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Master Degree in Transport Systems Engineering

Thesis

**A step-by-step process for developing a competitive rail
transport network.**

The Sultanate of Oman case study

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ABBREVIATIONS AND ACRONYMS

AIB	Accident and Investigation Body
ANSF	Agenzia Nazionale Sicurezza Ferroviaria
CIS	Charging Information System
CSI	Common Safety Indicator
CSM	Common Safety Method
CST	Common Safety Target
DGTF	Direzione Generale Trasporto Ferroviario
ECM	Entities in Charge of Maintenance
ERADIS	European Railway Agency Database of Interoperability and Safety
ERAIL	European Railway Accident Information Links
FS	Ferrovie dello Stato
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
HHR	Haramain High Speed Rail
IM	Infrastructure Manager
IR	Indian Railways
ISA	Independent Safety Assessor
MIT	Ministry of Infrastructures and Transports
MOTC	Ministry of Transport and Communications
NOBO	Notified Body
OU	Organizational Unit
PA	Public Administration
PIR	Prospetto Informativo della Rete
PKP	Polskie Koleje Panstwowe
RFI	Rete Ferroviaria Italiana
RNE	Rail Net Europe
RU	Railway Undertaking
SAR	Saudi Railway Company
SMS	Safety Management System
SRO	Saudi Railway Organization
TCDD	Türkiye Cumhuriyeti Devlet Demiryolları
TSI	Technical Specification for Interoperability
UAE	United Arab Emirates
URSF	Ufficio Regolazione Servizi Ferroviari
UTK	Urzad Transportu Kolejowego
VIS	Verificatori Indipendenti della Sicurezza

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Summary

The present study has a dual purpose. On the one hand, it is aimed at analysing the current transport situation of the Sultanate of Oman, by investigating, through the information declared by the MOTC, the present Omani general transport system that proves to be active in the maritime and road one both for passengers and for goods. On the other hand, it is aimed at preparing an Organizational Structure to satisfy the idea of development of the Railway network which makes the State competitive from the point of view of the railway transport, homogeneous and in line with the railway development of GCC: it can reduce the times and simplify the charge of the freight transport that currently is weighing on the road infrastructure.

At the moment Oman is lacking of railway infrastructures but it is intended to develop a railway system to be in line with the International transport development; it has the necessity to identify the basic aspects that are necessary to organize the development of the national network.

The study aims at identifying such fundamental points that will permit to MOTC (Ministry of Transport and Communications) to underline the basis for a new railway network as an organizational structure of the system with all the involved fundamental entities and the Railway Authority as the entity in charge of safety and market regulation.

From these two fundamental topics, will realized hypothesis about the different opportunities to be realized concerning each theme, a precise evaluating analysis and the identification of fundamental characteristics.

To prove the importance of the three fundamental aspects considered in the present study, will be taken into account the experiences of three Countries in the World: Poland, Turkey and India decided to renew their railway systems considering as fundamental aspect of the reform a new organizational structure, new laws and, consequently, the important role of the Railway Authority.

It will be taken as example and analysed in all the details the Italian Railway System that is considered avant-garde, well structured, grounded and functioning.

Will be used exemplifying and illuminating tools such as tables and flowcharts to underline and define the outputs fundamental for the system characterization.

The expected outputs resulting from this analysis are certainly the Organizational Chart of the entities involved in the system and the peculiarities of each Department of the Railway Authority.

As I am doing internship in ITALCERTIFER S.p.a (Gruppo Ferrovie dello Stato Italiane), I have been involved in the project in which the company is involved in Joint Venture with RINA SERVICES S.p.A.

In 2015 Italcertifer and RINA SERVICES won the tender published by MOTC concerning “Services for preparing the Laws, Rules and Regulation and other institutional Requirements for the railway sector in Oman”.

This project, is part of a big project put in place by the MOTC to the develop the railway system from the design to the construction of the network, the definition of an Organizational Chart with competencies, duties and responsibilities of all the entities, the railway market development and the consolidation of the Omani network as fundamental part of the GCC one.

As final step is possible to identify some scenarios for short, medium and long period for both the organizational structure and the future development of the network.

In particular will be define a basic structure for the short period (vision to 2020) and two upgrades for medium (vision to 2030-35) and long period (vision to 2050) for both the structure and the network according to the necessity of development of the GCC Railway System, the development of the proper Omani system and best international practices.

1 Introduction

The objective of this study is to define a complete model of regulatory framework and a new organizational chart of the Railway System for the Ministry of Transport and Communications (MOTC) of the Sultanate of Oman.

The analysis will include several processes managed by a new Rail Authority for safety and market regulation and the relations of this Authority with other involved Entities to better understand which are rights, duties and responsibilities of each entity involved in the System. This Railway regulatory framework, that will be designed according to international best practices and taking into account the best Railway Regulatory Frameworks existing in Europe such as the Italian one, is consisting of a structural and legal framework based on laws and regulations that harmonize both national and GCC (Gulf Cooperation Council) rules which shall apply to the rail infrastructure, rail rolling stock and the organization of rail transport, as well as the necessity to create the so-called Railway Authority, a separate administration in the MOTC.

The aim is to identify and define the internal interactions within the Oman Railway System as part of the GCC Railway System, to set how the various parties interact with each other and to schedule the most suitable strategy for a phased implementation plan.

In the present document will be described the current Railway situation in Oman considering this Country as a strategic member of the GCC that is investing in a new Railway Network in the Arabic Peninsula.

The Network of the other GCC Countries will be described to better understand, compare and align the development of the different Railway Systems of all the area.

The experience of renewal of three Countries as Poland, Turkey and India will be mentioned as example to prove the importance of a solid structure and of a good legislative structure to develop a performing railway system.

Furthermore, the Italian Railway Network will be described as a case in point, to better understand all the entities involved in such System and to compare and improve the Omani one, according to the general laws of the country and to those of the GCC.

2 Reference framework

The Sultanate of Oman is currently planning to invest consistently in the railway development; to this regard, Oman Rail Company is being established with the vision to develop the railway network so that the logistics industry can become a significant Gross Domestic Product (GDP) player and Oman becomes the gateway to the region.

At the moment, Oman does not have a rail network or, indeed, any major railway line.

Moreover, the National Railway Network project in the Sultanate of Oman has been planned, with the aim to form a central element in the modernization of the Sultanate's freight distribution system. Oman railway project is considered to be one of the major and strategic projects that will contribute in achieving a sustainable development at all levels in the country. This will be achieved by the role it will play in connecting the development centres in the country. In addition, the project will add a new pattern of transportation in the region due to its capabilities of transporting large quantities of goods and merchandises as well as large number of passengers for long distance and with low operating cost. This project also aims to enable the transport sector in the sultanate to be vital, effective and substantial to the Omani economy. This can happen by connecting the sultanate ports with the other ports in the region. As a result, ports will be promoted in order to be main hubs playing a major role in the region. Particularly, the project will open new horizons on diversifying in-revenue and empowering commercial movement in the country. This will allow Oman to be a commercial, industrial and logistic attracting platform which will led to finding new investment opportunities in which it will positively impact GDP. Major flows are expected to include containers between the ports and inter-modal hubs, bulk raw materials from the ports to industrial centres and export of raw materials and semi-finished goods to the GCC (Arab Gulf Cooperation Council) countries.

The estimated total length of the Oman National Railway Network is about 2135 km (Figure 1), linking Omani border with United Arab Emirates-UAE (at Al Ain and Khatmat Milahah) to the port of Sohar and to Muscat, as part of GCC Railway Network, and to the southern parts of the country to the Port of Ad Duqm and Salalah and to Yemen border.

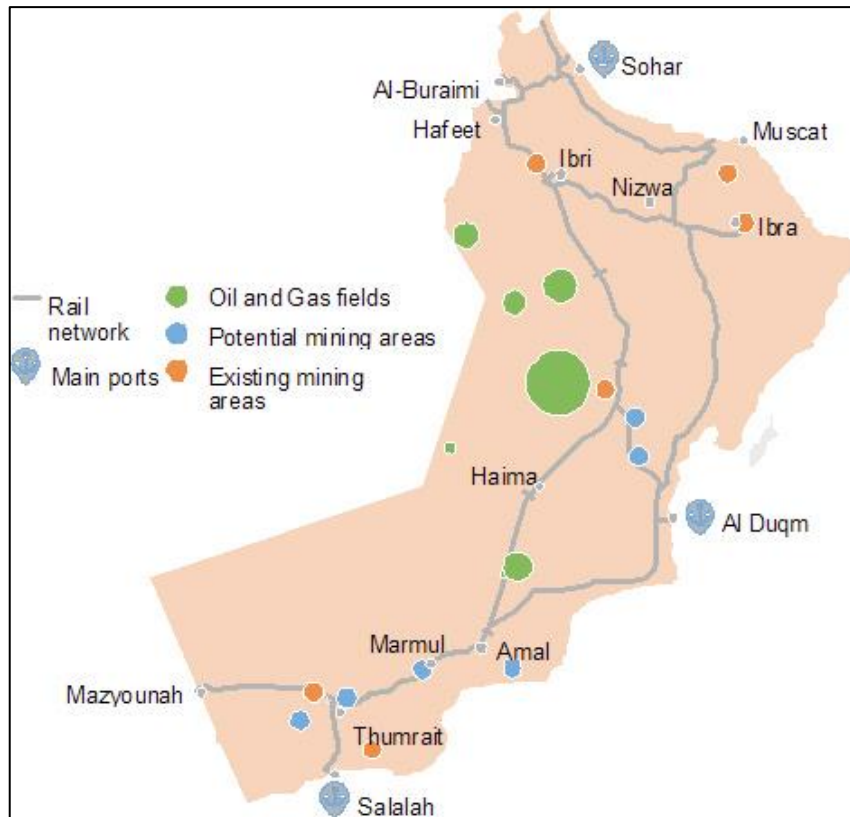


Figure 1: Oman Railway System (source: Oman Rail)

It is intended to be a double track mixed freight and passenger non-electrified railway line, speeds shall be 120 km/h for freight trains and 220 km/h for passenger trains (the corridor will be designed to 350 km/h for possible future line-speed increases) and will be part of the GCC Railway (Figure 2). On average, one freight train can carry 1.000 tonnes of freight replacing 50 trucks movement and a rail-based cargo transport is at least 30 % cheaper than by road and double track railway can carry up to 10 times the number of people per hour than a two-lane road.

Rail transport also uses about 60-80% less energy per kilometre than road transport and CO₂ emissions are lesser than the road ones.



Figure 2: GCC Railway System (source: Oman Rail)

GCC is the International Regional Organization of the six states of the Persian Gulf and the GCC Railway will connect these six states of the Persian Gulf (Saudi Arabia, Bahrain, United Arab Emirates, Kuwait, Oman and Qatar).

As international companies locate offices in the Gulf States and service industries develop in response to new opportunities, along with this growth in buildings and population, there has been a dramatic increase in the demand for transport and infrastructure and facilities needed to support it such as roads, ports and airports. It is now becoming apparent that the growth in metropolitan travel demand cannot be met by roads alone.

As part of Oman's logistics strategy and overall development direction, Oman intends to realize the value that its geographical position provides as a gateway to the Middle East, Africa and South Asia.

All the aforementioned planned projects that will characterize the growth of the Sultanate of Oman in the incoming years in the railway domain imply the necessity to establish the Railway regulatory framework of Oman, currently not existing in the state.

3 Aim of this work

According to the objective of this thesis, the different activities described in this document try to answer to the needs of MOTC of a Railway System; the aim will pursue defining a complete **model of regulatory framework** including several processes managed by the new Rail Authority for safety and market regulation, as well as the relations of this Authority with other involved Entities and the internal organization including manpower plan.

The Railway regulatory framework of Oman, that will be designed according to international best practices, is consisting of a legal framework based on laws and regulations that harmonize both national and GCC rules, an organization of rail transport and the creation of the so-called Railway Authority, a separate administration in the MOTC, responsible at least to:

- elaborate, adopt and publish national safety targets, develop and publish national regulations, ensuring that they are comprehensible and compliant with the Government's transport policy objectives;
- set and publish requirements for Safety Management System (SMS), carry out safety supervision, to check that the railway companies are monitoring and controlling safety also providing them the necessary assistance to implement their SMS, thus obtaining and maintaining a high level of safety in the railway transport system and preferably improving this currently;
- set and publish requirements for safety certificates for Railway Undertakings (RUs) and Infrastructure Manager (IM), set and publish requirements for licences, monitoring and checking that everyone who is granted a permit complies with the appropriate regulations and requirements, if not renew or withdraw safety certificates and licences;
- set and publish requirements for certificates for Entities in Charge of Maintenance (ECM);
- assess the systems put in place by Companies, that shall enable them to self-regulate their compliance with the regulations and monitor and follow-up enforcement by inspections and audits. Review and approve corrective actions decided by RUs and IM and approve implementation timelines and control results and efficiency of corrective actions;
- analyse accident reports from RU and IM, investigate accidents or near misses and elaborate findings, issue accident report and provide assistance to Accident

Investigation Body (AIB) if requested and analyse report from AIB to ensure follow-up and recommendations, communicate regulations on the reporting of accidents and incidents and regarding the events that must be reported;

- collect and analyse statistics of accidents and incidents, used for its supervision, recording violations, issuing warnings and setting restrictions;
- adopt existing technical standards, reviewing safety standards ensuring technical survey, set and publish procedures to approve to put in service an infrastructure or vehicle or other technical systems; this also applies to upgrading or renewal of an already approved subsystem, where safety is affected, as well as to station names and education plans;
- grant licenses, certificates or authorization to persons and/or legal entities with public service or commercial interest for rail traffic services or/and holding railway infrastructure;
- set training and accreditation requirements for safety critical staff, approve RUs and IM training Plan on Safety and receive and analyse annual report on training. Also qualifying and training Inspectors;
- check that the current market requirements are met (reactive measures), monitor the development and function of the market in relation to political expectations (proactive measures), settle disputes and set conditions, in order to achieve an effective railway market with healthy competition ensuring a fair and non-discriminatory access to the rail network and services. The Authority also monitor the competition in the rail services market through the control of the fair balance between rail capacity offered by the Infrastructure Manager and fair track access charge paid by the RUs.
- coordinate statistic figures, hold registers and issue periodic reports and specific reports, especially annual reports to Ministries and follow up coordination with other Authorities.

In the light of this, it becomes of vital importance to identify and define the internal interactions within the Oman Railway System as part of the GCC Railway System, to set how the various parties interact with each other and to schedule the most suitable strategy for a phased implementation plan.

For a more precise analysis, this document will focus on the main topics, significant for a correct evaluation and to design the basis for a Railway Network. Such topics are, as follows:

- Oman railway system description
- Legal framework of the Railway Authority
- Track access charges
- Oman railway Sector's law
- Organizational process development
- Organizational structuring
- Human resources managing plan

Both the characterization of the activities related to each theme, the comparison to the Italian Railway System and the identification of the characteristics to assign to the Omani system, will allow defining a structure for each topic as output for each section.

4 The Methodology

In order to achieve the objective, a fundamental issue is the analysis of the current transport situation in Oman and in the other GCC countries. Such analysis will allow to underline the Railway development in this area as well as to focus on a railway system already strengthened and appreciated as the input to structure the Omani one.

It is useful to contextualize the actual framework of the Country as part of the GCC countries and, above all, as one of the new railway project that the GCC will realize, taking into account the laws in force in the Country, the present transport system (road, maritime and air), the needs of the customers and the necessity to be compliant with the others railway systems in the world.

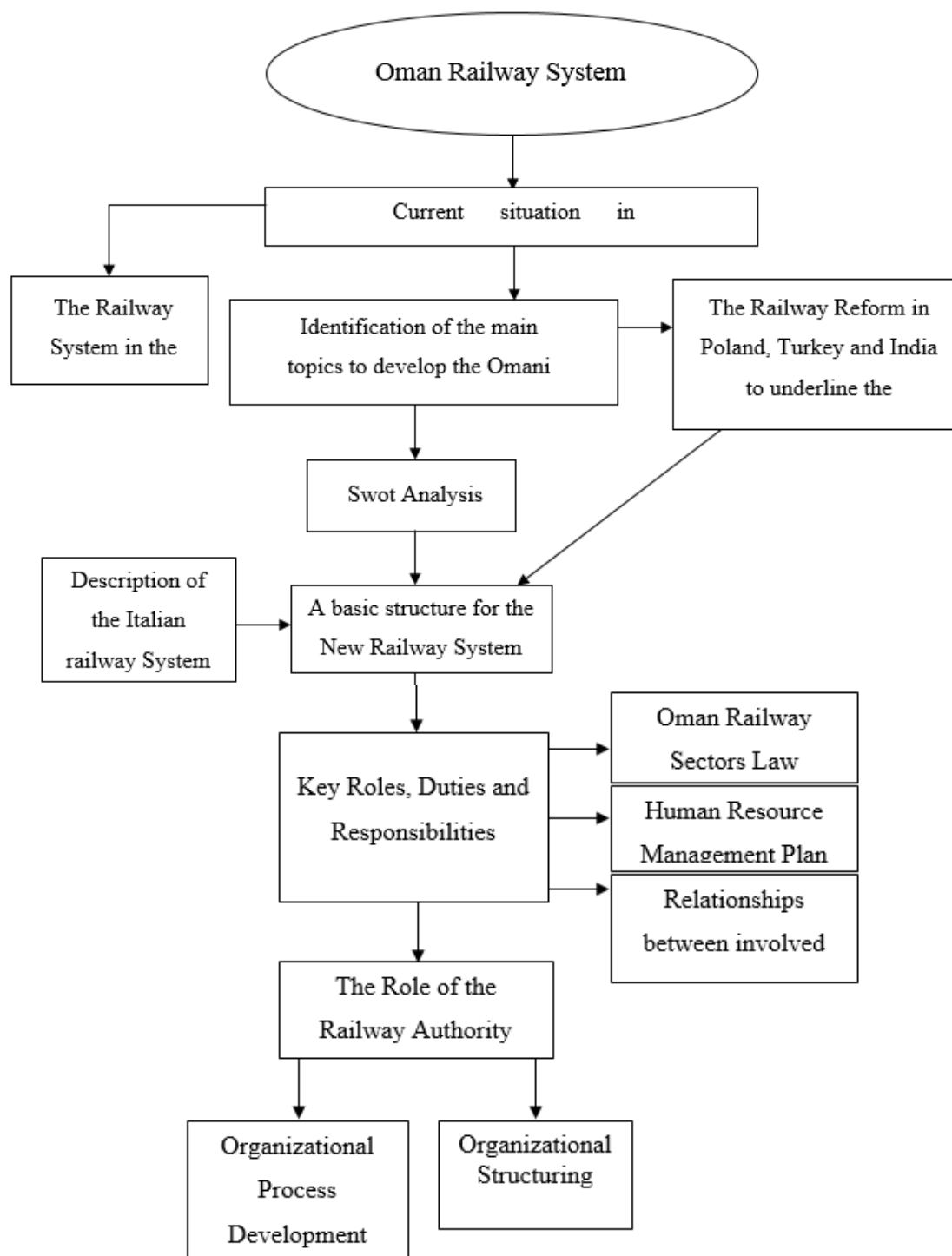
Contextualize the Country as member of the GCC is significant to align it to those countries that have already developed a railway system but also to be considered as a stimulus for those lacking of railways.

To characterize the new railway system, it is important to identify the most important peculiarities that are considered as essential for the development and that will be the basic topics for increasing the competitiveness of the railway network under study also considering the experience of reform of other Countries in the World such as Poland, Turkey and India.

It is possible to consider the basic and essential topics of an existing Railway System pursuing it as a guideline for a more characteristic Omani System. To this sense, the Italian Railway System can be considered as one of the best in the world for its logical structure, the legislative and organizational system.

Underlying the basic topics as the involved entities and the relationships between them, the essential aspects of the laws and the basic organizational structure of the Italian System will be useful to define the starting point for a successful system because the aim of this document is to identify a system with performing laws and a basic organizational structure with all the involved essential entities, roles, individual tasks and responsibilities.

The identification of the layout, the organizational properties and the comparison with the Italian Railway System through exemplifying tables and flowcharts, will allow to define the outputs related to each task that will be useful to MOTC to underline the basic fundamental aspects of the Omani System such as the importance of the Railway Authority as super partes entity.



5 The Railway Network in the GCC Countries

The members of Gulf Co-operation Council – Saudi Arabia, Kuwait, Bahrain, Qatar, United Arab Emirates (UAE), and Oman – are proposing to build a heavy railway line to link all six states. It is intended to run from Kuwait City to Muscat via Saudi Arabia and the United Arab Emirates with a loop via causeways through Bahrain and Qatar. This will present a formidable task in a region where there is little or no history of railways with the exception of Saudi Arabia and to a lesser extent the UAE. This will involve the co-ordination of standards across six states and integrating with the existing heavy rail system in Saudi Arabia and the proposed rail networks of the other five states. Heavy rail has advantages over road transport for long haul freight and passenger transportation in terms of operational efficiency, carbon dioxide emissions, and cost. However, these advantages have not been apparent for the GCC members – Saudi Arabia and Oman aside – because they do not kick-in for shorter distances involved in domestic transportation.

Nowadays, due to lack of the rail mode, which can move large volumes of cargo safely and economically, the Transport Industry in the GCC has had to rely primarily on road networks for movement of goods. Since the GCC nations are connected only by road, the entire trade across the borders is reliant only on road transportation. High cost of air mode and non-viability of coastal shipping has also resulted in the GCC Transportation Industry being reliant solely on the road mode.

Like the cargo transportation industry, passenger transportation services are also limited to either road or the costlier mode, air, due to lack of rail transport facilities. Passengers are compelled to use air travel even to travel between two neighbouring GCC states that would normally be just about 4-5 hours by rail. This results in high costs, without providing any benefits, as productive hours are lost due to waiting time at airports.

It is possible to trace the reasons of the lack of Railway mode in:

- Small geographic size of the nations: except for Saudi Arabia and Oman, GCC nations are small in terms of geographic area; rail transport is advantageous for covering longer distances;
- Unfavourable Geographic Conditions: The desert terrain with shifting sand dunes and volatile ground surface across the GCC nations has been another prominent reason to avoid rail transport. Challenges of maintaining the railway network in such unfavourable conditions have dissuaded both governments and rail infrastructure builders from undertaking railway projects in these countries;

- Availability of cheap fuel for road transport: Railways in several countries have shifted to electric power from petroleum fuel, primarily to avoid the impact of oil prices. But, the GCC nations are oil rich and the price of fuel in their domestic markets is extremely low as well as stable, when compared to oil prices in other nations such as India and the US. Hence, road transport has gained prominence in these countries;
- High investment cost and potential low returns: Rail transport involves high investment costs for materials, equipment, and labour both for initial development as well as for management. Such high investments are justified when there is high potential usage of the network to reap the benefits and return on investment. The GCC nations' cargo volumes are heavily dependent on the oil and gas sector, which prefers to use pipelines over other modes for surface transportation. Therefore, the scope of reaping returns from high investments in rail gets diminished, discouraging governments and transporters from considering the development of rail transport.

Each of the six GCC member states are responsible for implementing the portion of the project that lies within their territory and will construct their own railway lines and branches, stations and freight terminals. The costs will be proportional to the length of the rail network in each country.

In the next paragraphs will be described the Railway System of each GCC country to better understand the development of this mode of transport in each area.

5.1 Railway Development in Saudi Arabia

Saudi Arabia is the GCC Country with the best development of the Railway System but this mode of transport has not received a high level of investment as the road and air one.

The Saudi Ministry of Transport is investing in the development of the public transport to ensure comfort and wellness to the customers of the major cities in the country and established an independent Public Transport Authority to:

- Control the passenger's transport public services in the cities and between cities, manage adequate levels of quality and costs and stimulate investments in line with the objectives of economic and social development of the country;

- Implement Public Transport Plans to grant the means of resources, select the network, give licenses and propose a mechanism to regulate the track access charges and to propose adequate conditions to implement investments;
- Elaborate a complete work for public transport coordinated with the different authorities in charge for each city to implement the coordination among the various modes of transport

The country has two state-owned companies that operate Saudi Arabia's rail network: Saudi Railways Organization (SRO) and Saudi Railway Company (SAR).

SRO operates the Railway System from 1966 a network with a total length of 1.380 kilometres. The network consists of two main lines (red in figure 3). A 449 km passenger line that links Dammam with Riyadh and a 556 km freight line that connects the King Abdul Aziz Port in Dammam with Riyadh. Moreover, about 373 km of auxiliary lines branch from SRO's main lines and connect some industrial and agricultural areas, military sites with export ports and residential areas.

Safety took priority within SRO over the past years; Safety Projects include:

1. Projects to enhance train safety through the introduction of modern technologies such as the integrated signals and communications system that is being implemented by an international specialized company, the integrated train detection during travel system, the train on-track stability sensing systems and simulation system for training train drivers;
2. 1. Projects to enhance train safety through the introduction of modern technologies such as the integrated signals and communications system that is being implemented by an international specialized company, the integrated train detection during travel system, the train on-track stability sensing systems and simulation system for training train drivers;
3. Projects designed to enhance the safety of the network. SRO completed the installation of an 800-km fence to provide more safety on railways in areas with heavy car and livestock traffic. SRO also completed a project to build passageways for cars and livestock at the railway intersections in remote areas. SRO is now preparing for a project costing over SR 600 million to relocate the entire route of the railway in Al-Ahsa to outside urban areas, thus eliminating intersections with high traffic;

4. Projects aimed at enhancing safety at intersections, through fitting some of these intersections with electronic gates, light signals, alarming bells, and warning plates, as well as assigning controllers to these intersections around the clock; and providing only light signals without gates at medium traffic sites. SRO has also installed speed bumps to force drivers to reduce their speed at such intersections.

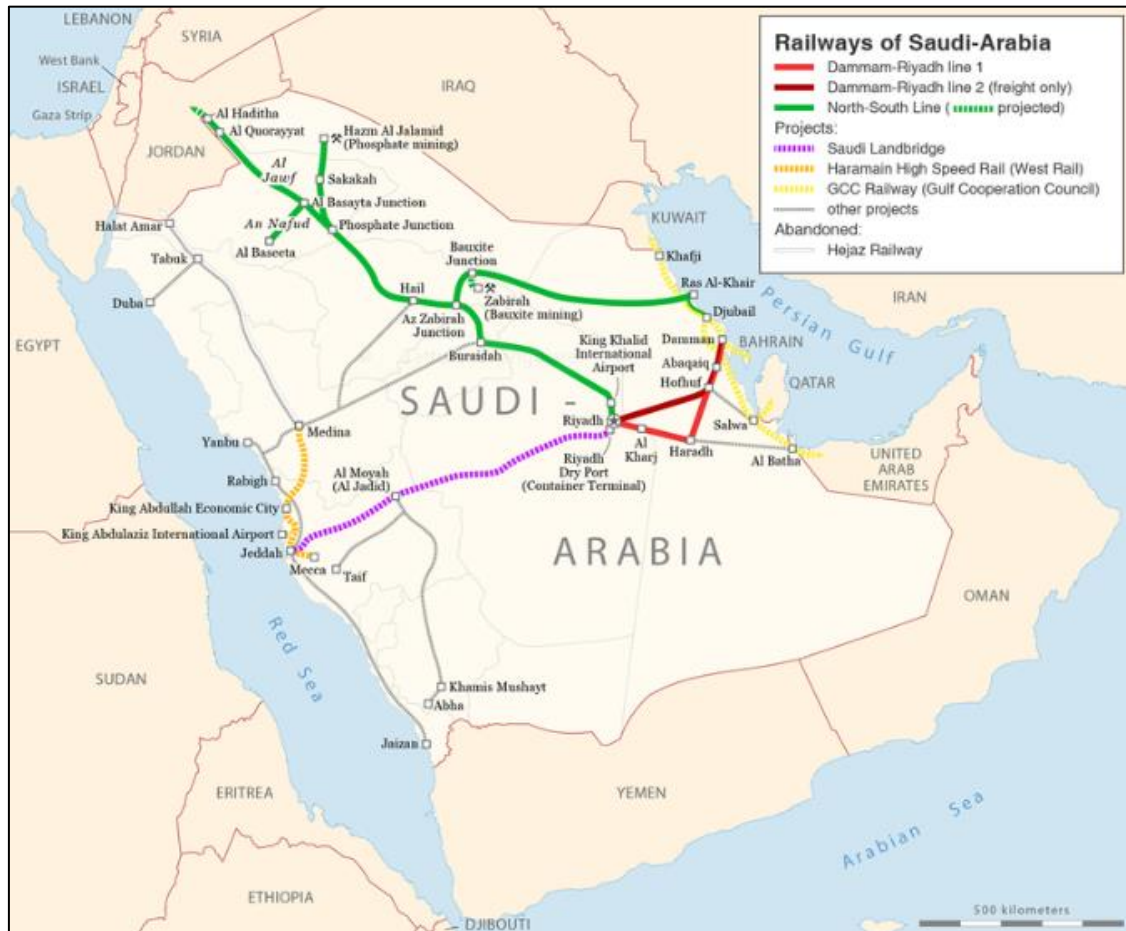


Figure 3: Railways of Saudi Arabia (source: Saudi Railways Organization)

SAR was established in 2006 to build, operate and manage the 2750 km (green in figure 3) north-south railway line (only for freight trains) and a passenger line from Riyadh to Al Haditha (both passenger and freight services will be operated on this line).

In figure 3 (in orange) there is also the under construction Haramain High Speed Rail (HHR) also known as the “Western Railway” or “Makkah Medina high speed railway”; it is a 453 kilometre long high speed intercity transport system.

The Government has taken a decision to implement a railway project linking the holy cities of Makkah and Madinah via Jeddah. The HHR will be a high speed electrified passenger line, primarily designed to provide a fast, comfortable, reliable and safe mode of transport. The overall objective of the Government is to implement the HHR project as a public funded project.

The important features of the Project given below are based on preliminary estimations and are subject to revision on more detailed analysis and design:

- The HHR will be a high speed (360 km/h design speed) electrified passenger double line between Makkah, Jeddah and Madinah.
- Madinah will have only one passenger station.
- Station will also be required in the King Abdullah Economic City and a station may be required for the Hajj Terminal at Jeddah Airport.
- The design, construction, operation, maintenance of HHR shall be executed in two phases.

Haramain High Speed Project is considered an urgent need at the present time for several reasons, the foremost of these reasons is the growing number of pilgrims year after year, as well as the Umrah performers, visitors and residents who come to Makkah and Madinah throughout the year particularly during the seasons and holidays.

The impacts and benefits of the project are:

- Alleviating the pressure and congestion on the roads between Makkah and Medina as well as Jeddah Governorate.
- The Comfort, safety and speed provided by the train.
- Reducing the pollution caused by vehicle exhausts.

The railway is expected to carry three million passengers a year.

There will be five stations on the line and will be managed by SRO.

Saudi Arabia is also the major investor in the GCC Railway (yellow in figure 3) that will be 663 km long in the Saudi territory.

The speed of trains transporting passengers is estimated at 220 km per hour and those transporting goods will be between 80-120 km/h and the locomotives will rely on diesel to generate electricity.

5.2 Railway Development in United Arab Emirates (UAE)

The UAE is the second largest economy in the GCC and has been a pioneer in the region's rail revolution with the Dubai Metro Project. The nation is building another ambitious rail project, the Etihad Rail, to link the seven Emirates of the UAE by Rail.

Etihad Rail was established in June 2009 under Federal Law, with a mandate to manage the development, construction and operation of the UAE's national freight and passenger railway network and with the mission to provide a safe and sustainable passenger and freight transport railway system in the UAE through innovation and continuous improvement of technologies and practices.

This network would later be integrated into the GCC Railway Network as can be seen in figure 4.

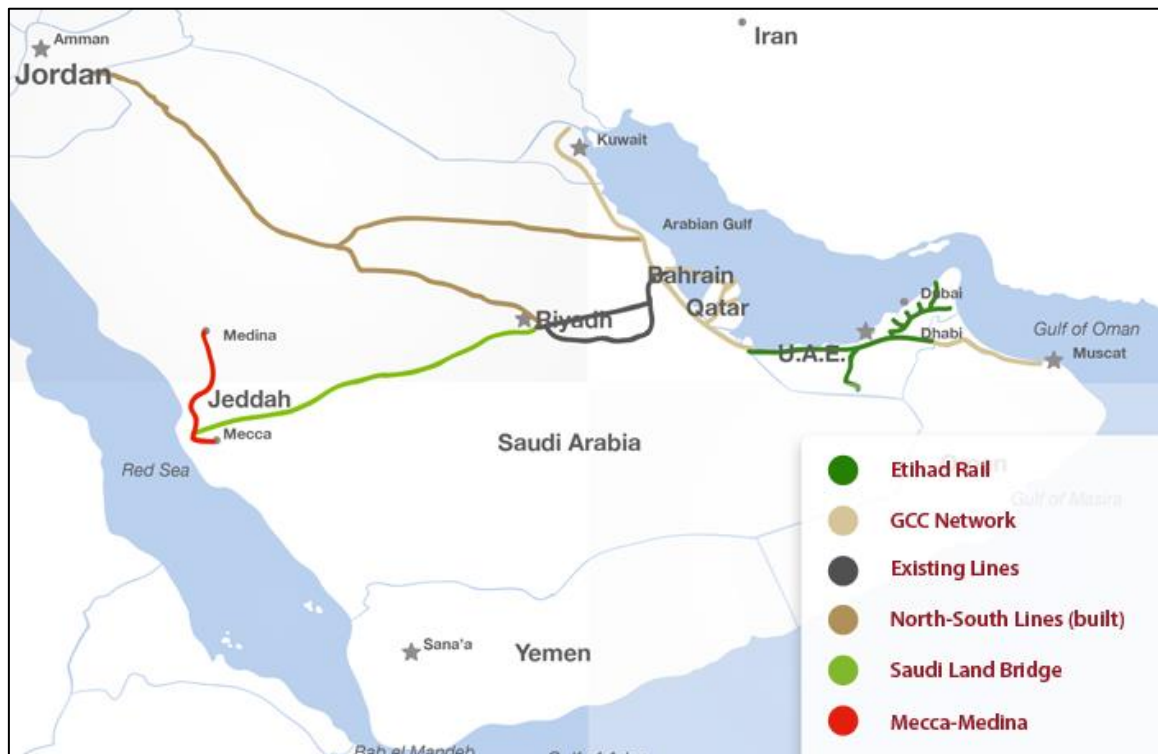


Figure 4: GCC Railway Network (source: Etihad Rail)

Etihad Rail is a 1,200 km network (figure 5) with a mandate to manage the development, construction and operation of the UAE's national freight and passenger railway network.

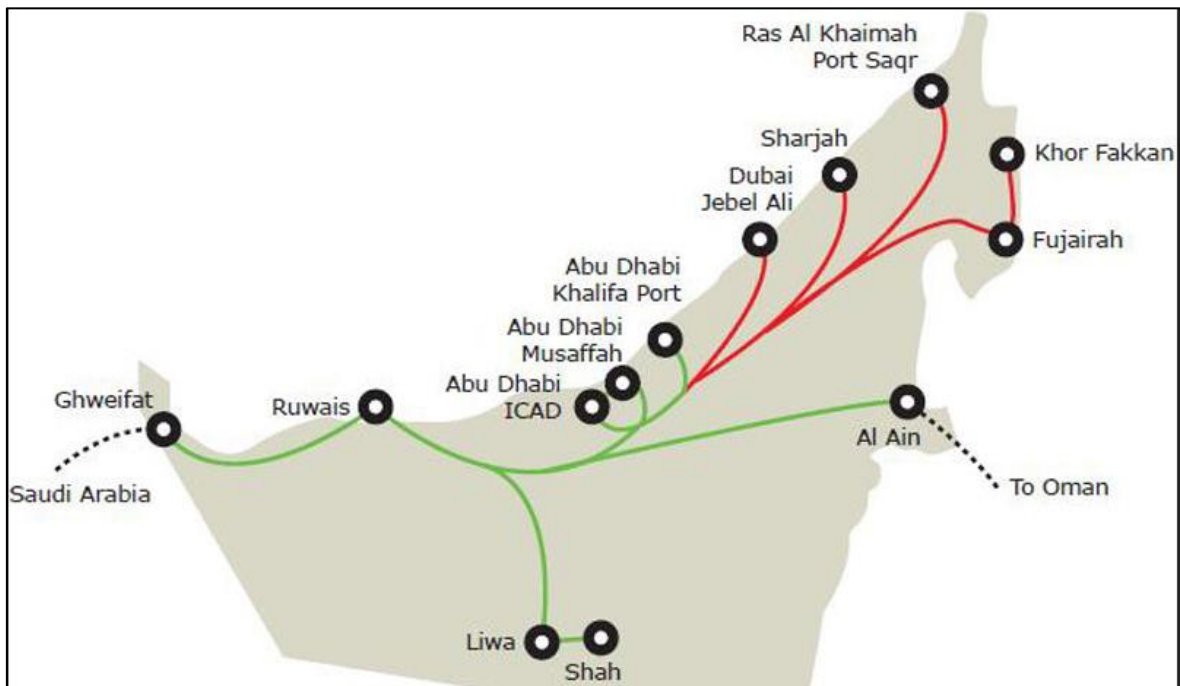


Figure 5: Etihad Rail Map (source: Etihad Rail)

It is considered as the biggest and most complex infrastructure projects ever undertaken in the UAE and will be built in three stages to link the principal centres of population and industry of the UAE, as well as to form a vital part of the planned GCC railway network linking the six countries of the GCC.

Built to international standards, Etihad Rail's state-of-the-art network will act as an essential element for economic growth and sustained social development.

There are numerous benefits brought about by Etihad Rail. The direct economic benefits delivered by the Etihad Rail network include freight cost savings, business travel time savings, along with other economic remunerations. These economic benefits will support businesses, commuters and other travellers across the region. The project will also contribute to tourism and the wider UAE economy.

The rail network will ultimately provide services for both freight and passengers, with social benefits including lower cost transportation, faster journeys than highway alternatives and reduced levels of highway traffic.

By offering a time and cost advantage over trucks when compared with the no-rail scenario option for freight transportation, Etihad Rail will attract container and bulk freight demand that is currently transported by trucks. The cost savings made by businesses that transfer

their freight via rail will enable them to be more commercially successful and therefore further contribute to economic growth.

The Etihad Rail network will reduce greenhouse gases by more than 2.2 million tonnes annually and also road congestion and accidents (a single freight train can carry the load of up to 300 trucks).

5.3 Railway Development in Qatar

The Qatar MOTC has a specific Land Transport Planning Department in charge of setting the general planning policy, preparing the necessary studies and design plans, as well as planning the construction and development in coordination with the relevant authorities in the state of Qatar and identifying the licensing requirements and fees of land and railway transport activities.

The MOTC is in process of bringing in a law relating to the Regulations of Railway Affairs which will be supported by the development, certification and Right of Way Protection Guidelines.

The MOTC has drafted these guidelines covering railways and other guided transport systems in the State of Qatar to ensure development and operations of rail systems is regulated and consistency is achieved across the network. The certifications will be issued by the MOTC at various stages of projects and its purpose is to achieve compliance with the key objectives of safety passengers, staff, contractors and sub-contractors, Third parties and the general public.

The scope of safety certification broadly covers two key areas during the overall project life cycle, firstly at development stages without passengers and secondly Operations & Maintenance with passengers.

Responsible for rail transport in Qatar, is the Qatar Railways Company, commonly known as Qatar Rail, a state-owned railway company. It is owned and operated by the Government of Qatar. Established in 2011, the company is responsible for the design, construction, commissioning, operation and maintenance of the entire rail network and systems, and will manage Qatar's rail network once operational.

The individual rail projects comprise the Doha Metro and the Long Distance Passenger and Freight Rail connecting cities in the north and west with Doha, and the country with the forthcoming GCC rail system.

5.4 Railway Development in Bahrain

Nowadays, there are no railways in Bahrain but the state will be involved in the construction of the GCC Railway Network with a 84 km double track line with mixed traffic and they are also looking for a light rail network inside the country.

With an overall aim to unifying the region and enhancing people connectivity and freight movement, the project is also expected to contribute to the region's economic growth, development and prosperity and in diversifying the transport supply reducing transportation costs.

5.5 Railway Development in Kuwait

As Bahrain, transport in Kuwait is largely road based due to an important presence of oil and, nowadays, the country has no rail infrastructure.

Several railways are being planned in the years but none have gone into effect, except for the planned project concerning the GCC railway network.

6 Focus on reformed Railway Systems in the World

6.1 Poland, Turkey and India

The path that is intended to undertake in Oman for the birth of the railway transport, was started by many countries already during the XIX century, refined during the '900 and in recent years aimed at making the system competitive worldwide.

The actions undertaken by various nations do not refer only to a renewal/upgrading of the infrastructure or of the rolling stock but above all to the structural organization and to the legislative system of the entire railway sector that is looking for an alignment to the international directives in the field of safety (the structure and laws are considered the primary contents for a new competitive railway system).

Several nations, during the years, decided to pursue the idea of an important improvement of their proper railway systems, for example Poland, Turkey and India; these nations saw the birth of the railways at the end of '800, a rapid development in the first decades of 1900 and an unexpected stop during XX century due to the different wars characterizing the period, to the lack of stimulus for a renewal and above all to the chaos in the railway sector due to the lack of a solid structure and laws inadequate for the development of the sector.

I'm considering nations completely different one from the others from a geographical (each one in a continent), morphological, historical, costumes and traditions, religious, legislative, economic, social point of views but at the same time they shared the same wish to push ahead, to adapt themselves to the international railway sector from a safety, legislative, technological and structural point of view.

Poland, Turkey and India conveyed the economic difficulties involving many countries in the world during the XX century but thanks to the intervention of each Parliament, to the actions undertaken at international level to improve railways and to proper allocated funds, they began a substantial upgrading of the railway sector.

It is possible to identify some reference parameters to measure, in comparison with similar realities, the efficiency, effectiveness and economy of the service rendered.

The possibility of identifying and understanding the best practices and critical success factors of other organizations, allows to intervene in a virtuous way on the studied system: it permits to focus on best points adapting them in an intelligent and creative way to the specificity of each system to improve the performance.

As it will be possible to verify from the next paragraphs, considering all the differences above mentioned, it is possible to underline that the three nations pursued the same initiatives to go toward a railway reform; they started from the basis and, through determined and precise acts, they stated the characteristics of an organizational structure identifying competencies of each involved actor and realizing the birth of intermediate entities between the Ministry of Transport and infrastructure managers and railway undertakings.

Through new amendments and legislative acts, they constructed the normative aspects connected to the railway world with respect to the existing laws, the culture and the previous engagement already developed for the railway sector

6.1.1 Poland

Polskie Koleje Państwowe SA (PKP SA, English: Polish State Railways, Inc.) is the dominant railway operator in Poland. The company was founded when the former Polskie Koleje Państwowe state-owned operator was divided into several units based on the requirements laid down by the European Union. PKP SA is the dominant company in PKP Group.

Passenger transport and freight transport are provided by licensed railway undertakings (18 for passengers and dozen for freight railway transport).

The history of the Polish railway system began on the 11 November 1918 with the independence of the State that allowed Poland to reclaim the former Russian and Austrian sectors from military railways. The Railway Department in the Ministry of Communication was created and the Polish railways were officially named Polskie Koleje Państwowe.

In December 1918, the Great Poland Uprising started. The rebels took over the former Prussian sector of railways. After the victory over the Red Army in the Polish-Bolshevik War (1920), a great deal of damage in railway structure was discovered and there was a crisis of the railway sector until 1990. From 1990 the Polish State Railways have faced ever increasing competition from private automotive transport and the country's rapidly expanding network of motorways and express roads. However, ever decreasing journey times, better schedules which allow for well-coordinated connections, the rise of private operators and large-scale investment in infrastructure as well as new rolling stock is slowly enticing people back to railways.

According to the necessity of renewal, in the 27 of June of 1997 was signed the Poland Railway Transport Act, the Law that regulates rules and conditions for operation of railway lines, management thereof and that performs transport activities thereon, as well as rules and conditions for operation of rail vehicles.

A new railway transport act was signed in 2003 liberalizing the market and allowing the entities outside the PKP Group to render freight transport services and manage infrastructure. So as to satisfy the necessity to have a transition figure between the Ministry of Transport and IM and RU's (the equivalent of the National Safety Authority also expected for the Omani system), the Office of Rail Transport (Polish abbreviation UTK) was established on 1 June 2003 within the framework of adjusting the Polish railway market to the requirements binding in the European Union in order to have a better and well-structured system despite the negative situation of the previous decades. UTK upholds the cohesion of the rail system by supervising the technical solutions that influence rail traffic and rail system safety.

From the beginning of the XXI century, the railway network all over Poland has undergone intensive modernisation.

The investment works have not only enabled the improvement in the operational parameters of railway lines, such as the maximum speed or the permissible axle load, but also ensured, to a large extent, the compliance with the applicable European interoperability requirements defined in TSI.

Considering the high significance of international transport, it is of utmost importance to ensure that the Polish railway network is as interoperable as possible (complying with TSI requirements).

This will not only foster the significance of Poland as a transit country between Eastern and Western Europe but also limit the technical barriers currently existing within railway networks in the EU area, thus contributing to the establishing of the common market of goods and services intended for railways. In the long-term perspective, it will also increase the competitive power of rail transport in relation to other transport sectors.

Nowadays, Poland is investing consistently in the railway system with positive results in terms of better performances of the rolling stock and of the infrastructure and the characteristics of the actual network are the following:

Total Length	23.420 km
Standard Gauge (1.435 mm)	21.639 km
Broad Gauge (1.520 mm)	646 km
Narrow Gauge (various)	1.135 km
Passengers per year	292.5x10 ⁶
Major Lines	4 (E20, E30, E65, E59)
High Speed Lines	No (2 lines scheduled)
N. employees	22555
Revenues per year	12.79x10 ⁹ PLN (EUR=3.197.500.000)
Costs per year	12.56x10 ⁹ PLN (EUR=3.140.000.000)
N. trains per year	1,7x10 ⁶
Goods per year	222,2x10 ⁶ tonnes
Trains x km	160x 10 ⁶

Table 1: Characteristics of the Polish Railway System (source: Author's own elaboration)

UTK improved consistently the efficiency and the safety of the railway sector.

The President of the Office of Rail Transport is a regulator with jurisdiction over cases of:

- regulating the rail transport market,
- licensing rail transport,
- technical supervision over the operation and maintenance of railway lines and railway vehicles,
- rail traffic safety,
- supervising the observance of passenger rights in rail transport,
- train driving licences and certificates.

The Office of Rail Transport also performs its tasks in the field of monitoring rail market development, improving rail transport safety standards and cooperating with European institutions responsible for the functioning and development of the common rail services market.

The President of UTK is in charge of supervising over the operation of railway lines and rail traffic safety issuing, extending, amending and revoking safety authorisations, certificates and attestations controlling the conformity of activities performed by infrastructure managers and railway undertakings with Community and national laws in the field of safety

and authorising the placing in service of new or heavily modified rolling stock. The President of the Office of Rail Transport, under his supervision, by way of a decision, can suspend or limit the rail traffic on a railway line or its section in the event of identifying any risk to rail traffic safety and withdraw a railway vehicle from operation or limit its operation, if it ceases to meet technical requirements.

6.1.2 Turkey

TCDD is the State Railways of the Turkish Republic (Turkish: Türkiye Cumhuriyeti Devlet Demiryolları) and is the government-owned national railway carrier in the Republic of Turkey. The TCDD was formed on 1 June 1927 by the Turkish government to take over the administration of the existing rail lines

The history of rail transport in Turkey began with the start of the placement in 1856 of a 130 kilometres railway line between Izmir and Aydın.

The state corporation that manages the Turkish railway system, Turkish State Railways, subdivides the history into the Pre-Republic period (Ottoman period), the Republic period (which extends from 1923 to 1950) and the period after 1950. During the first period, railways were built and operated by foreign concerns with permission from the state. In the second, the state took over its own railways and expanded them in support of Turkish financial interests. In the third period, attention turned from rail travel to highways, and the expansion of railways dramatically slowed: in the early part of the period, the improvement of the roadway system was conceived to support the rail system, but instead of the coordinated building of both road and rail structures intended, railroad construction slowed dramatically. In the 1980s, the national transportation plan "1983-1993 Transportation Interim Planning" was adopted with a goal in part of decreasing highway transportation share from 72% to 36%, but the plan was abolished in 1986 without implementation. In 2002, only 4% of freight transported in Turkey traveled by rail, and only 2% of passenger travels was conducted by rail.

It was not until the end of the 20th century that railways returned to favor with major passenger infrastructure projects being initiated (the High-Speed Line project and the Marmaray Project), and five thousand kilometres of new lines planned for construction.

Today, the passenger ratio is slowly increasing with the opening of high-speed rail lines in Turkey that began service in 2009.

Nowadays, TCDD have a monopoly on passenger and freight rail transportation, as well as the manufacturing of rolling stock and tracks; it owns and operates all public railways in Turkey and controls 12,532 km (7,787 mi) of railways, making it the 22nd-largest railway system in the world.

The Turkish State Railways operate passenger services on 90% of their system.

The types of passenger service are:

- High-speed (Hızlı Tren): High-speed rail services and TCDD's premier service.
- Mainline (Anahat): Intercity trains operating between major cities.
- International (Uluslararası): Trains operating on international routes, toward Europe or the Middle East.
- Regional (Bölgesel): Trains operating within their respective districts.
- Commuter (Banliyö): Commuter trains, currently operating in Ankara and İstanbul.

TCDD has branded its high-speed service as Yüksek Hızlı Tren or YHT. YHT currently operates on two lines: the Ankara–İstanbul high-speed railway and the Ankara–Konya high-speed railway. High-speed rail in Turkey is still developing, with two lines under construction and many more planned. By 2023, the Ministry of Transport expects Turkey's high-speed rail system to increase to 10,000 kilometers.

Nowadays the Turkish railway network has the following characteristics:

Total Length	12.532 km
Standard Gauge (1.435 mm)	12.532 km
Narrow Gauge (various)	NO
Electrification	25 kV, 50 Hz AC
Passengers per year	77297512
High Speed Lines	2 existing and 2 under construction
N. employees	29590
Revenues per year	28368709127 TRY (EUR=6.305.547.099,4)
Costs per year	4312024703 TRY (EUR=958.438.917,23)
Goods per year	25,878x10 ⁶
Trains x km	41872573
Passengers x km	4828x10 ⁶

Table 2: Characteristics of the Turkish Railway System (source: Author's own elaboration)

According to the new International Acts and Rules concerning the railway sector, also the Turkish Parliament began to reform his own system starting from the acceptance of the law about “Liberalization of Railway Transportation in Turkey” in April 2013. Railway was the last state-controlled-monopoly in Turkey, and the biggest step about that seems to be taken. Of course, there is still a lot to do before running first private loco on rails in Turkey. TCDD continues to be a governmental organization, but only responsible for the infrastructure and the units of TCDD responsible for the operations of trains will be separated, as an affiliate of TCDD naming “TCDD Taşımacılık AŞ” that will be supported for a determined period by government in order to continue the current railway services until the reorganization of railway transportation in Turkey is completed successfully.

Thanks to this new Law, the management of current railway network will be handled only by TCDD but his monopoly will end for things like “building/repairing of railways, operating stations and terminals. Private companies will be partially free to own infrastructure (only the new lines they build), and completely be free to operate trains on the infrastructure owned by TCDD or any other private companies. Government will support connections to main railway network from plants, industrial areas and warehouses with the target of increasing the total volume of railway transportation.

Everybody is expecting a rapidly development and improvement after liberalization but many experiences in Europe show that transition period will not be so easy and fast. Beside many reasons that make railways more conservative, the hard competition with trucks and vessels may slow down the money that’s supposed to be invested in train transportation.

The development in railway transportation in near future will continue to be based on the capabilities and efforts of TCDD, and its new child TCDD Taşımacılık AŞ.

For the future, The Turkish State Railways (TCDD) may be split with the passenger and freight operations being part of a new company named DETAŞ (Demiryolu Taşımacılığı Anonim Şirketi, meaning Railway Transport Company) with TCDD left as a track and infrastructure operator. This restructuring will also allow other rail operators to run trains on TCDD tracks by means of track access charges, and will end the monopoly of TCDD.

6.1.3 India

With its more than 150 years old history, Indian Railways (IR) is a state-owned public utility of the Government of India under the Ministry of Railways. It is the fourth largest railway network in the world by size, comprising 119,630 kilometres of total track.

The first proposals for railway in India were made in Madras in 1832. The first train in India ran in 1837. first electric passenger train in India ran between Victoria terminus and Kurla. The re-organization of railways in India into regional zones began in 1951, when Southern Railway (14 April 1951), Central Railway (5 November 1951) and Western Railway (5 November 1951) were created. In 1952, it was decided to replace the existing rail networks by zones. A total of six zones came into being in 1952. As India developed its economy, almost all railway production units started to be built indigenously. The Railways began to electrify its lines to AC. On 6 September 2003 six further zones were made from existing zones for administration purpose and one more zone added in 2006. The Indian Railways has now seventeen zones including Kolkata Metro.

As a national common carrier transporting passenger and goods over its vast network, Indian Railways has always played a key role in India's social and economic development. It is a cheap and affordable means of transportation for millions of passengers. As a carrier of bulk freight ores and minerals, iron and steel, cement, mineral oils, food grains and fertilizers, containerized cargo etc., the importance of Indian Railways for agriculture, industry and the common man is well recognized.

IR, functioning as Ministry of Railways, is headed by the Minister for Railways. The apex body entrusted with the management of this mega enterprise is led by the Chairman, Railway Board as shown in the figure below (figure 6).

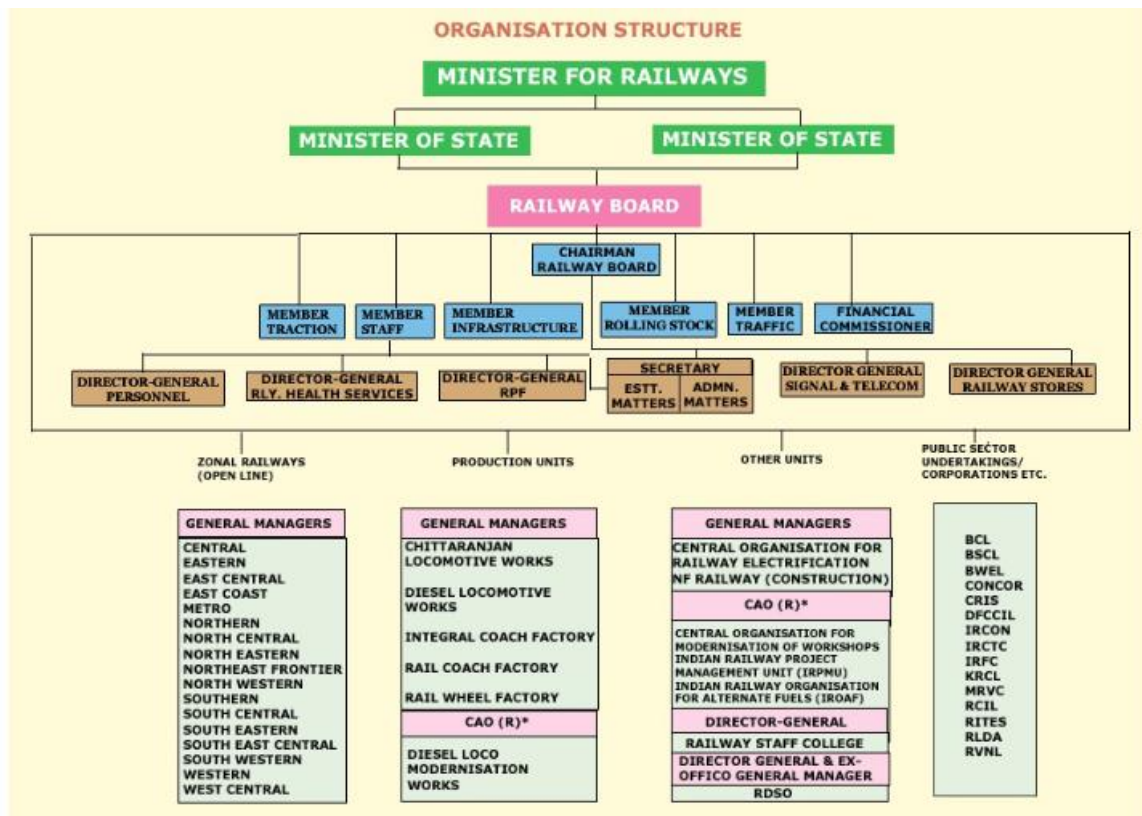


Figure 6: Organizational Structure of IR (source: Indian Railways)

Members of the Railway Board include Financial Commissioner, Member Traffic, Member Engineering, Member Rolling Stock, Member Traction and Member Staff who represent their respective functional domains. For administrative purposes and due to the consistent territory of the nation, IR is divided into 17 Zones, each headed by a General Manager. Zonal Railways are further divided into smaller operating units called Divisions. There are 68 Operating Divisions in IR at present, each under a Divisional Railway Manager. In addition, there are a number of Production Units, Training Establishments, Public Sector Enterprises and other Offices working under the control of Railway Board.

This act put into practice by the Indian railways has certainly given a shock to an important development of the network: the substantial territorial extension of the country would have made any general initiative develop by the Indian government dispersal and not conclusive while the current division into 17 zones makes efficient the projects put into practice in each area as they are aimed at solving the problems encountered in the same zone.

Nowadays the Indian railway network has the following characteristics:

Total Length	119.630 km
Standard Gauge (1.435 mm)	Only for some urban rail transit
Broad Gauge (1.676 mm)	108.500 km
Metre Gauge (1.000 mm)	3.715 km
Narrow Gauge (various)	1.935 km
Electrification	25 kV AC
Passengers per year	8224×10^6 passengers
High Speed Lines	No
N. employees	1331×10^3
Revenues per year	$1,64,333.51 \times 10^7$ INR (EUR= 21.700.986.592)
Costs per year	$1,47,835.93 \times 10^7$ INR (EUR= 19.522.406.201)
Trains per year	3960000
Goods per year	1101×10^6
Trains x km	$759,3 \times 10^6$
Passengers x km	1147190×10^6

Table 3: Characteristics of the Indian Railway System (source: Author's own elaboration)

India does not have any railway to be classified as high-speed line but India's Prime Minister approved the choice of Japan to build the first high speed line.

The nation has a huge territorial potential for a further increase of the network but unfortunately it has to deal with the economic difficulties that characterize it and also with the problems related to a technology and security systems not adapted to the world standard but for this issue the Indian Government has planned, in short time, investments in safety and security and on technological issues so as to improve its system.

According to the above mentioned characteristics of each Country, it is possible to define some parameters identifying the performance of each Railway System.

It is possible to define different classes of basic parameters such as technical productivity (e.g. Treni x km and employees as indices of the offer and passengers/year and passengers x km/year as indices of the demand) and economic productivity (e.g. revenues and costs) from which is possible to deduce other specific indices.

According to the available characteristics it is possible to calculate specific indices:

- Operative Margin: $(\text{Total Revenues} - \text{Total Costs}) / \text{Total Revenues}$
- Cost for unit of service: $\text{Total costs} / \text{Trains km}$

- Index of Technical Productivity: Trains km/ Employees
- Index of commercial productivity (1): Passengers/ Employees
- Index of commercial productivity (2): Passengers km/Employees
- Intensity of the service: Trains km/length of the network

The results are reported in table 4:

INDEX		POLAND	TURKEY	INDIA	REFERENCE VALUES
Operative Margin	(Total Revenues-Total Costs)/Total Revenues	1,7%	85%	10%	30%-90%
Cost for unit of service	Total Costs/trains km	€ 34,25	€ 22,89	€ 25,71	€ 20-€30
Index of technical productivity	Trains km/employees	7093,77	1415,09	570,47	10 ³ -8x10 ³
Index of commercial productivity (1)	Passengers/employees	12968,3	2612,28	6178,81	2,5x10 ³ -14x10 ³
Index of commercial productivity (2)	Passengers x km/employees	-	163163,23	861900,82	10 ⁵ -3x10 ⁵
Intensity of the service	Trains km/ length of the network	6831,76	3341,25	6347,07	3.000-10.000

Table 4: Indices for each country (source: Author's own elaboration)

In the table are represented the reference values as the range in which the results are considered acceptable for a good railway system.

In particular, this reference values come from a sector study developed by RINA and Italcertifer among different country in the world.

Considering the range of acceptance of each index it is possible to underline that the reform contributes to an improvement of the railway performance in Poland, Turkey and India.

Turkey is now a virtuous country from different point of views as the adequacy of the offer for the customers and the productivity both economic and commercial.

From UTK "Report of the Railway Market in Poland", Poland emerges as a country that is trying to increase the various aspects concerning the offered services and the quality but is not yet virtuous from an economic point of view.

As it is possible to deduce also from the figures below (Figures 7 and 8), the passenger service only in 2016 recorded an increase, even if slightly, of revenues compared to costs

and therefore, nowadays, its percentage operating margin is still very low while in the transport of goods the revenues are still lower than the costs.

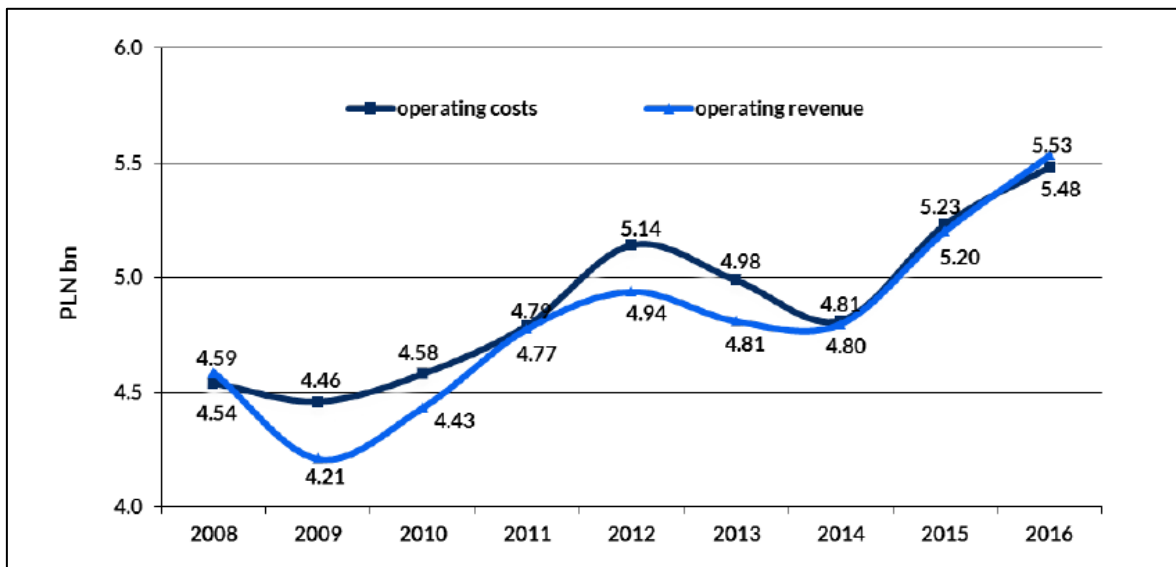


Figure 7: Revenues and Costs of Passenger transport in Poland (source: UTK)

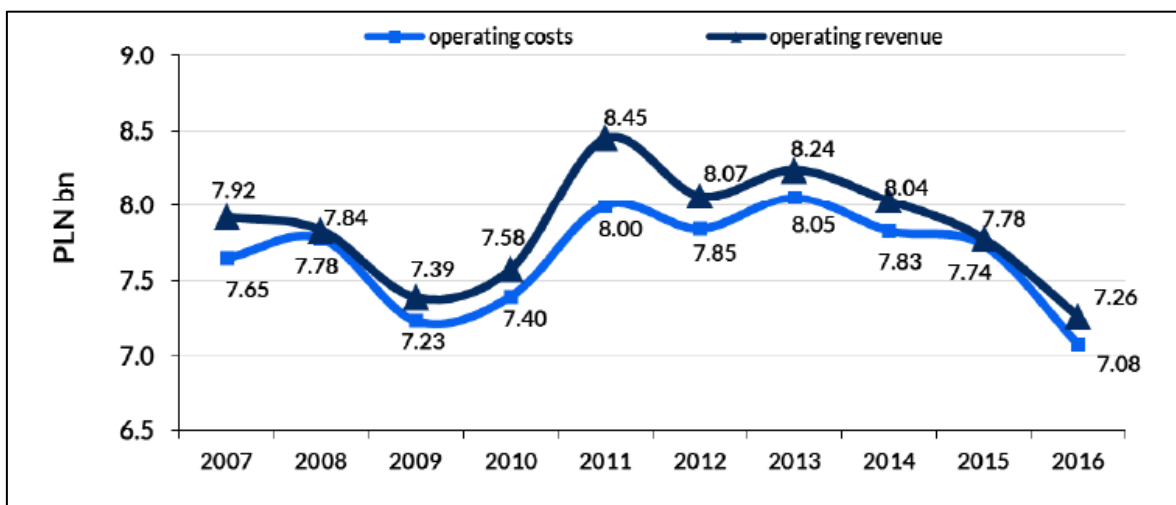


Figure 8: Revenues and Costs of Freight transport in Poland (source: UTK)

India is perhaps the country that is most suffering the transition period between the pre- and post-reform, but the obtained results concerning commercial productivity and intensity of service are hopeful for a positive development of the network.

The obtained results hope for a good but slow development of Polish and Indian networks and it is therefore clear that the idea of setting up a good and solid organizational structure for the Omani railway system is the starting point for a performing network.

6.2 The Italian railway system. Key issues

The Italian Railway System in 90's was involved in the Liberalization Process introducing the separation between the infrastructure manager and railway undertakings, the definition of safety conditions for the access to the market of railway services, the born of the Italian Authority for Safety Regulation (ANSF) and the interoperability of the European Railway System.

A. Government Bodies

Ministry of Infrastructure and Transports: According to this Process, The Railway Department of the Italian Ministry of Infrastructures and Transports (MIT) is well-structured in General Management for Railway Transport (Direzione Generale Trasporto Ferroviario-DGTF) and Office for Railway Services' Regulation (Ufficio Regolazione Servizi Ferroviari-URSF).

DGTF grants concession documents to the Infrastructure Manager and exercises the correspondent supervision, it establishes the access fee to the infrastructure, it grants licenses to Railway Undertakings and it supervises on ANSF.

URSF monitors the competitors and the competition degree of the services markets for railway transport, it takes part to cooperation activities, activities coordination in International setting for regulatory Organisms, it manages legal issues, it takes decisions related to railway undertakings and the infrastructure manager, it supports the MIT defining the guide lines of the railway sector.

The MIT states the activities to be realized and controls the utilization of public investments for projects' realization and maintenance of the railway; it defines the standards for interoperability and for European integrated railways, it monitors the observance of the rules for persons with reduced mobility, it pursues international issues as the definition of European standards, directives and participation in working groups for European Organisms.

Ministry of Economy and Finance: It controls Ferrovie dello Stato Italiane (FS Italiane) that is a government-owned holding company that manages infrastructure and services on the Italian rail network.

Other Ministries: Local Governments involved in the rail system.

B. Rail Operators, Railway Infrastructure Managers and Railway Related Services

The European Liberalization Process introduced the separation between the Infrastructure Manager and the Railway Undertakings; this Directive was also pursued in Italy introducing the reorganization of Ferrovie dello Stato Italiane (FS Italiane) in terms of working activities.

Infrastructure Manager: The Infrastructure's management was entrusted to Rete Ferroviaria Italiana (RFI) that is under control of the Ministry of Economy and Finance; RFI signed Utilization Contracts with different Railway Undertakings.

RFI has also the role to produce an informative document of the network (Prospetto Informativo della Rete-PIR) that has the function, in accordance to the Liberalization Process, to regulate the relationship between the Infrastructure manager and the railway undertakings.

Railway Undertakings: The Management of Passengers and goods is mainly under the control of Trenitalia, the Italian Public Railway Undertaking belonging to FS Italiane that is completely independent from RFI as stated in the Liberalization Process. Trenitalia as the others private railway undertakings, exercises activities of transport for goods and passengers once obtaining the licence, authorizations, the safety certificate and the utilization contract.

Independent Safety Assessor: Independent Safety Assessors (ISA) are Independent Inspection Bodies with specialized competencies in Railway systems and components and are accredited by ANSF to evaluate the conformity of a generic product, a generic application or a component to safety certification applicable requirements.

ANSF can attribute to the Independent Safety Assessor functions of conformity evaluation for systems and processes connected to the safety for movements; ANSF can issue certificates for generic products, generic applications or components after verifying the activities performed by the independent safety assessor.

The Agency is also responsible for accrediting independent safety assessors, ensuring compliance with specific requirements of competence, independence, impartiality and integrity set out in specific guidelines issued by itself.

The Agency has recognized as eligible for the performance of "Independent Safety Assessors" the Notified Bodies recognized by the Italian Ministry of Transport in accordance with European Railway Interoperability Directives 96/48 / EC and 2001/16 / EC as amended by the 2004 Directive / 50 / EC.

ANSF has recognized 6 Independent Safety Assessors:

- Bureau Veritas Italia S.p.A.
- IISCERT S.r.l.
- ISARail S.p.A.
- Italcertifer
- Rina Services S.p.A.
- CERTIFER Italia Srl

Notified Body: Notified Bodies(NoBo) are independent organisations responsible for assessing the conformity of interoperability constituents and subsystems regarding the requirements of the TSIs (Technical Specifications for Interoperability that mean the specifications by which each subsystem or part of subsystem is covered in order to meet the essential requirements and to ensure the interoperability of the European Community's high speed and conventional rail systems). They are the only recognised as third party carrying out the assessment of performance of construction products. Notified bodies are designated by EU countries; the European Commission ensures co-operation between them.

The tasks issued by notified bodies shall include:

- assessment of the performance of a construction product;
- certification of constancy of performance;
- factory production control certification.

These bodies carry out tasks related to conformity assessment procedures set out in the applicable legislation, when a third party is required.

Conformity assessment is the process carried out by the manufacturer of demonstrating whether specified requirements relating to a product have been fulfilled.

In the European Union harmonisation legislation, conformity assessment procedures cover both design and production phases of a product; those procedures are called “modules”. There are modules covering the design phase, the production phase or both. The main document on conformity assessment is the Decision No 768/2008/EC, which lays down the modules usable for all the regulated sectors. The specific nature of the regulated railway sector, needs a specific set of “modules” implementing the generic provisions; the specific railway modules are defined in the Decision 2010/713/EU. In most of the modules, there is the need to have a third party independent conformity assessment, performed by bodies notified by Member States to the Commission.

C. Authorities

National Safety Authority for Railway: In the Italian System, the Safety issue is completely entrusted to ANSF, the National Safety Authority for Railways. It fulfils regulatory, authorization and control tasks. It has the function to defined the standards concerning safety, it grants the Safety Certificate and it verifies the application of the dispositions issued to the infrastructure manager and the railway undertakings.

ANSF was instituted on the basis of the European Directive 2004/49/CE concerning Safety. The Ministry of Infrastructure and Transport supervises the ANSF activities that is technically independent from all the railway operators: it guarantees a non-discriminatory treatment to all the subjects related to the railway transportation.

ANSF shall fulfil the following main tasks:

- Defining the legislative framework for railway operational and technical aspects, cleaning-up the national safety and technical rules;
- Enforcing the adoption of regulations;
- Issuing the authorisation for placing in service of the structural subsystems and of the railway vehicles (according to the Interoperability Directive);
- Issuing the authorisation for placing in service of generic and specific applications and the authorisation for the use of generic products and constituents;
- Issuing Safety Certificates enabling railway undertakings to operate on the railway, as well as safety authorisations authorising infrastructure managers;
- Carrying-out studies, researches and analysis in the field of railway transport safety;
- Making proposals and observations concerning railway safety;
- Cooperation with the European Union Agency for Railways;
- Qualifying the Verificatori Indipendenti della Sicurezza-Independent Safety Assessors (VIS), the evaluation bodies.

Authority for Transport Regulation: is competent to regulation in the transport sector, to the access to infrastructures and to the connected services. In its competencies, we can find the definition of services quality levels and the minimum subjects of rights. It is an administrative independent authority, it is autonomous and work in conformity with the European regulation. In particular, for the railway sector, its roles are:

- Ensure, by incentive methodologies, the efficiency of production management and the containment of costs for users, companies and consumers, fair and non-discriminatory access conditions to railway, port, airport and highway infrastructure

and the mobility of passengers and goods at national, local and urban levels, also connected to stations, airports and ports;

- Determine, where deemed necessary in relation to the actual conditions of competition in the individual markets of national and local transport services, the criteria for fixing rates, charges and tolls;
- Establish the minimum quality conditions for national and local transport services with public service obligations, identified according to territorial demand and supply characteristics;
- To define, in relation to the different types of services and infrastructures, the minimum content of the specific rights, even of a nature of remedies, that users may demand from service providers and transport infrastructures;
- Carry out the functions of the regulatory body for access to the railway infrastructure, defining the criteria for the determination of tolls and for the assignment of routes and capacity and monitoring their correct application;
- In the railway sector, in accordance to the Ministry of Infrastructure and Transport, the regions and local authorities concerned, it has to define the area of interest of the public service on routes and financing arrangements. After an appropriate observation period, the Authority analyses the efficiency of the different degrees of separation between the infrastructure manager and the railway undertaking, in relation to the experience of the other EU Member States.

Also for the Omani Railway System it is possible to adopt a similar structure to improve the development of the sector, dividing tasks and responsibilities between all the actors.

Nowadays in Oman is existing a Ministry of Transport that must improve the Railway sector establishing an internal Railway team.

The first step for the country railway development was the institution of the Oman Rail that is a state-owned railway company born in 2014, responsible for rail transport in Oman. It is owned and operated by the Government of Oman through the Ministry of Transport and Communications. Oman does not currently have any rail infrastructure so Oman Rail will be responsible for developing the rail network in the country.

7 Development of the Project

7.1 *The SWOT ANALYSIS*

For a correct and effective scheduling of the elements to be implemented and to describe in a synthetic way the intrinsic characteristics of a project and the related context in which it will be applied, the SWOT analysis is used as a tool to identify important elements for the development of alternative strategies aimed at improving information sets thus reducing uncertainty.

This working method is accredited to Albert Humphrey who conducted a research project at Stanford University in the 1960s and 1970s. In the past, such technique was developed for defining business strategies in contexts characterized by uncertainty and strong competitiveness; starting from 1980s such an analysis was also used as decision support to public intervention choices based on alternative scenarios analyses.

The SWOT analysis takes into account the specific environment under study and highlights the internal factors to be discussed. It is graphically rendered by a 2x2 matrix that investigates the 4 hinges -respectively Strengths, Weaknesses, Opportunities, Threats composing the SWOT acronym. It is a technique with general validity because it can be applied to extended backgrounds as well as to business realities.

With the purpose of carrying out interventions on the territory, it can be a valid tool for analyzing the different economic, geographical, environmental and cultural aspects, allowing to identify the main strengths and weaknesses as well as opportunities and threats. It is a flexible tool since it can be applied to different research fields.

The first element needed to perform the SWOT analysis is the definition of the main target to be pursued; it must be explicit and approved by all participants involved in the analysis process. On the one hand, strengths and weaknesses are endogenous characteristics of the analysis, they are an integral part of the system, as well as relevant for the reference context and changeable thanks to specific interventions and policies. On the other hands, opportunities and threats are exogenous elements referred to the context under study; they are external to the system but they can condition it. Thus they are not changeable, it meaning that it is not possible to directly act on them but it is necessary to keep them under control in order to exploit the positive events and prevent the negative ones.

Moreover, strengths are the benefits and the excellence areas (tourist attraction, importance of a port system); Weaknesses arise from those sectors where high improvements are

expected (degradation of the local infrastructure network); opportunities are the benefits derived from planned changes (technological, quality of life, employment rate increase); threats and risks are the obstacles (excessive use of natural resources). The analysis presents limitations that constrain its application:

- It is not suitable for generating an organizational strategy but it identifies only key factors
- The factors identified in the four perspectives may be subject to the judgment of people
- The Analysis provides a static view of the reference context.

With the aim to develop the Omani Railway System, the SWOT analysis helps to identify the best approach for a performing system, the results to be achieved and the strategies to be pursued for the ultimate goal.

The objective is to pursue and propose a new transport policy that has as peculiarities the safety of citizens, energetic and environmental impacts (energy redevelopment, rational use of the land, limitation of emissions, containment of waste production), accessibility (availability of networks, accessibility and integration between the various modes of transport), effectiveness (system utility and quality of the supply), the viability of the land and quality of life. The protection of the environment is certainly one of the most fundamental aspects of public interest and shared at all levels; the ultimate goal is to reduce the risks for the environment (mainly linked to the impact of the infrastructure on it and to the emission of harmful substances) and to support energy choices with a lesser impact on the life cycle of vehicles and infrastructures. Modifying the current mobility model towards an innovative, "clean" and multimodal system imposes the introduction of more sustainable modes of transports characterized by low environmental impacts, improving air quality and limiting noise production.

The SWOT analysis enables to identify the peculiarities and potentialities of the current transport, environmental, economic and social systems that characterize the country to intercept the most appropriate way to achieve the ultimate goal.

As evidenced by the preliminary description of the Omani Reference Network, the areas of reflection, interest and substance in the Omani framework are the current transport system for people and goods (road, sea and air), the economic system and that of the available resources, the natural-environmental system and that of the productive activities.

The matrix of the SWOT analysis is related to the systems identified in the preliminary analysis of the Reference Network.

Strengths	Weaknesses
<ul style="list-style-type: none"> - Tourist attraction of the country's seaside resorts (e.g. the Salalah's seaside resort); - Strategic position of ports both on the Indian Ocean and on the Persian Gulf; - Strategic position compared to other countries of Arab culture; - Cruise ships 'tourist destination at various ports in the country: Al Wajajah, Matrah, Mina al Fahal, Sohar (on the Gulf of Oman) and Duqm, Mina' Raysut (on the Arabic Gulf); - Increasing trend in tourist demand and sufficient overall accommodation; - Tourist-cultural specialization of some areas; - Diversification of the tourist offer (bathing areas, desert areas, lush coastal plains and mountains); - Potentiality for the development of new activities and production systems such as agriculture (dates, cereals and vegetables), fisheries and industry; - No customs barriers on all consumer and industrial products; - Presence of airports with significant international traffic; 	<ul style="list-style-type: none"> - Inadequate development of agriculture and manufacturing activities; - Inadequacy of the services both for quality of life of rural populations and for the economic development of the same territories; - Absence of railway infrastructures; - Presence of morphological characteristics (desert areas) and meteorological (excessive heat) which are unfavourable to stability and safety; - Critical conditions for connecting the most important ports in the country; - Limited intermodality; - Infrastructure lacking between land transport networks and the port system, resulting in accessibility problems;
Opportunities	Threats
<ul style="list-style-type: none"> - Specialization in the cultural tourism of some sites and circuits inserted in international markets; - Increased in local demand for quality services, resource utilization and recreational and naturalistic uses, coupled with increased sensitivity to cultural heritage and traditions; - Increasing environmental sensitivity; - Reduction of transport related negative externalities - Development of the agricultural system; - Qualification of tourist reception services and higher incidence of quality tourism; - Attractiveness of cultural demand by existing tourism, attracted by other reasons (bathing); - Propose the country as a leader in the development of rail transport (in the Arab context); - Improvement of trips (travel quality, time, costs); - Implementation of intermodal meeting points for both people and goods; - Creation of new jobs; - Creation of mixed public-private partnerships to carry out large-scale transformation projects in the country's transport system; - Significant increase of port/airport transport sector; - Greater connections with the remote areas of the country and with the other States of the Arab peninsula; - Existing transport infrastructures modernization; - Commercial traffic Increase (country-bridge between the maritime trade of the Indian Ocean and the Mediterranean Sea) - Plans and investment projects for the completion of the GCC Railway Corridor; - Increase in freight transport throughout the Arab peninsula; 	<ul style="list-style-type: none"> - Increasing risk of infrastructure disruption due to the desert nature of the territory; - Lack of a background, even least, of experience in sectoral regulations on the rail transport; - Rejection of a transport mode not based on the oil, the most appreciated resource of the country; - Lack of awareness of institutions responsible for the protection of the system, due to total inexperience in the sector; - Absence of integrated projects; - Risk of destroying the present beauty of the desert landscape as a disadvantage for tourism; - collapse in auto industry sales, resulting in increased fuel costs; - Investors' tendency to focus on the nodes of large infrastructure networks, by overlooking the medium-size areas; - Delays in system development for bureaucratic problems; - Delays in developing the system for problems related to the other GCC countries; - Restricting infrastructure development related to problems for desert areas; - Slowdowns in construction related to the presence of desert areas; - Enhancement of the environmental load resulting from the construction of infrastructures, particularly in areas with high naturalistic-landscape sensitivity or environmental risk; - Excessive bureaucracy processes resulting in uncertainty of the implementation times and costs.

Table 5: Matrix of the SWOT Analysis (source: Author's own elaboration)

What results from the SWOT Analysis is an absolute feasibility of the initial project concept as well as the real and concrete possibility to develop an efficient rail system in Oman. In this framework, the analysis highlights many positive aspects related to the project also identifying the minor issues affecting the project respect to the many economic, social and environmental benefits that the railway development can bring to the country.

7.2 The development of the Oman railway system

In order to achieve the objective, it is the intention to firstly propose a general framework describing roles and relations of the different players; such approach will rely on the current state-of-art and best practices at both national level in Italy and Europe, based on the lessons learned and the return of experience coming from the direct involvement in projects and processes concerning safety and the identified various actors in charge of specific tasks and functionalities in the railway international system. According to the international practices and secondly, because of the organizational interacting chart, the project will collect information about the specific Oman situation and existing regulations among the various actors and more widely in the GCC Railway System, with the aim to customize and adapt roles and responsibilities of all these actors.

It is extremely important to tailor the processes to be established so as to exploit the current best practices and to be in line with international standards.

In the Railway market there are different actors, as indicatively presented in the figure below (figure 9).

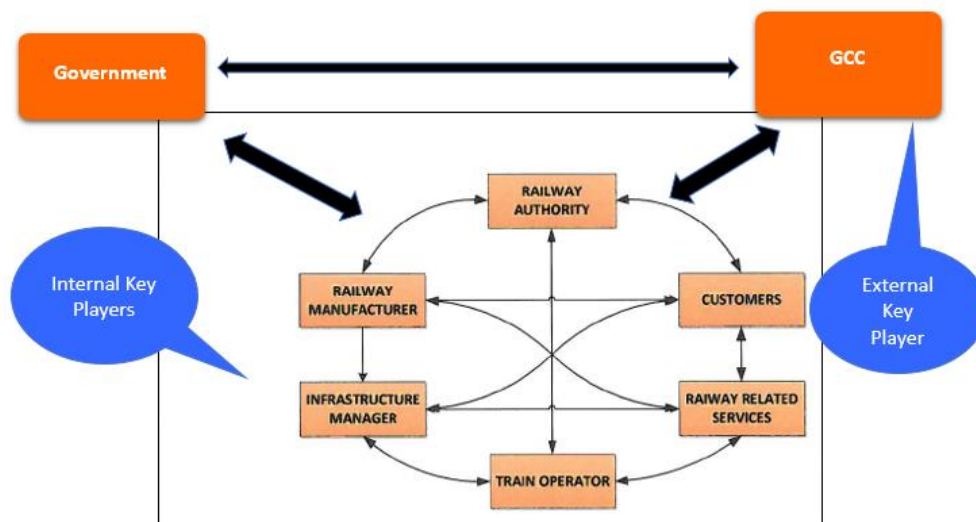


Figure 9: Predicted roles on the Railway Market (Author's own elaboration)

The regulation of the railway transport system should be defined through a “Railway Law” that embed and regulate the roles of all Players as part of the transport sector of the Country, organized as a business-oriented sector, regulated by rules which encourage competition, based on a legal and institutional framework promoting non-discriminatory policies for all modes of transport.

The key Players in a railway sector usually are:

- the Government;
- the Minister of Transport and other related Ministries;
- the Authorities for Safety and Regulation Affairs;
- Infrastructure Manager and the Railway Transport Operators;
- Railway manufacturers.

All of these Players can be traced to the following three main areas.

A. Government Bodies

Ministry of Finance: provides funding for rail infrastructure investments and maintenance to guarantee level and quality of the network. Also pays fees for the Public Service Obligations defined by law and the Contracts;

Ministry of Transport: addresses general transport policy and supervising rail activities; delivers licenses to railway undertakings; it is also part in the Service Contract with Infrastructure Manager and for Public Service Obligations.

Other Ministries: like Ministry of Interior, Ministry of Housing, local Governments involved in the rail system.

B. Authorities

Railway Authority for Safety and market regulation: Independent body. Main tasks are Issuing of Safety license, setting of Safety rules for infrastructure and train operation; conformity checks, carrying out the approval processes for systems, sub-systems and constituents; issuing of the safety authorizations to infrastructure managers, investigation, requirement definition for safety critical jobs, licenses data base. As rail market regulator, the main task is to ensure a fair and non-discriminatory access to the rail network and services. The Authority also monitor the competition in the rail services market.

In some Countries, this Authority is split in two separate Entities (like in some European Countries).

C. Rail Operators, Railway Infrastructure Managers and Railway Related Services

Infrastructure Manager: It owns the infrastructure and is responsible for designing, building and maintaining the infrastructure and develops the technology of systems and materials

Railway Undertakings: Provide passenger and freight transportation services, after having obtained a license, a safety certificate and after having entered into a 'Contract for utilization of the network with the infrastructure manager.

Each of the above Entities bears responsibilities according to the assigned role and exchange information with the others. The interdependencies between regulation, structure and competition of a railway system appear crucial to better determine which role the key players in a railway sector usually are entitled to play. This organization will provide:

- the list of procedures and regulations and contracts supporting the whole process;
- the timing of each event (who, what and when);
- a proposal of timeplan for the implementation of the whole process inside Oman Institutions.

It is of vital importance to have a close co-operation and exchange of information with the actors present in the GCC Railway System and in Oman, such as the MOTC, the Directorate General for Land Transport and Railway, so as to guarantee that there will be no overlaps and duplications of responsibilities/functionalities among different actors.

The above mentioned organization of a general railway system can be taken into account and proposed to MOTC to design and organize the Omani one; the general structure, the definition of roles and responsibilities represents the output of the fundamental topic of this study.

A basic Omani Railway Organization can be the following:

- GCC: GCC General Secretary, GCC Railway Authority- It has to grant an Interoperable and integrated system among the GCC States both for passengers and for goods;
- MOTC- It has to produce legislations to manage all the Omani modes of transport, to adopt international standards, promote management and supervision systems and it is responsible for licensing and audits;
- Railway Authority- It will be independent under the General Directorate for Land Transport and Railway; it is responsible for permits and approval, regulatory

framework, market monitoring, safety supervision and safety measures for accidents and incidents;

- Oman National Rail (Infrastructure Manager)
- Railway Undertakings- They will be private companies
- Railway related services- Public or private companies
- Other Ministries-Finance, Housing and Regional

This Railway Structure will be proposed to MOTC that can manage the main contents as an input to edit a Manual to be submit to all the entities involved in the system clarifying duties, responsibilities and professional partnerships among different institutions (e.g. the track access charges, Human Resources management plan, the Omani Railway Law).

7.2.1 Relationships between involved entities

The track access charge can be considered as an economic transition between the IM and the RUs: the IM make available the infrastructure capacity to Railway Undertakings which utilize such capacity for their transport of passenger and freight.

The track access charge can be seen whether as an element of the integration between IM and RUs and also as an economic unbundling between the Players.

In this context, Infrastructure capacity and access fee represents the economic transaction between IM that makes available rail capacity for transport and RUs that require capacity, paying for the paths assigned to them through the track access charge.

In Europe, the track access charge rationale has been defined through a regulatory framework that is the same for all Countries (EU 14/2001), but each Country with his own rail system developed specific access charge methodology having in common two basic elements of the algorithm: the type of line and the kind of rolling stock.

According to the above considerations, it is possible to develop the following activities:

1. Revise the track access charge international methodology focusing the approach on the Oman regulatory legal framework and organization;
2. Definition of the economic costs to be covered by the access charge in connection to the kind of contributions coming from State and from the market;
3. Definition of pricing targets;
4. Definition of the pricing factors involved in the identified algorithm;

5. Simulations and fine tuning of the model according to the traffic data available and forecasted.

To pursue the objective, it is possible to use a calculation tool that will be tested on the whole railway network, using train circulation data provided by MOTC. More precisely, such tool could be based on a process similar to the following:

- Collect historical and statistical data about transport costs, set up business plan data (future data) and collect transport policies (the inputs could be transport data and forecasts, financial data and forecasts, financial support from the Government, Business development and marketing, productivity improvement programmes);
- Evaluate direct costs, develop charging regime and set up or change accounting system to allow allocation to products based on Track Access Charges system;
- Test charging system (Target costing);
- Modify charging system in order to achieve target;
- Evaluate charging regime based on current figures.

It is possible to suggest to MOTC a specific tool for Track Access Simulation: in CIS (Charging Information System) is used RNE (Rail Net Europe) to calculate the track access charge and it is available for all European customers.

The Charging Information System (CIS) is an infrastructure charging information system for Applicants provided by Infrastructure Managers (IMs) and Allocation Bodies (ABs). The web-based application provides fast information on charges related to the use of European rail infrastructure and estimates the price for the use of international train paths within minutes. It is an application for the various national rail infrastructure charging systems.

At the moment CIS covers the network of 20 European Infrastructure Managers and is being enhanced continuously. Around 1600 users from all over Europe are making use of this advanced system with more than 200 routings per day.

CIS also uses a corridor-based approach. The user can choose one of the RNE Corridors and estimate the price for a particular route on the selected corridor. Additionally, the system provides the possibility to exclude some line sections on the route in order to find an alternative way across the railway infrastructure network.

CIS calculates charges for Train Paths, Station Use and Shunting.

RNE was set up in 2004 to help meet the challenges faced by the international rail sector; it has adopted the typical structure of an international organisation and its role is to provide

support as regards compliance with the European legal framework. This entails developing harmonised international business processes, templates, handbooks, and guidelines. RNE's mission is to help its Members meet the challenges of the rapidly-changing railway sector in Europe and to promote international rail traffic.

7.2.2 Human Resource Management Plan

This topic takes into account the possibility to develop a Human Resource Management Plan in line with the activities to be carried out by all the entities described in the previous paragraphs, according to their duties and responsibilities and in conformity with the existing laws and regulations.

The Plan includes:

1. Human resource policies and procedures;
2. Employee job description and requirements;
3. Job enhancement system and grade;
4. Employee classification and position grading;
5. Training and career development plan;
6. Personnel Policies, compensation and benefits;
7. Performance appraisal review;
8. Evaluation system.

This Plan has the aim to clarify the working position of each person, guaranteeing its rights and duties and also investing in its working growth.

7.2.3 Oman Railway Sector's Law

The Omani Railway Law will be structured in order to define the communication mechanisms, the responsibilities, the institutional, operational and financial relationships with the Government and will address as a minimum the following issues:

- Governance of the sector in terms of overall policy-making
- Safety management in rail
- Access to rail infrastructure
- Technical specifications and operating rules (development and issuing)
- The status of railway infrastructure and the ways for the infrastructure financing
- The roles of the State in the railway sector (as owner of railway infrastructure, client for transport services, regulator etc.)

- The roles of the Infrastructure Manager
- The roles of the Railway Undertakings
- Principles for licensing of railway operators
- Rules for regulation of competition in rail transport
- Principles for freight and passenger management
- Investigation of railway accidents
- Public service obligations

These are the essential topics that the legislative body must debate to define the guidelines to pursue for an efficient Railway System in terms of responsibilities of the governance, discussing the role of the IM and of the RUs as operational entities and of the State as supervisor and financier of the improving initiatives for an avantgarde system.

The laws will also discuss the operational modes for the RUs to access to the infrastructure limiting the conflicts, the competition and to not favour one operator from another, both for freight and for passenger transport.

To develop a successful and safety system is important to improve a regulatory framework stating the operational rules to prevent incidents and accidents.

In order to achieve the objective, it is intended to rely on the legal framework currently in place in Europe and at International level and get into contact with the relevant actors directly and indirectly impacted by the introduction of the Oman Railway Sector's Law, so as to identify their needs and identify the most suitable procedures and means to regulate the legal framework in Oman.

As mentioned above, it is useful to define the Italian Railway System to better understand its structure and the relationship between all the involved entities as an example to be pursue from the Omani MOTC.

7.3 Legal Framework of the Railway Authority

This section describes activities and procedures applicable to the role of the Railway Authority, as well as those related to Third Parties. Each procedure shall be clearly described and presented by using appropriate tools (e.g. flowcharts).

The proposed legal framework that is part of this second topic, will be prepared in close relation with the contents related to Organizational aspects of the Rail Authority

(Organizational Process Development and Organizational Structuring) with the aim to build a coherent and effective framework.

The activities of the Rail Authority can be divided in some main tasks that detail the description of the mission, the expected results, outputs or goals, the actions under the responsibility of the Rail Authority and the other interacting bodies or entities.

It is worth noting that the list of activities proposed includes also some critical tasks, as follows:

- a) check of RUs and IM rules and procedures;
- b) training and accreditation of safety staff;
- c) rules and procedures for Entities in Charge of Maintenance (ECM);
- d) power of sanctions.

All these activities belong to one of the possible governance model; it is proposed to show, analyse and compare different models based on the experience developed in Europe and worldwide, allowing MOTC to choose the most adequate model, also taking into account the general GCC framework.

Hereafter is described the list of the main responsibilities divided in main organizational Units. At each point can correspond a procedure to be issued by the Railway Authority that will be discuss in the paragraph “Organizational Structuring” in which is considered as example the point “National Safety Regulation”.

1 - National Safety Regulation

- 1.1 Elaborate, adopt and publish National Safety Targets;
- 1.2 Adopt and publish National Safety Regulation;
- 1.3 Follow-up coordination with other authorities;
- 1.4 Issue periodic and specific reports (especially annual reports to the Ministries).

National Safety Regulation is a State level safety rule. It sets safety targets and general principles.

The ways to reach targets and detailed safety rules are elaborated by RUs and IM (or other railway undertakings if ever).

2 - Safety certificates and licenses

- 2.1. Set and publish requirements for Safety Management System-SMS (including assistance to RUs and IM for elaborating their SMS);
- 2.2. Set and publish requirements for safety certificates for RUs and IM;
- 2.3. Set and publish requirements for licenses;
- 2.4. Deliver, renew or withdraw Safety Certificates (Includes setting and publishing procedures to deliver, renew, or withdraw safety certificates, and guidelines to candidates);
- 2.5. Deliver, renew or withdraw Licenses (Includes setting and publishing procedures to deliver, review or withdraw licenses and guidelines to candidates (if ever it is the intention of the MOTC to set such licenses));
- 2.6 Set and publish requirements for ECM's (Entities in Charge of Maintenance).

3 - Technical standards and authorisations

- 3.1 Define safety standards that shall be reviewed in the future according to the evolution of the techniques;
- 3.2 Ensure technical survey (In order to be able to review standards and regulation, Rail Authority shall ensure a technical survey in order to be aware of evolution of techniques and international standards);
- 3.3 Developing safety standards (Further or new standards will be adopted by Rail Authority but may be elaborated by RUs or IM);
- 3.4 Publish Standards and guidelines (Existing, and future standards have to be published to be accessible for RUs and IM, manufacturers, bidders, etc.);
- 3.5 Set and publish procedures to authorise putting into service of new or modified rolling stock or network subsystems;
- 3.6 Examine proposals for putting into service of structural or functional sub-systems, new constituents or spare parts;
- 3.7 Authorise putting into service of new or modified rolling stock or equipment.

4 – RUs and IM Rules and procedures

- 4.1. Check the assessment reports produced by a third-party Assessment Body concerning the compliance of the rules elaborated by RUs and IM to safety targets and principles set by national safety regulations;

4.2. Risk Assessment: Transport operators should perform a specific duty to carry out a “suitable and sufficient” assessment of the safety risks involved in running the transport system. The purpose of this assessment is to identify the measures needed to make sure the transport system runs safely. Must be put in place any measures identified by the risk assessment, and make arrangements for planning, organising, controlling, monitoring and reviewing these measures.

5 - Monitoring, Inspections, Audits and Follow-Up

- 5.1. Monitor and follow-up enforcement by inspection;
- 5.2. Monitor and follow-up enforcement by audits (including for instance enforcement of National safety regulation, implementation and efficiency of SMS, compliance with rules and procedures, accreditation of staff, checks that equipment is operated and maintained according to the rules and checks on conformity of constituents and spare parts);
- 5.3. Monitor overall safety level;
- 5.4. Review and approve corrective actions decided by RUs and IM and approve implementation timelines (either after accidents, AIB recommendations, or on RUs/IM own initiative);
- 5.5. Control of the results and efficiency of corrective actions.

6 - Training and accreditation of safety staff

- 6.1 Set training and accreditation requirements for safety critical staff;
- 6.2. Approve RUs and IM training programmes on safety;
- 6.3 Qualifying and training inspectors (the said inspectors are Rail Authority’s own ones);
- 6.4 Receive and analyse annual report on training.

7 - Power of sanctions

- 7.1. Recording violations;
- 7.2. Issue warning and setting restrictions.

8 - Accidents and incidents

- 8.1. Analyse accident reports and data from RUs and IM;
- 8.2. Investigate accidents, incidents or near misses and elaborate findings;
- 8.3. Issue accident reports;

- 8.4. Provide assistance to AIB if requested;
- 8.5. Analyse accident reports from AIB and ensure follow up of recommendations
- 8.6 Elaboration of requirements for security including emergency plans in co-ordination with other Authorities

9 – Quality and Market regulation

- 9.1 Ensure a fair and not discriminatory access to the rail infrastructure by different railway Operators acting as competitors in the market;
- 9.2 Definition of criteria for the infrastructure charge to be paid for such access by the railway Operator to the infrastructure;
- 9.3 Definition of principles regarding the development and issuance of railway standards (quality levels, Customer care);
- 9.4 Definition of criteria for tariffs, charges and enforcement policies in railway regulation;
- 9.5 Cooperate with Public Administration (PA) in identifying Public service obligation routes and support it in identifying the most effective methods to finance them.

Concerning the market monitoring, the main task of the Rail Authority is to ensure a fair and non-discriminatory access to the rail network and services and also monitor the competition in the rail services market.

Moreover, the Rail Authority can also contribute to establish a more stable, clear and transparent regulatory framework.

If it is assumed to assign the responsibility and competence for all transport modes, it will define a better level of intermodal competition, favouring the development of the more sustainable ones, guaranteeing equitable and non-discriminatory access to rail, port, airport and highway infrastructures and defining criteria for setting tariffs, fees and tolls linked to the minimum quality levels for national and local transport considered to be a public service. The Rail Authority can also define public tender mechanisms to assign transport services and criteria for appointing tender commissions' members.

It is also intention to identify the main OUs (Organizational Units) of the Rail Authority; an example of OUs is shown in the following flowchart (figure 10) and in the following table 6.

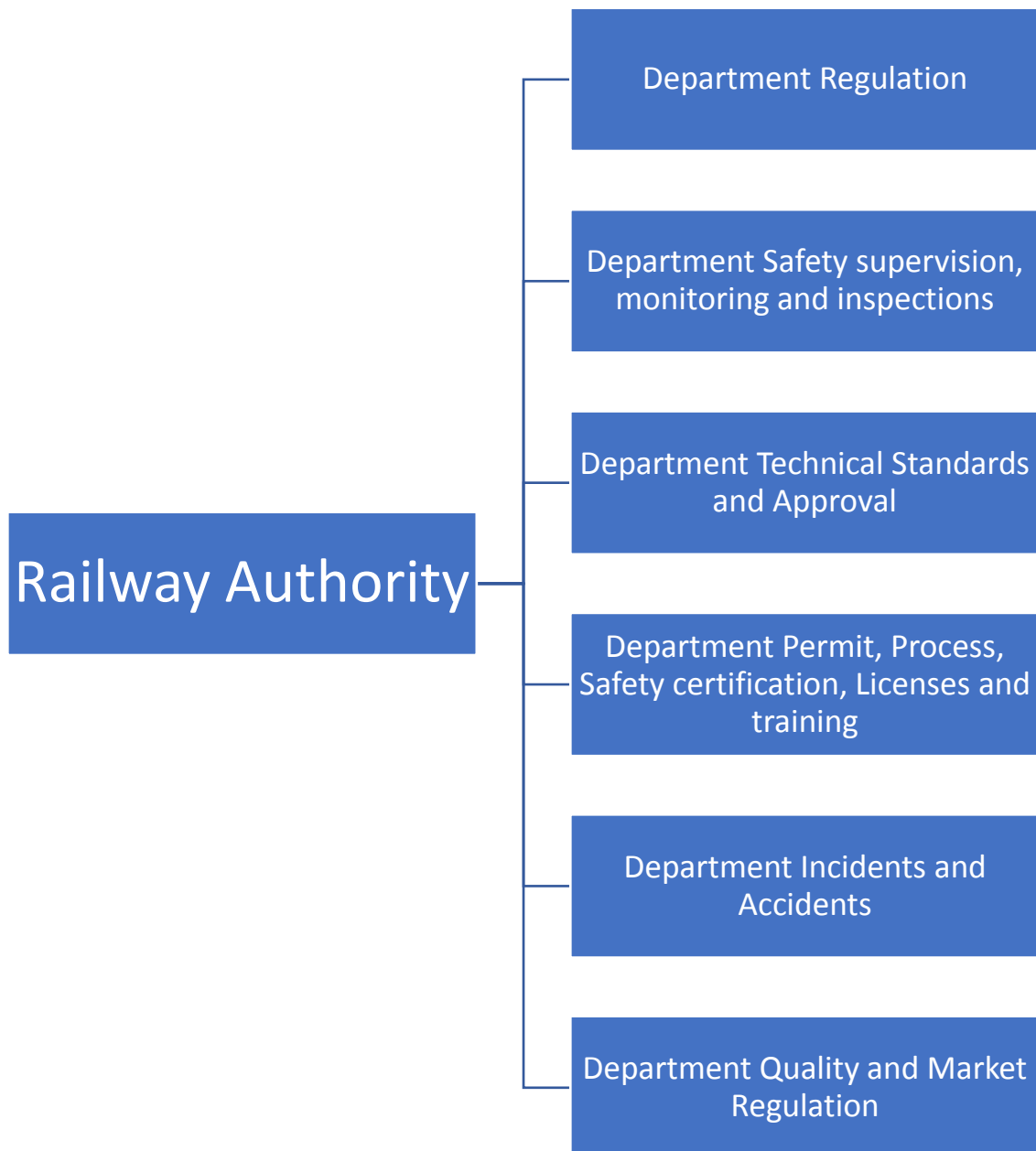


Figure 10: Organizational Units of the Railway Authority (Author's own elaboration)

Organizational Unit proposed	Assigned tasks
Department Regulation	1 - National Safety Regulation <i>(Regulation, Register and statistics, Organisational interactions)</i>
Department Safety supervision, monitoring and Inspections	5 - Monitoring, inspections, audits and follow-up 7 - Power of sanctions <i>(Safety supervision)</i>
Department Technical Standards and Approval	3 - Technical standards and authorisations <i>(Approval)</i>
Department Permit, process, safety certification, licenses and training	2 - Safety certificates and licenses 4 – RUs and IM Rules and procedures 6 - Training and accreditation of safety staff <i>(Permit process)</i>
Department Incidents and Accidents	8 – Accidents and incidents <i>(Accidents and incidents)</i>
Department Quality and Market Regulation	9 – Quality and Market regulation <i>(Market monitoring, Market supervision)</i>

Table 6: Assigned tasks of the different Organizational Units (Author's own elaboration)

Some further methodological explanations are given below.

7.3.1 Regulation

Focusing the attention on the “Regulation” task assigned to the Railway Authority, it is relevant to define a straightforward process that will allow the Railway Authority to meet the challenging objective to have a clear regulatory framework, guarantying the compliance with the Government’s transport policy objectives. In order to be sure that all these objectives are taken into account during the elaboration of a regulation and that any regulation does not cause privileges to any actor, a structured process shall be defined.

7.3.2 *Safety supervision and Risk Management Process*

It is important to highlight some methodological notes related to two fundamental concepts: the Safety Management System (SMS) and the risk management.

The purpose of the SMS is to ensure that the organisation achieves its business objectives in a safe manner. These objectives need to be fulfilled in today's ever changing and complex railway environment. In addition, the SMS should ensure that the organisation complies with all of the safety obligations that apply to it.

It is considered an added value to propose the adoption of the concept of Safety Management System, as prescribed by EU Directives, and taking into consideration the Oman and GCC context. Such Directives in Europe clearly state that the responsibility for safe operation is with the railway undertakings (RUs) and infrastructure managers (IMs) and, to fulfil this responsibility, it requires that they establish a safety management system (SMS).

European regulations contain the framework principles for assessing an SMS, the criteria to be used for this assessment and principles for supervision after the award of Safety certificates or authorisations.

Concerning the risk management, the purpose is the adaptation to the Oman and GCC context of a Common Safety Method (CSM) on risk evaluation and assessment as referred to in EU Directive 2004/49/EC.

CSM shall improve the reliability and effectiveness of a rail transport services through harmonisation of:

- a) the risk management processes used to assess the safety levels and the compliance with safety requirements;
- b) the exchange of safety-relevant information between different actors within the rail sector in order to manage safety across the different interfaces which may exist within this sector;
- c) the evidence resulting from the application of a risk management process.

In case of a significant change of the context, it is possible to apply the process described in the figure below (figure 11), that will be consequently subject to an Independent Assessment by an Assessment Body, to check its correct application and the results of this application.

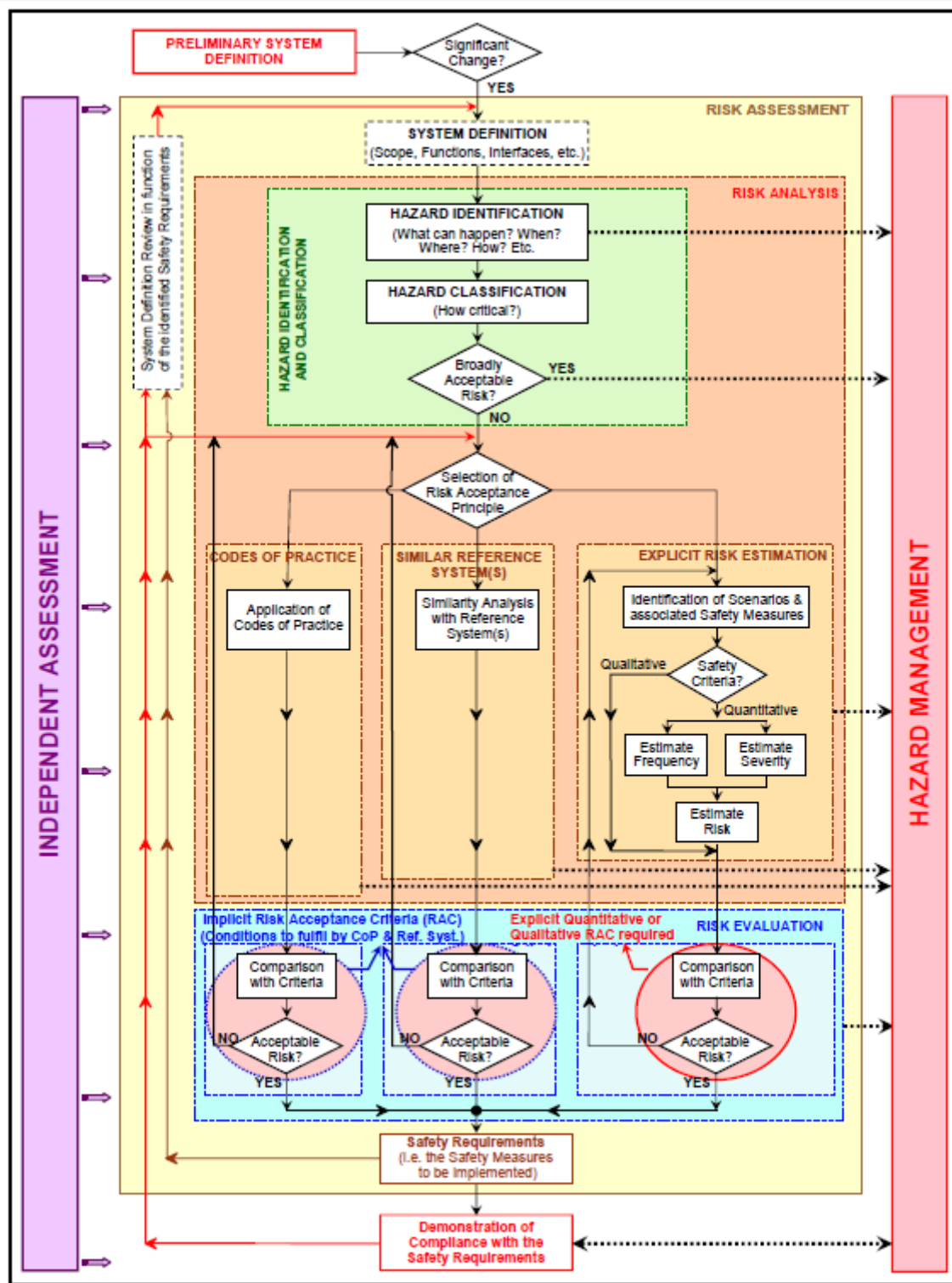


Figure 11: Risk management framework in the CSM UE Regulation 402/2013
(source: European Railway Agency)

A typical iterative risk Management Process is structured around the following three main steps:

- Systematic identification of the hazards, based on the definition of the system under assessment, of the associated safety measures and of the resulting safety requirements;
- Risk Analysis and Risk Evaluation;
- Demonstration of the system compliance with the identified safety requirements.

In addition to these classical steps, the following ones are specified in the CSM process, mainly to enable the mutual recognition of results from such risk assessment:

- Hazard Management documentation using hazard records;
- Independent Assessment by an assessment body of the correct application of the overall CSM process.

The Risk Analysis consists of the estimation of the frequency of accidental events and their respective consequences. The frequency of the accidental events may be estimated based on historical data of previous incidents, fault tree analysis or expert judgement.

The consequence analysis identifies both immediate consequences on those that are not apparent until sometime after the accidental event.

Preliminary system definition

In order to assess whether the change is significant or not, it is important to conduct a preliminary system definition that should give a clear statement on what is being changed and the scope of the change.

System definition

The risk management process starts with the system definition; this provides the key details of the system that is being changed - its purpose, functions, interfaces and the existing safety measures that apply to it. In most cases, the hazards which need to be analysed will exist at the boundary of the system with its environment.

The definition is not static and during iterations of the risk management process, it should be reviewed and updated with the additional safety requirements that are identified by the risk analysis. It therefore describes the condition (or expected condition) of the system before the change, during the change and after the change.

The system definition may change due to factors other than the specification of safety requirements, such as changes in scope, changes in client requirements, increasing design definition and implementation of changes proposed by contractors and suppliers.

Such changes may necessitate iteration of the risk management process.

Equally, changes to the system definition for other reasons may require the proposer to repeat all or part of the process and discuss with the assessment body the implications.

The risk management process states that the system definition should address at least the following issues:

- system objective, e.g. intended purpose;
- system functions and elements, where relevant (including e.g. human, technical and operational elements);
- system boundary including other interacting systems;
- physical (i.e. interacting systems) and functional (i.e. functional input and output) interfaces;
- system environment (e.g. energy and thermal flow, shocks, vibrations, electromagnetic interference, operational use);
- existing safety measures and, after iterations, definition of the safety requirements identified by the risk assessment process;
- assumptions which shall determine the limits for the risk assessment.

Hazard Identification

The purpose of the hazard identification is to identify all reasonably foreseeable hazards.

The hazard identification should be systematic and structured, which means taking into account factors such as

- the boundary of the system and its interactions with the environment;
- the system's modes of operation (i.e. normal/degraded/emergency);
- the system life cycle including maintenance;
- the circumstances of operation (e.g. freight-only line, tunnel, bridge, etc.);
- human factors;
- environmental conditions; and
- relevant and foreseeable system failure modes.

Whichever technique is used, it is important to have the right mixture of experience and competence while maintaining impartiality and objectivity. Correct hazard identification will underpin the whole risk management process and give assurance

that the risks will be managed in the project.

The level of detail of the hazard identification depends on the system that is being assessed and needs to be sufficient to ensure that relevant safety measures can be identified. If, following a high-level hazard identification, it can be successfully demonstrated that a hazard can be controlled by application of one of the three risk acceptance principles required by the risk management process, then no further hazard identification is necessary.

The purpose of risk analyses and evaluation is to identify those safety requirements and measures that are necessary to control the risks arising from the identified hazards.

Risk acceptance principles

Hazards can be analysed and evaluated using one or more of the following risk acceptance principles:

- the application of codes of practice;
- a comparison with similar systems (reference systems); or
- an explicit risk estimation.

Individual hazards can be closed out by the application of one of the three principles but it is likely that, for most major projects, a combination of all three will be used.

Any risk assessment conducted under the CSM RA should always be proportionate to the extent of the risk being assessed.

The CSM RA has been introduced to ensure that levels of safety are maintained or improved when and where necessary and reasonably practicable, in accordance with the requirements of the Railway Safety Directive (2004/49/EC). Applying one or more of the three risk acceptance principles correctly for all identified hazards means that the risk has been reduced to an acceptable level.

Codes of Practice

Standards and rules have to meet all the criteria to be used as a code of practice for the risk management process such as to be available to an assessment body so that it can:

- assess the suitability of the how the CSM RA is applied and the results of applying it;
- mutually recognise any safety assessment report on the same system.

Standards and rules that are widely accepted in the railway sector include

- TSIs or other mandatory European standards, for example those used in other EC verifications;
- notified national safety rules;

- notified national technical rules;
- Euro standards or ISO standards.

Deviations from codes of practice are possible where the proposer can demonstrate that at least the same level of safety will be achieved. Mandatory standards such as TSIs and Railway Group Standards include a process for deviating from them.

Most non-mandatory standards do not have a process for deviating from them. If one or more conditions of the code of practice are not fulfilled, the proposer may have to conduct an explicit risk estimation on those hazards where the code of practice is not relevant for the control of the hazards in the system under assessment.

Reference Systems

Reference systems can be used to derive the safety requirements for the new or changed system. For an existing system to be used as a reference system, is necessary to demonstrate that:

- it has been proven in use and has an acceptable safety level;
- it is accepted in the Member State where the change is to be introduced;
- the system being assessed is used under similar functional, operational and environmental conditions and has similar interfaces as the reference system.

Explicit Risk Estimation

Explicit risk estimation is an assessment of the risks associated with hazard(s), where risk is defined as a combination of the rate of the occurrence of the hazard or hazardous event causing harm (the frequency) and the degree of severity of the harm (the consequence).

The estimation can be qualitative, semi-quantitative or quantitative. The choice will be determined by factors such as the availability of quantitative data and confidence in such data. Any analysis should be proportionated to the potential risks. Any risk assessment should follow a systematic and structured process.

The CSM RA does not impose any specific tools and techniques to be used in an explicit risk estimation.

Hazard Record

The proposer has to create and maintain a hazard record for the system (or part system) that is to be changed. Its purpose is to track progress of the risk assessment and risk management process for the project. The CSM RA requires that it contains certain information but does not mandate any particular format.

The hazard record should concentrate on key issues. To aid transparency and consistency, it needs to contain the safety measures relating to the identified hazards and the assumptions taken into account in the definition of the system. It needs to include details of the risk assessment principles used and the actors in charge of controlling each hazard.

The CSM RA places some minimum requirements on proposers to document certain information to assist the assessment body. These are

- a description of the organisation and the experts appointed to carry out the risk assessment process;
- the results of the different phases of the risk assessment and a list of all the necessary safety requirements to be fulfilled in order to control the risk to an acceptable level;
- evidence of compliance with all the necessary safety requirements; and
- all assumptions relevant for system integration, operation or maintenance, which were made during system definition, design and risk assessment.

Demonstration of System compliance

The demonstration of compliance can involve further activities including causal analyses, testing, etc. It is also possible that new hazards may be identified during the validation phase which will need to be analysed further. Where a non-compliance with safety requirements is discovered, then the proposer must be notified. The proposer must then further notify others who are affected and responsible for the same or similar subsystems so that they can take the appropriate action.

Independent Assessment

The CSM RA requires an independent assessment of

- how the risk management process is applied; and
- the results from the risk management process.

An Assessment Body must carry out the independent assessment.

7.3.3 *Quality supervision task*

Concerning Quality supervision, it is important to consider the Development of a Quality Management System compliant with the ISO 9001-2015 standard.

This means the definition of:

- objectives at various levels of IM and RUs for the maintenance and improvement of products quality, services and operations quality and responsibility to achieve these objectives;

- quality policies issued by Management and applied to all IM and RUs staff;
- duties and responsibilities for the correct definition and availability of the necessary resources to provide the quality required by all Entities involved;
- practices and procedures for carrying out periodical check of quality management system with the definition of input-output process indicators;
- definition of best practices and assigned responsibilities to guarantee IM and RUs internal effectiveness communication and towards the Customers for products/services and contract management, Customer satisfaction and claims collection;
- definition of best practices and assigned responsibilities for the documentation of quality management system;
- operational procedures system inside IM and RUs, with definition of ways and responsibilities to ensure the efficient provision of IM and RUs products and services in order to guarantee the determined quality standards and the achievement of set objectives. Such procedures regard the design, provision, realization of products and provision of services, control of fixtures, equipment and the necessary measuring instruments, transport, movement and conservation of products.

7.3.4 Accidents and incidents

Concerning accidents and incidents and the achievement of the objectives, it is important to take advantage of the lessons learned in the latest decades concerning the collection of information about these topics in Europe and to avoid problems that still represent a bottleneck in the analysis of the number of accidents and incidents at European level.

In fact, the current legislative framework in Europe does not require Member States to collect information on all railway occurrences, that are typically limited to significant accidents, shared through a register of investigated accidents. The information about less serious accidents and incidents and/or near misses are not systematically collected at the EU level.

The European Railway Agency has been registering the information about occurrences (accidents and incidents) investigated by the National Investigation Bodies (NIBs), in accordance with Railway Safety Directives, through the European Railway Agency Database of Interoperability and Safety (ERADIS) and ERAIL-REP (European Railway Accident Information Links) databases, that will be taken into account as an input for the definition of the best practices to be adopted for this task in the Oman.

In addition to this, the ‘leading practices’ for incident analysis are taken into account as part of previous ERA projects:

- ERA/2009/SAF/NP/02 – Review of Accident Investigation Methodologies,
- ERA/2010/SAF/NP/03 - Designing a Framework and Specifying Modules for the European-Wide Training of Railway Accident Investigators
- ERA/2011/SAF/NP/02 - Facilitating the use of new approaches in accident investigation by NIBs

As a result of all the information collected, the MOTC will be provided with a structured and well-defined process for the management of accidents and incidents reporting, making it feasible to elaborate intelligence from accidents and incidents, that will also drive the safety supervision task of the Authority.

7.3.5 Approval

In addition to this, the MOTC will be provided with an overview of the authorization to put into service process in several EU Member States and with the various technical solutions, procedures and processes adopted in various EU Member States, so as to give MOTC the possibility to select those that best fit its needs in Oman.

The definition of specific roles currently present in the European railway system will be proposed for the railway domain in Oman, aimed at supporting the Railway Authority in the execution of its tasks (e.g. the Independent Safety Assessor). In particular, on the basis of public and well-defined criteria applicable to the organization, personnel and instruments used by the staff, the Railway Authority will qualify organizations that will operate in the railway domain, assessing the technical dossiers, safety-related procedures and processes and any other aspect defined in ad-hoc guidelines, so as to provide the Applicant with an assessment report that will be then analysed by the Railway Authority in order to issue the approval (known as Authorization to Put Into Service).

It is also important to consider in the analysis the fact that there is a harmonized process within the GCC and another one, applicable at national level, used for subsystems that are based on national rules, such as metros and tramway systems and national constituents and subsystems for which there are no GCC regulations in force.

As stated, also station names and education plans that are part of the Safety Management System that all railway companies shall establish will be subject to an approval by MOTC,

as well as any other aspect that will have a direct and/or indirect impact on safety in the railway domain. To this regard, in addition to the approval of the education plans established by all railway companies, it is suggested to introduce the concept of Competence Management Centres, that are in charge of providing training on specific railway safety-related topics, such as infrastructure maintenance, rolling stock maintenance, traffic management.

Such Centres will be authorized by the Railway Authority on the basis of their compliance with requirements and procedures defined in a specific document to be issued by the Railway Authority and subject to inspections and audits by the Railway Authority representatives on regular basis. An official register of all the Centres, with a clear indication of the services that they provide, will be made available.

7.3.6 *Permit process task*

Concerning the Permit process that will be implemented by the Railway Authority, granting licenses, certificates or authorizations to persons and/or legal entities with public service or commercial interest for rail traffic services and/or holding railway infrastructure, the strategy suggested is to provide the MOTC with the list of all the cases requiring a permit according to the procedures above mentioned.

Another permit (in the form of a license) shall be issued to train drivers and critical staff, after having completed and passed the required training courses.

A permit shall be granted also to the Assessors that support the Railway Authority in the permit process, assessing the technical dossier, procedures and processes, management of risks and Safety Management System in general put in place by the Applicant requesting the authorization.

7.3.7 *Market monitoring*

Concerning the market monitoring, the main task of the Rail Authority is to ensure a fair and non-discriminatory access to the rail network and services and also monitor the competition in the rail services market.

Moreover, the Rail Authority could also contribute to establish a more stable, clear and transparent regulatory framework.

If it is assumed to assign the responsibility and competence for all transport modes, it will define a better level of intermodal competition, favouring the development of the more sustainable ones, guaranteeing equitable and non-discriminatory access to rail, port, airport and highway infrastructures and defining criteria for setting tariffs, fees and tolls linked to the minimum quality levels for national and local transport considered to be a public service. The Rail Authority can also define public tender mechanisms to assign transport services and criteria for appointing tender commissions' members.

7.3.8 Registers and statistics management

The neutral role in the railway market of the Railway Authority makes it the most suitable entity in charge of coordinating statistic figures and holding registers.

Another topic for which the definition of a register is crucial is represented by the accidents and incidents.

It is important to analyse not only the required registers present at national level, but also those managed by the European Railway Agency, so as to provide MOTC with the best practices and state-of-the-art in the EU railway system.

The definition of these registers will pave the way for an important task to be carried out by the Railway Authority: the elaboration of statistic figures.

In fact, the European Union collects Common Safety Indicators (CSIs) across Member States. CSIs are a common set of rail safety data, gathered to facilitate the assessment of achievement of Common Safety Targets (CSTs) and monitor the development of safety in Member States.

CSIs are based on common definitions and calculation method; the data set is structured as follows:

- Significant accidents (Figure 12);
- Deaths and serious injuries;
- Suicides;
- Precursors of accidents;
- Economic impact of accidents;
- Technical aspects (level crossings by type and automatic train protection systems);
- Management of safety.

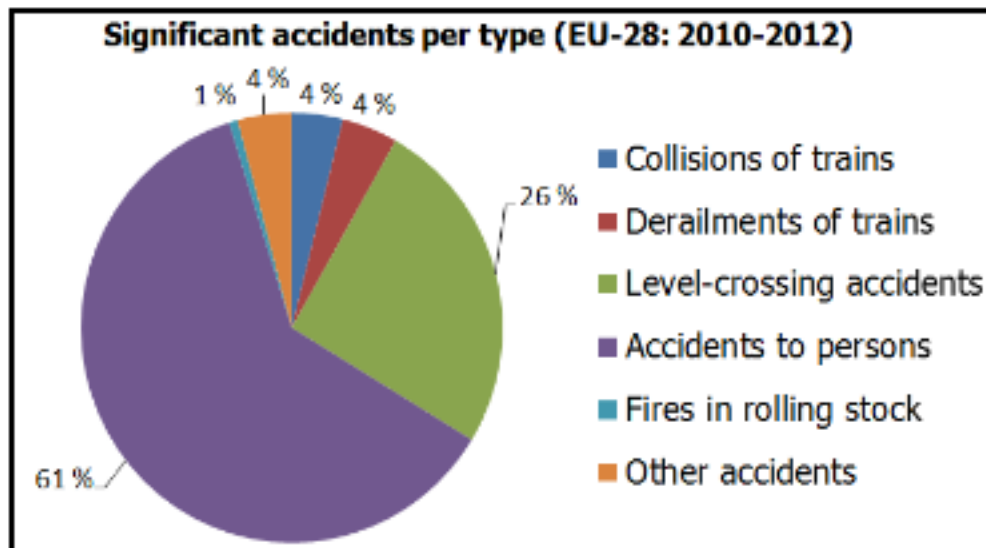


Figure 12: Significant accidents per type (source: European Union)

This information supports Member States in understanding their safety performance and considering sustainability issues during decision making. ERA has developed guidance for CSIs, where explanations, examples and fall-back values are provided.

It is useful to underline safety indicators, databases, registers and any other tool defined at European level (European Railway Agency).

The characterization of the main Departments constituting a Railway Authority and the dedicated assignments and responsibilities outline the structure of the Omani Authority according to International best practices.

According to the EU Directive 2004/49/EC; each Member State shall establish a safety authority that may be the Ministry responsible for transport matters and shall be independent in its organization, legal structure and decision making from any railway undertaking, infrastructure manager, applicant and procurement entity; the safety authority shall authorize the placing in service of the structural subsystems the rail system in accordance with Article 15 of the Railway Interoperability Directive and checking that they are operated and maintained in accordance with the relevant essential requirements; the Railway Authority must have regulatory functions, responsibility, perimeter of action, registers, databases and data format.

In particular the Manual shall cover:

- Definitions of all terms to be used for the scope of service
- Authorization System

- Licensing and certification requirements and procedures (infrastructure manager, railway operator, any other third party)
- Certificate templates for rolling stock certification
- Certificate templates for Railway Operators certification
- License template for licensing the infrastructure manager
- Guidelines and processes/procedures for certification/put in service of infrastructure and rolling stock
- Requirements for a Safety Management System
- Train driver license
- Safety Supervision
- Quality Supervision
- Safety Indicators and targets
- Reporting of incidents
- Accidents investigation
- Report templates for all reports to be elaborated by the Railway Authority. Infrastructure Manager, Railway Operator, the Accident Investigators and any other third party
- Infrastructure register (parameters needed for the tasks of the Railway Authority, register structure, data format)
- Vehicle register (vehicle parameters)
- Requirements for Security Plans including requirements for Emergency Plans (taking into account Royal Oman Police and other Authorities requirements)
- Statistics (method to collect and evaluate data from third parties and develop Key Performance Indicators for monitoring safety, quality and other parameters)

It is possible to summarize functions and tasks of each Organizational Unit in the following flowcharts (figures 13, 14, 15, 16, 17, 18).

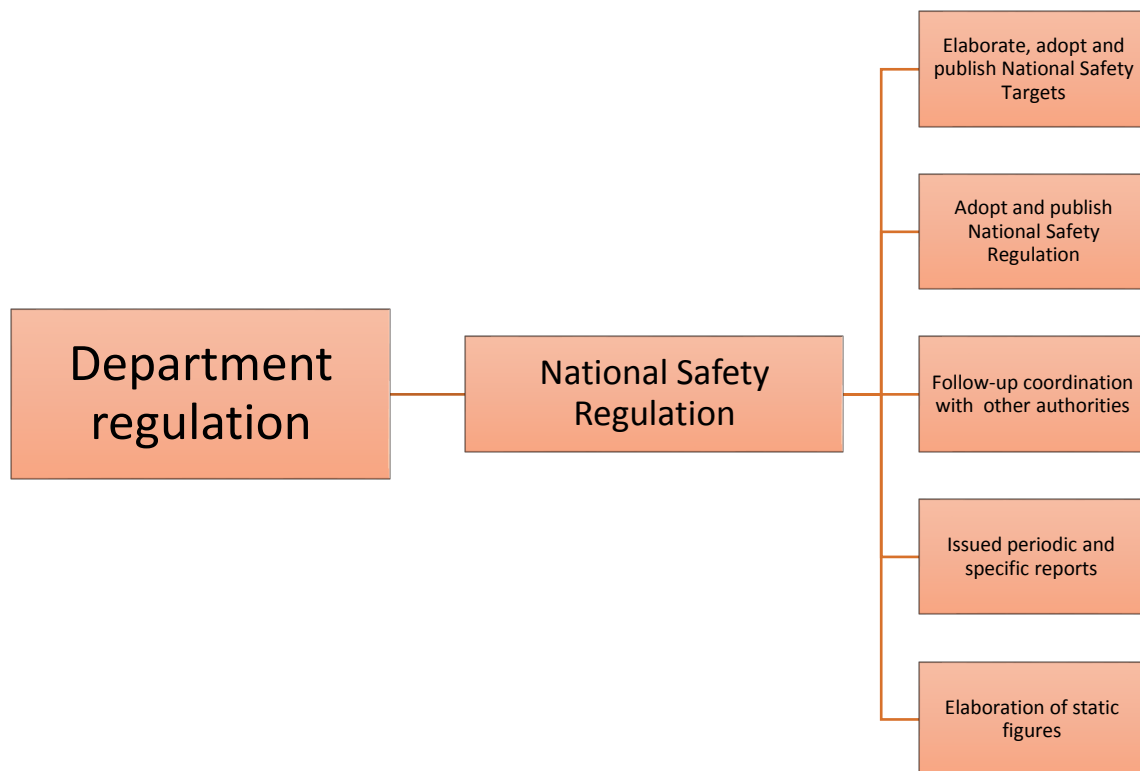


Figure 13: Flowchart Department Regulation (source: Author's own elaboration)

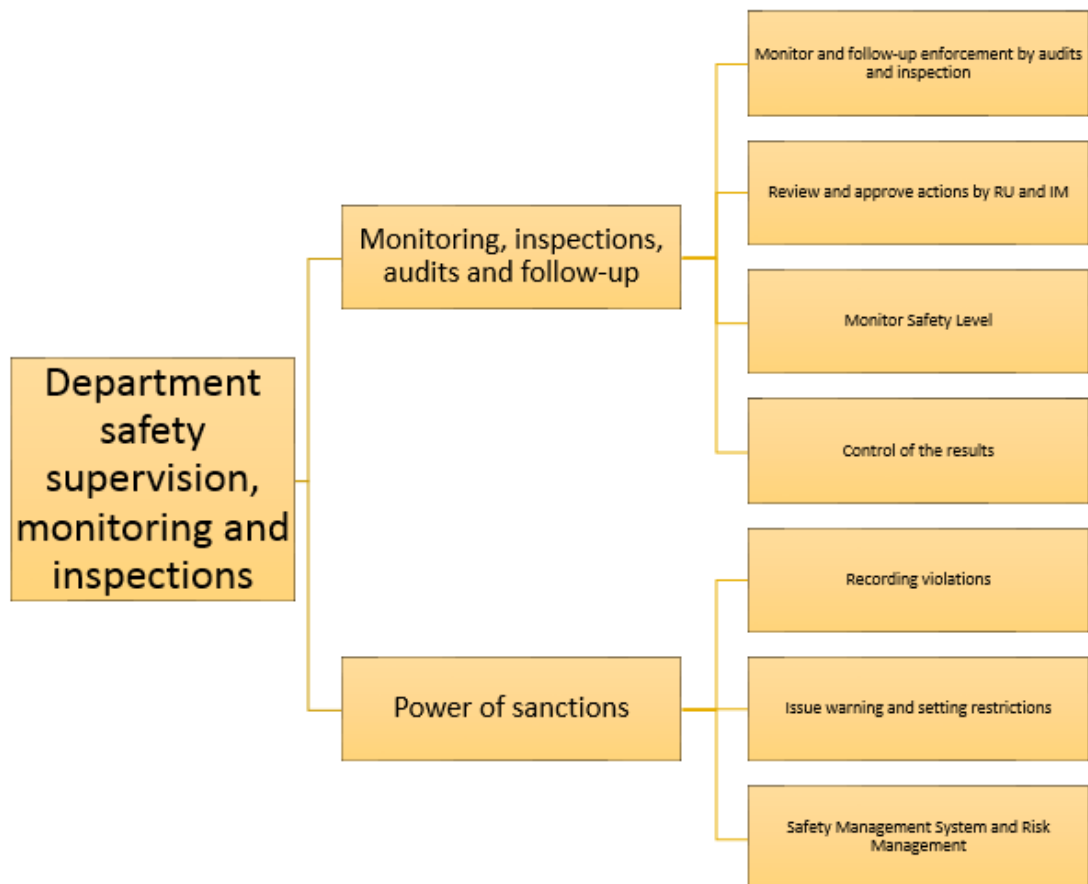


Figure 14: Flowchart Department safety supervision, monitoring and inspections
(source: Author's own elaboration)

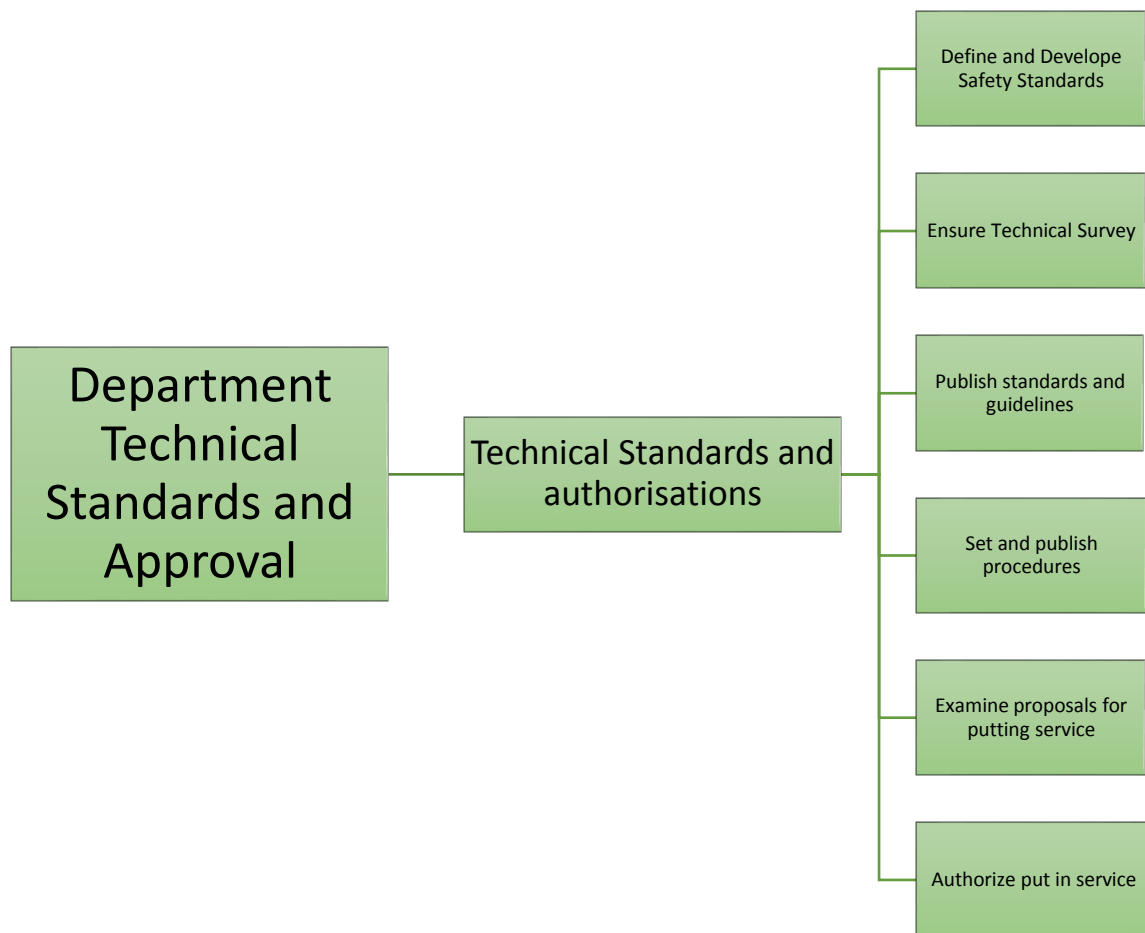


Figure 15: Flowchart Department Technical Standards and approval
(source: Author's own elaboration)

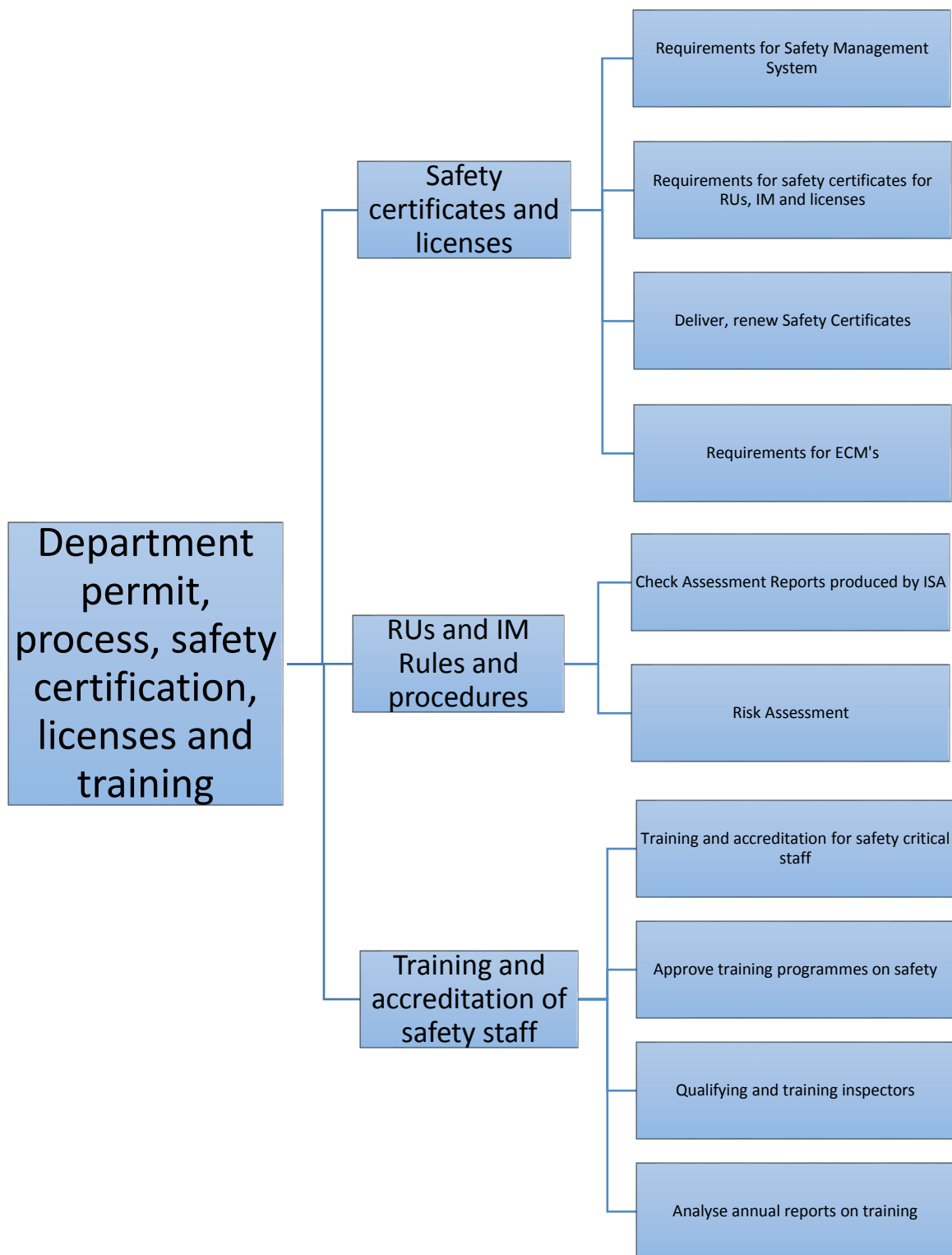


Figure 16: Flowchart Department permit, process, safety certification, licenses and training
(source: Author's own elaboration)

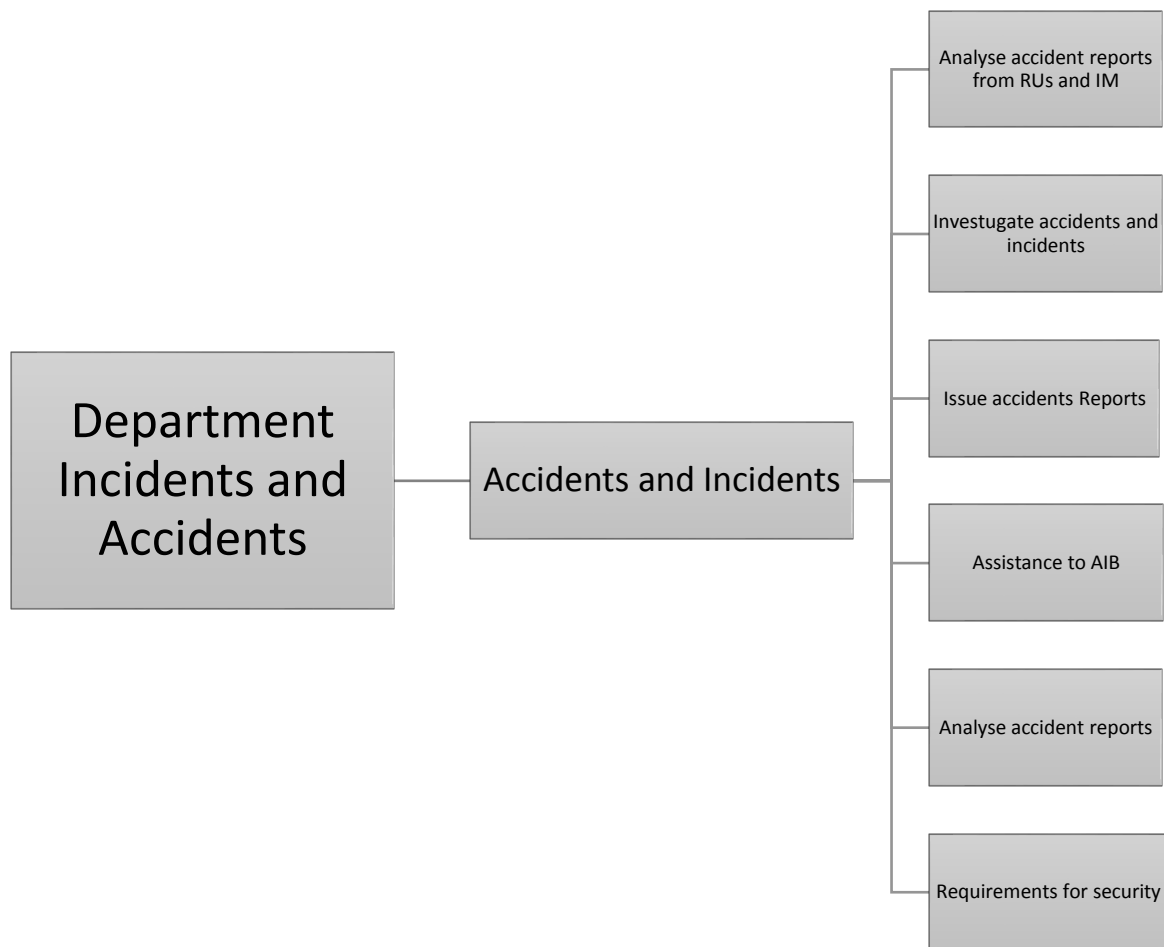


Figure 17: Flowchart Department Incidents and Accidents (source: Author's own elaboration)

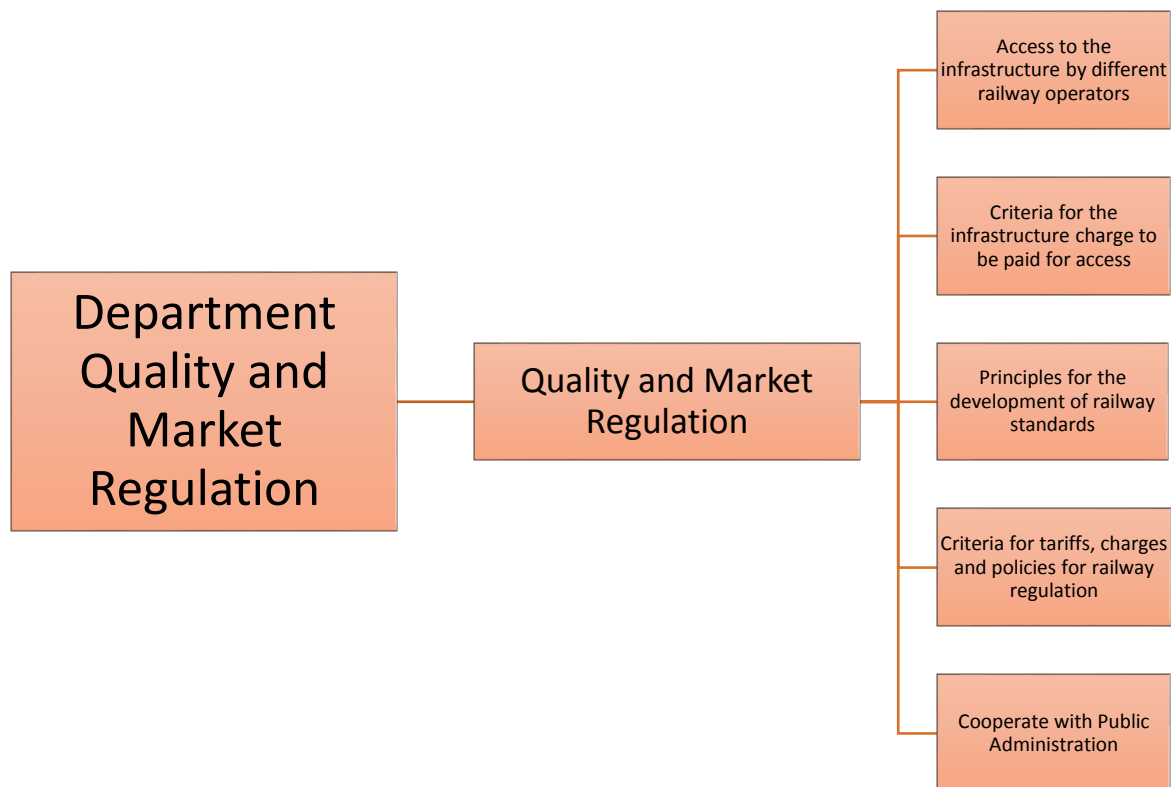


Figure 18: Flowchart Department Quality and Market Regulation (source: Author’s own elaboration)

7.4 Organizational Process Development and Organizational Structuring for the Railway Authority

The objective is to identify the framework within which the Railway Authority shall operate, its relationship with MOTC, the Director General for Land Transport and Railway and other related Government Agencies as well as the overall legal perspective. The ultimate aim of this topic is to establish processes in line with international standards, while remaining compliant to existing legal regulations.

The output of this topic is a detailing operational framework within which the Railway Authority operates, functional organization/departmental responsibilities and the section of the implementation plan - organizational requirements dealing with the applicable organizational processes.

In order to achieve this objective, it is possible to benefit of the activities carried out for the Structure of the Railway Authority.

In the light of this, it will be possible to motivate the proposal for the operational framework within which the Railway Authority operates, functional organization/departmental responsibilities, objectives and mission on the basis of a comparison with various other successful models adopted by railway entities.

What is extremely important, however, is to tailor the processes to be established so as to exploit the current best practices and to be in line with international standards, while remaining at the same time compliant to existing legal regulations in Oman and GCC.

It is intended to propose the organizational structure for the Railway Authority and to identify the authorities and responsibilities of each position within this organization structure, developing job descriptions for all positions and providing the Railway Authority with a “Matrix of Authorities” detailing the financial and authority obligations and rights for all managerial positions across the Railway Authority.

As an example, it is shown below, from table 7 to table 11, the organization of the Department Regulation (already described) above showing the responsibilities (description of the mission), expected results and the matrix of responsibilities also in relation with other Entities of the Oman rail system.

The Department Regulation includes the following tasks/procedures:

- 1.1 Elaborate, adopt and publish National Safety Targets;
- 1.2 Adopt and publish National Safety Regulation;
- 1.3 Follow-up coordination with other authorities (especially for investigation of accidents);
- 1.4 Issue periodic and specific report (especially annual report to the Ministries).

For each task/procedure it is proposed a table.

1 – DEPARTMENT REGULATION

Task 1.1 - Elaborate, adopt and publish National Safety Targets

Description of the mission:	Expected results:
<ul style="list-style-type: none"> - National Safety Targets describe the overall safety results to be achieved by Railways. - They are a political commitment of the State and describe the general safety results to be achieved by the railway system. They shall be realistic and achievable. - It is the responsibility of Rail Authority to elaborate those targets with all interested parties, to adopt them officially (approval by the Minister may be necessary) and to publish them so that every interested entity is aware. - Elaboration of a “Guiding principles” for RUs and IM. 	<p>Safety Targets are used to:</p> <ul style="list-style-type: none"> - Elaborate National Safety Regulation - Approve, review and develop safety standards - Elaborate (by RUs and IM) and approve (by Rail Authority) Safety rules and procedures - Deliver safety certificates - Examine proposals for putting into service of structural or functional sub-systems, new constituents or spare parts - Authorise to put into service new rolling stock or equipment

ACTIONS UNDER THE RESPONSIBILITY OF RAIL AUTHORITY	INTERACTING BODIES OR ENTITIES			
	MoTC	AIB	RUs / IM	Others
Elaborate	✓	✓	✓	Ministry of Finances
Adopt	✓			
Publish	✓			

Table 7: Task 1 of the Department Regulation and the interaction between Entities

DEPARTMENT REGULATION

Task 1.2 - Adopt and publish National Safety Regulation

Description of the mission:	Expected results:
<ul style="list-style-type: none"> - National Safety Regulation is State level safety rule. - Rail Authority shall determine if ever existing RUs and IM rules shall be integrated as national regulation. - Rail Authority elaborates drafts and projects of safety regulatory framework and submits the proposal to the Minister in form of a draft decree. - Once published, Rail Authority decides or not to amend, complete or improve the national safety regulation (through the same process). 	<p>The objective of binding national safety regulation is:</p> <ul style="list-style-type: none"> - To take into account the diversity (or possible diversity) of players, increase safety awareness and define each one's safety missions; - To have by all players dedicate needed resources to ensure the strict respect of these rules; - To have SMS taking into account national Regulations and targets, - To have RUs and IM elaborate as far as needed their own additional safety rules, compliant with the national safety regulation and allowing to reach the said targets.

ACTIONS UNDER THE RESPONSIBILITY OF RAIL AUTHORITY	INTERACTING BODIES OR ENTITIES			
	MoTC	AIB	RUs /IM	Others
Elaborate	✓	*	✓	Ministry of Industry
Adopt	✓	*		
Publish	✓	*		

*NB: AIB shall NOT be associated in any way in the elaboration or approval of National Safety Regulations, nor in any other missions of Rail Authority. Any involvement of AIB would jeopardize its independence and could influence its analysis of accidents.

Table 8: Task 2 of the Department Regulation and the interaction between entities

DEPARTMENT REGULATION	
Task 1.3 - Follow-up coordination with other authorities	
Other Authorities:	Field of cooperation:
Minister of Transport	<ul style="list-style-type: none"> - Elaborate, adopt and publish National Safety Targets - Set and publish requirements for licenses - Publish safety decrees
Accident Investigating Body	<ul style="list-style-type: none"> - Provide assistance to AIB if requested - Analyse accident reports from AIB and ensure follow up of recommendations
Third bodies (if ever)	<ul style="list-style-type: none"> - Certificates to deliver authorization of the bringing into service of subsystems, equipment or rolling stock.
Ministry of Industry and Ministry of Economy	<ul style="list-style-type: none"> - Evolutions outside the company (legislative and normative modifications, and technical watch concerning the company),
The judiciary authority and the police	<ul style="list-style-type: none"> - Methods dictated, in the shape of contracting documents, to the service providers, partners and suppliers in order to be in phase with the safety policy. - Information about new investigation bodies and methods - Answer to inquiry about accidents and incidents.

ACTIONS RESPONSIBILITY AUTHORITY	UNDER OF	THE RAIL	INTERACTING BODIES OR ENTITIES			
			MoTC	AIB	RUs / IM	Others
Elaborate			✓	✓		✓
Adopt			✓			✓
Publish			✓			✓

Table 9: Task 3 of the Department Regulation and the interaction between entities

DEPARTMENT REGULATION

Task 1.4 - Issue periodic reports

<p>Description of the mission:</p> <p>Rail Authority establishes an annual activity report and transmits it to the Minister.</p> <p>Rail Authority may as well establish any periodic reports to the Minister, depending on the circumstances.</p>	<p>Expected results:</p> <p>The content of the annual report can be declined in the following manner:</p> <p><u>A – PREVIOUS YEAR:</u></p> <ul style="list-style-type: none"> General overview: <ul style="list-style-type: none"> General situation of the railway sector with regard to Safety and developments of the previous year, evolution of safety indicators Specific situation of each “sector”: <ul style="list-style-type: none"> RUs and IM Safety Department and operational Business Units Other railway companies Railway industry and providers Regulatory issues <ul style="list-style-type: none"> New legislation in the field of railways and new decrees published in the previous year General state of the Safety regulations and procedures and new procedures introduced in the previous year Instructions, criteria, standards and recommendations issued by Rail Authority Instructions, criteria and standards issued by RUs and IM Compliance of railway sector with rules and procedures, barriers to implementation Compliance of railway sector with instructions, etc, issued by Rail Authority and barriers to implementation Accidents and safety events: <ul style="list-style-type: none"> Annual accident statistic Accidents investigated by Rail Authority, conclusions and recommendations issued Accidents investigated by AIB, conclusions and recommendations issued Follow-up of recommendations issues by Rail Authority and by AIB Noticeable accidents and safety events Rail Authority Inspections and controls: <ul style="list-style-type: none"> Implementation of Rail Authority inspection plan Other controls or inspections performed by Rail Authority Certificates and authorisations: <ul style="list-style-type: none"> Safety certificates delivered by Rail Authority Authorisations delivered by Rail Authority Approval of non-objection issued by Rail Authority Others tasks performed by Rail Authority <ul style="list-style-type: none"> Technical survey about evolution of the “state of the art” at international level Innovations relevant for Oman and GCC Rail Authority Staffing and training: <ul style="list-style-type: none"> Implementation of staffing schedule Implementation of training programme Rail Authority Objectives: <ul style="list-style-type: none"> Implementation and achievement of objectives in previous year <p><u>B – CURRENT YEAR:</u></p> <p>Objectives forecast and previsions for current year (same headings as for previous year, as far as accurate).</p> <p><u>C – PROPOSALS TO THE MINISTER:</u></p> <p>Proposals to change the institutional or legal frame of railway safety</p> <p>Other important concerns about railway safety</p>
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ACTIONS UNDER THE RESPONSIBILITY OF RAIL AUTHORITY	INTERACTING BODIES OR ENTITIES			
	MoTC	AIB	RUs/IM	Others
Elaborate	✓	✓	✓	✓
Adopt	✓			
Publish	✓			

Table 10: Task 4 of the Department Regulation and the interaction between entities

DEPARTMENT REGULATION

Task 1.4 - Issue specific reports

Description of the mission: In case of serious safety concerns, Rail Authority establishes a specific report and transmits it to the Minister.	Expected results: Such specific reports shall be especially presented in any case when Rail Authority intends to: <ul style="list-style-type: none"> - Set restrictions, - Revoke relevant parts of safety certificates and of safety authorisations, - Revoke or suspend a License.
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ACTIONS UNDER THE RESPONSIBILITY OF RAIL AUTHORITY	INTERACTING BODIES OR ENTITIES			
	MoTC	AIB	RUs/IM	Others
Elaborate	✓	✓	✓	✓
Adopt	✓			
Publish	✓			

Table 11: Task 5 of the Department Regulation and the interaction between entities

8 Conclusions

Considering the aim of the present work, that is the analysis of the current transport situation of the Sultanate of Oman and the Organizational Structure to satisfy the idea of development of the Railway network, it is possible to outline a basic organizational chart.

For an efficient and effective solution in the short time (vision to 2020) that allows to start the transport reform in Oman, considering the installation and operation of the first section of the line and the existing Oman Rail, it is sufficient to represent few key figures (Figure 19) as the infrastructure manager, the railway undertaking (one for both passenger and freight transport) and the Railway Authority as a pivot and guarantor of safety and of all the involved actors.

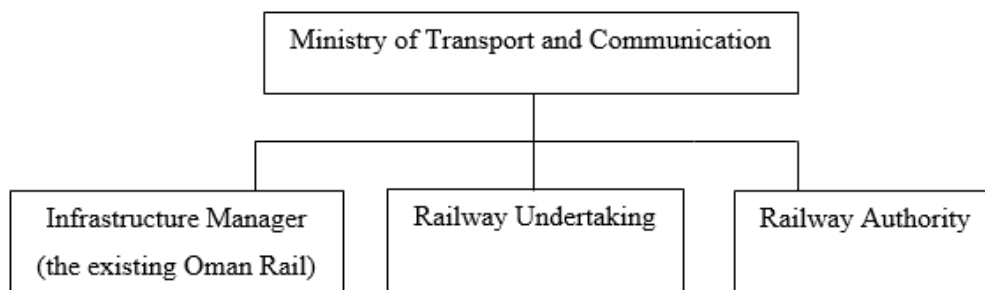


Figure 19: Organizational Structure: vision to 2020 (source: Author's own elaboration)

The present structure will manage the first section of the network in compliance with the idea of development of the GCC Railway System; it is considered a first section of railways in Oman (figure 20) that will connect the north of the country with the city of Sohar and the capital Muscat.



Figure 20: The future network: vision to 2020 (source: Kuwait local News)

Considering the possibility of development of the organizational structure and of the network, it is possible to make assumptions for medium and long time with the aim to increase the performance of the Omani Railway System.

In the medium time logic (vision o 2030-2035) it is possible to think about a further specificity of the organizational structure considering a subdivision of the Railway Authority in to branches distinguished by competences (as today in Italy): a branch guaranteeing safety and the other guaranteeing the relationships among different involved entities.

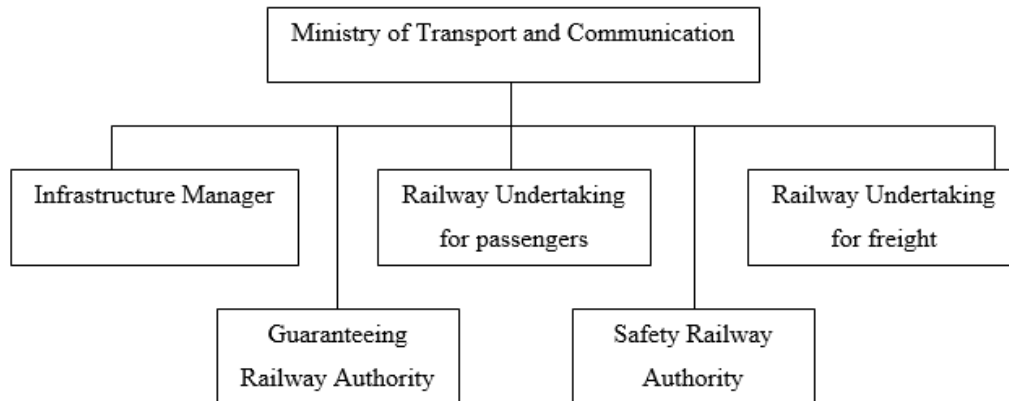


Figure 21: Organizational Structure: vision to 2030-35 (source: Author's own elaboration)

With an upgrade of the organizational structure it is rational to increase the network (figure 22) in order to grant a simplest connection between the capital Muscat at the other focal points of the country; nowadays Oman is a desire location by tourists and also a focal point for cruises in the Arabic peninsula so will be convenient to privilege the internal connection by train among the capital Muscat and the major ports of the country as Duqm and Salalah. An upgrade of the network to 2030-2035 could be the one in figure 22.



Figure 22: The network in 2030-2035 (source: GCC Rail Connectivity)

According to the idea of homologation to the international best practices, also the Omani Railway System could pursue an additional upgrade taking into account the possibility to introduce, in a long-term vision, some additional entities essential for a performing system such as Independent Safety Assessors with the role to evaluate the conformity of a generic product, a generic application or a component to safety certification applicable requirements. A possible structure could be the following (figure 23):

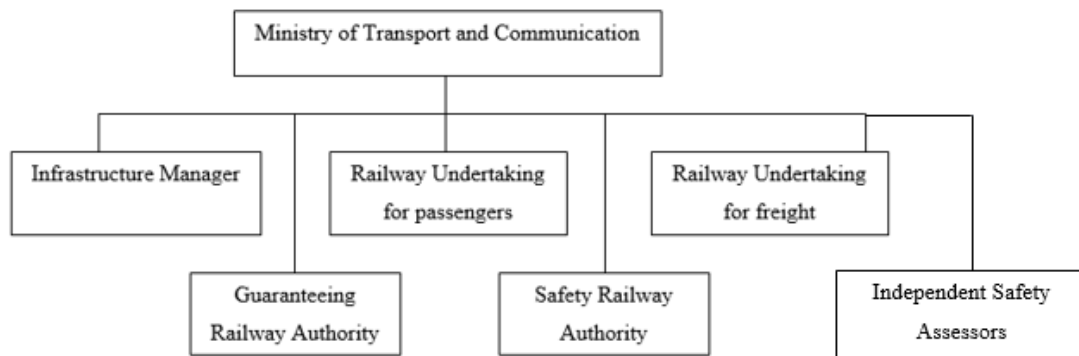


Figure 23: The Structure for a long-term vision (source: Author's own elaboration)

Once stabilized the structure and also a basic network in the country connecting all the focal points, it is possible to take into account an upgrade of the system considering the birth of new lines among the virtuous country of the Arabic Peninsula such as UAE and Arabia.

According to the idea of GCC to implement High Speed Lines among the Countries and the actual projects in Arabia, it is a good practice to plan also for Oman, a High-Speed Line connecting, for example, Muscat with Riyadh (yellow in figure 24), and also preventing an extension of the line (red in figure 24) from Salalah to the capital of Yemen (Sana'a) that nowadays is not included in projects involving railways in the Arabic Peninsula.

A possible network for a long-term vision could be the one in the following figure 24.

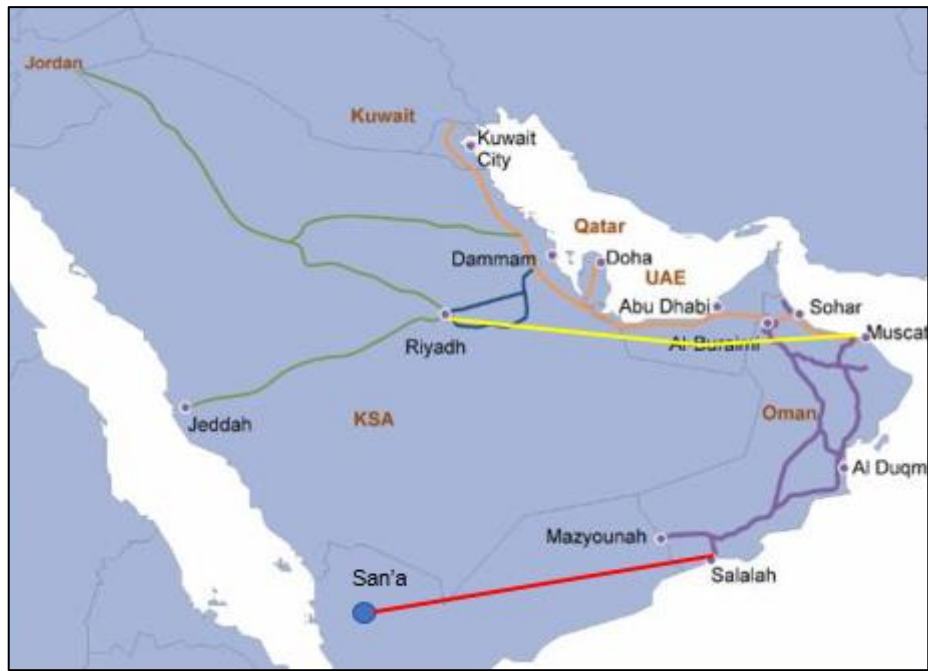


Figure 24: Long-Term Network in the Arabic Peninsula (source: Author's own elaboration)

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