealed higher-than-expected costs for LU prompting more detailed benchmarking analysis
- Deeper research revealed substantial differences in engineering and maintenance approach
- LU is now undertaking radical changes to escalator approach, adopting world best practices
- Expected savings: £0.5 bn (e.g. £65 m saving in the procurement of 50 escalators, June 2012)
Some Benchmarking Examples - Helping with Key Challenges
Railways/metros have returns to density and not scale (so we can compare organisations of different sizes)


- **Nova Metros**
- **CoMET Metros**

Nova & CoMET: Part of the same community and contribute to each others’ studies

Compared to metros, Sydney Trains’ network is very large

Based on publically available data
ISBeRG Suburban Railways: Sydney Trains’ network also large relative to these, but more comparable

Network Length, Number of Stations and Passenger Journeys
(2012 or Latest Available)

Network Length
Stations
Passenger Journeys
5816
2536

Sydney Trains’ network still very large in ISBeRG

Based on publically available data
A key structural factor and financial constraint for Australian Railways: low average passenger density

Compared to metros, Sydney is very low density (more comparable with Suburban Rail – see next page)

Based on publically available data
High frequencies and density in the urban core countered by long branches – lower returns to density

Passenger Density (2012 or Latest Available)

- Very high densities in Asia and S. America
- Lower / peaked demand
- Dispersed city / sprawling network
- Higher / all day demand
- Greater city / network density

Compared to major suburban railways, Sydney is also relatively low density

Even lower densities in N. America

Based on publically available data
Empirical Evidence: Average cost per passenger km declines with density of capacity

Metro Railway Returns to Density

![Graph showing the relationship between capacity km per Network km and average cost per passenger km. The graph indicates a downward trend with an R² value of 0.3101.]
Supply varies both spatially and temporally (Here: Buses in major cities – over 24 hours)

Use of Vehicles in Revenue Service (Average Weekday) - 2008

% of total fleet

What is the right service level? Marginal costs vary significantly throughout the day
Key challenge that benchmarking addresses: off-setting wage growth with revenue growth and increased productivity

Cost of Labour per Hour
(Nominal prices: Index 100 = earliest data year)

On lower density systems, maintaining efficiency is an extra challenge
When economies were strong, a combination of poor fares policy and rising costs set metros in the wrong financial direction.

Experience of CoMET and Nova metros, 2004-2009

- Real Fares Falling 60% Metros
- Unit Labour & Energy Costs Up 65%
- Labour Productivity Falling 75% Metros*
- Cost Recovery from Fare Income Falling 70% Metros
- Demand up for 89% of metros

*European and North American Metros
A turnaround in fortune since 2009 for many metros, but only temporary, with fundamentals of energy, labour, fares unchanged.

Experience of CoMET and Nova metros, 2009-2011

- Real Fares Falling 64% Metros
- Labour Productivity Improved 84% Metros
- Unit Energy Costs Falling 60% metros
- Unit Labour Costs Up 68% metros
- Cost Recovery from Fare Income Improved 76% Metros
- Demand up for 81% of metros
On average, operating costs +40% has been spent on reinvestment. But fares revenue barely covers operating costs (except in Asia).

Key factors: density, fares, network, efficiency

Revenue = operating cost

Observed Metro Reinvestment Rate (~40%)
Case Studies drill down to understand ‘how’ and ‘why’ operators can become more productive (examples)

- 50/50 productivity gain shares
- Contracting out of station staff (Hong Kong)
- New contract deals for new drivers (EU metro)
- Part time staff in peak period (S. America)
- Split Shifts (N. American Metro)
- Multi-skilling: Drivers/ station staff (EU metro)
CoMET and Nova benchmarking shares experience in use of technology to improve productivity / effectiveness

- Unattended Train Operation (UTO) (Paris Line 1 & 14)
- Attended driverless train operation (Taipei)
- Automatic train turnaround (Madrid)
- Ticketing: station staff in more customer facing roles / dispatch
- CBTC: Potential for much higher energy efficiency / regeneration
- Automatic Train Operation (ATO) – higher reliability, fewer spare drivers
- Remote signing on for train drivers (European metro)
Factor of 9 variation in staff productivity: What is the right level? What is achievable? Benchmarking helps transport providers make such choices.

Car km per Total Staff and Contractor Hours

Such high level KPIs can mask efficiencies and inefficiencies in sub-divisions: disaggregation, econometric modelling and drill-down studies are performed.

What is the right balance for each railway?

Structural Factors: e.g. Density Quality (customer service etc)
Continued world economic growth affects major capital cities such as London, New York, driving continued rapid passenger growth.

Annual Passenger Journeys

% Change 2006 - 2011

Growth continues in London, Paris, New York

Network expansion driving passenger growth in Asian metros

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Demand for rail also growing across the world

Figures (%): national GDP growth (same period)
UK evidence: +1% GDP typically leads to +1% demand

Major growth in London (network expansion) and Sao Paulo (service improvements and economic growth)

Average Annual GDP Growth Over Equivalent Time Period

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London
Conclusions: Benchmarking can be highly effective

- Benchmarking has become a **key management tool** for operators: at strategic and day-to-day level
- Very **different demands between ‘regulatory’ and ‘best practice’ benchmarking**
- The **long term, continuous approach with operator ownership**, is key
- Benchmarking is **not an exact science** requiring qualitative and contextual understanding
- **Drill-down necessary:** statistical and deep investigation of practices, processes
- Our process has continued for 19 years due to the **significant benefits achieved by operators**
Any questions?

b.condry@imperial.ac.uk

www.imperial.ac.uk/rtsc
Metro Codes – used in graphs to represent metros

BA – Buenos Aires Metrovías
Bc – Barcelona TMB
Bs – Brussels STIB
Bk – Bangkok BMCL
Dh – Delhi Metro Rail Corporation
Is – Istanbul Ulasim
Lb – Lisbon Metropolitano de Lisboa
Mt – Montréal STM
Nc – Newcastle Nexus
Nj – Nanjing Metro
Np – Naples Metronapoli
RJ – Rio Metro
Sg – Singapore SMRT
Sy – Sydney Trains
To – Toronto TTC

Bg – BMTROC, Beijing
Bn – BVG, Berlin
Gz – Guangzhou Metro Corporation
HK – MTRC, Hong Kong
Ln – LUL, London
MC – STC, Mexico City
Md – Metro de Madrid, Madrid
Mw – MoM, Moscow
NY – NYCT, New York
Pm – RATP Metro, Paris
Pr – RATP RER, Paris
SC – Metro de Santiago
Sh – SSMG, Shanghai
SP – MSP, São Paulo
Tp – Taipei TRTC

Anonymised Graphs: As = Asia/Australia; Eu = Europe; Am = Americas
<table>
<thead>
<tr>
<th>Railway</th>
<th>City</th>
<th>Code</th>
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<tbody>
<tr>
<td>Ferrocarrils de la Generalitat de Catalunya (FGC)</td>
<td>Barcelona</td>
<td>Bc</td>
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<tr>
<td>Queensland Rail</td>
<td>Brisbane</td>
<td>Br</td>
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<tr>
<td>S-Tog, Danish State Railways (DSB)</td>
<td>Copenhagen</td>
<td>Ch</td>
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<td>PRASA – Metrorail, Cape Town</td>
<td>Cape Town</td>
<td>CT</td>
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<tr>
<td>MTR Hong Kong (East Rail and West Rail only)</td>
<td>Hong Kong</td>
<td>HK</td>
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<tr>
<td>MTA Long Island Rail Road (LIRR)</td>
<td>New York</td>
<td>LI</td>
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<td>London Overground – London Rail</td>
<td>London</td>
<td>LO</td>
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<td>Metro Trains Melbourne</td>
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<tr>
<td>MTA Metro-North Railroad</td>
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<td>MN</td>
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<td>East Japan Railway Company (JR East)</td>
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