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for

RAILMED
A PROJECT FOR MEDA 2020

A global approach for the Arab Railway Integration.

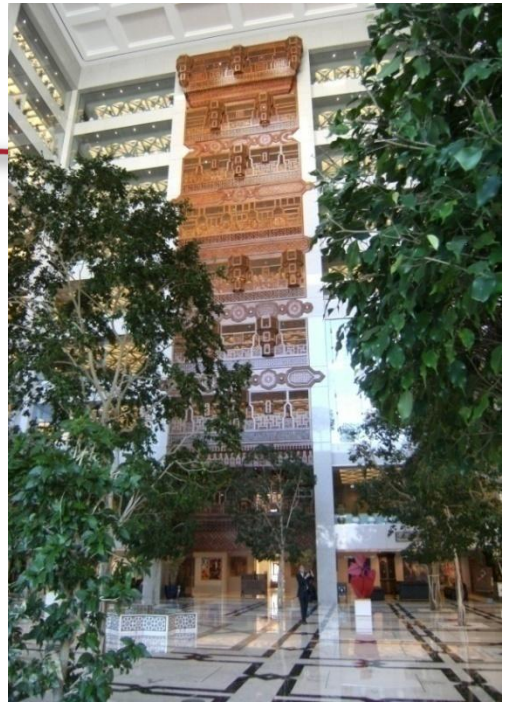
Results of the

"ARAB RAILWAY NETWORK STUDY"

Lecce, October 11-12, 2012

Marco Stegher, Project Manager Italferr

THE IDEA BEHIND THE PROJECT



Arab Fund Headquarter in Kuwait – Atrium

1. Within an ambitious "unified economic market" long-term scenario, the Project of the Arab Rail Network aims at the creation of an interoperable, complete and modern railway system.

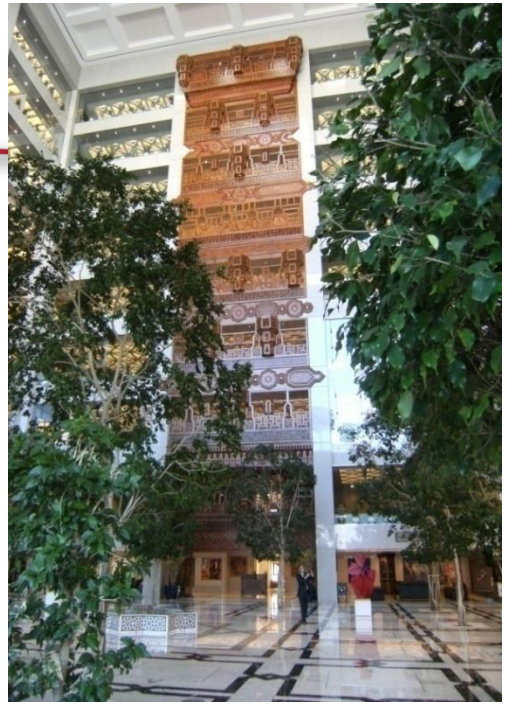
2. High degree of heterogeneity in the rail industry, ranging from the complete absence of railways to the existence of a developed network.

3. The Project implementation comes to be one of the greatest and most ambitious Projects for the Arab countries in the 21 century, for both technical and economical aspects.

4. The idea behind the Project is therefore to make the Arab Rail Network act as a fundamental backbone for the economic and social development of the whole Arab Region.

SCOPE OF THE STUDY

A "Strategic Planning Study", whose OBJECTIVES are:



Arab Fund Headquarter in Kuwait – Atrium

1. To outline of a comprehensive scheme of the Arab railway network, incorporating both existing and planned rail networks.

2. To highlight missing sections and corridor locations of the major regional axes linking the Arab countries.

3. To propose a ranking of the railway projects of regional relevance through assessments on transport, engineering, environmental and economic aspects, and to plan their implementation according to their strategic importance and expected return on investment.

4. To provide to the AFESD a valid instrument for project funding appraisal in the rail sector across the Arab Region; and to the various Project Beneficiaries important elements for further development within each country's National Plan.

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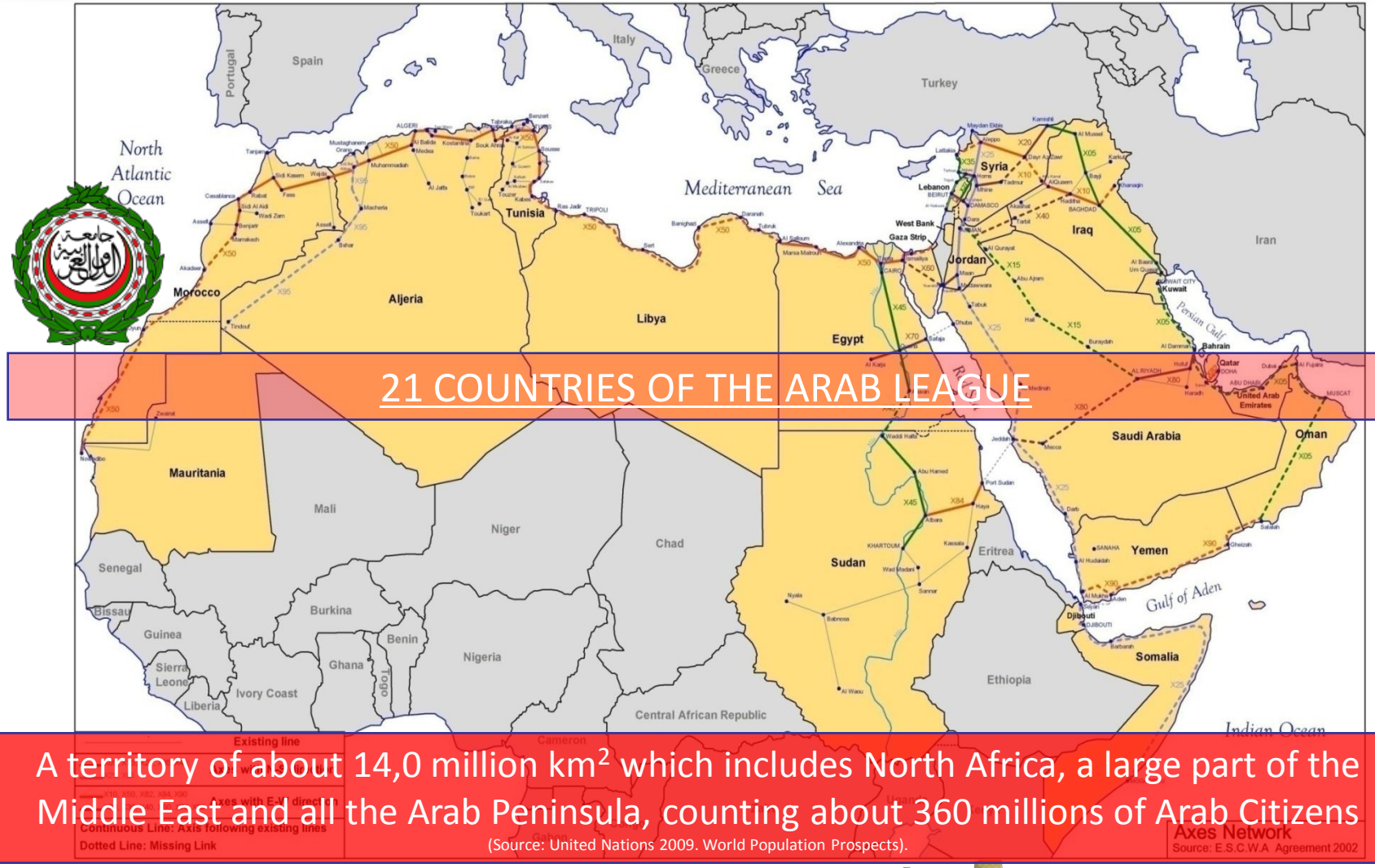
GEOGRAPHIC COVERAGE OF THE STUDY



A territory of about 14,0 million km^2 which includes North Africa, a large part of the Middle East and all the Arab Peninsula, counting about 360 millions of Arab Citizens

(Source: United Nations 2009. World Population Prospects).

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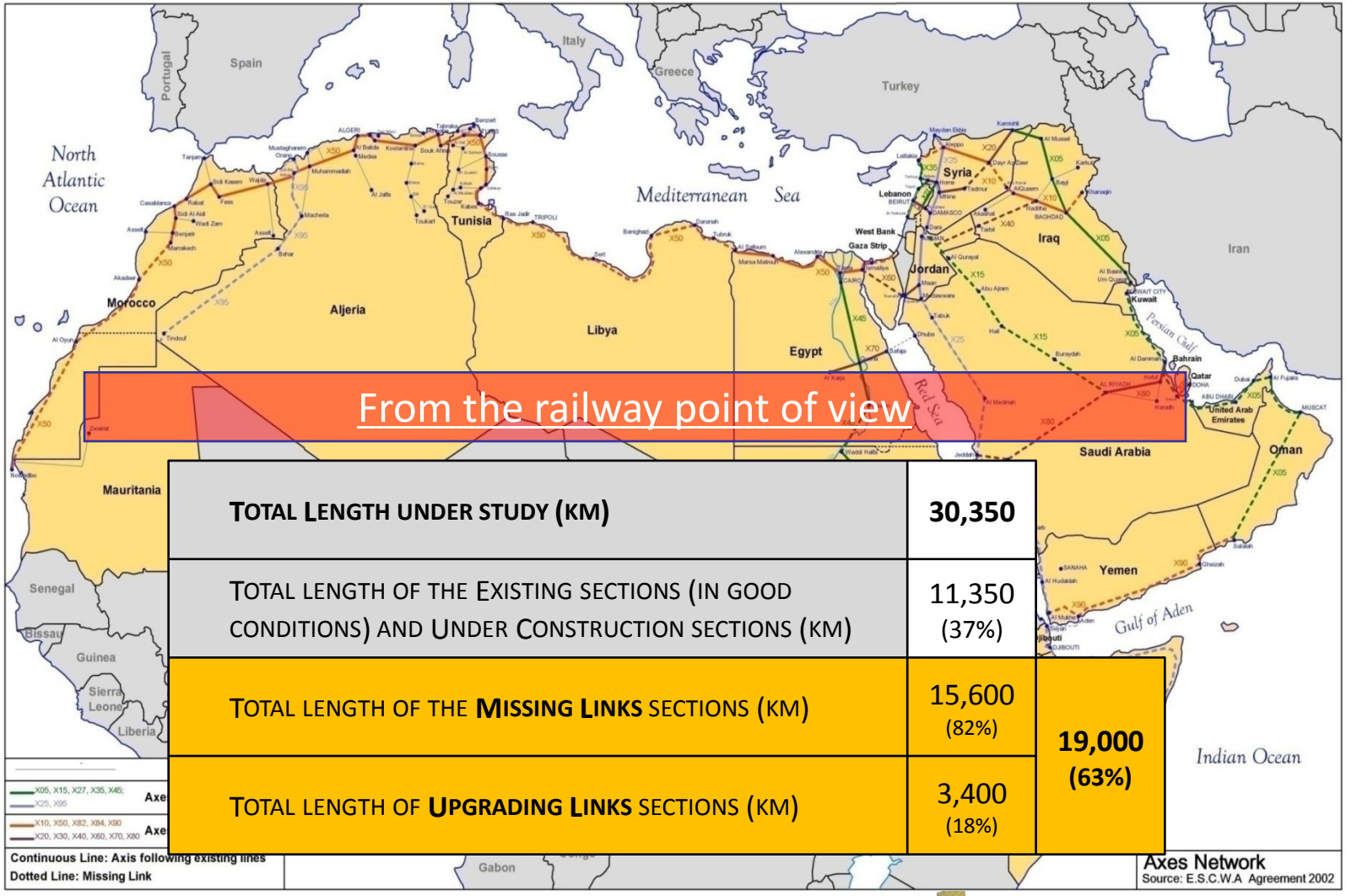

From the railway point of view

TOTAL LENGTH UNDER STUDY (KM)	**30,350**	
TOTAL LENGTH OF THE EXISTING SECTIONS (IN GOOD CONDITIONS) AND UNDER CONSTRUCTION SECTIONS (KM)	11,350 (37%)	
TOTAL LENGTH OF THE **MISSING LINKS** SECTIONS (KM)	15,600 (82%)	**19,000 (63%)**
TOTAL LENGTH OF **UPGRADING LINKS** SECTIONS (KM)	3,400 (18%)	

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PHASES OF THE STUDY

The Study was characterized by SEVEN subsequent Phases and by three main STAGES:

- ❑ Phase I: Start up and Data Collection
- ❑ Phase II: Determination of Future Rail Transport Needs

"STRATEGIC PLANNING" STAGE

- ❑ Phase III: Identification of Route Alignment
- ❑ Phase IV: Environmental Impact Assessment
- ❑ Phase V: Economic/ Financial Analysis

"TECHNICAL INSIGHT" STAGE

- ❑ Phase VI: Capital Investment Plans and Implementation Strategy
- ❑ Phase VII: Preparation of Scheme Documents and Recommendations

"ACTION PLAN" STAGE

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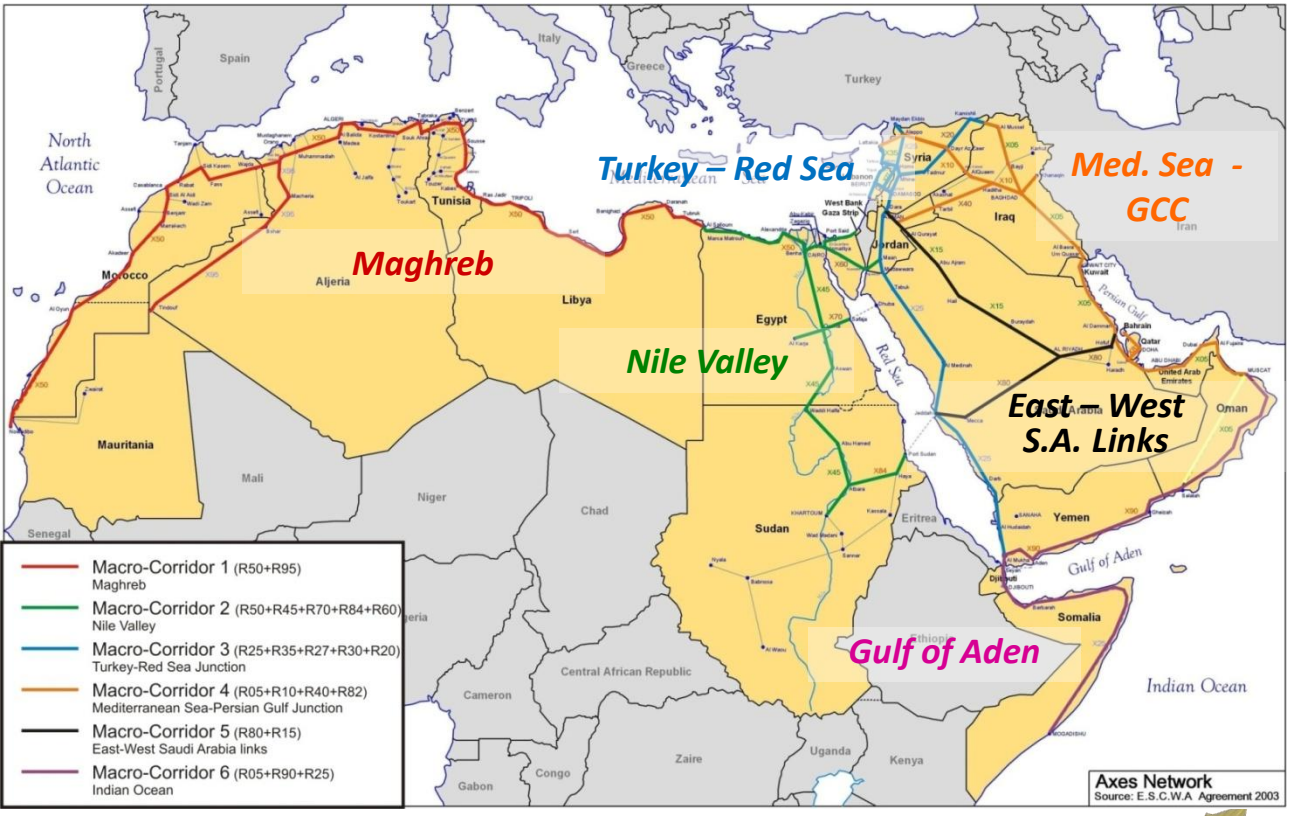
"STRATEGIC PLANNING" STAGE - CONVENTIONAL MACRO AXES

- To analyze more meaningful and logical regional routes (bringing together lines with a wider common scope), a proposal to aggregate the 18 regional axes (identified by ESCWA and UACF) into a smaller number of axes was advanced



Six Macro Axes were identified:

1. Macro Axis 1: ***Maghreb***
2. Macro Axis 2: ***Nile Valley***
3. Macro Axis 3: ***Turkey-Red Sea***
4. Macro Axis 4: ***Mediterranean Sea - GCC***
5. Macro Axis 5: ***East-West Saudi Arabia links***
6. Macro Axis 6: ***Gulf of Aden***

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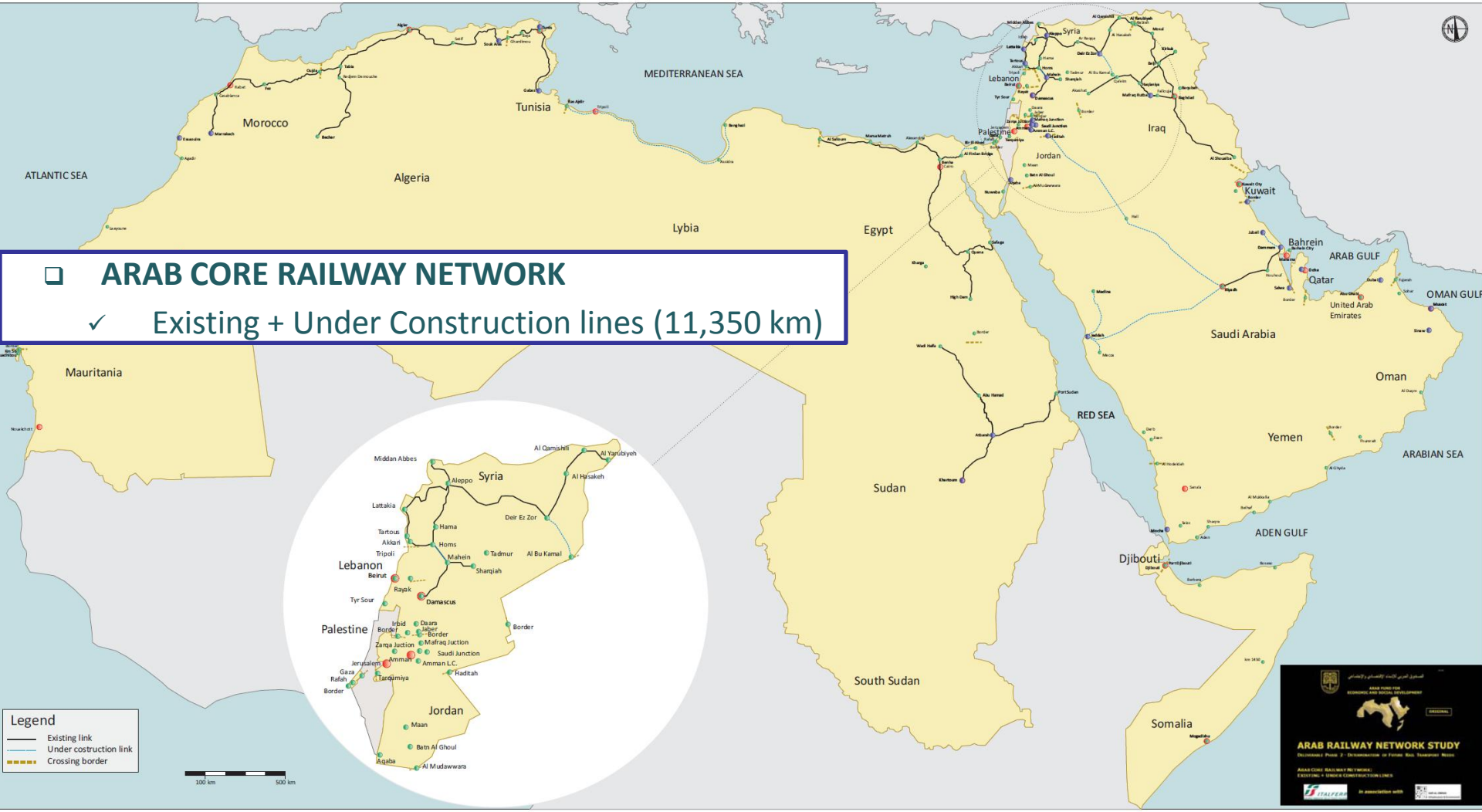
"STRATEGIC PLANNING" STAGE - OVERALL PROJECT RANKING



- **ARAB CORE RAILWAY NETWORK**
  - ✓ Existing + Under Construction lines (11,350 km)

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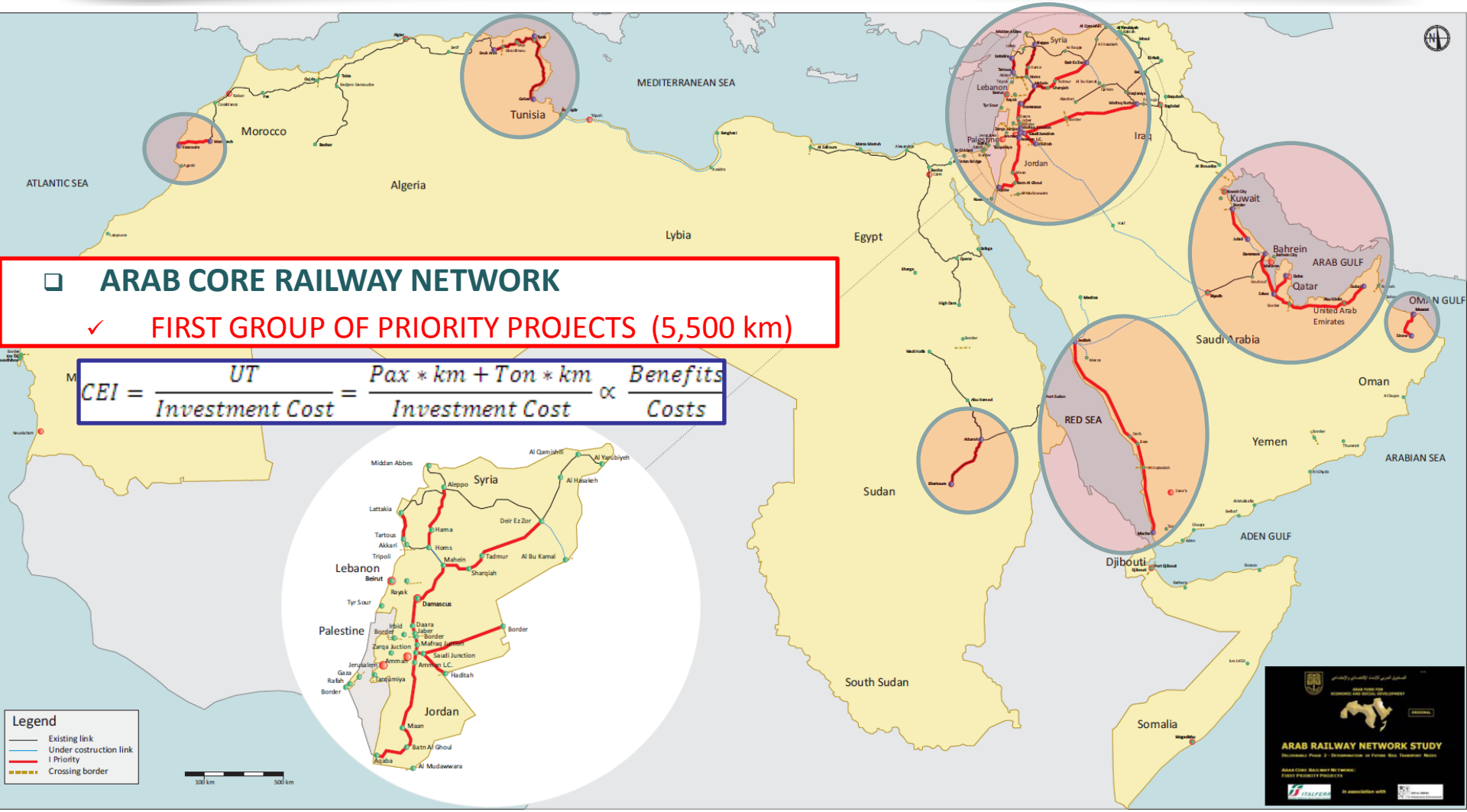
"STRATEGIC PLANNING" STAGE - OVERALL PROJECT RANKING



- **ARAB CORE RAILWAY NETWORK**
  - ✓ FIRST GROUP OF PRIORITY PROJECTS (5,500 km)

$$CEI = \frac{UT}{Investment\ Cost} = \frac{Pax * km + Ton * km}{Investment\ Cost} \propto \frac{Benefits}{Costs}$$

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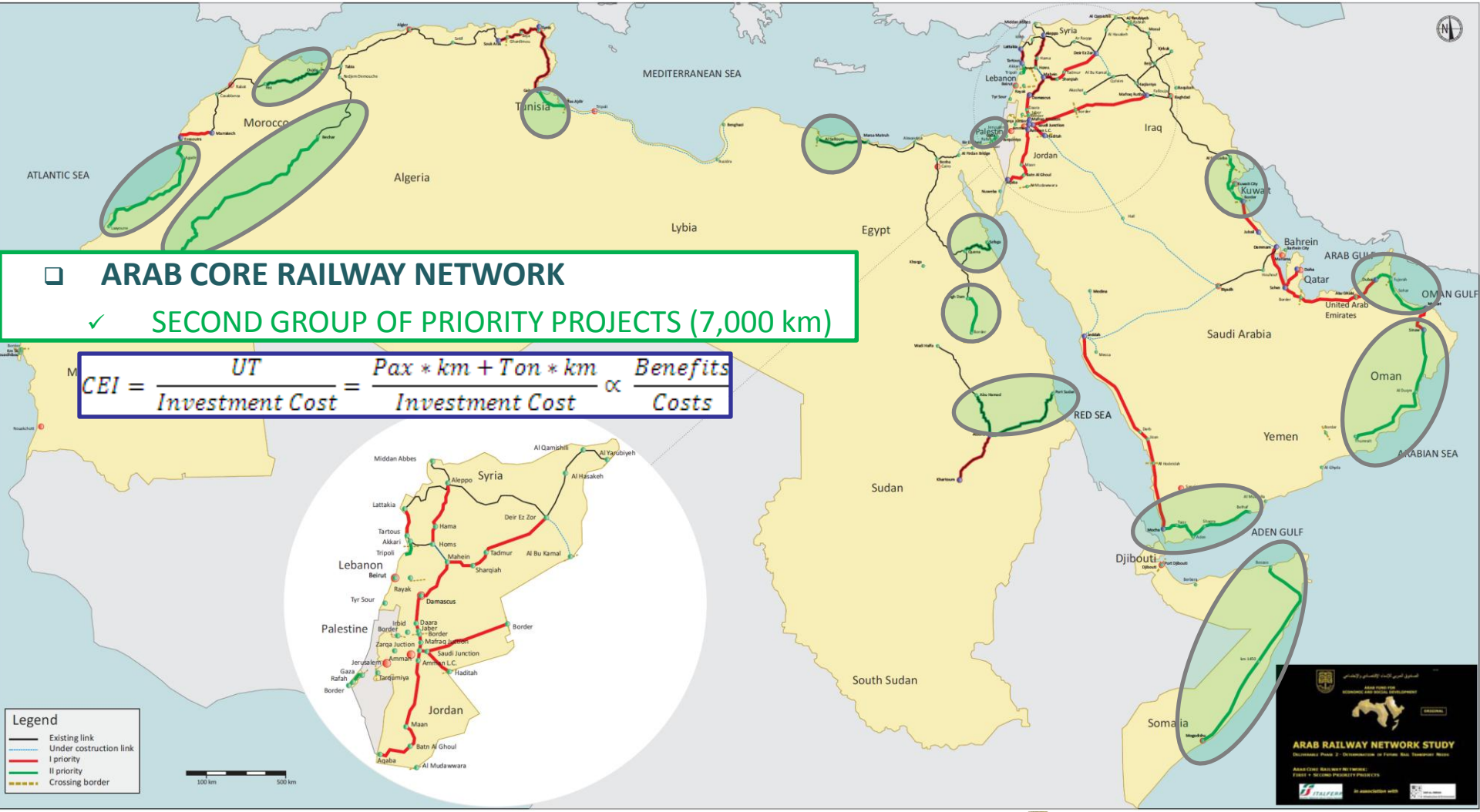

- **ARAB CORE RAILWAY NETWORK**
  - ✓ SECOND GROUP OF PRIORITY PROJECTS (7,000 km)

$$CEI = \frac{UT}{Investment\ Cost} = \frac{Pax * km + Ton * km}{Investment\ Cost} \propto \frac{Benefits}{Costs}$$

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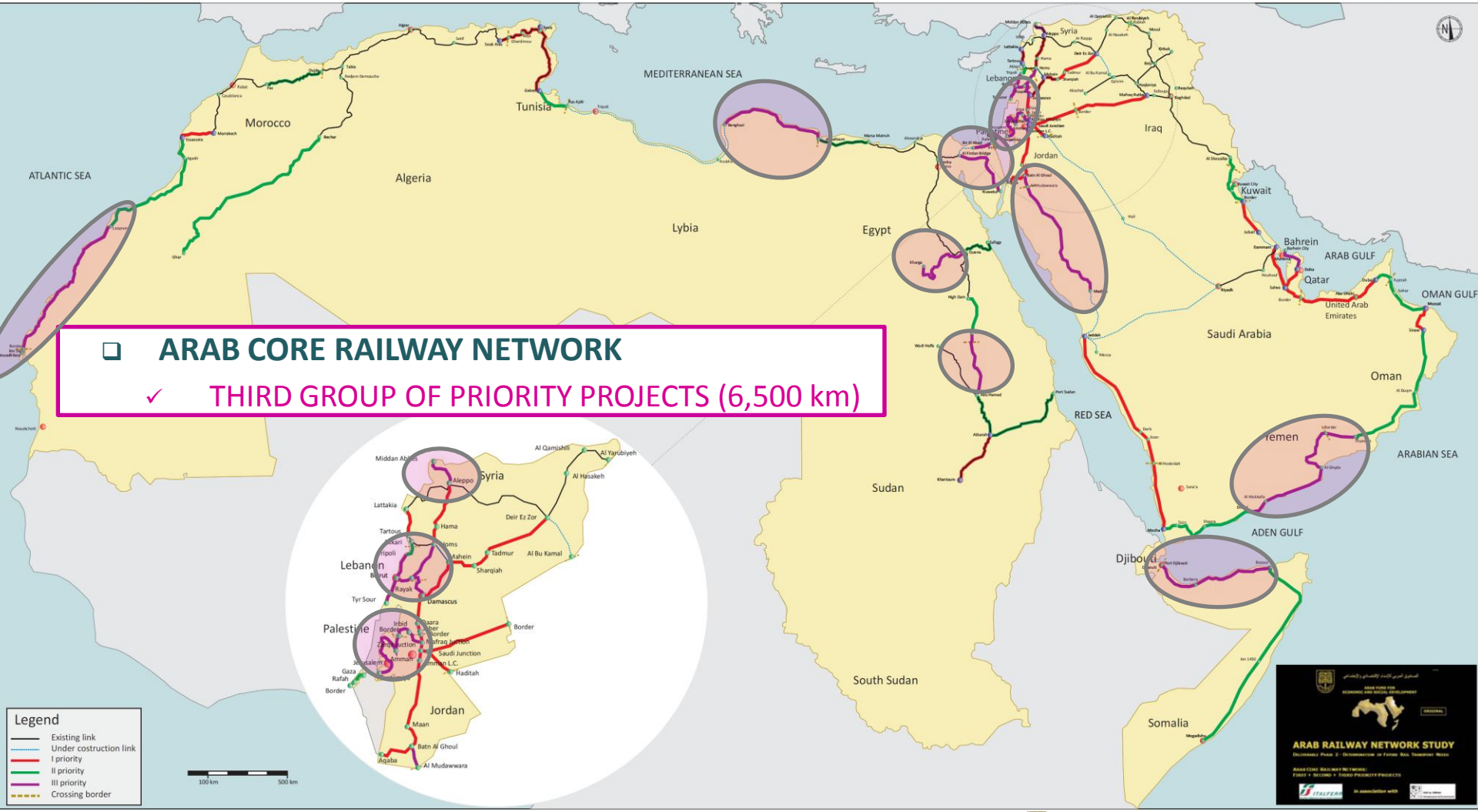
"STRATEGIC PLANNING" STAGE - OVERALL PROJECT RANKING



- **ARAB CORE RAILWAY NETWORK**
  - ✓ THIRD GROUP OF PRIORITY PROJECTS (6,500 km)

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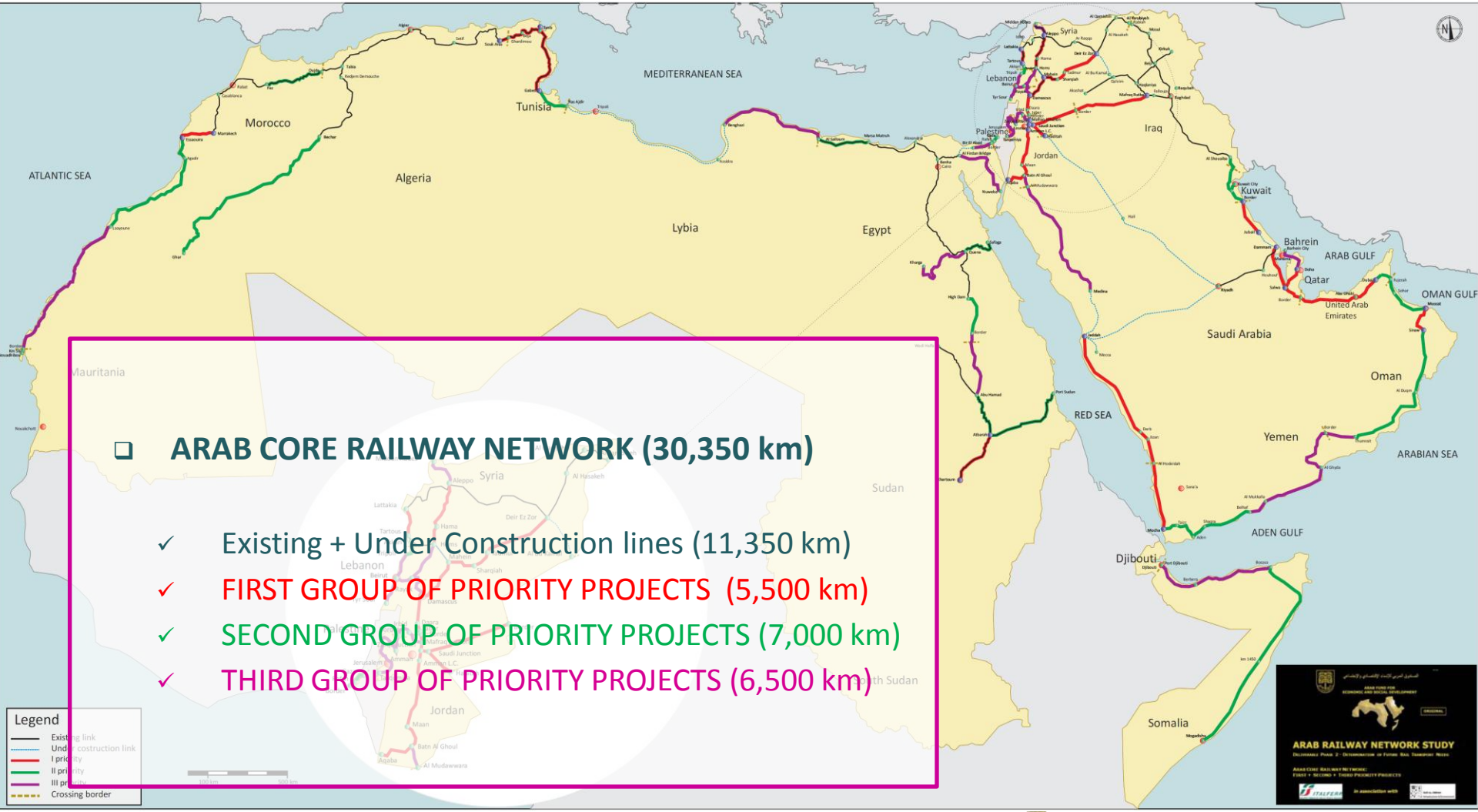
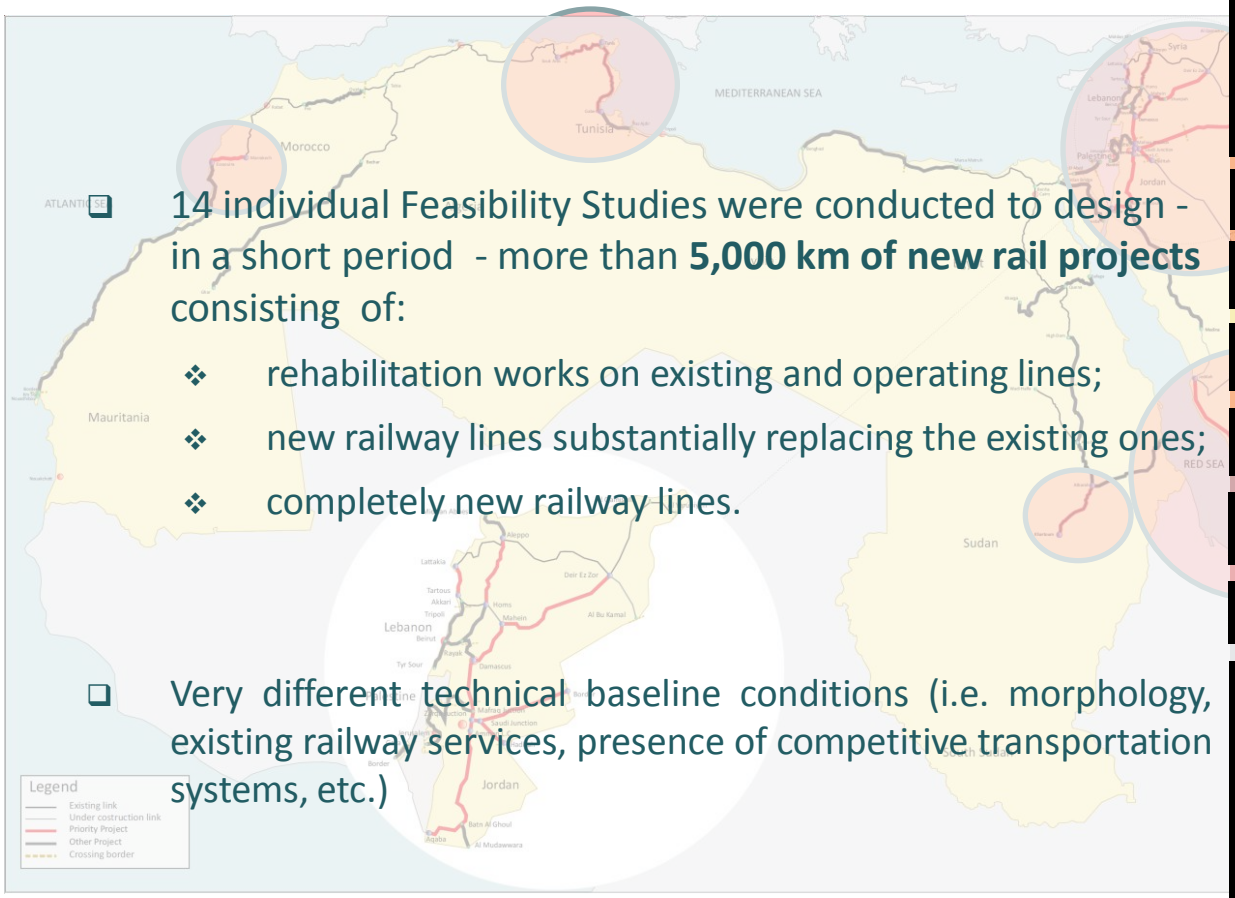
"STRATEGIC PLANNING" STAGE - OVERALL PROJECT RANKING



- **ARAB CORE RAILWAY NETWORK (30,350 km)**
  - ✓ Existing + Under Construction lines (11,350 km)
  - ✓ FIRST GROUP OF PRIORITY PROJECTS (5,500 km)
  - ✓ SECOND GROUP OF PRIORITY PROJECTS (7,000 km)
  - ✓ THIRD GROUP OF PRIORITY PROJECTS (6,500 km)

"TECHNICAL INSIGHT" STAGE - FIRST PRIORITY PROJECT



- 14 individual Feasibility Studies were conducted to design - in a short period - more than **5,000 km of new rail projects** consisting of:
  - rehabilitation works on existing and operating lines;
  - new railway lines substantially replacing the existing ones;
  - completely new railway lines.

- Very different technical baseline conditions (i.e. morphology, existing railway services, presence of competitive transportation systems, etc.)

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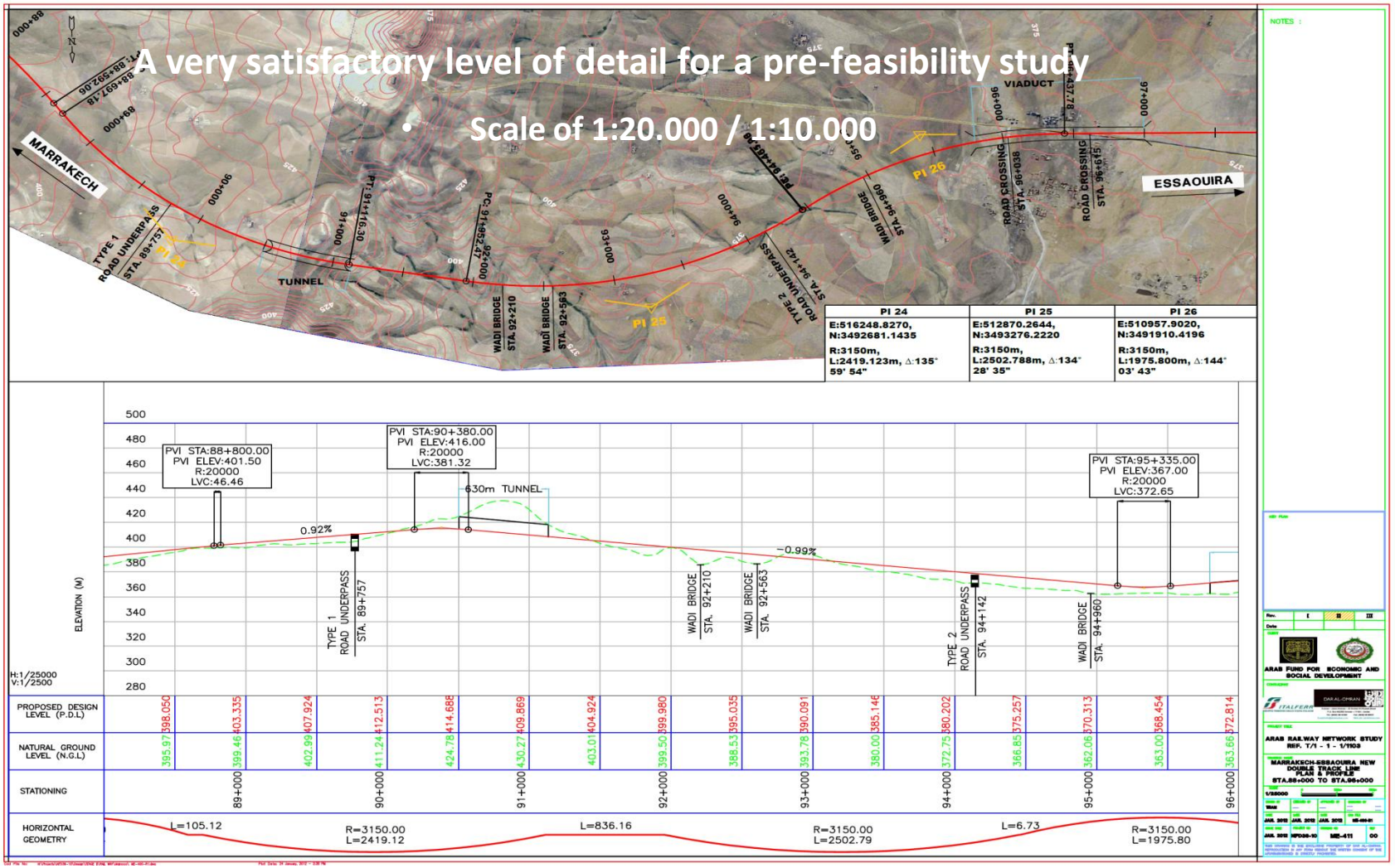
"TECHNICAL INSIGHT" STAGE - FIRST PRIORITY PROJECTS

- A very satisfactory level of detail for a pre-feasibility study
- Scale of 1:20.000 / 1:10.000



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"TECHNICAL INSIGHT" STAGE - FIRST PRIORITY PROJECTS

Arab Core Railway Network	Project Marrakech-Essaouria - New Line	N° 1

TYPICAL PROJECT FICHE

THE PROJECT

The project:	New standard gauge double track line (joining the existing line in Marrakesh)
Railway Line:	Marrakech – Essaouria
Macro Axis:	1
ESCWA AXIS:	R50
Country:	Morocco
Operation Type:	Passenger and Freight

Technical Data

TRACK CHARACTERISTIC

Length:	187	km
Gauge:	Standard	
Track:	Double	
Maximum Gradient:	12	‰
Minimum Radius:	3150	m
Gabarit:	UIC - 505 -3	

TRACTION

Type:	Diesel

DESIGN SPEED

Design speed of the infrastructure: (*) except for the last 18 km	220*	km/h
Maximum operational speed for passenger trains: *220 km/h with future electrification	160 (*)	km/h
Maximum operational speed for freight trains:	120	km/h

RAIL

Maximum axle load:	25	t/axle
Type (Weight):	UIC-60	kg/m

Investement Costs

Line cost* :	1,931.74	MUSD	Line cost/km:	9.94	MUSD	Total Rolling stock (first step):	522	MUSD

* Sum of Engineering, Infrastructure, Technological, Environmental and Land Acquisition costs

Economic - Financial Analysis

ECONOMIC ANALYSIS

NPV:	4,675.82	MUSD
B/C:	4.04	
IRR:	20.69%	
Comments:	very good feasibility of the investment from the socio-economic point view	

FINANCIAL ANALYSIS

Two scenarios were considered for the financial CBA:
Case "A": infrastructure construction, rolling stock investment, maintenance of infrastructure and operation in the hands of just one subject (public or private under concession regime);
Case "B": rolling stock investment + maintenance of infrastructure + operation in the hands of just one subject (private under concession regime).

FINANCIAL ANALYSIS - CASE "A"

NPV:	-309.94	MUSD
B/C:	0.91	
IRR:	3.86%	
Comments:	practical unfeasibility of the investment from the strict financial point of view	

FINANCIAL ANALYSIS - CASE "B"

NPV:	1,331.44	MUSD
B/C:	1.83	
IRR:	25.44%	
Comments:	financially feasible; possibility that a private shareholder can have an active part in the investment	

Traffic Forecast

PASSENGER

Pax traffic (2011):	0	Mpax*km/year
Pax traffic (2025):	2,478	Mpax*km/year
Pax traffic (2040):	2,734	Mpax*km/year
Average Pax Flow (2040)	14.6	Mpax/year
Average distance per pax:	187	km

FREIGHT

Freight traffic (2011):	0	Mt*km/year
Freight traffic (2025):	1,848	Mt*km/year
Freight traffic (2040):	2,919	Mt*km/year
Average Freight flow (2040):	15.6	Mt/year
Average distance per tonne:	187	km

Operation Model

TIME ESTIMATION FOR PASSENGER AND FREIGHT TRAIN

Scheduled time for pax service:	1 h 35'	h, ', "
Pax train commercial speed :	120	km/h
Scheduled time for freight service:	1h 55'	h, ', "
Freight train commercial speed :	98	km/h

SIGNALING SYSTEM

Type:	ERTMS - I LEVEL

PASSENGER FLEET SIZE

UP TO 2025		UP TO 2040	
Number of trains:	19 trains	Number of trains:	27 trains
Train Capacity:	600 seats	Train Capacity:	600 seats
Number of modules per train:	3	Number of modules per train:	3

FREIGHT FLEET SIZE

UP TO 2025		UP TO 2040	
Number of locomotives:	62	Number of locomotives:	117
Numeber of wagons:	648	Numeber of wagons:	1,283
Average load:	800 t	Average load:	800 t

Environmental Impact Analysis

POTENTIAL ENVIRONMENTAL INTERFERENCES AND TYPE OF IMPACT		INTERESTED AREA
Fauna and Flora:	Loss of natural areas; Disturbance on sensitive fauna and flora	90 km along the line
Soil:	Removal of agricultural soil	90 km along the line
Noise:	Annoyance for residential areas - operational phase	4 km along the line
Water:	Water bodies risk of contamination	5 water body crossing
Landscape:	Geomorphology and visual modification	18 km along the line

ESTIMATED QUANTITY SAVED WITH RESPECT TO THE ROAD CASE

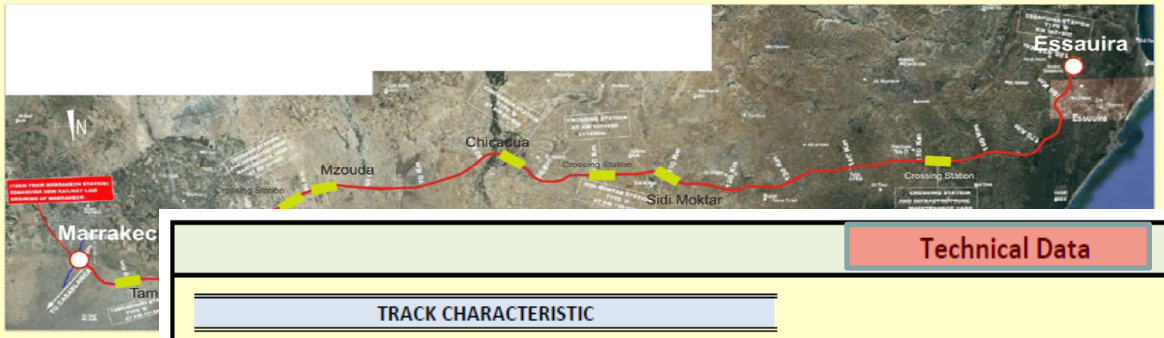
CO2 emission:	485,905	t/year
NOx emission:	1,817	t/year
CO emission:	11,039	t/year
NMVOC emission:	802	t/year
PM emission:	71	t/year

MITIGATIONAL COSTS

Total cost:	

"TECHNICAL INSIGHT" STAGE - FIRST PRIORITY PROJECTS

Arab Core Railway Network	Project Marrakech-Essaouria - New Line	N° 1



THE PROJECT	
The project:	New standard gauge double track line (joining the existing line in Marrakesh)
Railway Line:	Marrakech – Essaouria
Macro Axis:	1
ESCWA AXIS:	R50
Country:	Morocco
Operation Type:	Passenger and Freight

Technical Data

TRACK CHARACTERISTIC

Length:	187	km
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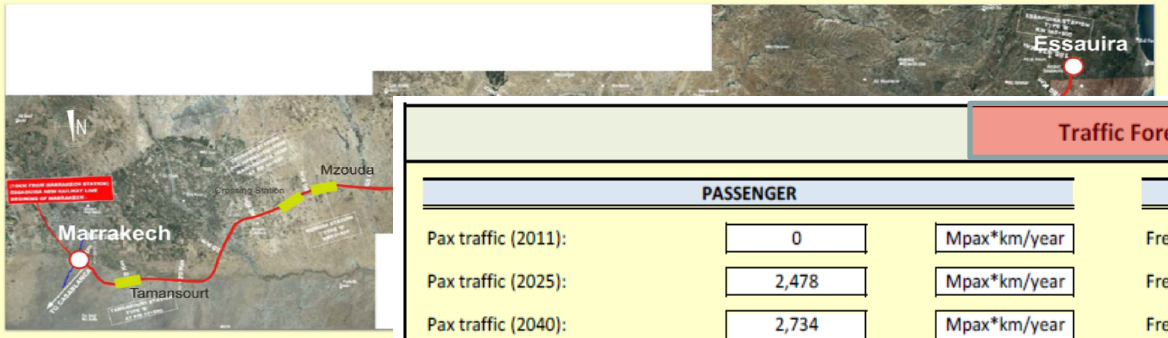

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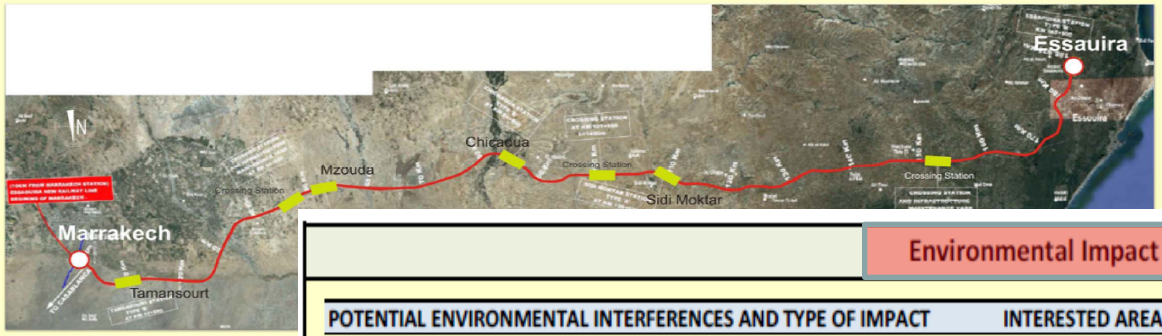

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NPV:	-309.94	MUSD
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IRR:	3.86%	
Comments:	practical unfeasibility of the investment from the strict financial point of view	

FINANCIAL ANALYSIS - CASE "B"

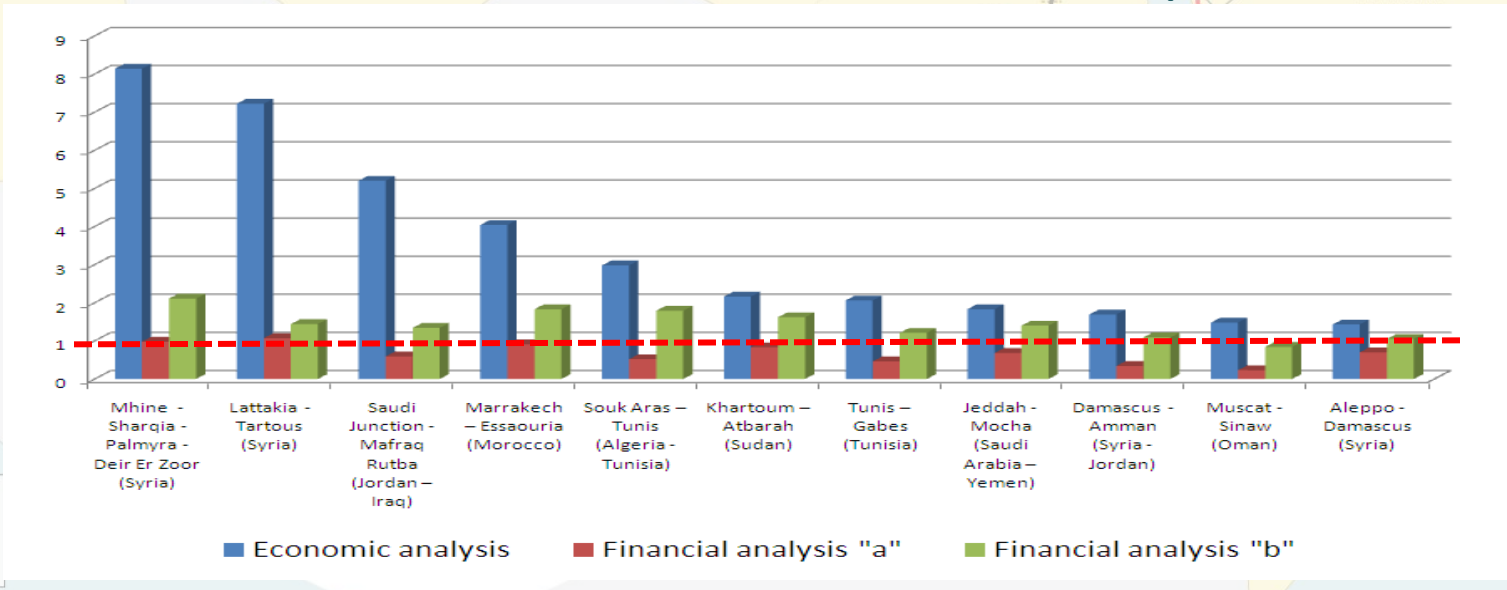
NPV:	1,331.44	MUSD
B/C:	1.83	
IRR:	25.44%	
Comments:	financially feasible; possibility that a private shareholder can have an active part in the investment	

- FIRST PRIORITY PROJECTS

- The "first priority projects" demonstrated (with few exceptions) their capability to attract **significant potential rail markets** and to have interesting margins of profitability, both under the socio-economic point of view and the financial point of view.

- From the financial perspective, the results demonstrate in many cases the possibility that private shareholders **might have an active part in the investment** (case 'b')

COST-BENEFIT ANALYSES OF PRIORITY PROJECTS: OBTAINED B/C RATIOS



- Additionally it is to be emphasized that the Consultant **did not consider external benefits into its CBA analysis** (socio environmental effects), differently from what is frequently carried out within more detailed approaches. The inclusion of such externalities will undoubtedly **increase** the socio-economic performances of the projects

Percentage of saved annual emission due to modal shift from road to rail

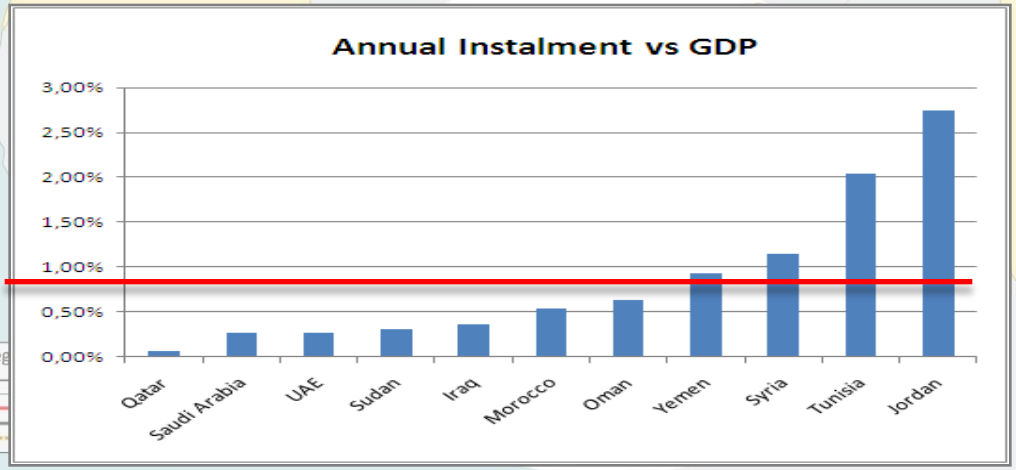
Project N.	from	to	Total ANNUAL EMISSION CO2 Annual Emission [t/year]	NOX Annual Emission [t/year]	CO Annual Emission [t/year]	NMVOC Annual Emission [t/year]	PM Annual Emission [t/year]
a) total road annual emission			4.062.442	23.549	76.630	6.279	824
b) total rail annual emission			738.817	12.329	2.518	1.094	358
c) total saved annual emission due to modal shift from road to rail (a-b)			3.323.625	11.220	74.112	5.185	466
% of saved emission (c/a*100)			**82%**	**48%**	**97%**	**83%**	**57%**

"ACTION PLAN" STAGE - FINANCE REQUIREMENTS

- An OVERALL **INVESTMENT COST** OF ALMOST **90 BUSD** (including civil, technological, land and environmental costs) has been considered, out of which:
  - ✓ **24,6 BUSD** (almost 30 BUSD including also engineering and rolling stock investments) needed for projects of **FIRST PRIORITY RANKING**, to be activated in the time frame of **ten years** (including institutional governance and capacity building).
  - ✓ **64,1 BUSD** for projects of subsequent priority ranking, to be implemented in further time horizons (time horizon of **30 years**).
- Investments evaluated for FIRST PRIORITY PROJECTS appear **proportionate** if compared to infrastructure investments plans of countries who are experiencing a strong revitalization of their national railway networks (such as Algeria, Saudi Arabia, or the Gulf Countries) and with reasonable kilometric costs (**4,7 MUSD/km,** including rolling stock requirements)

"ACTION PLAN" STAGE - FINANCE REQUIREMENTS

Country	Line investment [MUSD]	First Rolling stock investment [MUSD]	Total initial investment [MUSD]	Annual investment during first 5 years [MUSD]	Annual Instalment vs GDP	AVERAGE Annual Instalment vs GDP
Qatar	279.28	30.95	**310.23**	62.05	0.06%	
Saudi Arabia	5,146.31	570.36	**5,716.67**	1,143.33	0.26%	
UAE	3,682.72	408.16	**4,090.88**	818.18	0.27%	
Sudan	774.68	198.80	**973.48**	194.70	0.31%	
Iraq	1,326.34	184.51	**1,510.85**	302.17	0.37%	
Morocco	1,931.74	521.60	**2,453.34**	490.67	0.54%	**0.85%**
Oman	1,412.28	72.28	**1,484.56**	296.91	0.63%	
Yemen	1,114.95	333.68	**1,448.63**	289.73	0.93%	
Syria	2,351.93	1,043.89	**3,395.82**	679.16	1.15%	
Tunisia	3,897.10	610.45	**4,507.55**	901.51	2.04%	
Jordan	3,312.59	476.49	**3,789.08**	757.82	2.75%	



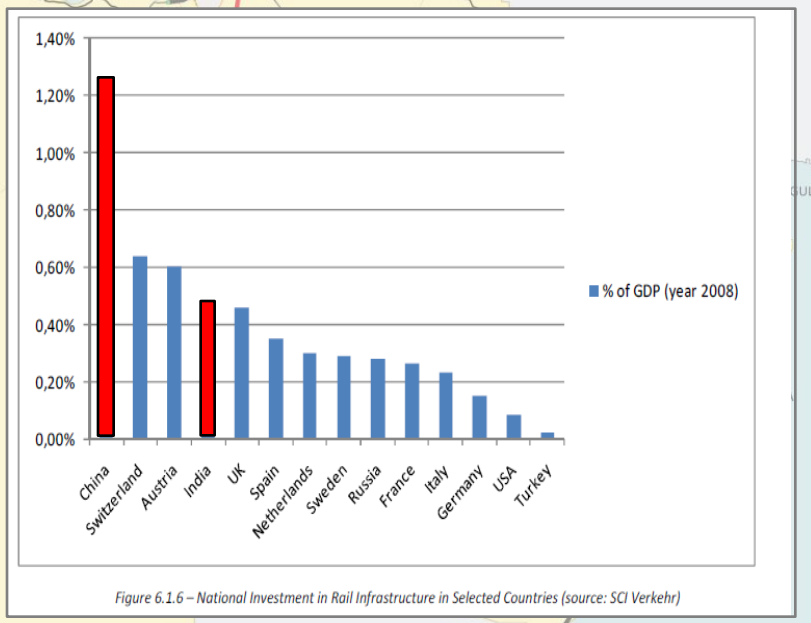


Figure 6.1.6 – National Investment in Rail Infrastructure in Selected Countries (source: SCI Verkehr)

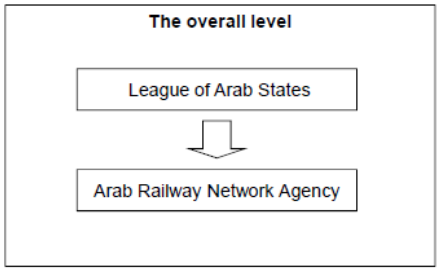
"ACTION PLAN" STAGE - PROJECT GOVERNANCE ARCHITECTURE

- Looking at the current situation of the transport connections within the Arab countries, the **magnitude** of the effort of the Project on the technical side must be underlined.
- Not only engineering and technical issues, but also **institutional and legal requirements** will have to be effectively put in place.
- The inherent complexity of the Project, due both to its international scale and technical magnitude, calls for **different levels of the political decision process**.
- An effective **governance** of the master plan implementation plays a crucial role in the matching objectives and it must be based on an organizational structure with clear roles and carefully planned tasks.

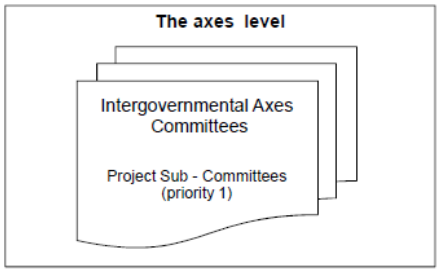
"ACTION PLAN" STAGE - PROPOSED GOVERNANCE ARCHITECTURE

Organization Chart for the Governance Architecture

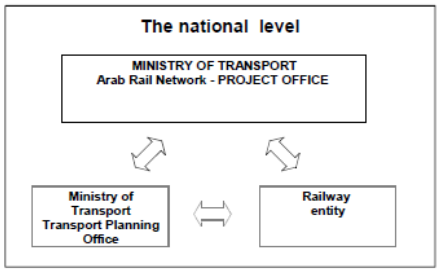
Level 1



Level 2



Level 3



Overall Governance Level: Management of the project

The Axes Level: Project definition (feasibility studies) and financial schemes agreements

The National Level: Detailed technical design, funding procurement

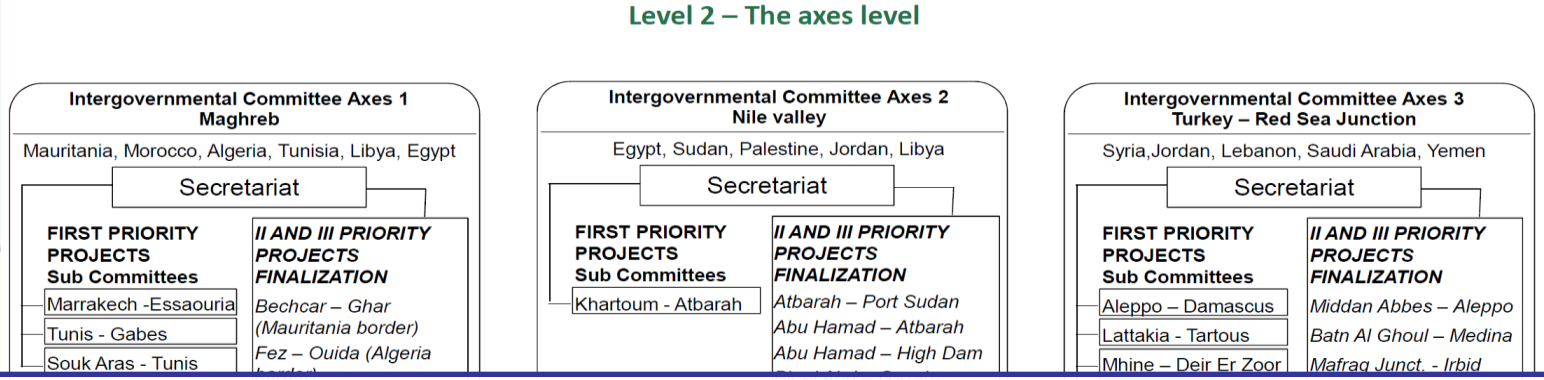
"ACTION PLAN" STAGE - PROJECT GOVERNANCE ARCHITECTURE

Level 1 – The overall Governance level

MAIN FUNCTIONS

- Definition and management of the road map for the Program implementation
- Proposal of possible schemes of financial aid for the priority projects financing
- Coordination of the relationships of the member-States with the development banks and the donors
- International treaty instituting the ARNA Agency and the six intergovernmental committees
- Approval of the project proposals presented by the level 2
- Definition of policy guidelines for the Arab countries railway sectors (safety, interoperability, right of access, etc.)
- Active stimulation of the capacity building at the different layers
- Fostering of relationship with the relevant international technical organizations of the railway sector (UIC - International Union of Railways; UNIFE - Association of the European Rail Industry; UACF(Arab Union of Railways)

"ACTION PLAN" STAGE - PROJECT GOVERNANCE ARCHITECTURE



MAIN FUNCTIONS

Definition of "project proposals" for approval of Level 1, including

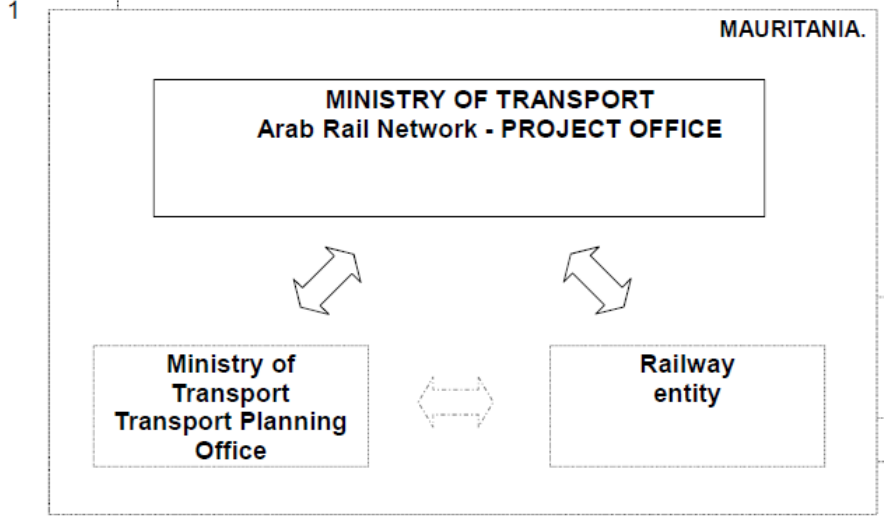
- More detailed Feasibility Studies for Priority Projects (Refined traffic study, connection with the ports, urban penetration , etc.)
- The financial and legal scheme
- The commercial agreements among the national railway operators (exploitation of the international traffic, the ticketing, the consignment note, the use of wagons, the technical acceptance of the rolling stock, the transport of dangerous goods)

- PROJECT GOVERNANCE ARCHITECTURE

Level 3 – The national level

MAIN FUNCTIONS

- Detailed design of each project, according to the national legislation for public works
- Project procurement (issuing and awarding of the construction tenders, issuing and awarding of the rolling stock tenders)
- Project commissioning
- Project management, supervision activities and testing



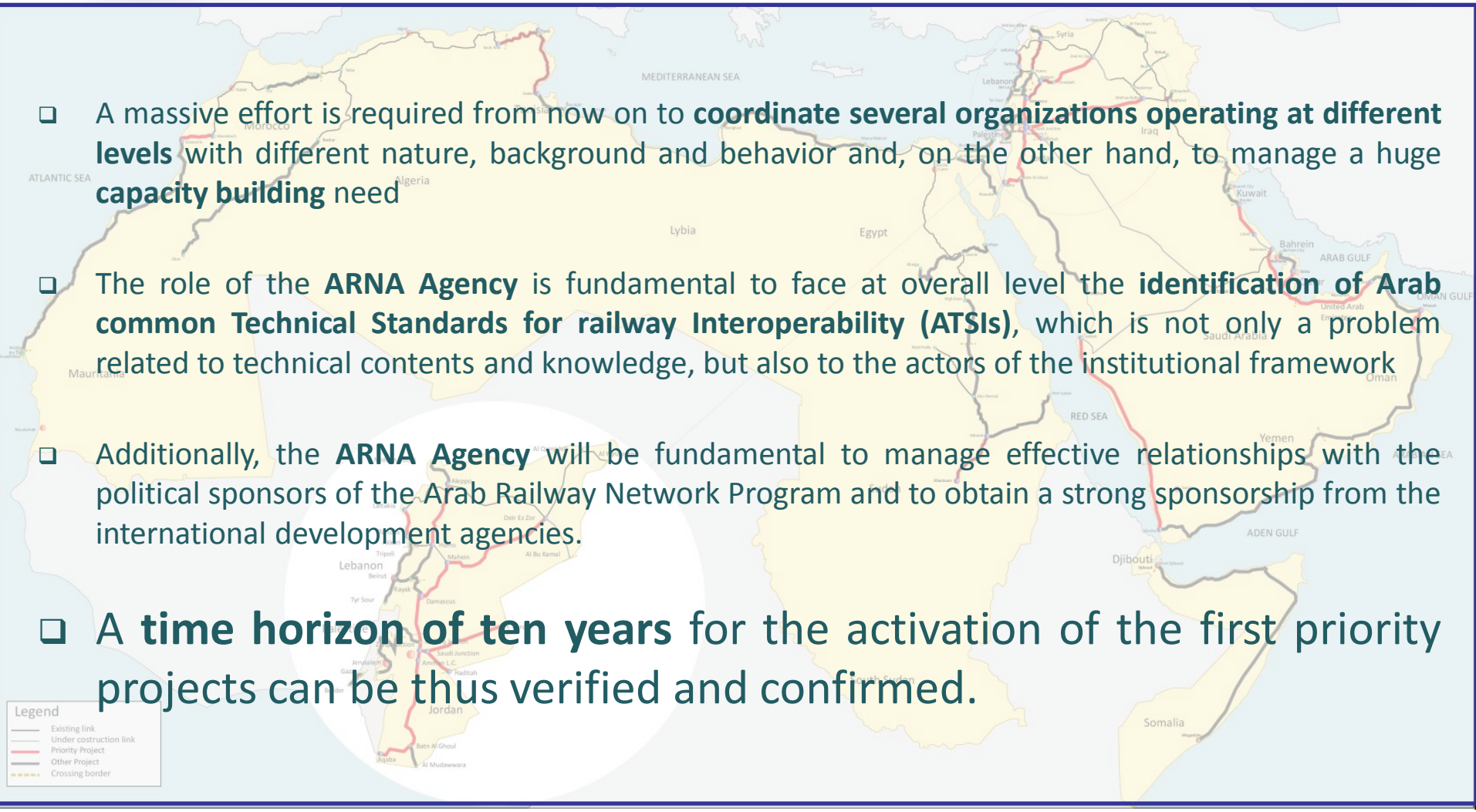
KEY SUCCESS FACTORS FOR THE ARN IMPLEMENTATION

- A massive effort is required from now on to **coordinate several organizations operating at different levels** with different nature, background and behavior and, on the other hand, to manage a huge **capacity building** need

- The role of the **ARNA Agency** is fundamental to face at overall level the **identification of Arab common Technical Standards for railway Interoperability (ATSIs)**, which is not only a problem related to technical contents and knowledge, but also to the actors of the institutional framework

- Additionally, the **ARNA Agency** will be fundamental to manage effective relationships with the political sponsors of the Arab Railway Network Program and to obtain a strong sponsorship from the international development agencies.

- A **time horizon of ten years** for the activation of the first priority projects can be thus verified and confirmed.

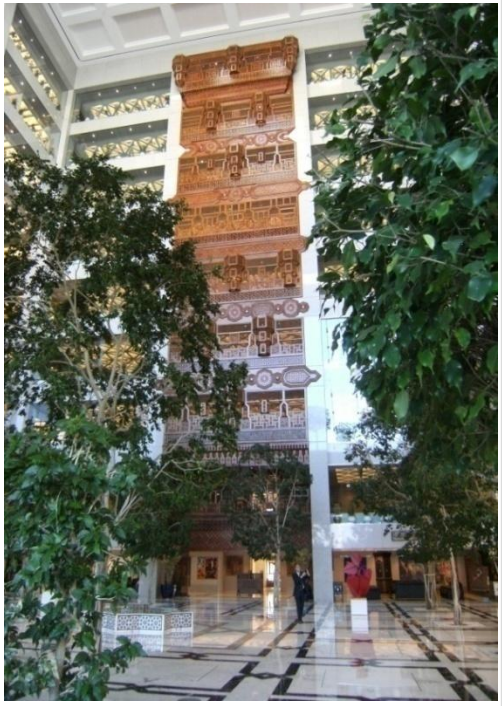


THANK YOU FOR YOUR ATTENTION

Italferr S.p.A.
Marco Stegher
International Activities
Project Manager

+39 06 4975 2036
+39 335 7125169
m.stegher@italferr.it
www.italferr.it/italferr.html

Via V.G. Galati 71
00155 Rome (RM), Italy
Ferrovie dello Stato Italiane Group



Arab Fund Headquarter in Kuwait – Atrium

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