

MODERN TRANSPORT AT THE HEART OF MAJOR CITIES

.....> METROS



keolis

320 KILOMETRES
of automated metro track

10
driverless metro lines

1983
Launch of the world's first
driverless metro in Lille

500 MILLION
metro passengers in 2017

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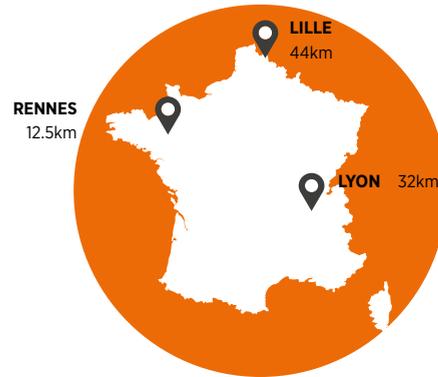
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THE LARGEST OPERATOR OF DRIVERLESS METROS

Keolis has been at the forefront of pioneering developments in metro operation since launching the world's first driverless line in Lille in 1983. We now operate and maintain networks in six cities and are about to launch lines in Doha, Shanghai, Rennes and Abidjan. All are fully or partially automated making us the largest operator of this technology in the world. Our recent success in winning contracts on three continents reflects forecasts of an exponential growth in automated lines over the next decade. Our view, based on 35 years of experience and technical research, is that this growing trend provides an opportunity to set new standards in mass transit.



SERVING CITIES ACROSS THE WORLD



OUR MAJOR NETWORKS AND THEIR ACHIEVEMENTS

IN MOBILISATION

DOHA, QATAR

Mass rapid transit system; phase one - 3 lines, 37 stations, 76km of double track; staged opening from October 2018; fully operational by 2020.

RENNES LINE B, FRANCE

15 stations; 12.5km of double track; opening in 2019.

SHANGHAI PUDONG INTERNATIONAL AIRPORT, CHINA

2 lines; 4 stations; 8km of double track; 220,000 passengers per day forecast; opening in 2019.

ABIDJAN, IVORY COAST

1 line; 20 stations; 37km of double track; 500,000 passengers per day forecast.

RECENTLY LAUNCHED

HYDERABAD, INDIA

World's largest elevated metro; launched November 2017; 450 million passengers per year forecast once network fully complete; 3 lines; 65 stations; 72km of double track.

SHANGHAI, CHINA

Launched in March 2018; first automated metro in Shanghai; 26 million passengers forecast in 2018; 1 line; 6 elevated stations; 6.7km of double track.

UNDERGOING MODERNISATION

LONDON, UK

Service reliability consistently >99% since Keolis took over in 2014; 124 million passengers in 2017; 6 lines; 45 stations; 40km of double track.

RENNES LINE A, FRANCE

Service delivery over 99.7%; 35 million passengers in 2017; 15 stations; 9km of double track.

LILLE, FRANCE

World's first driverless metro (1983); a peak train every 66 seconds - highest frequency in the world; 115 million passengers in 2017; 2 lines; 60 stations; 45km of double track.

LYON, FRANCE

World's first metro with Communications Based Train Control (1991); 200 million passengers in 2017 - 50% of the city's total public transport use; 4 lines; 44 stations; 32km of double track.

OUR PROMISES TO CLIENTS, PASSENGERS AND COMMUNITIES

Our service is based around a set of promises that combine to make using metro systems an attractive and natural choice.



1 Zero harm

We have set ourselves the highest possible safety standard – zero injuries to our passengers, employees and the public. Our management systems reduce safety risks year after year.



2 Operational excellence

Our precision planning and operation provides resilient services people can depend on whatever the conditions, with flexibility to cater for day-to-day variations in demand and special events.



3 Convenient, personalised travel

We make our services easy for everyone to use, with assistance available throughout passengers' door-to-door journeys and innovations to provide a personalised travel experience.



4 Economic efficiency

Our operations, asset management and commercial expertise increases revenue, optimises costs and strengthens businesses, providing value for money to our clients.



5 Sustainable business

We create sustainable businesses by reducing the environmental impact of travel, investing in employee skills and working with PTAs to develop networks.



Hyderabad, India

HOW WE KEEP OUR PROMISES

To keep our promises wherever we operate, we base our service offering on five pillars of excellence that reflect the entire lifecycle of a metro line – from planning and design to start of operations, improving day-to-day performance and modernisation.

PILLAR #5 ENHANCING NETWORK CAPABILITY

- Working with PTAs to renew lines effectively
- Managing major projects to raise capacity
- Transforming networks through automation

PILLAR #1 ENGAGING EARLY WITH AUTHORITIES

- Informing choices for new lines
- Designing high-performance metros
- Integrating metro lines to add value

PILLAR #2 SECURING SMOOTH LAUNCHES AND TAKEOVERS

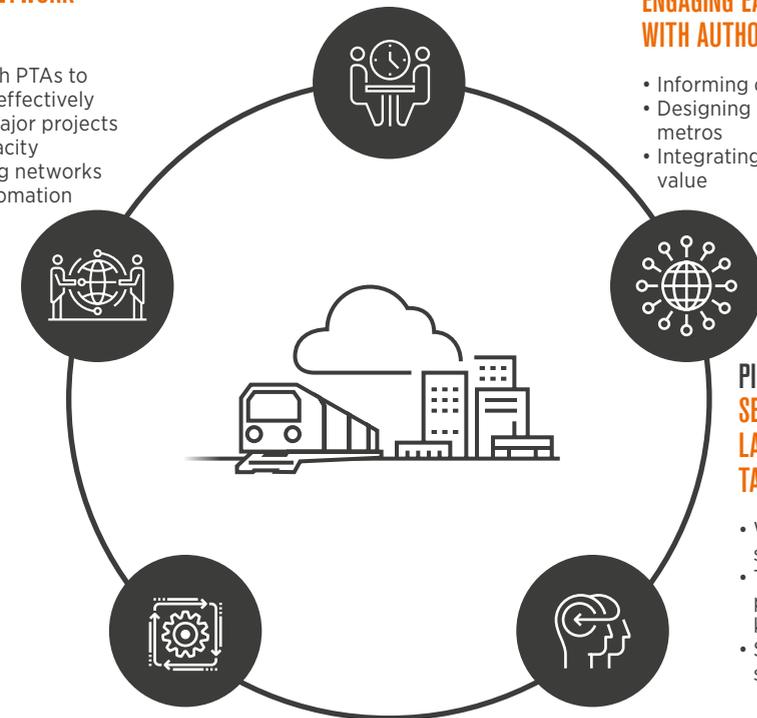
- Working well with all stakeholders
- Transferring proven processes and knowledge
- Service quality and safety from the start

PILLAR #4 OPTIMISING OPERATIONAL PERFORMANCE

- Dynamic train service management
- Maintaining high-performance metro lines
- Successful special events

PILLAR #3 THINKING LIKE A PASSENGER

- Easy journeys for all passengers
- Rapid response to disruption
- Using technology to personalise travel



PILLAR #1

ENGAGING EARLY WITH AUTHORITIES

We engage constructively with PTAs at the earliest opportunity, offering our over 40-year lifecycle experience and operator's perspective to inform the planning and design of new metro lines. The benefits include more reliable, efficient, customer-focused networks and the right transport choices for growing cities.

INFORMING CHOICES FOR NEW LINES

We form partnerships with PTAs to assess whether a new metro will be the most effective transport investment and identify the right routing and technology for new lines. Our planning studies include forecasting line capacity, advising on station layout and access, whether a rubber-tyred or steel-wheeled metro would be appropriate and whether terrain

is suitable for metro operation. We frame our proposals against PTAs' objectives for their overall transport network.

DESIGNING HIGH-PERFORMANCE METROS

Our operations experts work with PTAs to build the fundamentals of high-performance into the design of new metros. As such, our design reviews focus on enhancing infrastructure reliability and ensuring new

lines will be resilient, flexible and efficient to operate and easy for passengers to use. The impacts include:

- Signalling refined for precision operation
- Quicker recovery from delays
- Improved passenger flows in stations
- Easier access to maintain critical infrastructure
- Well-equipped and organised depots
- Lower lifecycle and construction costs.

Our recommendations are based on proven

solutions from our leading networks, adapted to local standards and regulations.

INTEGRATING METRO LINES TO ADD VALUE

We offer PTAs decades of experience of designing metros as the high-capacity spine of integrated transport networks with co-ordinated services, efficient connections and multi-modal termini. It adds value to PTAs' investment in new lines

by creating:

- Faster journeys including rapid transfer to and from the metro
- Modal shift from cars to the metro and other low-emission transport
- Integrated fares and ticketing.

We are working with PTAs in Hyderabad, Shanghai, Rennes and Lyon to integrate new lines with the wider transport network.

"Our design review of the Hyderabad metro resulted in the train service, infrastructure and customer facilities working as an integrated high-performance system."

François Vinsonneau,
Keolis Project Director, Hyderabad

8

design reviews for new metro lines since 2010

over €15M

of savings for our Hyderabad client

350

annual public transport trips per person on Lyon's integrated network – the highest in Europe

WHOLE SYSTEM DESIGN REVIEW OF HYDERABAD METRO

In **Hyderabad**, our early role included acting as shadow operator to bring practical experience to the client delivering the state's first metro. Our design review removed risks from the signalling specification, provided for efficient fault reporting and maintenance and positioned points and turnbacks for flexible, resilient service patterns. Station reviews modified wayfinding, ticket gates and waiting areas to make it quicker to reach the train. As well as creating a more reliable network with better customer experience, our proposals saved our client over €15M.

FEASIBILITY STUDY INFORMS RENNES LINE B CHOICES

During the planning of Line B in **Rennes**, we carried out a feasibility study of three options for the PTA. It examined whether each option would provide sufficient capacity and deliver a reliable service, integration of train control systems with the existing metro and future proofing the new route. The study included cost:benefit analysis for each option. The PTA adopted our depot design recommendations and track alignment specifications for the line, due to open in 2019. We are conducting a similar study for Lyon Line E.



Hyderabad, India

PILLAR #2

SECURING SMOOTH LAUNCHES AND TAKEOVERS

Our preparations to launch new metros and take over existing lines guarantee that services will begin smoothly and provide a strong foundation for the business. Based on decades of global experience our approach during these key stages in a metro's lifecycle works time and again.

- **800**
staff recruited and trained for launch of Hyderabad metro
- **20-35%**
increase in capacity on DLR routes within eight months
- **15%**
increase in commercial speed during the first six months of operation in Hyderabad

“Successful transfer of training and staffing arrangements from French networks was a key factor in providing a robust, resilient service from the launch of Shanghai's first automated metro.”

Philippe Debyser,
Chief Operating Officer, Shanghai Keolis

WORKING WELL WITH ALL STAKEHOLDERS

Our leading operations, engineering and HR experts guide our preparations for each launch and takeover to ensure train services meet performance standards from the start. Long-term secondments and sharing progress openly with PTAs creates productive relationships to resolve risks. We consult regulators and local partners on communication style and working practices, enabling us to apply our experience successfully.

TRANSFERRING PROVEN PROCESSES AND KNOWLEDGE Supporting asset commissioning and handover –

We form project teams with suppliers to build asset reliability to the level required for launch services and beyond. We adapt our experience to:

- Develop test plans for trains and technical systems
- Analyse results and resolve faults
- Verify asset reliability
- Carry out trial runs.

We continue to fine tune asset performance after the launch.

Training launch workforces – We adapt suppliers' training

manuals to reflect our proven teaching and operating techniques so that hundreds of new recruits achieve high competence in good time. Managers receive operations training at our leading metros.

Seamless takeovers – We work constructively with outgoing operators to complete all key tasks. Early meetings with trade unions and staff Q&A channels provide for smooth employee transfer. Specialist teams confirm IT systems work faultlessly. Audits and briefings prepare equipment and staff for our Day 1 service.

SERVICE QUALITY AND SAFETY FROM THE START

We instil high performance and safety into **new launch** metros by creating flexible, integrated businesses. Key aspects include:

- Multi-skilled frontline staff to repair faults, advise customers and manage risks
- Integrated operations and maintenance teams with joint performance targets
- Planned rapid responses to delays.

Our **takeovers** re-energise businesses with quick-win service improvements and a culture change programme.

HIGH-PERFORMANCE TECHNIQUES TRANSFERRED TO SHANGHAI

In 2018, we launched **Shanghai's** first automated metro after two years' preparation. Our role included rewriting 200 procedures to incorporate our proven high-performance methods such as maintenance systems to predict and prevent faults. We also made the case to our Chinese partner for multi-skilled staffing to resolve delays rapidly and reduce costs. To meet the launch date, we revised the training plan for 150 staff to match progress in commissioning the line. Our approach contributed to our selection to operate another new line from 2019.

RAPID DLR IMPROVEMENTS

In 2014, our preparations to take over **London's** DLR network laid the ground for a rapid increase in capacity. Asset audits and business reviews highlighted the potential to enhance operating and maintenance methods using techniques from our French metros. Within eight months, creative new timetables raised capacity by 20-35% on high demand routes. A new incident management plan with defined responses to scenarios contributed to punctuality exceeding the 99% target.



PILLAR #3

THINKING LIKE A PASSENGER

Every metro presents unique customer service challenges. We need to guide hundreds of thousands of passengers through the system each day, many are visitors unfamiliar with the network, and any service disruption affects a large part of a city's population. Our Thinking Like a Passenger strategy addresses these key issues.

→ **89**
record passenger satisfaction rating on the DLR

→ **9.5/10**
passenger satisfaction rating for information provision in Rennes

→ **10 minutes**
(maximum) to implement alternative transport plans if services are disrupted

“KeolisAmey Docklands settled quickly into the role of DLR operator, delivering improvements for our customers before the first anniversary of the new franchise was in sight.”

Jonathan Fox,
Director of Rail and Sponsored Services,
Transport for London

EASY JOURNEYS FOR ALL PASSENGERS

We design our customer service so everyone can travel with confidence. We train all staff to understand how passengers use the metro - from commuters to tourists and disabled people - and target assistance where needed most. Our control centres use monitoring technology to deploy mobile teams to manage passenger flows at crowded stations. High-visibility signage and announcements help passengers navigate the network and guide them to space on platforms and trains. Specially-trained staff work at stations with many first-time users. Co-ordinated plans cater for passengers' entire journey. Announcements, signs and apps provide details of connecting transport, we integrate timetables, offer 'last mile' options (e.g. bike rental) and inform visitors how to reach city attractions.

RAPID RESPONSE TO DISRUPTION

Our metros have practised rapid response plans to minimise the impact of any service disruption on passengers.

Our control centres determine the appropriate plan and inform passengers within five minutes. Alternative travel arrangements are in place within a maximum of 10 minutes. The plans include procedures to:

- Continue operating services either side of a failed train
- Divert buses from suitable routes to metro stations
- Provide real-time updates via announcements, information screens and apps.

Trained back office staff who work alongside station agents to offer extra assistance and help passengers complete their journey.

USING TECHNOLOGY TO PERSONALISE TRAVEL

We enhance customer service with IT innovation. In France, our world-first app combines journey planning with ticket purchase for metros and connecting transport. A refresh is introducing new features to reflect passengers' travel purposes and preferences. Further projects include equipping Lille and Lyon's metro so passengers can stay online in tunnels.



RECORD DLR SATISFACTION

In **London**, we made it easier for people to use the DLR within months of taking over. We trained all employees to Think Like a Passenger and set up a mobile Customer Action Team to make more staff available to assist at key times and places. New announcements provided targeted information and we implemented a safe, efficient queuing system at our most crowded station. Satisfaction scores rose to a record 89 - a level we continue to focus on as patronage grows. The new culture has led to numerous changes including revising maintenance times to improve lift and escalator availability.

NEW APP JOINS UP TRAVEL AND LIFESTYLE

In **Rennes**, we have updated our metro/bus app to integrate public transport into city life and inform travel choices. It includes real-time information comparing public transport, cycling and car sharing with driving, and social media feedback. Lifestyle information includes special events, theatre times and weather forecasts. Registered users personalise itineraries to their preferred mode of travel and receive disruption alerts. A dedicated section shows the best options for disabled people.

PILLAR #4

OPTIMISING OPERATIONAL PERFORMANCE

Our metros achieve near perfect reliability and total safety while carrying hundreds of thousands of passengers each day on some of the world's highest frequency services. Our success is based on precision planning, operation and maintenance and our ability to cater for changes in demand in real-time.

- **66 seconds** between each train in Lille – the world's highest frequency
- **More than 99%** service availability in Rennes, Lille and on the DLR
- **Zero** serious safety incidents on our automated metro lines

“Weeks of preparation enabled us to carry tens of thousands of passengers smoothly to each of the six matches and 50-plus broadcasts at fan zones, contributing significantly to the success of Euro 2016.”

Jérôme Berthonneau,
Chief Operating Officer,
Keolis Lyon

DYNAMIC TRAIN SERVICE MANAGEMENT

We manage metro services dynamically to maintain exact timings and headways, match capacity to demand and prevent platform overcrowding. Our companies define dozens of peak and off-peak operating plans, which vary train control and staff location by day, hour

and minute based on patronage trends for each train and station and their impact on performance. Flexibility in the plans caters for unforeseen spikes in use in real-time. Options include:

- Adding extra services
- Varying train speeds and station dwell times to maintain even service intervals
- Deploying mobile teams to manage boarding.

WORLD-LEADING PERFORMANCE ON RENNES METRO

In Rennes, where we run 36 peak trains per hour, our operating techniques deliver world-leading performance and maximum flexibility to manage growth. Continual refinement of over 100 pre-defined train service plans maintains total reliability and improves operational efficiency. Initiatives with stakeholders include the university agreeing to stagger lecture times, reducing peak crowding and travel stress for students and commuters. Small changes to train timings and flywheel technology have cut energy use 12%. Service availability is as high as 99.99%.

Our precision planning and flexible operation delivers service availability above 99% in Lille, Rennes and London.

MAINTAINING HIGH-PERFORMANCE METRO LINES

We maintain our lines to support high train service performance day-in, day-out. Advanced software integrates data from sensors, inspections

and train operation so that we understand asset condition and how it affects performance in detail. We use the analysis to design tailored plans, which prevent faults and maintain key assets at the right time. If faults occur, multi-skilled frontline staff fix 90%, minimising train delays. If depot repair is needed, our automated coupling process (in place in

Lille, Lyon and Rennes) rescues failed trains within five minutes. Joint operations and maintenance reviews investigate every incident to prevent reoccurrence.

SUCCESSFUL SPECIAL EVENTS

Our metros play a key role in the success of world famous and local festivals. We engage with city authorities to develop effective

transport plans and prepare weeks in advance. We schedule maintenance so vehicles are available for an extended maximum capacity service and run trains until crowds disperse. Station management ensures trains are fully loaded and everyone uses the metro safely.

MAXIMUM FREQUENCY SERVICE FOR EURO 2016

During Euro 2016, our Lyon and Lille metros successfully managed hundreds of thousands of extra passengers using the lines to attend football matches and fan zones. Station queuing systems released passengers in batches equivalent to train capacity. Additional staff spaced people evenly on platforms for rapid, efficient boarding. Dedicated apps and smart wristbands contributed to swift use of the network and smooth passenger flow. The measures played an essential part in providing a safe, efficient maximum-frequency service for up to five hours each match day.



Lyon, France

PILLAR #5

ENHANCING NETWORK CAPABILITY

Our companies work with PTAs to anticipate and respond to the challenges of networks reaching full capacity and replacing ageing assets. Our proven solutions and technical knowledge identify efficient options for renewing assets at the right time, upgrading lines and network transformation.

→ **€500M**
cost saving for Lyon's PTA from extending the fleet's life

→ **€50M**
annual budget for renewal and modernisation works on behalf of Lille's PTA

→ **30%**
additional capacity by automating conventional lines

“Supporting our PTA, Métropole Européenne de Lille (MEL), in the modernisation of Lille's metro, while minimising disruption to passengers, is part of day-to-day business for our teams at Transpole.”

Ludovic Soleil,
Director Projects and Engineering, Transpole

WORKING WITH PTAS TO RENEW LINES EFFECTIVELY

Our companies assist PTAs in developing efficient asset renewal plans to maintain and improve train service reliability. We provide simulations of future performance under scenarios from intensified maintenance to asset refurbishment and replacement, advise on choices and develop joint business plans. Our partnerships help clients prioritise upgrades and renewals and invest effectively at the right time.

MANAGING MAJOR PROJECTS TO RAISE CAPACITY

We work with PTAs to identify and manage projects to increase networks' capacity throughout their lifecycles. We have acted as a partner in projects to remodel infrastructure, lengthen trains, introduce new trains, extend lines and open new lines. Our role has included:

- Identifying small infrastructure enhancements (e.g. turnbacks) to increase service frequency
- Reviewing designs and tender specifications
- Recommending technology and selecting suppliers

- Integrating new infrastructure with existing lines. We arrange engineering works at night after the last train has run, ensuring services continue seamlessly.

TRANSFORMING NETWORKS THROUGH AUTOMATION

With many conventional metros approaching full capacity and assets near the end of their design life, we have developed a process for smooth conversion to automated operation. It provides an option to deliver new capacity more quickly, less disruptively and at lower cost than building new lines. Our development work shows deliverable benefits which includes:

- 99.9% service reliability
- 30% more capacity from greater service frequency and higher speeds
- 10% reduction in energy and staff costs.

Our conversion process draws on our experience of maximising the benefits of automation and includes a phased transition to the new technology and retraining staff.



RENEWING THE WORLD'S OLDEST DRIVERLESS METRO

In **Lille**, where we renew as well as maintain the world's oldest driverless metro, we are carrying out numerous projects to replace life-expired assets and modernise others. Recent renewals include 45 midlife trains, 159 escalators and lifts, 2km of track, 8 sets of points and ticketing, CCTV and electrical systems. Work planning, based on asset condition and importance, contributes to world-leading 99.8% of scheduled train kilometres operated. We also identified and carried out works to extend fleet life by 10 years. Lyon has agreed a similar solution.

SUPPORTING LYON METRO TRANSFORMATION

In **Lyon**, we are advising the PTA on its transformation of the 30-40 year old network. On Line B we helped select the signalling supplier for one of the world's first conversions to driverless operation and are developing test plans. On Line B, we are advising on renewal of automated systems and a 2.5km extension. For Line A, we developed and trialled a train lengthening scheme. We are also conducting a planning study for a new line. The programme will cater for growth forecasts of up to 50% by 2023 on high-demand routes.

EXPERT SUPPORT FROM OUR METRO CENTRE OF EXCELLENCE

Our Metro Centre of Excellence, staffed by our foremost specialists, is recognised as a world leader in operations and engineering, project management and skills development. Based in Lyon where we manage the multi-modal transport network, it has supported our metros with expertise and solutions for over 30 years.

ASSISTING METROS THROUGHOUT THEIR LIFECYCLE

Expert teams from the Centre of Excellence support all of our metros throughout the critical periods in their lifecycle from design to launch, modernisation and expansion. On-the-ground assistance includes readiness audits to assess progress and keep projects on schedule. Completion audits assess whether operations and safety management can be strengthened with best practice from our international networks. Where necessary, the centre develops bespoke technical and operating solutions for each metro.

WORLD-LEADING MANAGEMENT AND TECHNICAL SYSTEMS

The centre continually adapts our management and technical systems to meet the challenges metros face in delivering consistent, high-quality service as patronage grows. Key workstreams include:

- Use of digital IT for superior monitoring of infrastructure and train service performance
- Refining our integrated approach to operations,

infrastructure and customer management

- Automating driver-operated lines to increase capacity efficiently
 - Maximising the potential of automation to provide near perfect reliability.
- We provide global leadership by working with suppliers to enhance the capability of metro technology.

SKILLS DEVELOPMENT AND KNOWLEDGE SHARING

The centre's training institute develops and refreshes our managers' skills, providing courses on every aspect of service planning, maintenance and customer management. The emphasis is on how all parts of the metro function as a system, the interdependencies and how individual decisions impact the overall service. The centre also organises management events and opportunities including:

- Working groups on train control, signalling and asset management
- Online knowledge sharing communities
- Site visits.



Shanghai, China

“We use all the expertise of the Group to share best practice, develop our people and work collaboratively with our PTA to deliver service excellence day in, day out.”

Abdellah Chajai,
Managing Director,
KeolisAmey Docklands

INNOVATIVE SOLUTIONS FOR HYDERABAD LAUNCH

In **Hyderabad** we developed world-class solutions to meet the PTA's request to launch the state's first metro on a 30km route section rather than in the planned phases. Our Centre of Excellence worked with the safety regulator to gain approval for new driving and train control processes required for an initial mix of driver-operated and automated services. In addition, we integrated ticketing and signalling data to provide detailed information on patronage levels, enabling us to adjust train operation to match demand in real-time. Services began in 2017 on the longest metro line launched in India in one go and met the PTA's quality standards from the start.

Key areas of expertise:

- Network design
- Capacity planning
- Systems commissioning and handover
- Performance improvement
- Whole system planning and service delivery, Rolling stock & infrastructure maintenance and renewal
- Automated operation
- Integrating public transport
- Ticketing and fares development.

Design: EPOKA

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