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Imperial College London

Community of Metros
CoMET

The Operator's Story

Institutional and Financial Framework for Metro Systems

Urban Mobility India, Gandhinagar

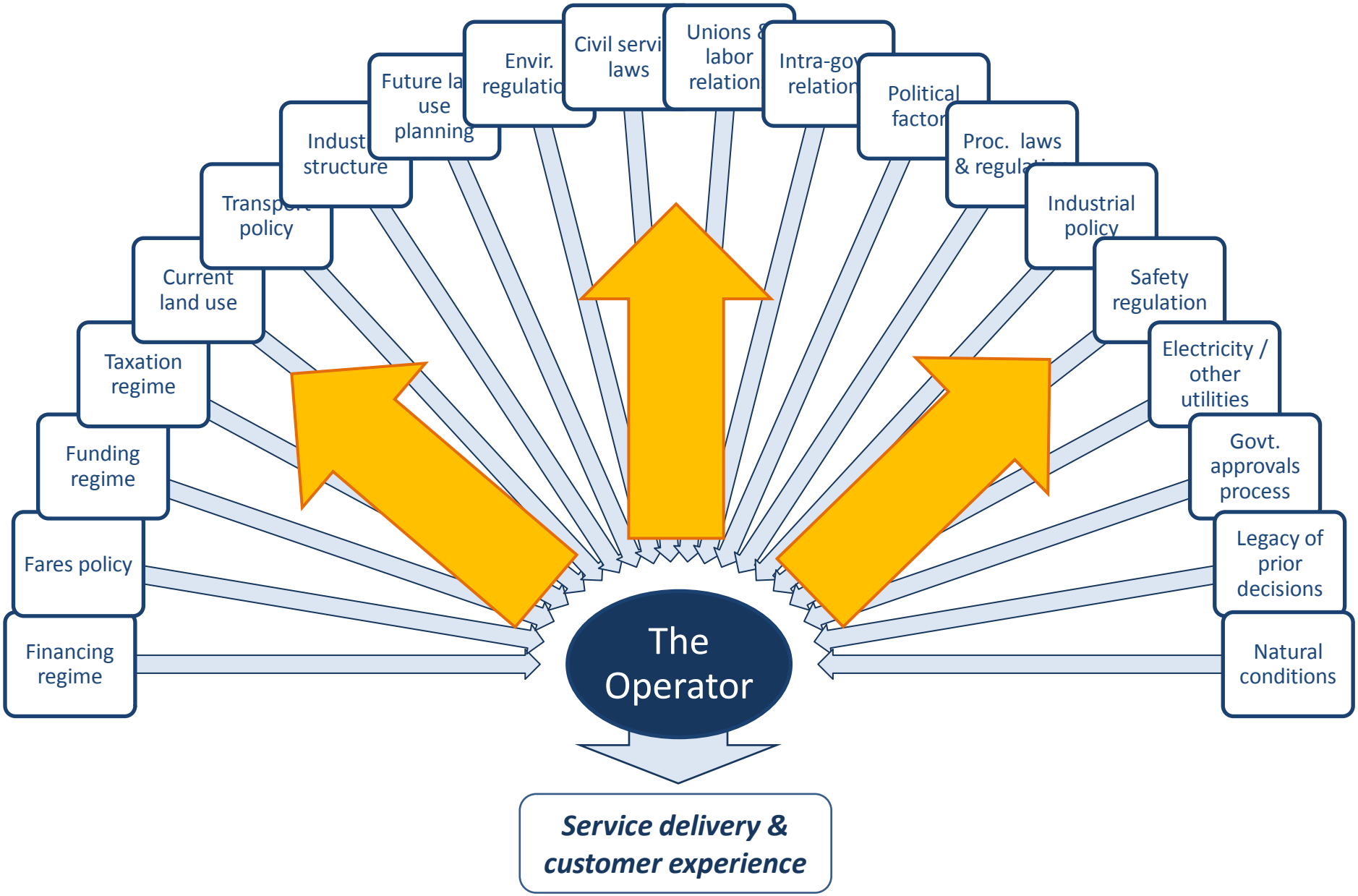
November 2016

Presentation Structure

1. Introduction to “The Operator’s Story” project
2. Metros and the cities they develop
3. Technical & operational success for metros
4. Financial sustainability
5. Business strategies for successful metros
6. Conclusions and ideas for India

1. Introduction to “The Operators’ Story” project

An Operator's World



Helping us tell the story – Community of Metros (CoMET)

CoMET: 34 Urban Rail Systems in 32 Cities, best practice benchmarking since 1994: unparalleled insight into "what makes metros successful"

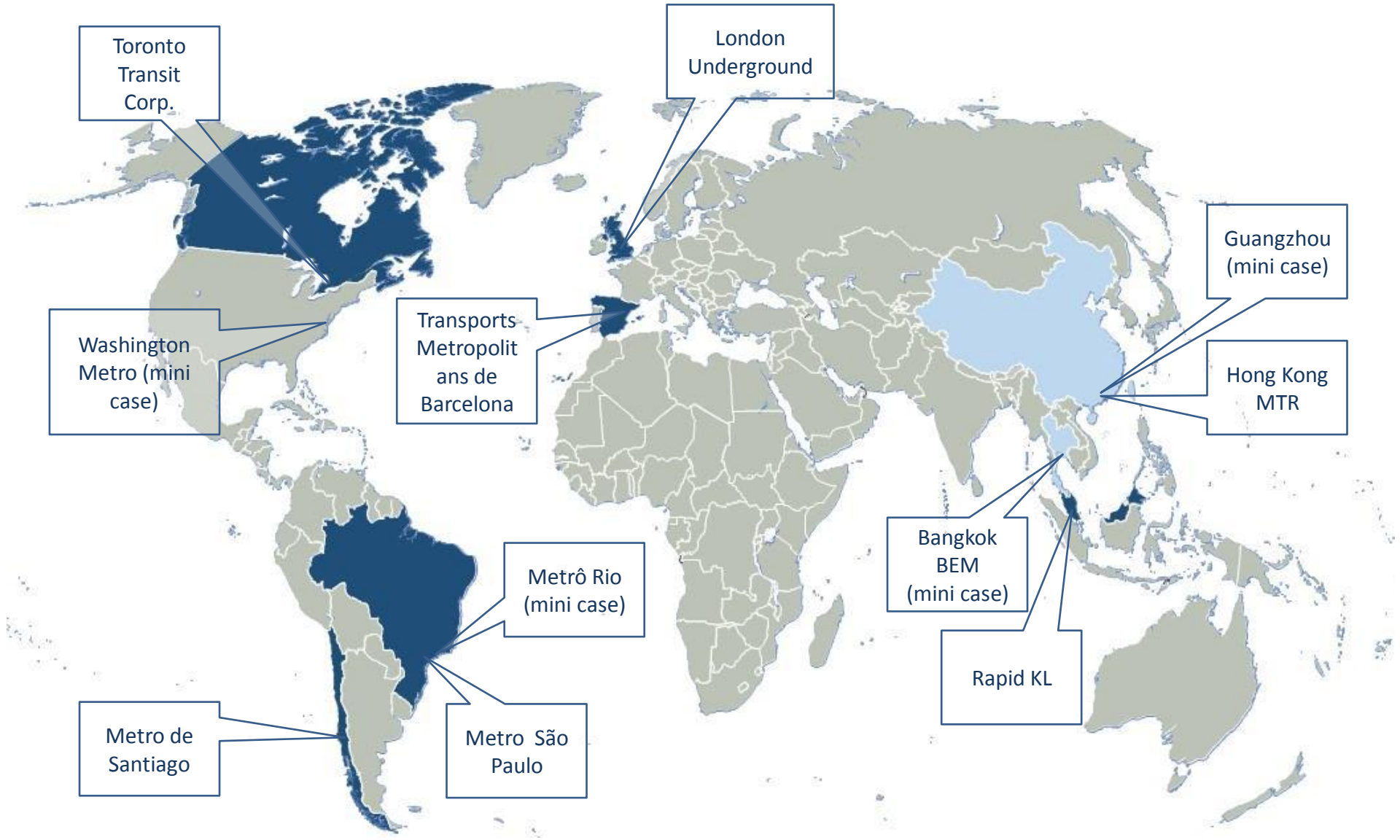
CoMET metros

Community of Metros CoMET

Nova metros

Nova Group of metros

Case Study Metros

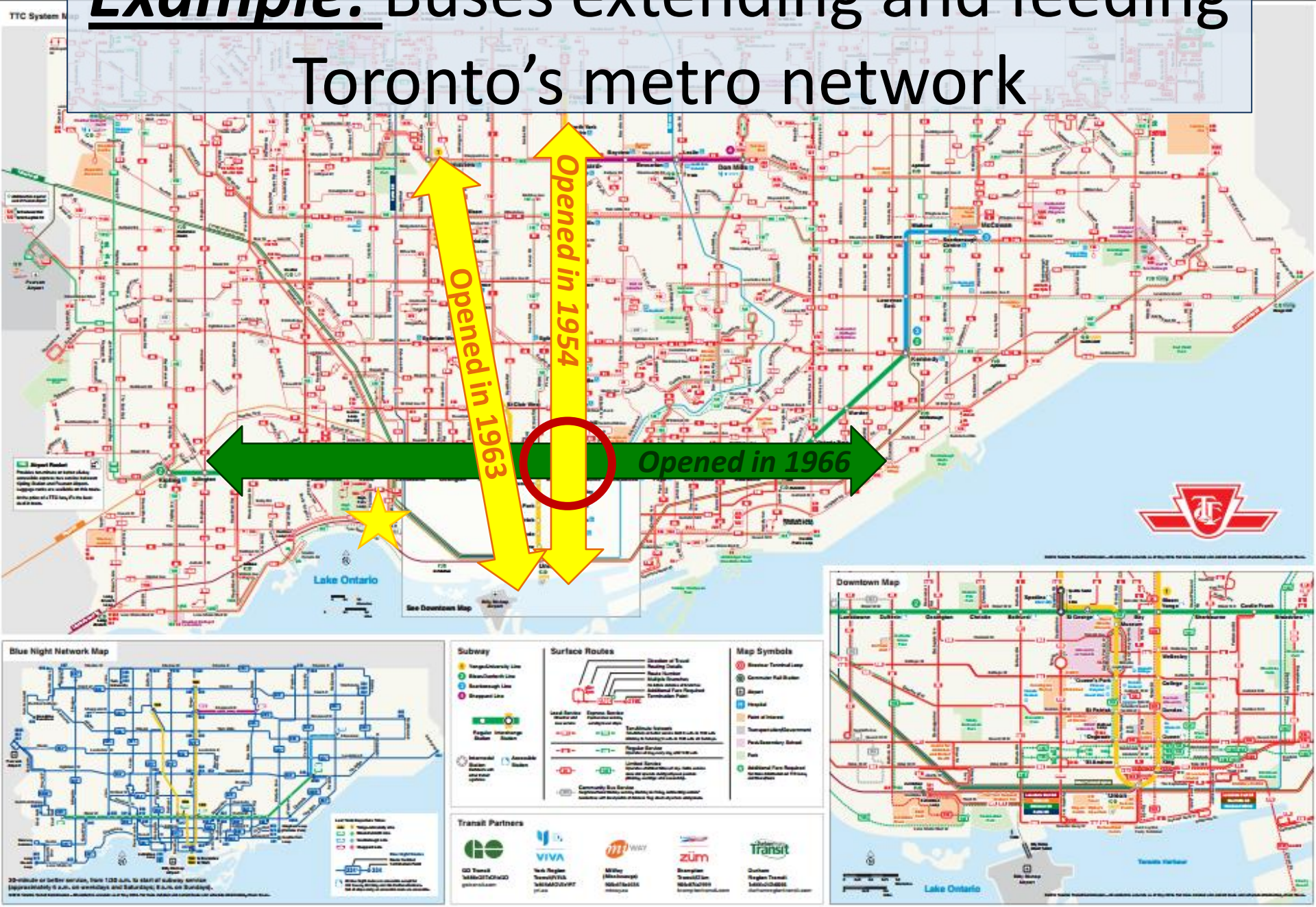


2. Metros, integrated transport networks, and the cities they develop

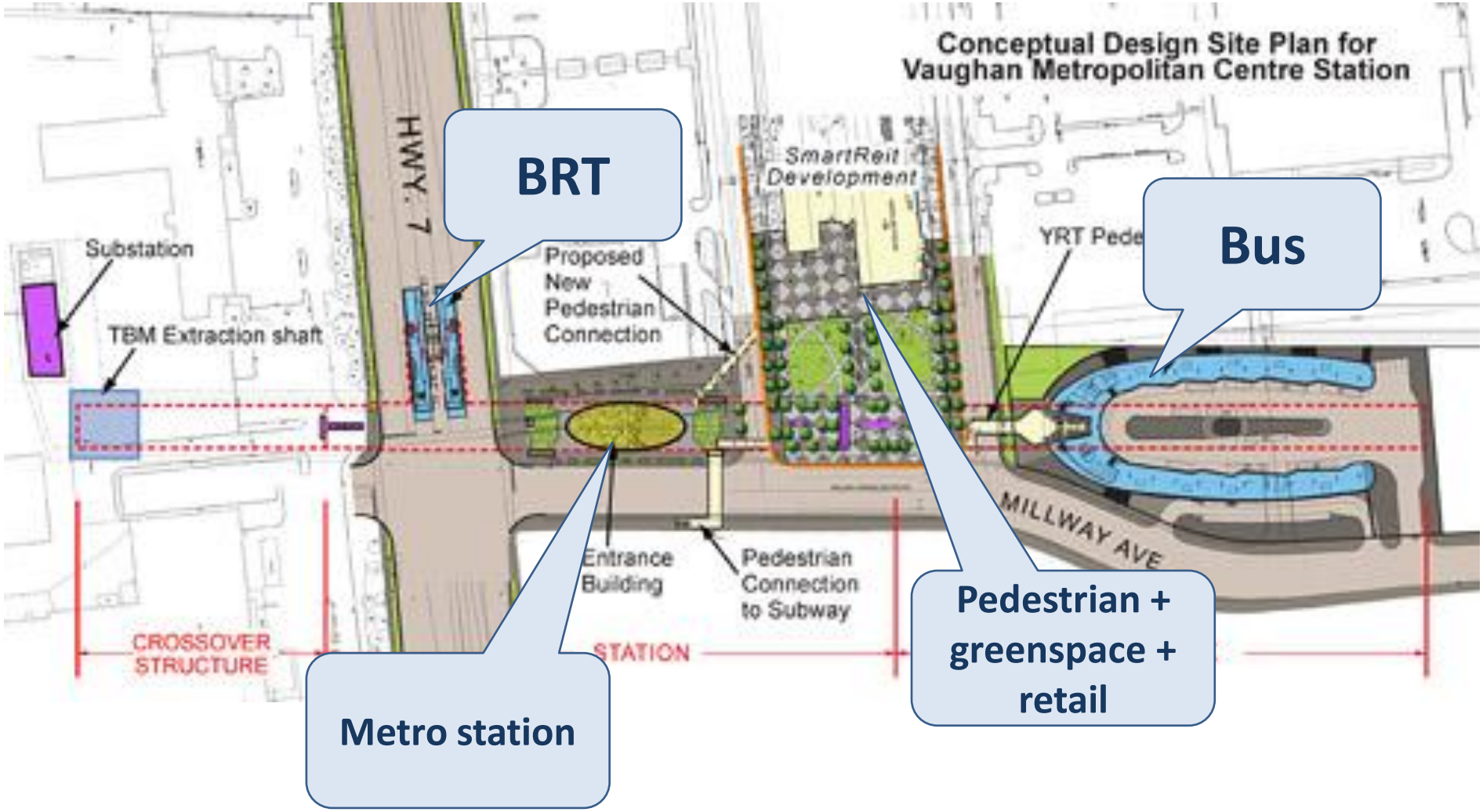
The most successful Operators think of their metros as tools of urban transformation within a wider network

Example: Toronto metro's impact on urban form

Example: Buses extending and feeding Toronto's metro network

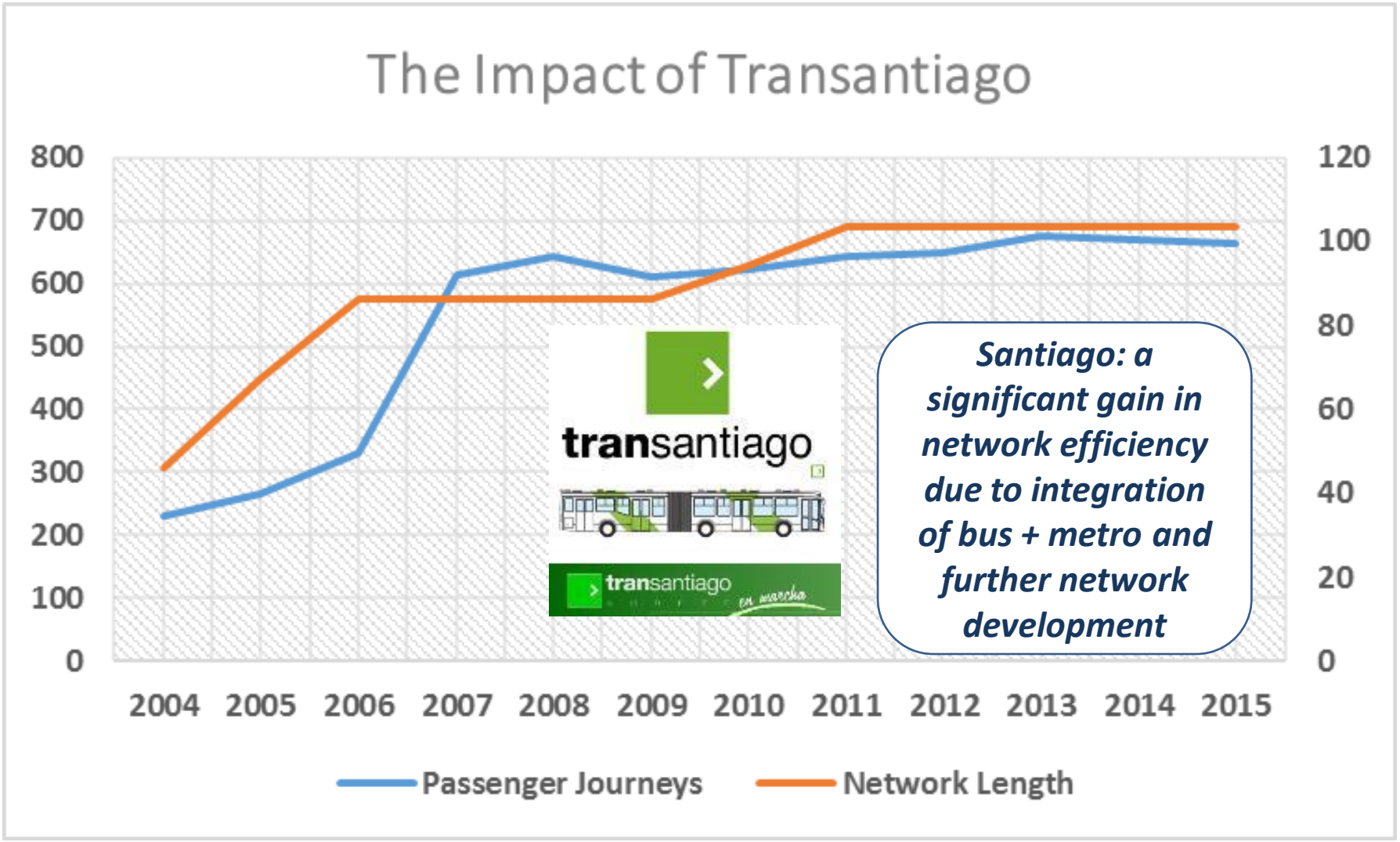


Example: Toronto's bus and metro network connections



Source: Toronto Transit Commission Planned Vaughan Metropolitan Centre Station https://www.ttc.ca/Spadina/Stations/Vaughan_Metropolitan_Centre_Station/index.jsp

Example: Reorganising Buses Around the Metro: Santiago



Network only as good as weakest link

Example: metro line integration at Siam Station, Bangkok

Two lines, four platforms, direct links to commercial development


Example: metro line integration at Siam Station, Bangkok
Cross platform interchange

Discussion points for India's context

- ***How can public authorities be empowered to take difficult decisions*** in the interest of the network that may ***increase*** land acquisition, cost, and local disturbance in the short term?

- **How to integrate institutional actions** to achieve integrated networks?

- **How to encourage thinking around** integrated transport network planning and focus on urban transformation?

3. Technical and operational success for metros

Start from the right projects

1. Large existing bus/ paratransit corridor demand
2. Incomes that are not low and preferably rising quickly
3. City economic growth prospects & an expanding dynamic corridor or center
4. Opportunities for a low-cost alignment
5. Fares that can attract ridership BUT also limit subsidy (i.e. “sweet spot”)
6. Proven sponsor capacity to deliver major projects successfully

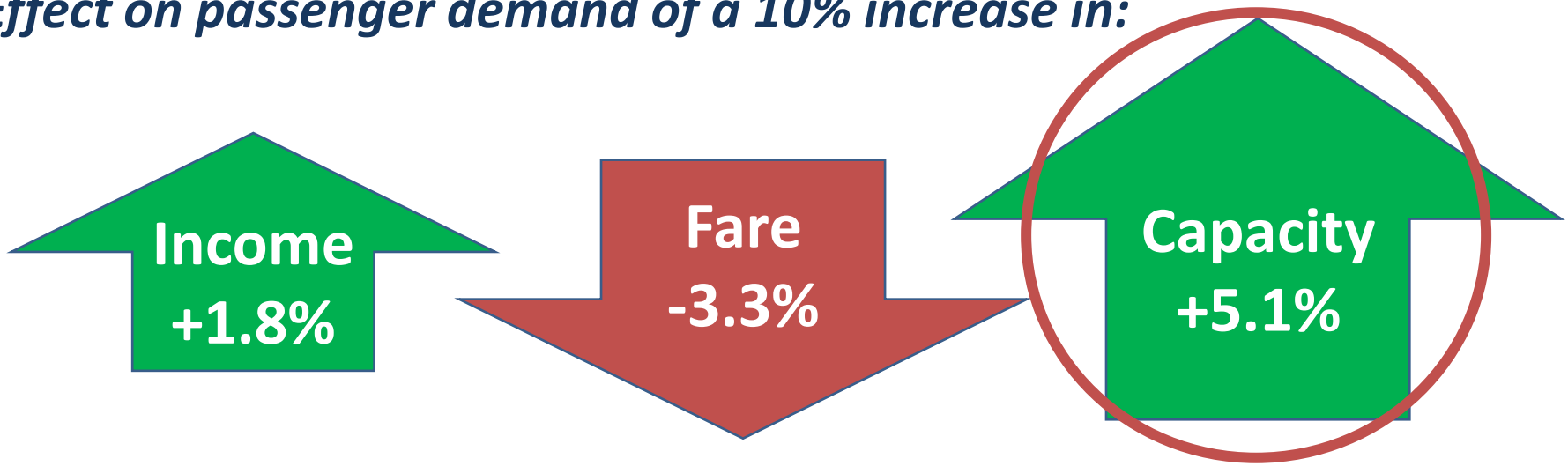
Advantageous to have strong unifying entity

“There are only two types of metros in the world. There are metros that are empty, and metros that are full…

If you can enmesh yourself into the city, you want every bit of capacity you can get. And if you’re not doing that, don’t build a metro.”

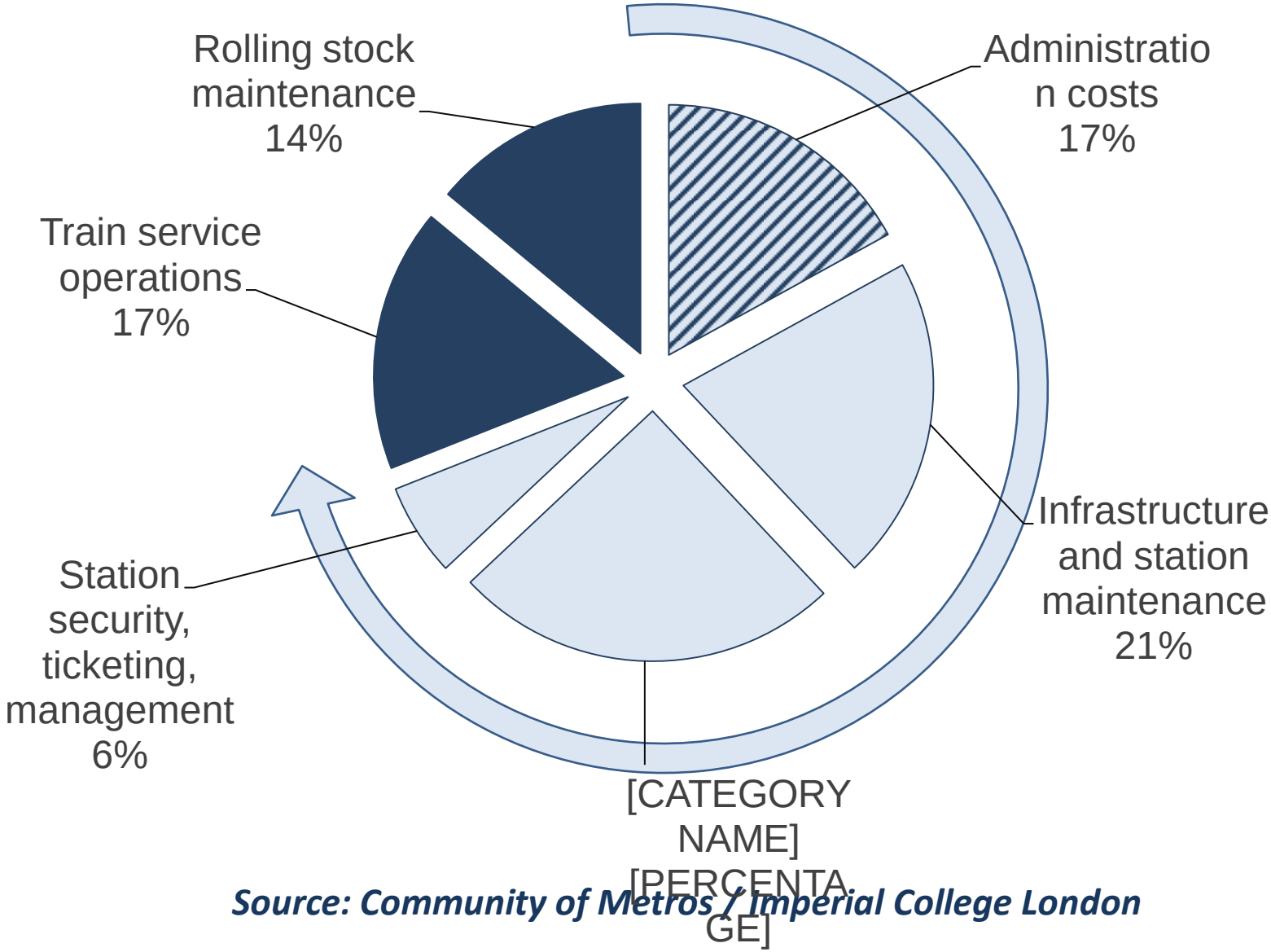
Capacity has the greatest impact on additional passengers and revenue

Effect on passenger demand of a 10% increase in:



- Higher capacity better than lowering fares to increase passengers
- Extra capacity and frequency could pay for itself in additional revenue.
- Keep fares up with inflation to afford higher capacity – a positive feedback
- Falling real fares and growing income >> crowding in Asian Metros

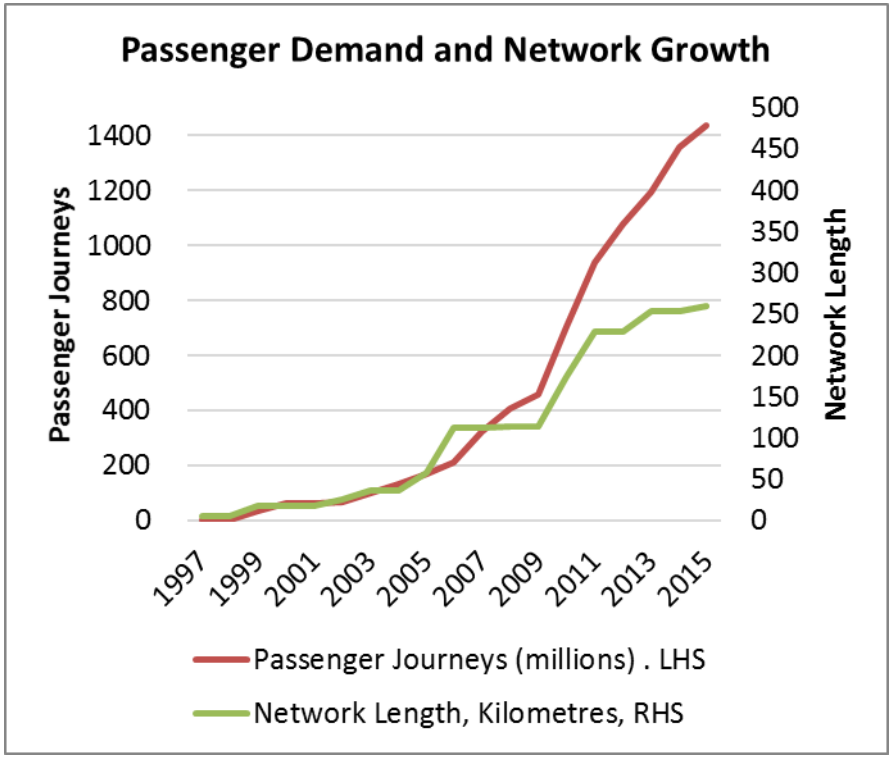
About 60% of OpEx are fixed costs – maximizing capacity can help achieve overall cost recovery

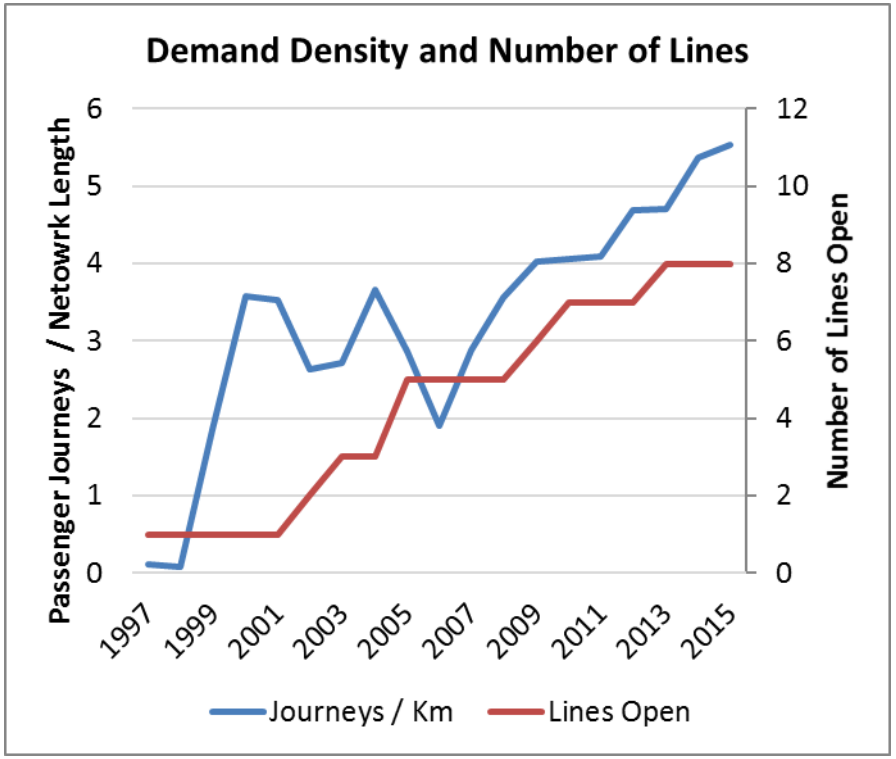


Source: Community of Metros / Imperial College London

Lift Off! - Network Effects

- A much busier Chinese metro with more lines

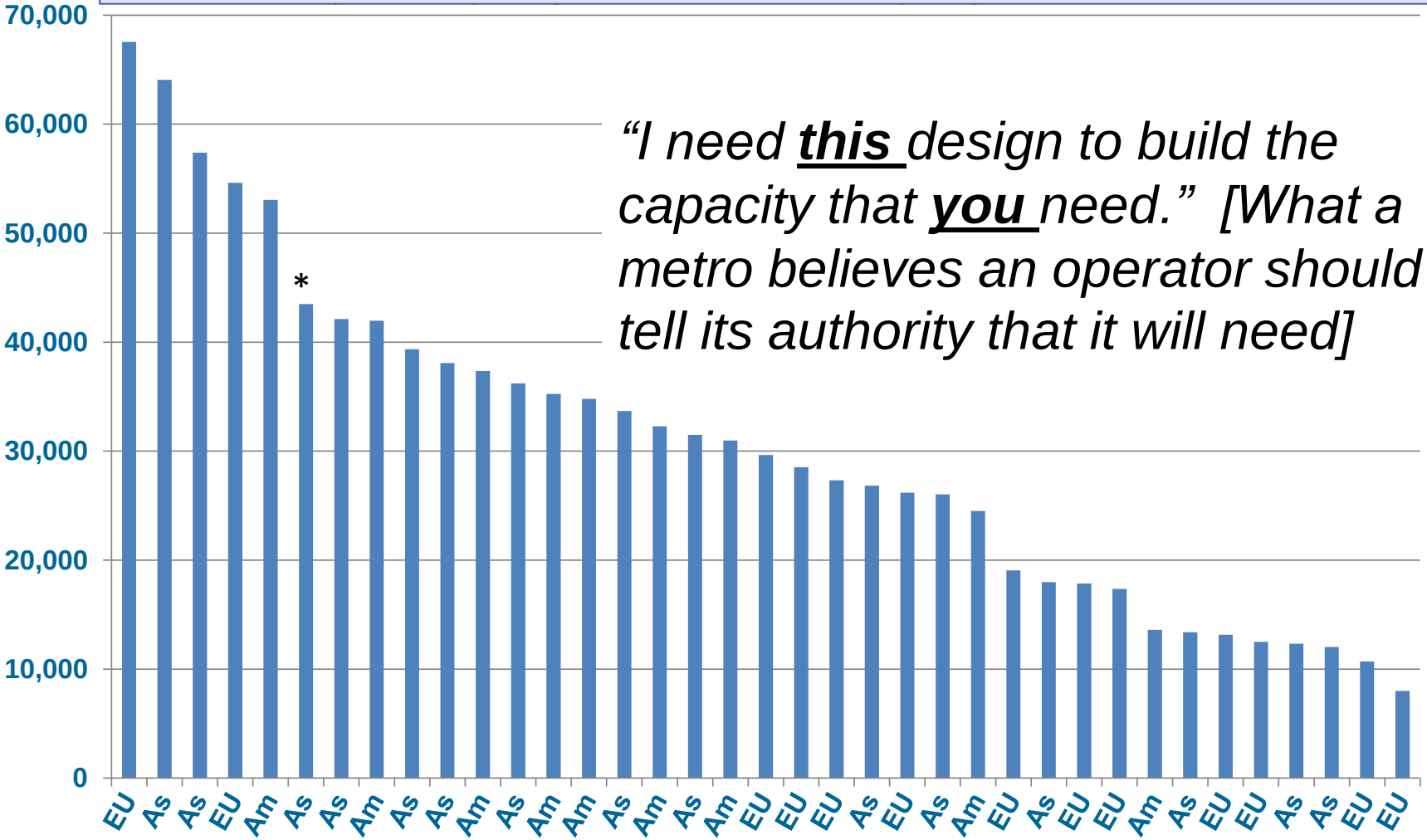




If it's a good metro, be ready for much higher capacity needs in the near future – *"trains with smaller capacity but higher frequency might be a mistake"*

Metros should be all about capacity

CoMET Metros' maximum capacity (PPPHPD, 4 persons /m2)

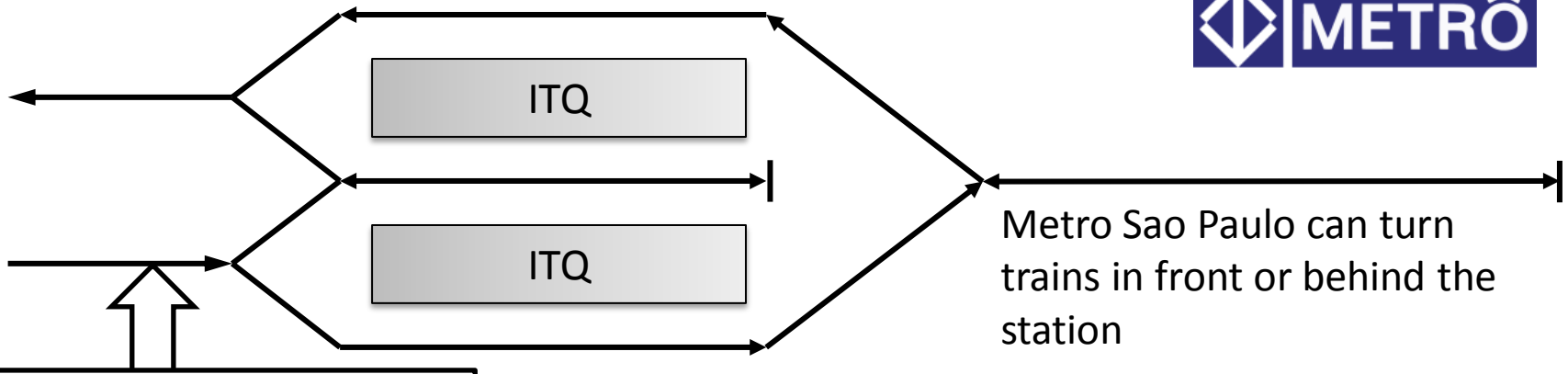


*"I need **this** design to build the capacity that **you** need." [What a metro believes an operator should tell its authority that it will need]*

Source: Community of Metros / Imperial College London

So what does it mean to design for high capacity?...

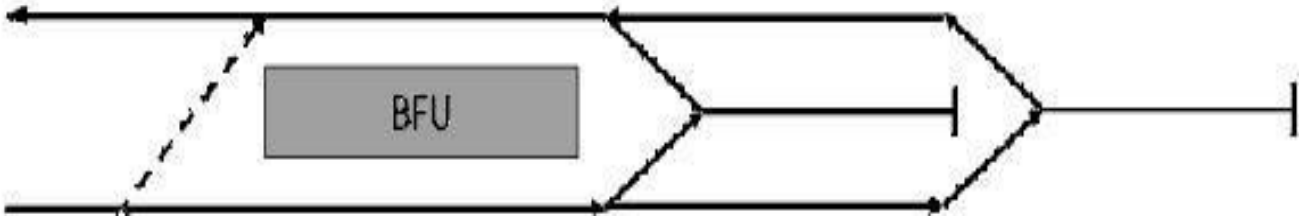
Example: Sao Paulo - design for operability



Metro Sao Paulo can turn trains in front or behind the station

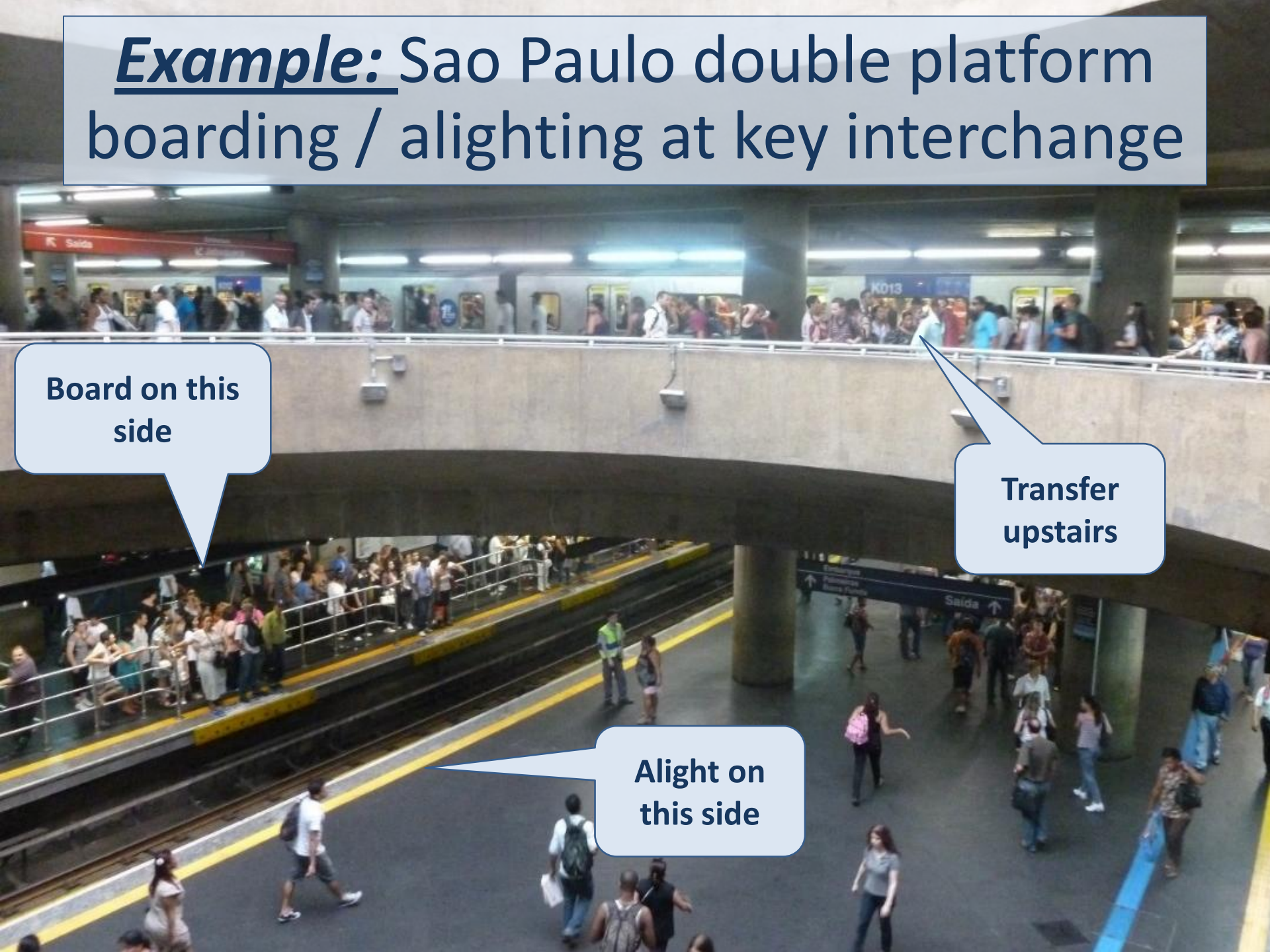
At decision point, regulation software decides which terminal should be used to optimise turnaround operation

Metro Sao Paulo has numerous options to turn trains in this design



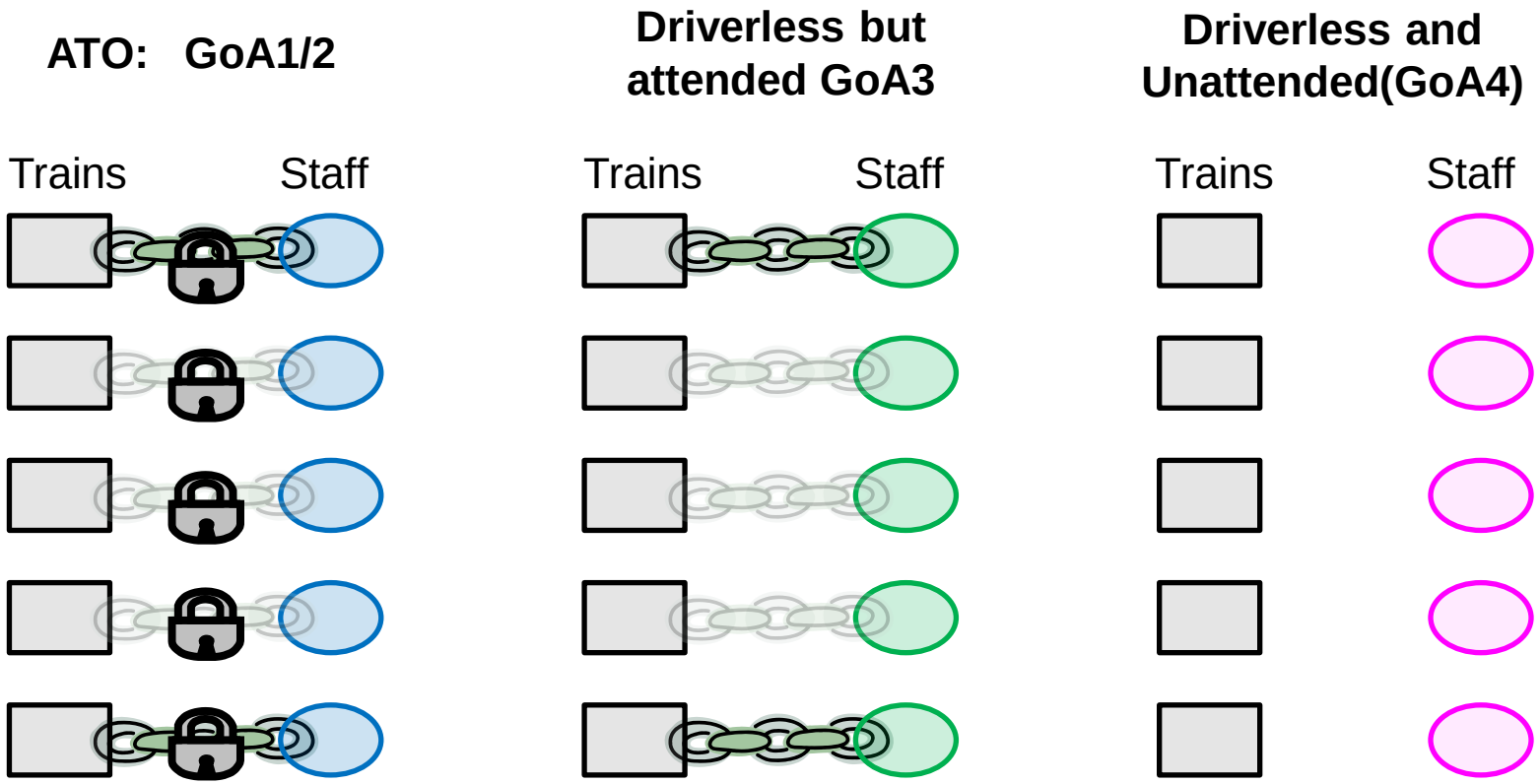
World best practice terminal design to allow maximum frequency and flexibility

Example: Sao Paulo double platform boarding / alighting at key interchange



How can technology help to improve throughput, increase service quality, make staff more customer facing, and future-proof against rising costs?

Automate to move your business closer to customers



EU Automated Metro:
Service scheduling for unusual events reduced from 3 months to 1 hour: automated metros don't need to plan for additional staff shifts

Example: Barcelona's new operating model based on automation

OLD MODEL

- Drivers

- Stations Chief
- Tickets Sellers
- Informers to the client
- Station activities

- Technical Station Supervisor
- Technical Circulation Supervisor

NEW MODEL

Customer Service Agent

Zone Manager

First Line Supervisor

Increased Job satisfaction:

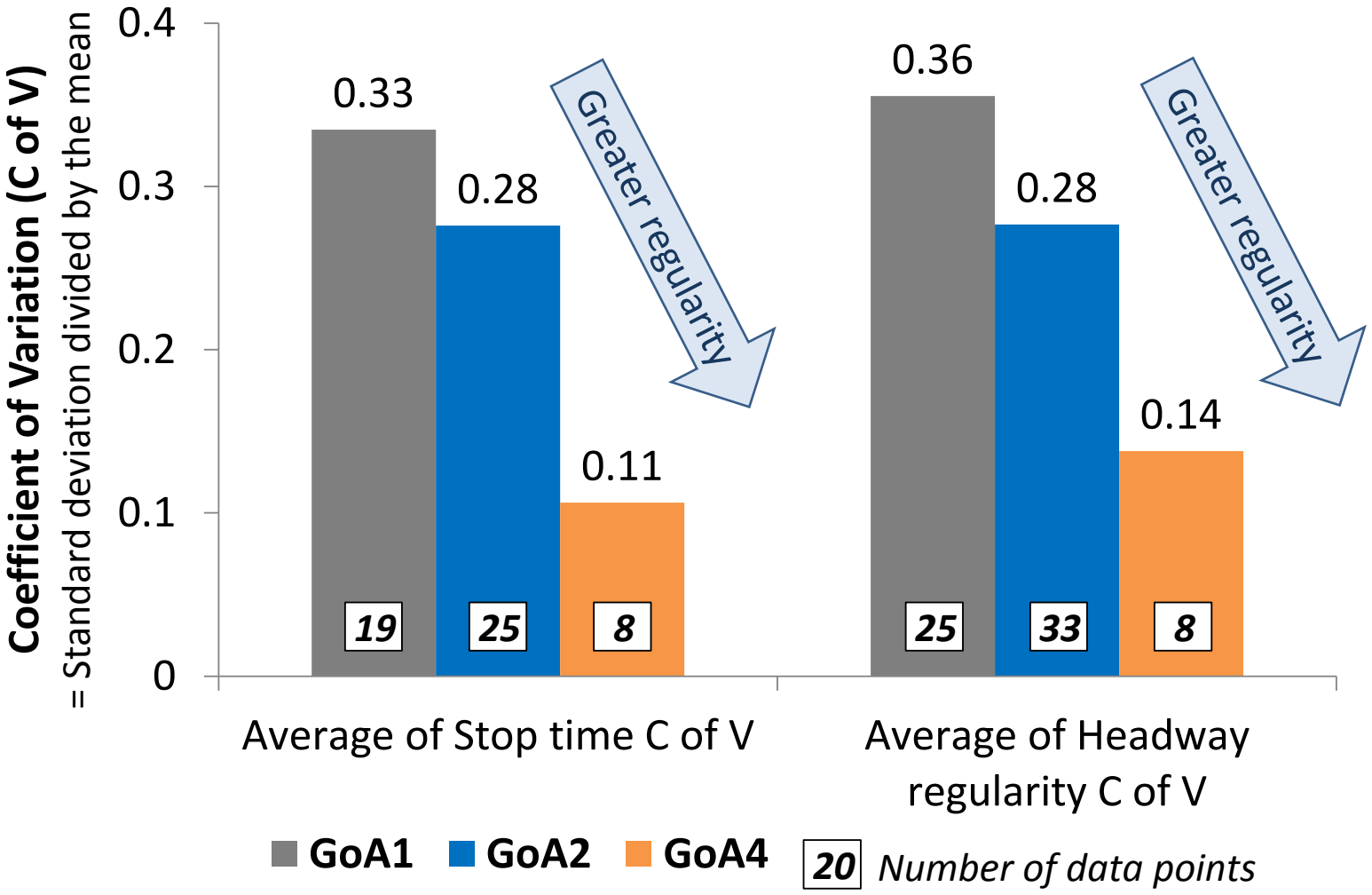
- Autonomy
- Empowerment (ability to take decisions)
- Client Oriented services

Increased operational efficiency:

- Flexibility
- Resilience

Source: With permission from Transports Metropolitans de Barcelona

Automate for improved regularity



Data from RTSC dwell time surveys and ATS data submissions. Coefficients in variations in peak hour stop times and headways for individual lines, averaged by Grade of Operation

“People didn’t even notice it was automatic, even when standing at the front of the train!”…. “If you are going to build a new line, I think most decisions now would go to an automatic line.”

Discussion points for India's context

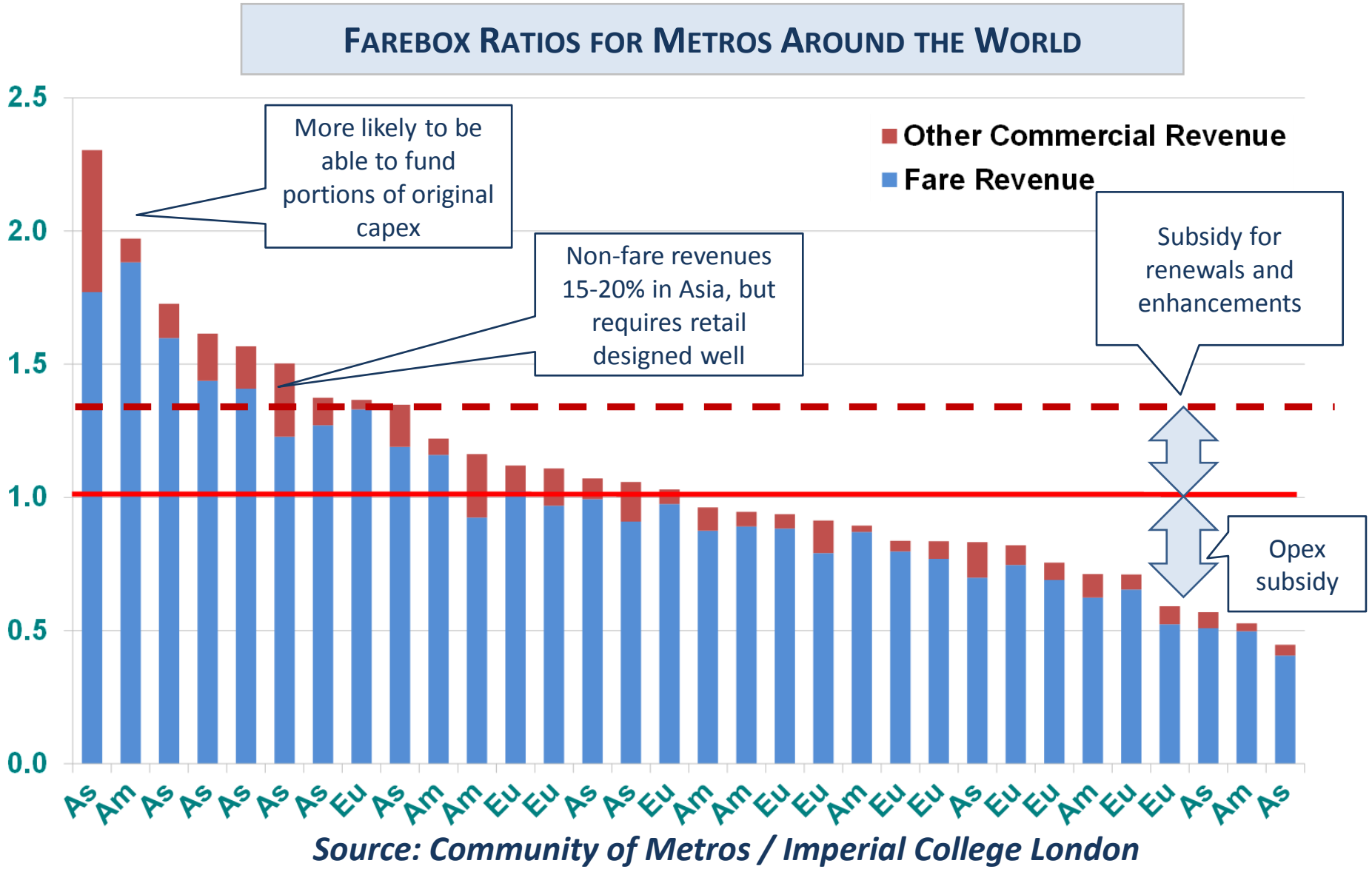
- **Should all new metros in India seek to pursue automation?** Is there a strong case against automation?
- **Should India's metros be planned and built for significantly higher capacities in mega-cities?**
- **How to shift thinking from cost minimization to ridership / revenue optimization** – i.e. supply greater capacity than envisaged demand?

4. Metro financial sustainability

Simple and brutal economics of metro

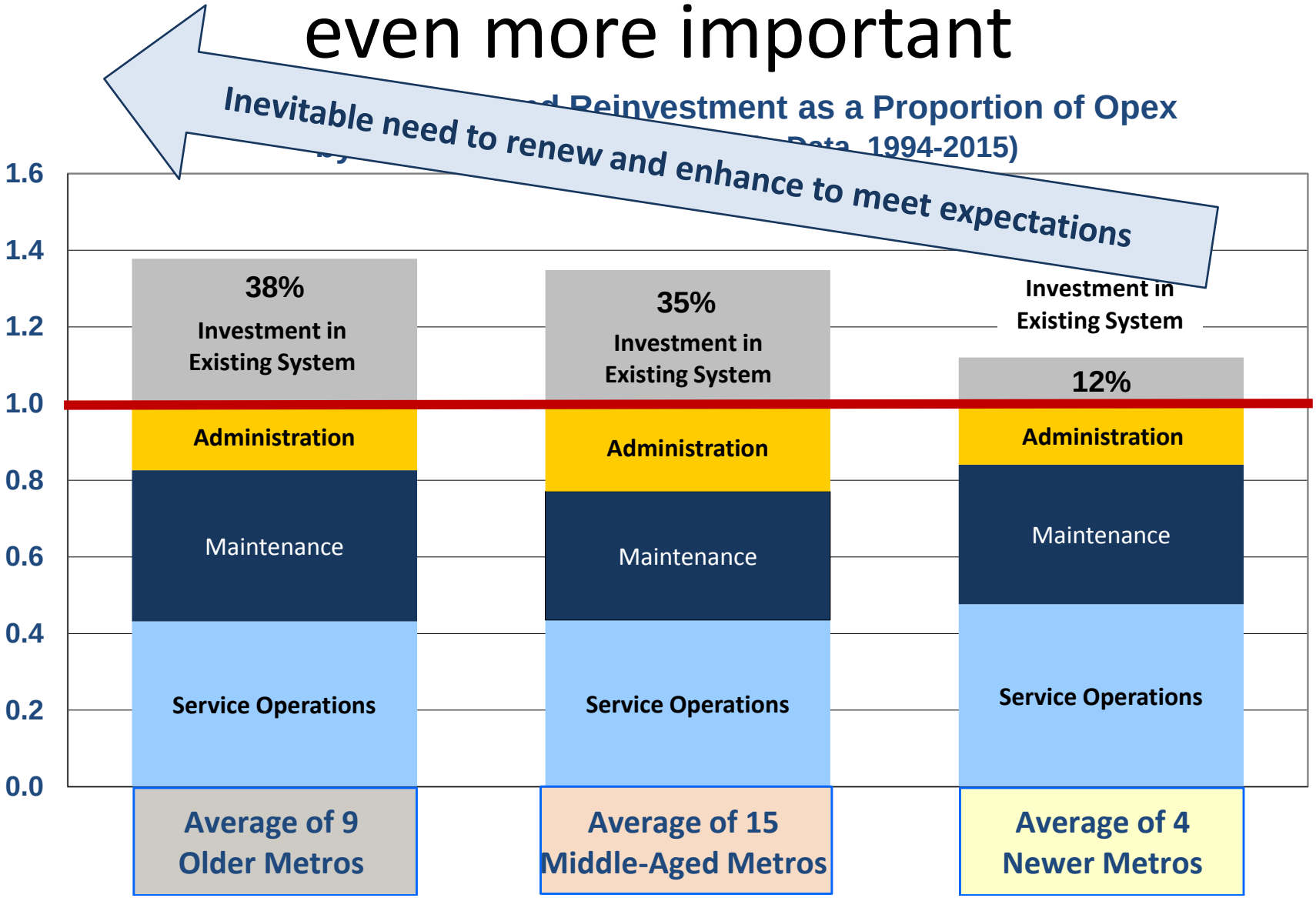
- New metro lines cost more money to build than can be recouped from fares.
- …but operational expenditure (including renewal) can be self-sustaining if fares are sufficient and there is a good level of non-fare revenue.
- Sustainable fares policy is crucial as is the approach to managing operating costs and subsidies

Fares sustain metros



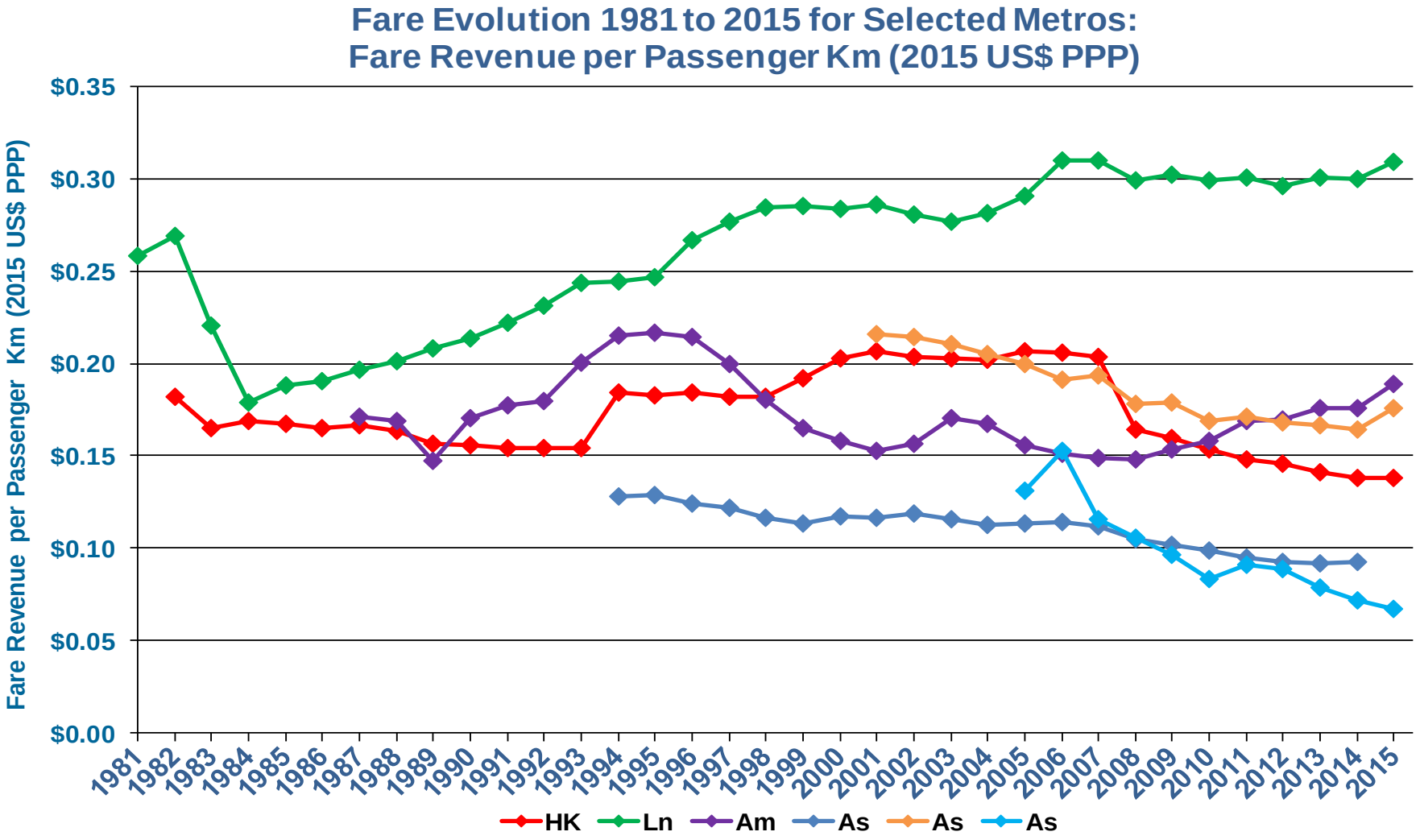
Source: Community of Metros / Imperial College London

Getting old makes sustainable fares even more important



Source: Community of Metros / Imperial College London

Fares must increase regularly to be sustainable



Source: Community of Metros / Imperial College London

Examples of Fares Regimes

Singapore

$$Fare\ Change = 0.4\ CPI + 0.4\ Wage\ Index + 0.2\ Energy\ Index - Productivity$$

Hong Kong

Overall fare adjustment rate =

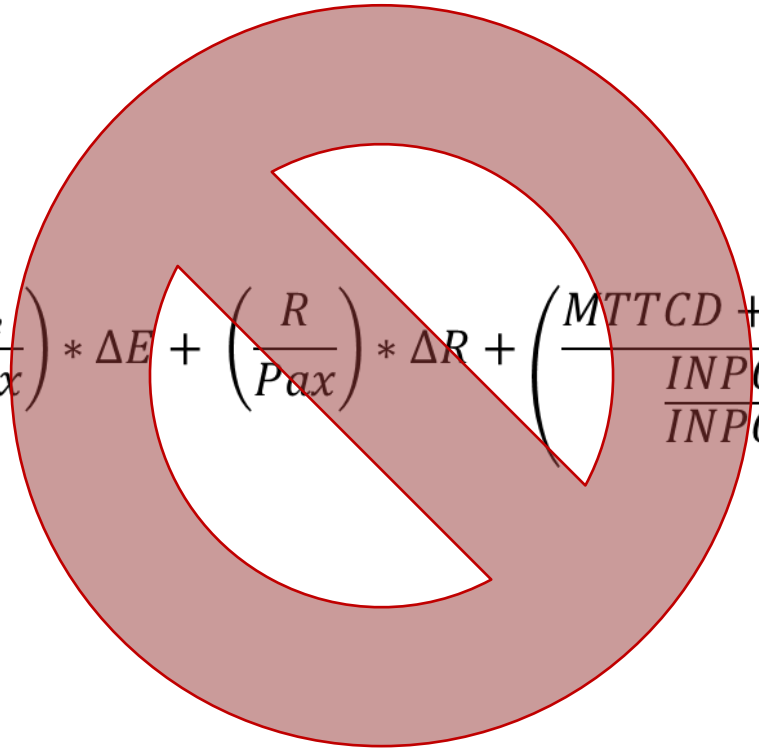
$0.5*\Delta$CCPI + $0.5*\Delta$Wage Index - Productivity Factor,

Metro Rio

$$Fare\ Change = CPI$$

Complicated?

$$Fare\ Change = \left[\left(\frac{C_e}{Pax}\right) * \Delta E + \left(\frac{R}{Pax}\right) * \Delta R + \left(\frac{MTTCD + CIND}{\frac{INPC_2}{INPC_1}}\right)\right] * \left[\frac{\Delta sm}{\left(\frac{INPC_2}{INPC_1}\right)}\right]$$

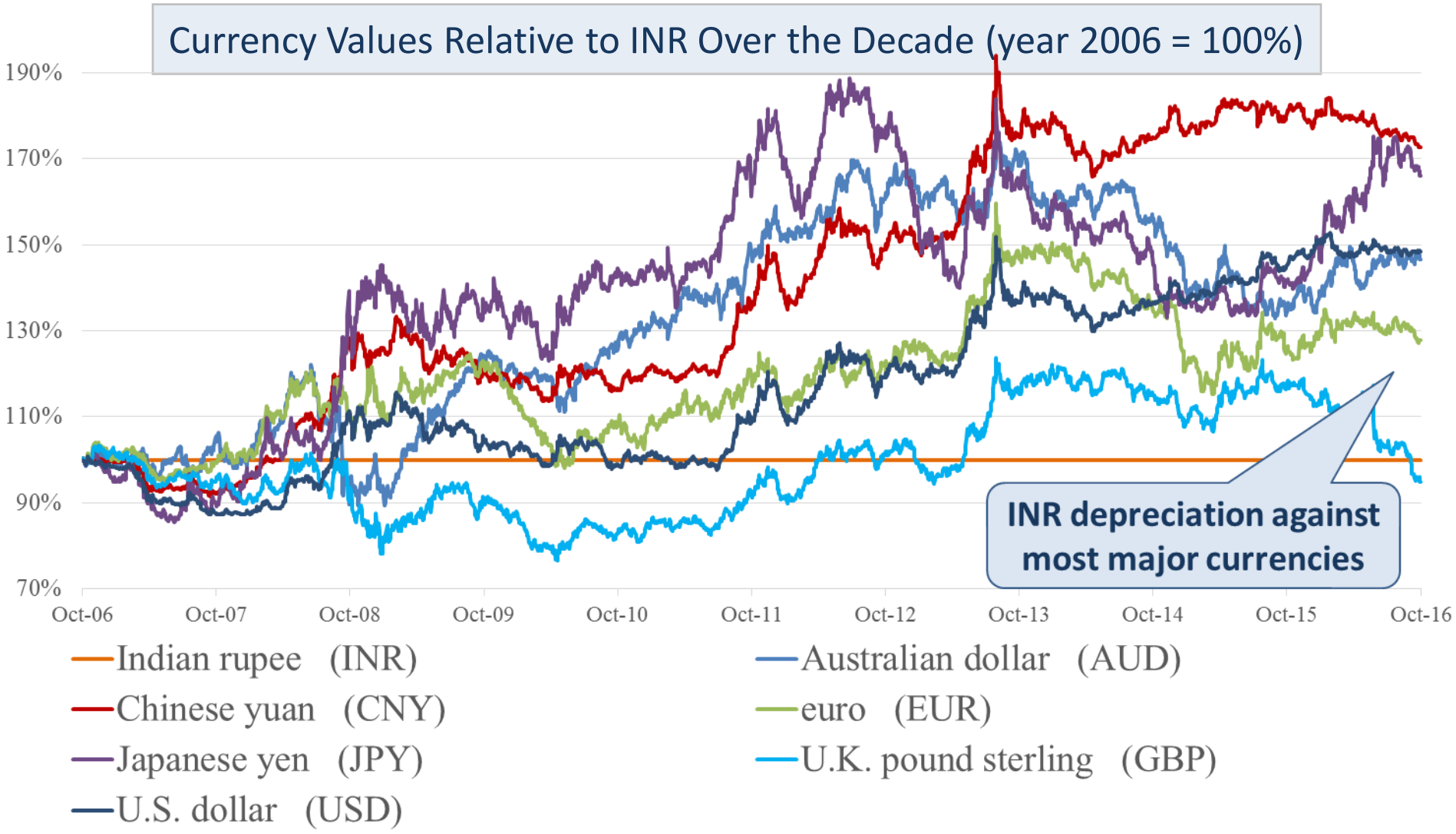


“A metro is a capital investment project that never stops”….

And you have to be able to pay for it

“Is IFI financing actually cheap?”

Foreign exchange risk is formidable



Suppose…

- 30 km system
- Built between 2006 and 2010
- Cost per km @ US 40 million (INR 181 cr. /km)
- 50% Financed by IFI loan

Comparing options @ IBRD terms

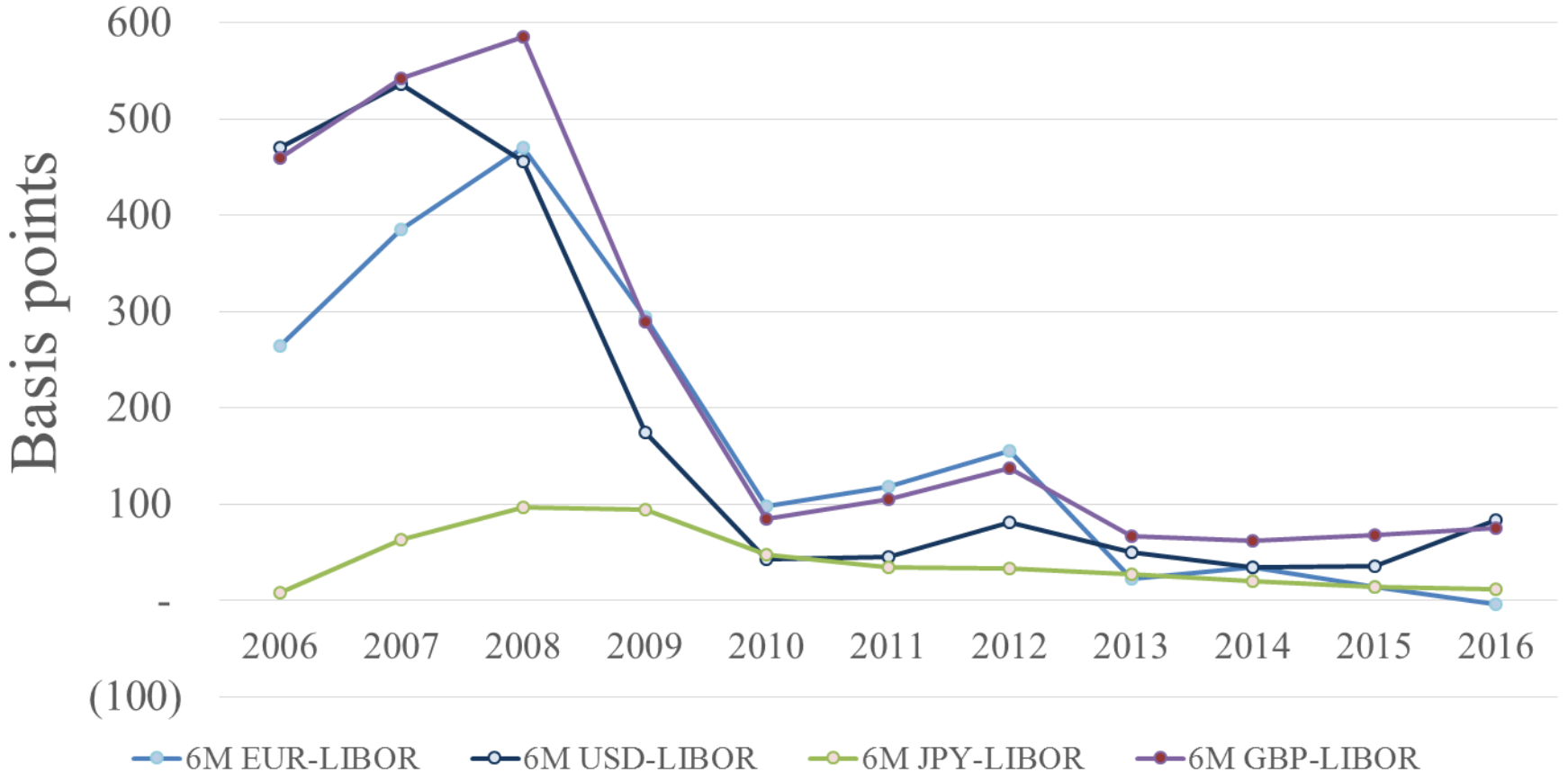
Description	*IFI loan 1 (USD)*	*IFI loan 2 (EUR)*	*IFI loan 3 (JPY)*	*IFI loan 4 (GBP)*	*INR loan (hypothetical)*
Currency (CCY)	USD	EUR	JPY	GBP	INR
Repayment method	Even principal	Even principal	Even principal	Even principal	Even principal
Benchmark rate (if debt)	6M USD-LIBOR	6M EURIBOR	6M JPY-LIBOR	6M GBP-LIBOR	Not applicable
Spread above benchmark [basis points]	165	150	130	160	900
Grace period on interest pmt (if debt)	5	5	5	5	5
Original tenor [years] (if debt)	40	40	40	40	40
Upfront fee (on committed amnt) [basis pts]	0.25%	0.25%	0.25%	0.25%	0.00%
Annual fee (on undrawn balance) [basis pts]	0.25%	0.25%	0.25%	0.25%	0.00%

Outcome over last 10 years (in INR)?

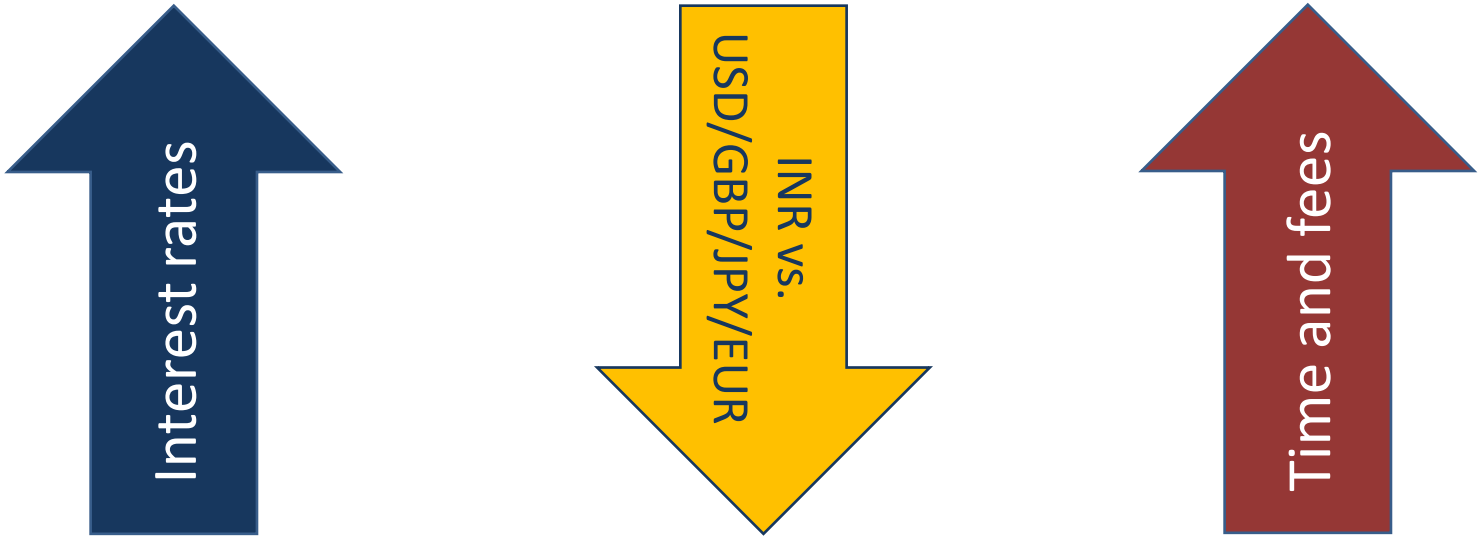
	Interest pmt (INR cr.)	*Principle payment INR cr.*	*Fees (INR cr.)*	*Total debt service & fees @ 10 years*	*% of INR loan*
Over past 10 years					
IFI loan 1 (USD)	(630)	(521)	(27)	**(1,177)**	**53%**
IFI loan 2 (EUR)	(351)	(461)	(26)	**(838)**	**38%**
IFI loan 3 (JPY)	(430)	(491)	(21)	**(942)**	**42%**
IFI loan 4 (GBP)	(640)	(458)	(29)	**(1,127)**	**51%**
INR loan	(1,844)	(384)	0	**(2,227)**	**100%**
Over full loan life (40 years if present rates and benchmarks continue)					
IFI loan 1 (USD)	(1,962)	(3,971)	(27)	**(5,961)**	**77%**
IFI loan 2 (EUR)	(996)	(3,234)	(26)	**(4,256)**	**55%**
IFI loan 3 (JPY)	(1,102)	(3,549)	(21)	**(4,672)**	**60%**
IFI loan 4 (GBP)	(1,631)	(3,179)	(29)	**(4,839)**	**63%**
INR loan	(5,055)	(2,686)	0	**(7,741)**	**100%**

Why?... ↓ interest rates

6 Month LIBOR benchmarks for different IFI currencies (2006-2016)



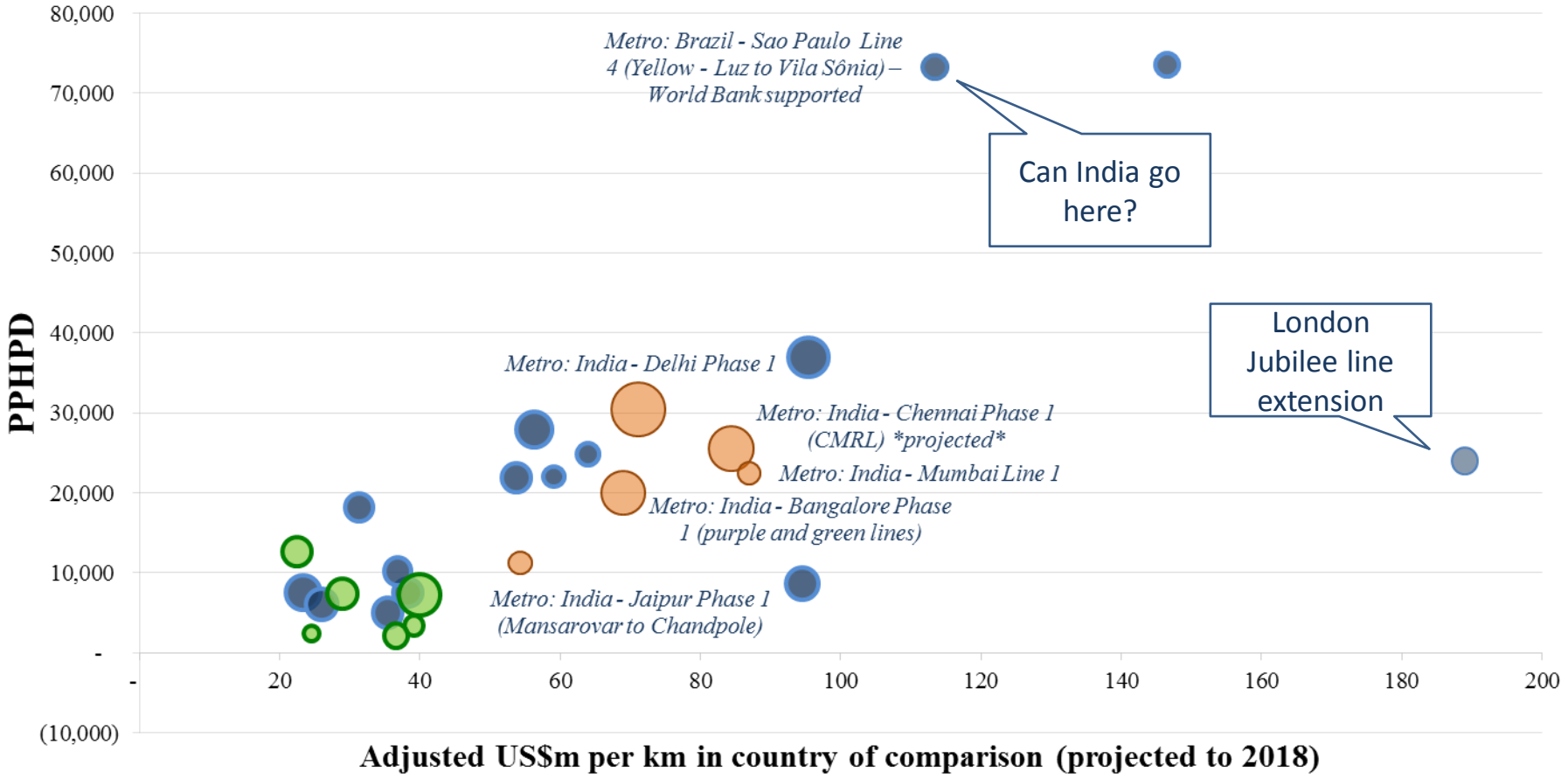
But outcome could have been different…



- Don't expect global finance to always go in your direction
- Pursue *additional technical value* from IFIs NOT just finance which may not turn out to be cheap

“How do we spend less on metros?”

Capacity is the business & it costs money



- Capacity costs money – tradeoff between building upfront or adding later
- Cutting upfront CapEx often comes at expense of later OpEx. Decisions get locked in and are difficult to reverse
- Mega cities need metros with capacity to support their growth. REMEMBER – it is difficult to shut down and expand a metro service once it is operating

Focus on spending more on the right metros and not spending where metro does not make sense

Discussion points for India's context

- ***How can India's metros gain increased discretion*** on the timing and nature of investment decisions to increase capacity?

- **How can Indian metros make best use of financing,** including international financing by development partners?

- **What are the key elements that would be necessary to put in place regular (i.e. annual) fare adjustment regimes?**

5. Business strategies for success

Customer-Oriented Focus on Service Quality

Measure the Customer Experience




Moving Trains and Hauling Passengers **vs.** Transporting People and Serving Customers


Technical Organizations Focused on Operational Goals


Service-Oriented and Customer-Focused Organizations

“Every night for 4 hours the patient has to go through brain surgery, heart surgery, then get up in the morning, run a marathon, and win.”

“Asset management from day 1”

Asset information

Planning & options assessment

- Refurbish / buy
- Timing
- Phasing
- Enhancement options
- Supplier options

Clear ***options and consequences*** for policy makers

Engineering based

More detailed analysis

Strategic / business case analsyis

“There is no such thing as an asset life”

Example: organizing around the assets in London

Asset management internal consultancy / centre of excellence

- Competence frameworks across TfL
- Benchmarking: other metros, utility providers
- Work with institute of asset management

Asset strategists

- Set strategic vision for each asset area: track, civils, etc.
- 20-80 year planning horizon linked to TfL strategic vision
- > 10year plan balancing cost, risk, performance and work > capex plan

Project sponsors

- Critical friend providing oversight
- Professional client
- Ensure project lifecycle plan adhered to

advocates for different asset classes and the project sponsors test TfL's thinking

“If we cannot value our own assets, you can’t expect others to see that value.”

Managing known and future risks

2000+

- Climate Change
- Terrorism
- Economic Austerity
- Social Media

"In a few years we have been 'hit between the eyes' by major unexpected events that have changed everything"

Future ?

- Competition for talented staff
- Energy price shocks
- Cybersecurity
- Re-regulation
- BRT systems
- Electric and autonomous cars
- Public health and pandemics
- Nuclear/bio-terrorism

Areas for further discussion

How can **Authorities** create an enabling environment?

Create **effective governance for** transport system	Develop **City Plans with TOD**	Identify **high-value projects** with robust performance	**Establish Operator** with capacity to succeed and influence
Use PPPs wisely with suitable contract periods and proper allocation of risk	Plan for **excellent integration:** between lines and modes	**Future-proof metro design**, maximising city economic benefits	Develop a **pipeline of projects**
Allow the operator to have **flexibility (**e.g. in labour)	**Procurement** to secure **whole-life** benefits	**Mitigate the impact of major projects** on existing operations	Ensure **financial predictability and fares policy**

How can **Operators** succeed within this enabling environment?

Safety first	**Engage with and influence the Authority** and stakeholders	Create **trust and confidence** with the Authority	**Design modernisation / extension projects and anticipate early reinvestment**
Be **customer-oriented** with **performance measurement** to match	Instil a "**Continuous Improvement**" culture. Use **benchmarking**	Manage **demand and revenue** as well as costs (service provision)	Prudent **financial stewardship**
Asset Management Systems from the outset	Analyse and **manage risks** and opportunities	**Be adaptive** to changes in technology, costs, demand	**Anticipate future change** –wages, energy prices – with productivity plans

Discussion points for India's context

- **What are the most important actions that Authorities and Government** can take to create a thriving, successful metro?

- **Where can Indian metros apply world best practices** in planning, design, funding, fares, financing, integration, sound network development and operational excellence?

- **What are the most important learnings (local and international) for India to take into future metro initiatives?**

Thank you!

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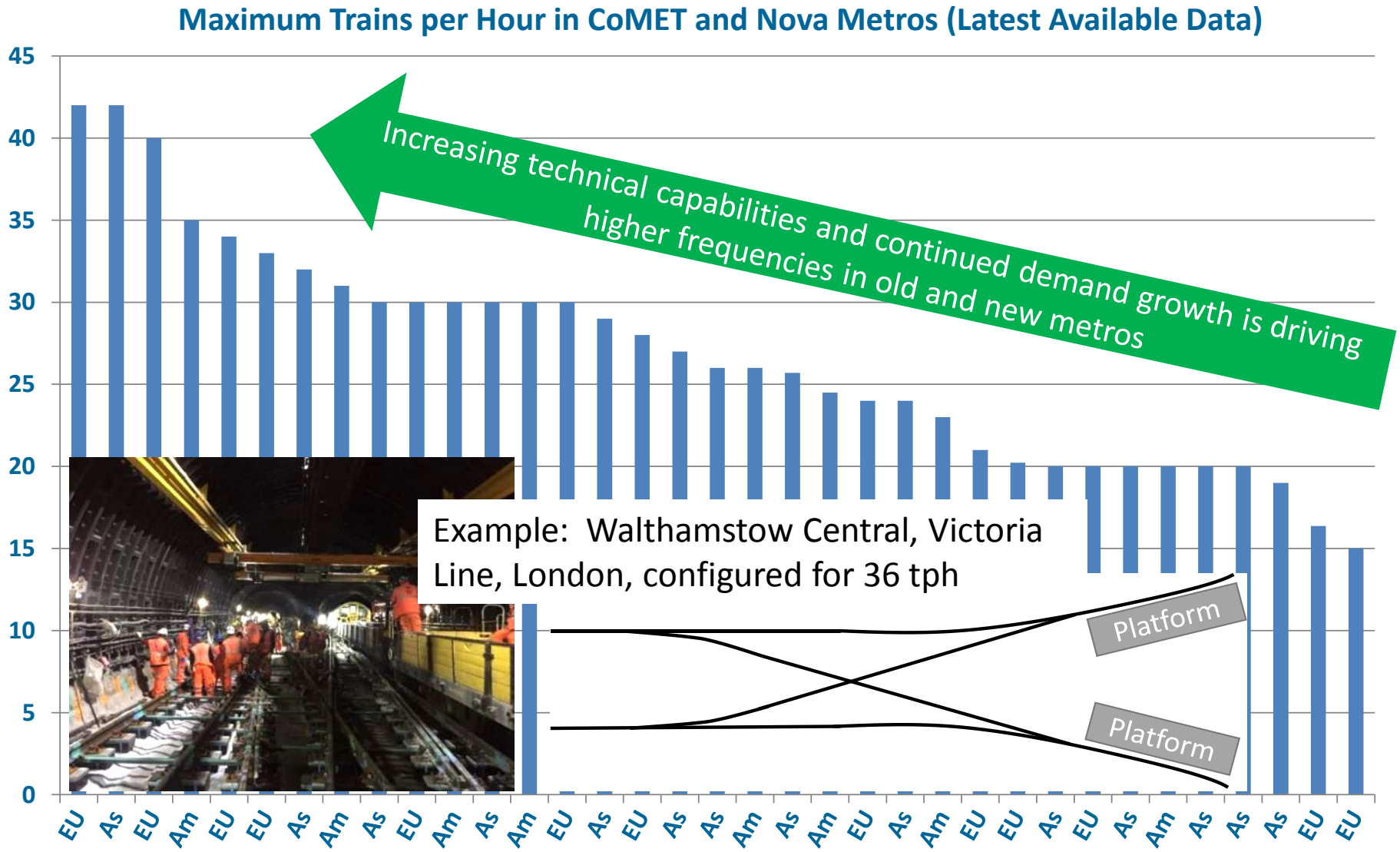
Leading metros operate at or above 30tph



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