SYSTRA SOLUTIONS

SUSTAINABLE TRAMS
for the future

LIGHT RAIL TRANSIT
A **DURABLE** SOLUTION FOR **RESPONSIBLE**
URBAN MOBILITY

Since the year 2000, Light Rail Transit has made a major come-back in France and worldwide, enabling towns to enhance the quality of air and the life of their inhabitants. LRTs redraw the cityscape, redesign mobility and built-up areas, and promote urban well-being.

SYSTRA has been entrusted with the finest projects. In France, Lyon, Paris and, of course, the whole network of Bordeaux. Further afield, SYSTRA has built networks for Algiers, Casablanca, Dubai, Ouargla and Rabat.

CHECKLIST FOR DEPLOYING YOUR PROJECT

Before you decide

1. **Take a long-term view of your project,** in line with your town's development objectives.
2. **Factor in** the project's urban and environmental requirements.
3. **Clarify the town's overall transport policy,** particularly for road traffic.
4. **Simulate funding and forecast ridership,** to assess the project's viability.
5. **Estimate whether the project is economically profitable,** find ways of cutting the cost per km.

Before breaking any ground

1. **Choose the route carefully**
   - Build on established travelling habits
   - Choose the best criteria for efficient service
   - Locate stations and depots judiciously
2. **Define the level of passenger comfort:**
   - LRT tramcars
   - Frequency
   - Stations
   - Commercial speed
3. **Choose the best way of fitting** LRT lines into roads along the route.
4. **Opt for the greatest energy savings**

For your LIGHT RAIL TRANSIT CHOOSE SYSTRA TO GET THE BEST

700 km of LRT
delivered worldwide

Our firsts

- The first ever 100% catenary-free LRT in **Dubai**
- The first ever LRT line in Africa: **Casablanca**

Innovative concrete solutions for extreme climate conditions

- **Ouargla**, temperature up to 55° and prevent from sand impacts
- Innovative underground water dripping solution **Paris T3 Line**

Our world's finest Light Rail Transit projects

From lines that incorporate landscaping in Casablanca to track that operates without overhead lines; From Ouargla located at the gates of the Sahara with difficult weather and geotechnical conditions to air-conditioned platforms with screen doors in Dubai: SYSTRA always put the client's needs first.

Casablanca ©SYSTRA

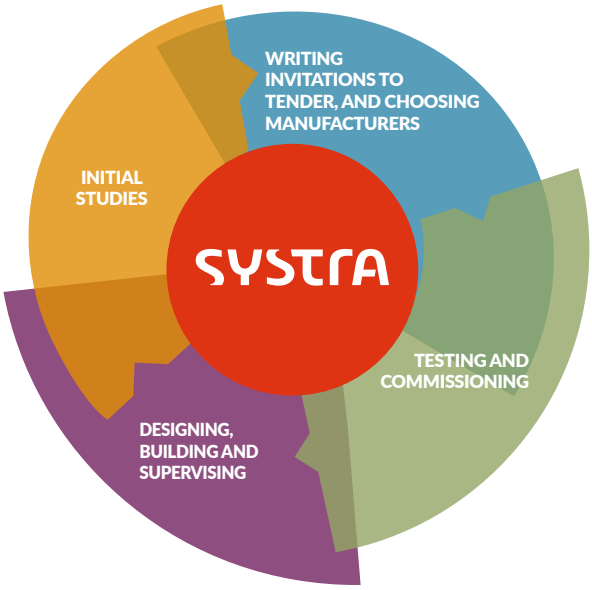
URBAN ARCHITECT

ON THE TRAVELLER'S EXPERIENCE AND THE RESIDENT'S PERCEPTION HANG THE ACCEPTANCE AND SUCCESS OF YOUR NEW LRT. FROM THE OUTSET, YOUR PROJECT HAS TO AIM FOR THESE TARGETS:

>> Integration of the LRT to conciliate other road users (pedestrians, cyclists, drivers), run at the best commercial speed, guarantee safe transport and respect the environment.

>> Efficient, reliable and regular service.

>> Cost-effective investment and maintenance.



You benefit from our experience gained on emblematic worldwide projects, and the skills we have tried and tested at every stage of the LRT infrastructure lifecycle. We offer you the most practical and original solutions, while respecting international standards and your local environmental and safety requirements.

1
SIMULATE FUNDING

and conduct ridership forecasts, to assess the viability of your project.

2
DEFINE THE BEST ROUTE, TO

- find the sweet spot between demographics, principal destinations and technical constraints
- build connections between present and future high-footfall areas.
- fit the LRT into the road network, particularly at intersections and parking places, from the earliest design phase.

3
SPECIFY THE BEST TECHNICAL SOLUTION, TO DELIVER CAPACITY, COMFORT, SAFETY AND ACCEPTABLE OPERATING COSTS

Our experts from each sector will help you define your transport system:

- Stations: location & insertion enhanced passenger protection at stations
- Track: alignment to guarantee trouble-free LRT movements
- Systems: for streamlined service and easy maintenance, energy efficiency, overhead wiring to blend into the cityscape
- Commercial operating speeds to suit urban traffic flows
- Passenger information: rationalise fare collection and ticket control, video surveillance for trouble spots information in real time, along with mobile applications interfacing with other solutions for urban mobility
- Rolling stock: save up to 30% on procurement. Rolling stock selected to improve comfort, streamline passengers flows and run at optimum speed in all circumstances.

4
MANAGE YOUR PROJECT EFFICIENTLY, RESPECT YOUR TIMETABLE AND BUDGET

We can match up architectural design and technical requirements. By taking an overall view, we think outside the box and work pragmatically. We are able to manage your project methodically, while integrating the dynamic requirements of infrastructure projects. We pay particular attention to cost control, risk anticipation, quality supervision and the tendering process. This means combining all present and future issues into a robust, original and competitive solution.

5
MANAGE INTERFACES

Transport system projects are often complex and multi-disciplinary. To meet such challenges, SYSTRA offers a proven systems integration strategy, delivering smooth project management. Our project coordinators and engineers take care of each interface between every technical component, to meet the most exacting standards.

6
SUPERVISE CONSTRUCTION AND TESTING

This crucial phase requires meticulous coordination, and has to be planned, right from the start of your project. Our experts are on hand to help you.

7
GUARANTEE OPERATIONAL RELIABILITY

From the first design blueprint to the start of commercial service, our experts ease your processes, apply the relevant regulations and eliminate every potential operating risk.

SYSTRA +

- **OUR CLIENTS GET THE BENEFIT OF THE EXPERIENCE** we have gained on more than 50 other projects worldwide.
- **WE PLAN OPERATING AND MAINTENANCE CONDITIONS,** right from the start of design, to deliver cost-effective operations and maximum comfort for passengers.
- **COMBINE OUR ARCHITECTS TALENTS** with those of famous architects.
- **WE CAN DEPLOY EVERY SINGLE TRACTION POWER** system, with or without overhead wires.
- **WE RECONCILE THE HIGHEST TECHNICAL REQUIREMENTS** with extreme climates or operating conditions.
- **WE TAKE AN IMPARTIAL VIEW OF INDUSTRIAL** deliverables. We select the best solution and adapt it to meet your real needs.
- **OUR PERMEABLE TRACK DESIGN SAVES ON BUILDING MATERIALS,** cuts costs and meets the highest standards.

Lyon ©Philippe Hervouet Pictures

SEGREGATED RIGHT-OF-WAY

Besançon ©SYSTRA

MIXED RIGHT-OF-WAY

Tours ©SYSTRA

AXIAL ALIGNMENT

Algiers ©M. Kadri (CAPA Pictures)

LATERAL ALIGNMENT

Bordeaux ©O. Toussaint (CAPA Pictures)

MIXED OR SEGREGATED RIGHT OF WAY: HOW TO DEFINE BEST SOLUTIONS

In France, most LRTs run along reserved lanes, or else share their route with pedestrians, cyclists and those vehicles authorised to drive through pedestrian precincts. Unlike other European countries, there is little use of shared lanes where sections of track are also accessible to road vehicles.

Different means of integration may be adopted for different track sections, to suit local circumstances.

ROAD SHARE OPTION

RESERVED LANE

PRINCIPAL CHARACTERISTICS

Road vehicles are entirely excluded from the LRT track.

INTERFACES WITH ROAD TRAFFIC

- Keeps road traffic away from the LRT track.
- Interfaces occur only where roads cross LRT track. Whether these crossings are crossroads or roundabouts, they all require urban integration and development studies, to conciliate road users and respect safety standards.

ROAD SHARE OPTION

SHARED LANE

PRINCIPAL CHARACTERISTICS

Road vehicles can drive along the LRT track for significant distances.

INTERFACES WITH ROAD TRAFFIC

- Maintains road traffic in districts with narrow streets. Encourages local service.
- Affects service regularity on the line, may be alleviated by access lanes at crossroads, priority at traffic lights, measures to prevent LRTs overtaken at stations or U-turnsstandards.

Tramway de Ouargla © RATP Dev

Dubai © Hywell Waters (PANOS-REA)

RETHINK THE RESILIENCE OF TRANSPORT INFRASTRUCTURE AGAINST THE THREAT OF CHANGING CLIMATES

Besides the objective to achieve net zero carbon emissions by 2050, it has become obvious that the design, construction and operation of more sustainable infrastructures has to be adapted to changing climatic conditions and increasingly extreme weather conditions.

Drawing on its experience with projects in extreme heat (Saharan light rail projects in Algiers, Casablanca, Dubai, Ouargla and Rabat) or cold temperatures (Quebec project), SYSTRA has designed and delivered new solutions capable of guaranteeing the operation and ensuring the comfort and safety of passengers.

In Saharan or Arabic areas, to cope with extremely hot temperatures, not only the equipment but also the stations and rolling stock have to be redesigned. Sub-stations and equipment rooms have been built underground and designed to use cooling from station air-conditioning, while power boxes were protected using layers of polystyrene and thermally insulated in cast iron. Rolling stock was also designed to achieve a maximum saloon temperature of 25C.

At the other end of the temperature scale, not anticipating in the design the effect of snow and ice to enable the system to run from -40°C to +50C could affect maintenance and operations making the installations non-operational or unsafe during the winter period. Developing some specific measures as well as care and maintenance rules to prevent snow accumulation has been necessary: use of specialised machines, running of non-revenue services at night to prevent ice formation on the overhead contact lines. Heated platforms and covered stabling yards, where trains can be pre-heated before their service in the morning, have been provided.

Designing sustainable infrastructures also means being more frugal with resources such as water. In Lyon (France) a solution was deployed to cut down on urban materials by reusing public lighting and recycling original kerbs on roadways. 70% of the line (some 134,000m^2) has been built on a permeable surface that allows grass to grow between tracks and rainwater to infiltrate the ground. Not only does this provide a more aesthetically pleasing environment, it also helps to avoid saturation of the sewer system and the risk of flooding in the case of heavy rainfall.

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RATP (PARIS) LRT T3 – THE GROUND SPRINKLER WATERING SOLUTION

Creating a greener city, enhancing the greenbelt and implementing 'green' transport in Paris, T3 was one of the first metro lines with grass tracks and is often described as 'looking more like a strip of parkland than a transit route'. SYSTRA has developed an innovative and sustainable underground watering solution using rainwater - a first of its kind for the transport network.

As well as the environmental benefits (reducing excessive watering and improving maintenance of the grass), the new watering solution and grass also creates efficiencies in maintenance, reducing OPEX and CAPEX costs.

CONFIDENCE MOVES THE WORLD

SYSTRA keeps the world moving through connecting people and places. By enabling mobility, our work strengthens communities and improves people's access to employment, education and leisure.

The Group delivers engineering, consultancy and specialist technical services that enable safe, efficient mobility and foster economic prosperity.

SYSTRA SA, French limited company with an Executive Board and a Supervisory Board. Share capital: 33 302 018 euros. Incorporated under N° 387 949 530 RCS Paris – Cover photo: Bordeaux © O. Toussaint (CAPA Pictures) – 12/2021

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