



Smithsonian
Institution



Reviewing Mitigation Hierarchy Implementation

LISBON METRO'S RED LINE (ORIENTE – AEROPORTO)

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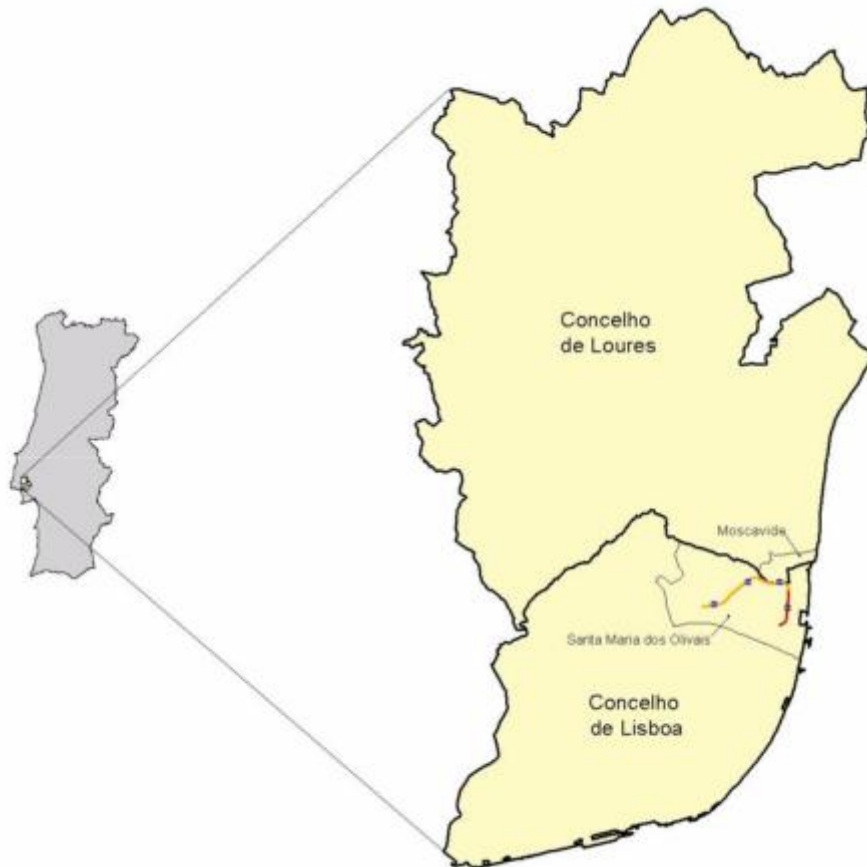
Presentation Outline

- Introduction
- Project
- Study/Research Goals
- Study/Research Methods
- Results
- Conclusions
- Recommendations
- Acknowledgements



Lisbon Metro's Red Line (Oriente – Aeroporto)

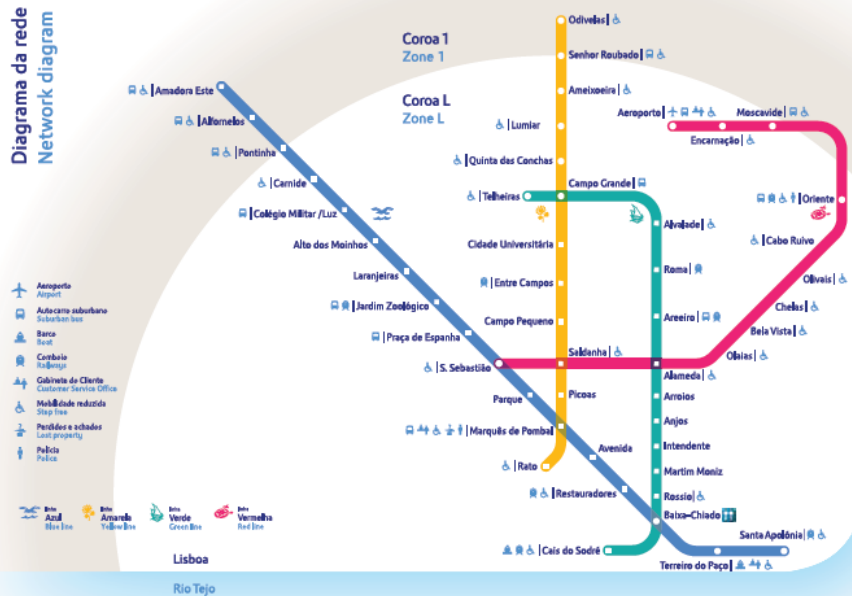
- **Geographical Location**



- Europe, **Portugal**
- 2 Districts: Lisboa & Loures
- 3 Parishes: Parque das Nações, Moscavide & Olivais

Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Development Project Context**



GOALS

- ***From the Metro to the world***
- Connect Lisbon's International Airport to the city's CBD through the Metro network
- Improve mobility and sustainability in Lisbon



Lisbon Metro's Red Line (Oriente – Aeroporto)

• Development Project Context



UNDERGROUND INFRASTRUCTURE

- 3.3 km of tunnel
- 3 stations - Moscavide, Encarnação & Aeroporto
- 5 ventilation shafts

INVESTMENT

- 202 M€, with a 140 M€ contribution from European Cohesion Funds



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Development Project Context**

IMPORTANT STEPS:

- **Ministerial Decision:** 1999
- **First studies:** 2002
- **With EU funds**
- **Environmental Impact Assessment (EIA)** according to Portuguese legislation
- **Environmental Impact Assessment Statement** – positive, but with constraints: 2005
- **Construction phase:** 2007 to 2012



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Development Project Context**
 - **Opening date: 17 july 2012**



- **Operation phase: almost 3 years...**



Lisbon Metro's Red Line (Oriente – Aeroporto)

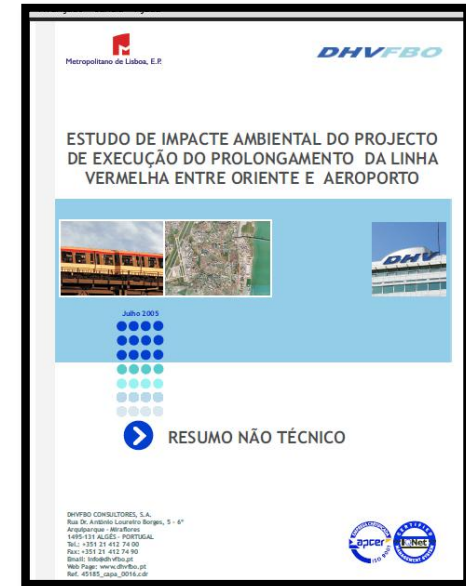
- **Project's Environmental Context**

Environmental Impact Studies (EIS)

- PRELIMINARY STUDY **2004**
- DETAILED DESIGN **2005**

- **Main conclusions:**

The balance between the inconvenience to the population during the construction phase and the benefits during the operation phase, as well as between the reduced time frame of construction and the extended time frame of operation, strongly supported the implementation of Lisbon Metro's Red Line.



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Project's Environmental Context**

Environmental Impact Assessment (EIA)

- This project was considered very delicate due to its integration in Lisbon's urban area.

Densely populated urban area

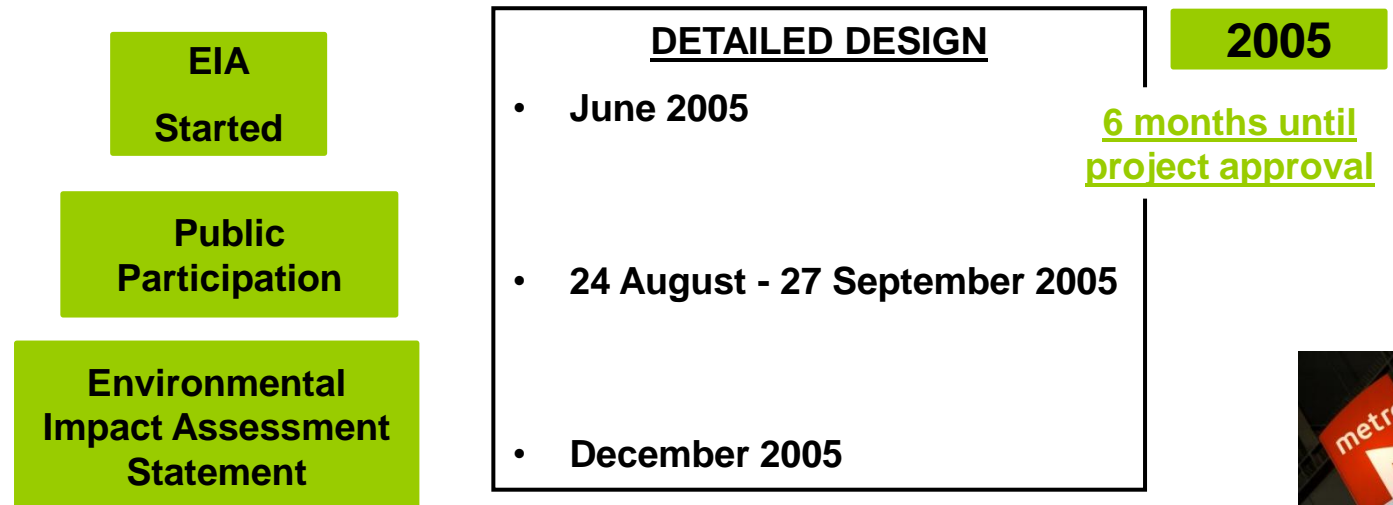


Lisbon Metro's Red Line (Oriente – Aeroporto)

• Project's Environmental Context

Environmental Impact Assessment (EIA)

- Under the Portuguese law this project was submitted to a lengthy and demanding procedure by the Ministry of Environment, just to guarantee its approval.



Lisbon Metro's Red Line (Oriente – Aeroporto)

• Project's Environmental Context

Requirements of the Environmental Impact Assessment Statement

- New solutions on detailed design
 - lowering of the tunnel to a depth of 30 meters to make it as deep as possible in relation to the houses on the surface
 - new project approval – October 2006 2006
- Mitigation measures
- Environmental monitoring
- Report to the National Authority for Environmental Impact Assessment



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Study/Research Goals**

- 1st STEP**

- To **describe** how Environmental Follow-up was developed at construction and operation phases in the last decade

- 2nd STEP**

- To **compare** the EIS' predictions to reality

- 3rd STEP**

- To **identify** the lessons learned



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Study/Research Methods**

ENVIRONMENTAL FOLLOW-UP (1st STEP)

- **Concept:** the phase that follows the approval or environmental assessment of a project
- It covers the construction, operation and decommissioning phases of a project



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Study/Research Methods**

ENVIRONMENTAL FOLLOW-UP (1st STEP)

- **International Best Practice Principles (IAIA)**

Operationalizing EIA Follow-Up

Few internationally accepted guidelines promote EIA follow-up. These principles provide a starting point for this. Similarly, there is a need for education in, and capacity building for, EIA follow-up across a range of international practice and individual practitioner competencies.

There is no single "right" way to conduct EIA follow-up; it can and should be adapted to suit the evolving needs of stakeholders, activity type and EIA system in question. Whatever approach is adopted, the management controls promoted through EIA follow-up should strengthen the overall structure and process for EIA, contributing to the disciplines involved and improving EIA practice and systems.



EIA Follow-Up International Best Practice Principles

EIA FOLLOW-UP MAY BE DEFINED AS THE MONITORING, EVALUATION, MANAGEMENT AND COMMUNICATION OF THE ENVIRONMENTAL PERFORMANCE OF A PROJECT OR PLAN.



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Study/Research Methods**

ENVIRONMENTAL FOLLOW-UP (1st STEP) in **Lisbon Metro**

- **Construction phase**

- Started at the beginning of each construction
- Requirements for each construction: Environmental Officer; Environmental Follow-up Plan before the start of the works; Reports during the construction phase and a Final Report upon completion
- Implementation and compliance with **mitigation measures**, which were assessed and redefined as a function of **environmental monitoring**
- Report to the National Authority for EIA



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Study/Research Methods**

ENVIRONMENTAL FOLLOW-UP (1st STEP) in **Lisbon Metro**

- **Operation phase**

- Identifying and quantifying the environmental and social benefits, centered on travel time savings and reduction of energy consumption per passenger
- Implementation of **environmental monitoring**
- Report to the National Authority for EIA



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

- CONSTRUCTION PHASE (1st STEP)**

- **Mitigation measures**

- Noise



Use of specially silent and enclosed equipment



Site equipment far from noise-sensitive areas

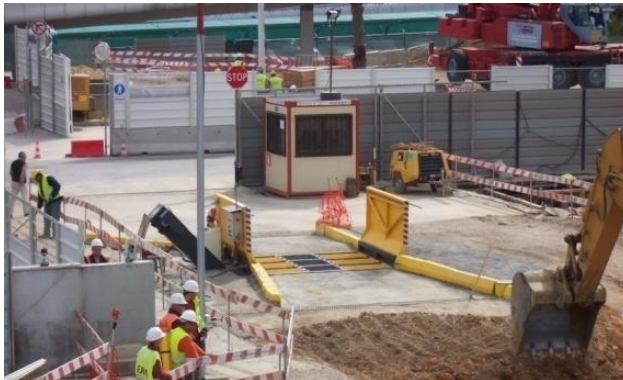
Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

- **CONSTRUCTION PHASE (1st STEP)**

- **Mitigation measures**

- Air Quality



Wheels washing



Materials coverage

Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

- **CONSTRUCTION PHASE (1st STEP)**

- **Mitigation measures**

- **Wastewater**



*Treatment systems -
sedimentation tanks*



pH control

Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

- CONSTRUCTION PHASE (1st STEP)**

- **Mitigation measures**

- **Soils**



Spill absorption



Specific areas for hazardous materials

Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

- CONSTRUCTION PHASE (1st STEP)**

- **Mitigation measures**

- **Waste**



On-site sorting of construction and demolition waste



Big bags for hazardous waste



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

- CONSTRUCTION PHASE (1st STEP)**

- **Mitigation measures**

- **Vegetation**



Tree protection



Transplant of trees

Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

CONSTRUCTION PHASE (1st STEP)

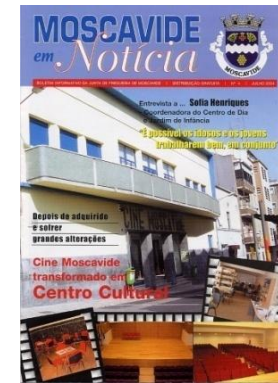
- **Mitigation measures**
- Social aspects



Public information office



Newsletters to the population



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

- CONSTRUCTION PHASE**

- **Environmental monitoring**



Noise



Vibrations

Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

CONSTRUCTION PHASE

- **Environmental monitoring**



Air quality



Wastewater



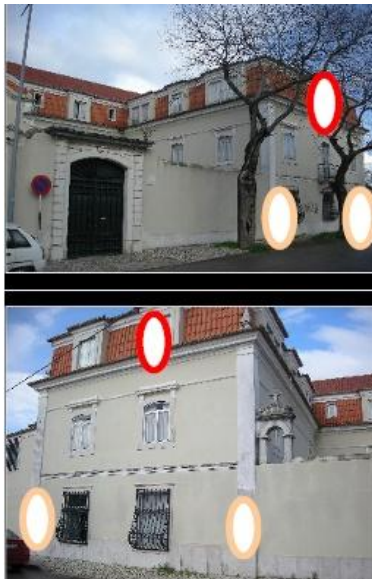
Soils

Lisbon Metro's Red Line (Oriente – Aeroporto)

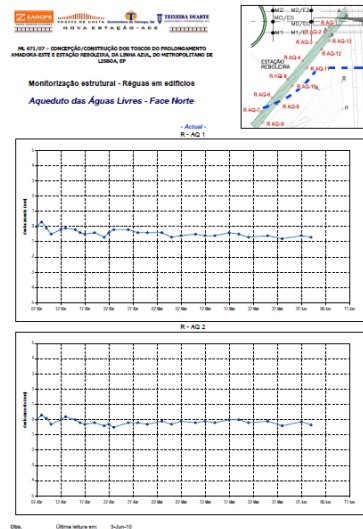
- Results

CONSTRUCTION PHASE

- Environmental monitoring



Architectural heritage



Archeology



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

CONSTRUCTION PHASE

- **Impacts remaining after mitigation**

HUMAN DISTURBANCE

- Noise
- Vibrations
- Air Quality (particles)
- Social aspects

ENVIRONMENTAL

- Wastewater (pH, total suspended solids and oils)
- Soils and waste (diversity and quantity)

ARCHITECTURAL HERITAGE

ARCHAEOLOGY



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

OPERATION PHASE

- **Environmental and social benefits**

- High level of acceptance:
 - favourability rating of 98% in the Media
- 2nd year after opening to operation:
 - 15,3 million passengers
 - global demand lower than expected (-37%)
 - Airport station attracts 16% more demand than estimated
- Improved mobility and sustainability in Lisbon - environmental, social and economic benefits



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

- OPERATION PHASE**

- **Environmental and social benefits**
- Landscaping

MOSCAVIDE STATION



Before



After



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

- OPERATION PHASE**

- **Environmental and social benefits**

- Landscaping

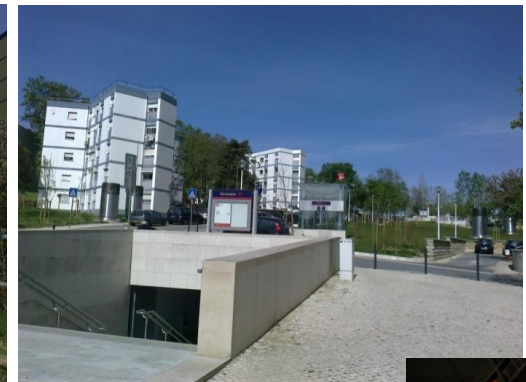
ENCARNAÇÃO STATION



Before



After



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

OPERATION PHASE

- **Environmental and social benefits**
- Landscaping

AEROPORTO STATION



Before



After



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

OPERATION PHASE

- **Environmental and social benefits**
 - Architectural projects

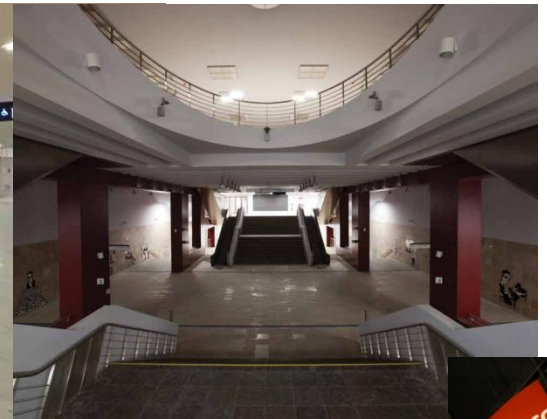
MOSCAVIDE STATION



ENCARNAÇÃO STATION



AEROPORTO STATION



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

OPERATION PHASE

- **Environmental and social benefits**

- Art work

AEROPORTO STATION



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

OPERATION PHASE

- **Environmental monitoring**



Noise



Vibrations

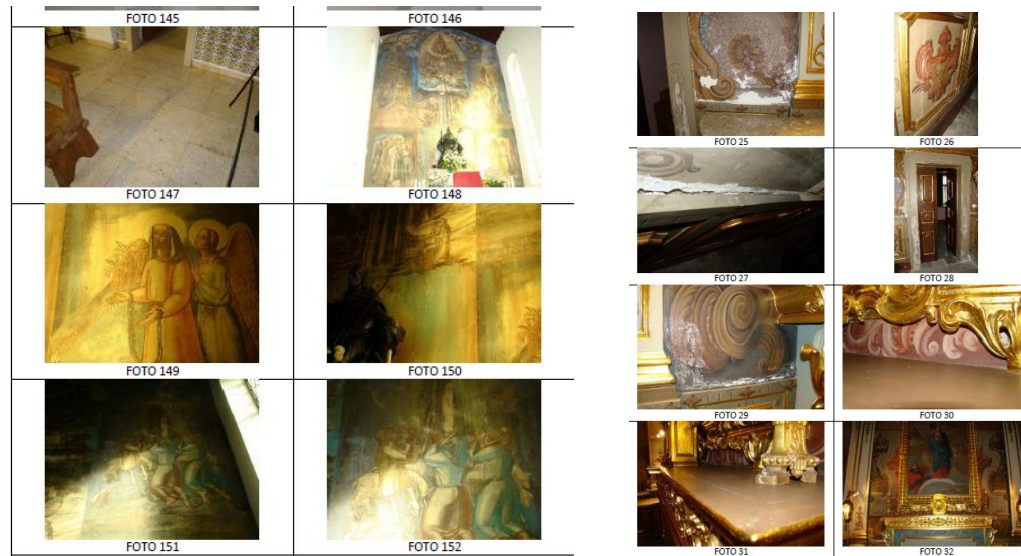
- **no** significant negative impacts in terms of Noise and Vibrations disturbance, but some environmental complaints received

Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

OPERATION PHASE

- **Environmental monitoring**



Architectural heritage

- 4 places with **some significant negative impacts** (structural pathologies) related with the project



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

OPERATION PHASE

- **Impacts remaining after mitigation**

**ENVIRONMENTAL, SOCIAL AND
ECONOMIC BENEFITS**

HUMAN DISTURBANCE

- **Noise**
- **Vibrations**

ARCHITECTURAL HERITAGE



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

EIS' PREDICTIONS AND REALITY (2nd STEP)



**WEATHER
PREDICTION**

*Tomorrow it
will be a sunny
day!*

Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

EIS' PREDICTIONS AND REALITY (2nd STEP)

- **Construction phase**

- PREDICTION:

- *Among the various environmental and socio-cultural factors analysed under the EIS, the following are highlighted for their great significance: **Noise, Vibrations and the Socio-economic component**, which will considerably impact, for a period of approximately 40 months, primarily the residential areas located in the vicinity of the areas*



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

EIS' PREDICTIONS AND REALITY (2nd STEP)

- **Construction phase**

- REALITY:

- Environmental complaints received concerning Noise, Vibration and Air Quality
- Additional mitigation measures for Noise, Air Quality and Wastewater + Archaeological artefacts
- GENERALLY, there is correspondence with the reality observed during the construction phase and the EIS (except for Air Quality, Wastewater and Archaeological Heritage; the impacts were not estimated as potential significant and for which the adoption of mitigation measures was crucial)



Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Results**

EIS' PREDICTIONS AND REALITY (2nd STEP)



- **Operation phase**

- PREDICTION: *The project will be particularly positive in terms of:*

- *improving **accessibility** in Lisbon*
- *increasing **intermodality** of the city's transport system*
- *creation and/or strengthening of new urban hubs*

- REALITY: For most of the environmental factors considered in the EIS there is no exact match with reality - undeniable environmental and socio-economic benefits associated with the operation phase were underestimated



Lisbon Metro's Red Line (Oriente – Aeroporto)

• Conclusions

- This presentation describes 10 years of experience on Environmental Follow-up at Lisbon Metro's Red Line (Oriente – Aeroporto).
- It demonstrates how **Environmental Follow-up was a crucial tool** for the Lisbon Metro to report periodically on how the mitigation measures, the environmental monitoring and the Environmental Follow-up stipulated by the Ministry of Environment were implemented.
- The Environmental Follow-up was extremely important in order to identify the real impacts during the construction and operations phases and to find practical ways to solve or reduce them.



The Red Line (Oriente-Aeroporto) of Lisbon's Metro

- **Recommendations**

LESSONS LEARNED (3rd STEP)

- Greater proximity between the estimated (EIS) and verified than in previous projects
- Practical implementation of the Environmental Follow-up model - effective process, very matured and experienced
- Actual knowledge of the truly significant and relevant environmental factors to the construction and operation phases of projects of this nature
- Experience that can help in future development both in Lisbon and on other infrastructure projects
- Knowledge that will indubitably lead to better projects



Lisbon Metro's Red Line (Oriente – Aeroporto)

• Acknowledgements

- Alexandra Rodrigues & team, Ferconsult
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Lisbon Metro's Red Line (Oriente – Aeroporto)

- **Questions**



The Metro takes you... everywhere!



Thank You!



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