Gulf Rail Connection: Realizing GCC Unity
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A.T. Kearney
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One of the strategic objectives crystallized by GPCA is to “establish credible regional industry data and information resources” in support of its mission which is singular and specific in that it intends to support the growth and sustainable development of the petrochemicals and chemicals industries in the Arabian Gulf, in partnership with its members and stakeholders.

In this direction, GPCA, since its inception in March 2006, has been very active in the development and dissemination of industry relevant content in the shape of reports and studies addressing industry trends, opportunities and challenges. Several of these reports focused on the functional segments of the industry, such as the Supply Chain Management, which derives its importance from the fact that the industry in the GCC is characterized by its huge network and extended supply chains, and therefore optimization in this is critical.

This report sheds light on various aspects of an underdeveloped mode of transportation within our Gulf region. Transportation of chemicals by railway has many merits from safety, environmental and economic standpoints. Development of a regional railway network is seen as a positive move by GPCA members. This strategic infrastructure development will undoubtedly enhance the cross-border trade amongst the GCC States and will minimize the use of trucking, thereby reducing the associated pressure on the road networks, which in turn will alleviate the safety concerns as well.

I am sure that this report will be of immense value to a wide spectrum of our industry stakeholders including policy makers, industry leaders, and investors and entrepreneurs seeking new business opportunities.

As a final note, I would like to recognize and extend my utmost appreciation to Mr. Saleh Al-Shabnan, Sabic’s Vice President for Global Supply Chain & Center of Excellence and Vice Chairman of GPCA Supply Chain Committee for his instrumental role in the development of this report and especially in sourcing the data which forms the basis of this report. Special thanks goes to A.T Kearney team headed by Mr. Dan Starta for drafting the report and enriching its content with data and analysis related to the global practice component. My gratitude is extended to all the GPCA Supply Chain Committee members and the GPCA Secretariat team for their hard work and collaboration in producing this report. Their support, valuable contribution, as well as their commitment and dedication had been critical not only in delivering this report but also for the Association’s ongoing success.

Abdulwahab Al-Sadoun
Secretary General, GPCA
GCC continues to grow

Initially driven by expanding oil and gas and petrochemical industries, GCC countries maintained robust growth through new investments, supported by strong governmental economic development agendas and low energy and chemical feedstock costs. The growth agenda continues to advance toward developing downstream industries, which leverages the broader range of molecules available to enhance manufacturing and service offering in the region. As a result, the overall GCC Gross Domestic Product (GDP) is expected to grow at a stable 5 percent per year until 2020, with population increases of 50 percent until 2040, driven mainly by Saudi Arabian and UAE populations (Fig. 1).

Until now, GCC economic growth was primarily enabled by infrastructure investments in ports, as the majority of growth was driven by export of oil and petrochemicals to European and Asian markets. As local populations and economies continue to grow, the need for advanced national and regional infrastructure becomes increasingly important to support economic growth.

Road-based infrastructure played the primary role in this support, yet with aggressive development targets, rail infrastructure will become a critical enabler and driver of sustainable growth for the GCC.
Overall GDP is expected to grow at 5 percent per year until 2020 with population increases of 50 percent until 2024.

Fig. 1

Population forecast (in million)

- Bahrain
- Qatar
- Kuwait
- Oman
- UAE
- KSA

Real GDP forecast (in US$ billion²)

CAGR +5%
Transportation and intra-GCC trade

Continued economic and population growth in GCC member states will generate the need for new and expanded land, sea and air transport infrastructure and services for both freight and passenger transport. Meeting this demand with the present means of transport will require significant ongoing investment in; roads, ports and airports, and further expansion of railway networks and public mass transport services in GCC member states.

Rail is well positioned to absorb expected demand increases by passenger transport, while air and road segments are expected to increase significantly over the next five years, and beyond. Cross-border intra-GCC trade has traditionally demonstrated lesser importance for GCC economies; the trade volume oscillates around 3 percent of the overall GCC GDP, with the outlook ratio stable over time (see figure 2).

This creates various opportunities as a result of the GCC rail connection. Firstly, at a minimum, freight volume addressed by rail will grow at the same rate of real GDP growth, leading to at least a 5 percent p.a. growth rate, until 2020. Secondly, an integrated GCC railway infrastructure can become an important catalyst in driving increased economic cooperation between GCC countries, fostering the economic regional and national development agenda, supporting growth and strengthening national capacity integration within the GCC. Thirdly, rail can raise the profile of the importance of intra-GCC trade in the overall balance.

Fig. 2
Cross border intra-GCC trade volume oscillates around 3 percent of the overall GDP

Intra-GCC countries trade as % of GDP

Source: UNCTAD
Role of the petrochemical industry as a GCC growth engine and volume driver

GCC petrochemicals are leading the current wave of economic growth in the region, aggressively diversifying from commodity products and supporting the development of advanced downstream industries in the region. The planned petrochemical product capacity is increasing along with this agenda (see figure 3). Growth is focused on specialized products, adding capacities for products never before produced in the GCC, presenting local manufacturing (downstream) companies with a competitive advantage.

The current estimated intra-GCC trade volume of petrochemical products, pertaining to production by GPCA companies (encompassing plastics, chemicals and fertilizers), is above 2.5 million metric tons per annum (see figure 4). The majority of products are transported by truck supported by marine logistics if required and these volumes are expected to grow along with local trade, GDP and petrochemical capacity additions.

Linking GCC national networks and key economic centers in the Gulf, will immediately position the GCC integrated rail network strongly to take over a significant portion of these trade volumes.
Fig. 4

2.5 million metric tons of polymers, chemicals and fertilizers are traded between GCC countries annually

Trade between the GCC countries Polymers, chemicals, fertilizers, 2010

Source: UNCTAD database 2010 data, product pricing information
The integrated GCC Railway will provide the required infrastructure to enable rail to absorb increasing freight volumes, efficiently and economically. The planned GCC railway will link Kuwait City, traversing along the Gulf, to Muscat in the Sultanate of Oman, serving the Kingdom of Saudi Arabia, the Kingdom of Bahrain, the State of Qatar and the United Arab Emirates. The total length of the GCC Railway main line is approximately 2,177 kilometres, including about 180 km of connecting lines to key traffic generators such as ports and industrial zones (see side bar 1: The GCC Railway at a Glance).

**Railway Length:** Totalling approximately 2,177 km, the GCC Railway includes about 180 km of connecting lines to traffic node generating centers and transport facilities such as ports, airports and industrial cities. These are broken down into geographical segments including Kuwait (145 km), Saudi Arabia (695 km), Bahrain (64 km), Qatar (283 km), UAE (684 km) and Oman (306 km).

**Corridor Alignment:** From Kuwait to the Kingdom of Saudi Arabia via Dammam to the Kingdom of Bahrain via a proposed causeway, in parallel to the King Fahd Causeway to Bahrain, the corridor connects key GCC city transport nodes. Extending to Qatar via the Qatar-Bahrain bridge, from Dammam to Qatar via Salwa and on to the United Arab Emirates via Al-Bat’ha to Abu Dhabi, Dubai and Al-Ain, and then on to Oman via Sohar to Muscat, the network will reach all member state key cities.

**Railway Characteristics:** The GCC Railway will service mixed passenger and freight operation, based mainly on single line tracks to standard gauge (1,435 mm), with double tracks in certain areas, dependent on demand, with diesel traction. Tunnels required in the mountainous regions of UAE and Oman will feature clearances to allow double stack containers. Air conditioned passenger trains operating at speeds of up to 200 kph, will operate mainly
during the day and are planned to run in each direction every two hours. Freight trains (including container and bulk freight) operating at 80-120 kph, will operate mainly at night.

**Stations and Facilities:** Passenger stations will total seven large stations each located at Kuwait City, SRO Interchange (near Dammam), Doha, Manama, Abu Dhabi, Dubai and Muscat, supported by three small stations at Salwa, Fujairah and Sohar and an SRO station at Jubail. As proposed in each of the GCC member states’ national transport master plans, metro and light rail links will facilitate connections to downtown centers.

**Train Control System:** In line with key objectives for a safe and efficient operation, critical signal systems will determine the rail network’s maximum speed and capacity. An European Train Control System (ETCS) Level 2 system, with no trackside signals, will underpin control. It will achieve this because it is safe and already in commercial use, facilitates a competitive bidding process and avoids a monopoly, allows conventional lines and the train density nodes to be increased—especially in mixed traffic with fast and slow trains and is reliable during operation.

**Environmental Assessment:** An environmental baseline assessment describes the existing environmental conditions and the potential construction and operation impact to GCC member states, prepared according to the applicable rules and regulations in each member state. As in any construction project, there are some adverse environmental effects, but in general, they are not major. By aligning the project to the relevant mitigation measures and environmental management plans, environmental impact will be minimized.

**Capital Investment:** The estimated capital investment (based on 2009 figures) for the initial construction of the railway infrastructure collectively represents over US$100 billion. This includes formation, track, sidings and yards, signaling and telecommunications, stations, workshops and other buildings. This is based on using diesel trains and train speeds of up to 200 km/hr for
passenger transport, as well as the construction of the proposed causeway between Saudi Arabia and the Kingdom of Bahrain.

**Allocations of Project’s Costs:** The proposed cost of the railway is expected to be distributed among GCC member states based on the planned route length in each member state. The cost of procurement of the rolling stock, and hence the operation and maintenance, is expected to be borne by the private sector. Another approach for consideration is the allocation of costs in relation to the expected benefits of each GCC member state, an approach that requires further study and analysis during the detailed engineering design and onward phases of project’s implementation.

**Project Implementation:** GCC governments are expected to pay the capital investment cost for the construction of the GCC Railway while railway

**Benchmarking:** The GCC railway compares with the use of best practices relevant to regional and international railway standards. This includes axel loads, signaling, communication systems and transport technologies, ensuring efficient and effective integration of the GCC railway within the GCC National Railways. This is key to achieving maximum compatibility and utilization between GCC member states. It is expected the GCC Railway will set a number of new standards for the railway industry.

**Railway Feasibility:** GCC Railway is economically and financially feasible and on the condition that Governments of the GCC member states pay the capital cost for the construction of the infrastructure, which is common practice for capital intensive transport projects aiming to provide public transport services.

**Benefits of Rail**

**Tracking safety, efficiency and environmental benefits:** Providing a safe, efficient and sustainable transport alternative is at the core of the GCC railway’s mission. It will change the face of transport and logistics, benefiting the entire region.

**An alternative, safe import and export trade route:** Railways are widely recognized for decreasing the volume of road traffic, which protects infrastructures impacted by excessive use of roads with overweight loads and contributes to minimizing road related accidents.* (Piracy & Hormuz Strait closure threats should be addressed in a more strategically focused way).

**An environmentally friendly transport alternative:** The integrated GCC railway is also expected to positively impact the environment with its Reinforce Responsible Care and Sustainability concepts through less CO₂ emissions and rationalized usages of fuel. Put simply, diverting traffic from roads to a more environmentally friendly mode of transport lowers air emissions, particularly greenhouse gases. This will also enable higher energy efficiency (easy and fast access) and reduce noise pollution levels (resulting from road traffic).

**Decreasing congestion at border gates:** The addition of on-board inspectors, supported by pre-clearance immigration procedures based at the point of journey origin will make railway transport more efficient and competitive; decreasing current delays experienced at borders for both freight and passengers.

**Less dependency on foreign laborers:** The usage of rail will substantially rationalize the need for foreign drivers and the associated challenges that result from heavy dependence on them especially during abnormal situations.

**Driving economic development for GCC member states:** The integrated railway is a powerful symbol of unity, to which all GCC members are committed. Apart from creating a transportation backbone connecting and integrating major urban centers, the railway will add diversified transport infrastructure development and service provisions across the region. Collectively this improves competitiveness and the investment environment, which in turn supports the development of export trading. On a regional level, this is critical to reaching key target GCC economic development goals of sustaining growth at national and regional levels, and supporting GCC national industries in neighboring economies.

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*An overweight load is a load that exceeds the standard or ordinary legal size or weight limits for a specified portion of road, highway or other transport infrastructure.
Linking GCC member states and national railways through an integrated and efficient transport network, strengthens institutional capacity, generates employment for GCC nationals and promotes the growth of specialized skills required for the development of sustainable railways. In addition, this will enhance regional trade.

Looking forward the railway plans to integrate and connect beyond the GCC, region linking into other countries in the Middle East. Following a detailed feasibility study, this includes specific plans for connecting to the Yemen Border. Other planned connections include reaching Jordan via the North-South Railway in the Kingdom of Saudi Arabia and Iraq via State of Kuwait (see figure 5). Syria and Turkey are also target destinations representing an important step toward a European connection.

In the long term, this will include exploring the possibility of extending a link via Central Asia and China, as well as other dynamic Asian economies. Similarly, linking with Turkey’s rail through Jordan will give GCC member states access to the European rail grid. The goal is to become an important strand of a reconstituted ‘Silk Road’ to position GCC member states and the wider MENA region as significant players on the transportation and logistics world map.

To capture opportunities available from the GCC integrated railway, demand drivers and key success factors need to be prioritized to maximize the benefits to the community and the economy.

This includes safety measures for people on passengers, assessment of passenger demand to improve mobility and productivity, and optimization of the environmental footprint of construction and operations. Growth in commercial and business activities as well as economic development and diversification depends on several other enablers. For example layout and coverage of the rail network, intermodal connectivity with hubs to

Fig. 5
The GCC Railway network will unite the GCC region and other countries in the Middle East
stimulate regions and industries, design capacity of railway tracks and rolling stock, investment attraction and promotion as well as rail industry establishment and services support.

**An alternative, safe import and export trade route**

With repeated threats of closure of the Strait of Hormuz, the GCC Rail connection will provide member states with alternative export and import options. Rail will enable connections from and to ports south of the Strait of Hormuz, as well as other ports on the Arabian Sea. The Land Bridge in Saudi Arabia will give member states access to the Red Sea ports of Jeddah, Yanbu and Rabegh.

Equally important from a strategic point of view is the fact that rail will provide an important alternative to sea trading routes, currently under threat by piracy. Piracy impacts supply chains of the Arabian Gulf through additional cost, risks and deceased customer confidence. Apart from the obvious negative impact on any one vessel, there is also an economic domino effect throughout the entire vertical value chain within the maritime sector. With only limited possibilities to bypass the dangerous waters zone, piracy is currently a direct threat to any industry using the Arabian Gulf as a transport route for imports and exports. Providing an alternative, safe transport route, interconnected with export points throughout the South of the Arabian Gulf, the Arab Sea and the Red Sea, is a potent weapon against potential future instability at strategic supply chain maritime transport routes, affected by the threat of piracy.

**GCC rail progress full steam ahead**

Each of the GCC Governments has launched various rail projects, currently worth over US$100 billion. Saudi Arabia and the UAE have taken the furthest strides to date.

**Saudi Arabia:** Well under way is the North-South Railway (NSR) project in Saudi Arabia, the world's largest railway construction and the longest route to adopt the European train control system (ETCS) to date. Trial operation began on the 2,400 km passenger and freight line, which runs from Riyadh to Al Haditha near the border with Jordan, in May 2011. Today the line transports phosphates from Jalamid to Ras-Al-Khair.
The East West Land Bridge Project will be interoperable with the North-South railway linking the Kingdom coast to coast; facilitating oil, agricultural and industrial product transportation. This will present a coast-to-coast journey time of around 18 hours, compared to a five to seven day journey by sea. Although the main traffic is expected to be freight, the line will also provide passenger train services cutting the current Riyadh - Jeddah journey time almost by half. When completed, it will represent a quantum leap in the Kingdom’s transport sector and usher in a new era of high-speed trains for passenger transport (see figure 6).

Fig. 6
The Saudi Arabian Railway network will represent a quantum leap in the Kingdom’s transport sector

<table>
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<th>Economic Cities</th>
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<td>RCJY - Industrial Cities of Jubail and Yanbu</td>
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<td>MODON - industrial cities (existing)</td>
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<td>MODON - industrial cities (under development)</td>
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<th>Intermodal Nodes</th>
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<td>Rail - Road (existing)</td>
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<td>Rail - Road (potential)</td>
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<th>Existing Infrastructure</th>
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<tr>
<td>International Airport (existing)</td>
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<tr>
<td>Regional Airport (existing)</td>
</tr>
<tr>
<td>Airport (planned)</td>
</tr>
<tr>
<td>Sea Port (existing)</td>
</tr>
<tr>
<td>Sea Port (planned)</td>
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Overview Third Level
2035-2040
Length: about 1,400km
4 Lines
Construction cost: about 35bn SAR

Total Network
2010-2040
Total Length: about 10,200km
19 Lines
Construction cost: about 175bn SAR (without HHR-Lines Costs)
UAE: The UAE rail network will link all of the country’s major population hubs and connect to Saudi Arabia via Ghweifat in the west and Oman via Al Ain in the east. The railway network will be built in phases linking principal population centers to industry hubs the UAE and will form a vital part of the planned integrated GCC Railway. The network will extend up to 1,200 km and will initially operate on diesel, but will be designed and constructed to accommodate electrification in the future (see figure 7). It will accommodate passenger and heavy freight such as rocks, aluminum, cement, iron, steel and will cater for all other trade commodities, as well as hydrocarbons.

Fig. 7
Etihad Railway network will service multiple industries
An International Perspective on Rail Freight Success Factors and Challenges

Western freight and passenger advanced network models and development milestones provide indicative key success factors behind the successful business case for rail. They also provide valuable insight into a number of challenges, from which the GCC can take key learnings. In particular, we look at rail impact on industry growth and chemicals freight transportation, as well as the development of rail networks in Europe and the USA.

European rail milestones
The first primitive horse-drawn wagons on wooden rails are known from central Europe as early as 1550. About two centuries later iron replaced wood for the rails and with the invention of flanged wheels and steam engines in England, rail spread across Europe in the early 1800s. As existing road transportation was too slow and expensive, rail emerged as an essential alternative means of transportation. In the beginning, railway continued to compete with barges on man-made canals and rivers. However, dramatic efficiency increases in speed, scheduling, and costs made rail critical for the economic and industrial development of the continent in the 19th century. Due to lack of geographical flexibility, rail lost much of its freight business to road transportation in the 20th century.

Many European governments encourage the use of rail for freight transportation due to its environmental benefits. This is in line with targets to reduce the dependence on imported energy and cut carbon emissions in transport by 60 percent by 2050. Today it is considered more efficient than many other means of transportation in terms of consumed energy by ton-miles; hauling bulk commodities over long distances realizes additional economies of scale. The challenge has been to accommodate transshipments, which inevitably lead to additional costs. Containerization of cargo practices (standard shipping containers) helps to control costs.

The European logistics market shows significant growth, especially on long haul routes where rail cargo represents cost advantages compared to road freight transportation.
With a share of approximately 10 percent of the total European logistics market, rail cargo is currently still below expected market share value. Winners in recent years include road and ship freight, but the modal split of different European countries varies strongly. Liberalization of the rail cargo market has led to aggressive competition and new rail operators who are concentrating on profitable traffic (“cherry picking”).

**European Rail Development**

Railways have a long history in Europe (see below: European rail milestones). The European Union has adopted a roadmap of initiatives to increase mobility, remove major barriers to effective integration in key areas and fuel growth and employment. Specifically, a key goal is to shift up to 50 percent of medium distance intercity passenger and freight journeys (around 300 km) from road to rail (including waterborne transport) by 2050. Based on the achievement of this goal, European rail freight transportation is expected to almost double 2005 volumes. Comparing the existing freight transport markets in Europe with other major economies suggests there is even greater potential to reach volumes beyond these levels, as the potential use of rail freight transportation in Europe is yet to be exhausted (see figure 8).

The Single European Transport Area has supported a number of successful axes in Central Europe, for example the North-South axis through Switzerland and Austria, which have become Europe’s strongest in terms of rail cargo volume (see figure 9). Despite only moderate growth, the North-South axis will remain the strongest one in terms of volume in 2020. In addition, the East-West transport flows, with low to medium volumes but high growth, are expanding due to a shift of production sites towards Eastern Europe. Combined, these conditions present a number of freight segments with significant growth potential including: international

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**Fig.8**

**European Rail freight has significant potential to grow**

*Comparison of rail freight transportation market share in different countries (in %)*

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Market Share</th>
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</thead>
<tbody>
<tr>
<td>EU 27</td>
<td>2007</td>
<td>15.8%</td>
</tr>
<tr>
<td>Germany</td>
<td>2009</td>
<td>16.5%</td>
</tr>
<tr>
<td>China</td>
<td>2008</td>
<td>32.5%</td>
</tr>
<tr>
<td>Australia</td>
<td>2008</td>
<td>38.5%</td>
</tr>
<tr>
<td>USA</td>
<td>2007</td>
<td>41.7%</td>
</tr>
<tr>
<td>Russia</td>
<td>2009</td>
<td>42.9%</td>
</tr>
</tbody>
</table>

Proportion of rail freight transportation volumes based on total ton-kilometers of the following transportation modes: rail, road, barge and pipeline

long-haul transport, container freight, selected niches of branch specific logistics solutions, as well as integrated total logistics solutions.

After decades of decline in Germany, rail freight transportation experienced an impressive renaissance from 2003, increasing its overall share of the transport market (see figure 10). Its success in capturing a significant share of the market was largely due to the fact that rail:

- offered greater predictability and reliability as compared to trucking—rail transport achieved shorter delivery lead times than road options and provided greater supply chain efficiency due to the integration of rail in comparison to “pure trucking”
- proved more reliable and reduced road traffic problems (from congestion to accidents and casualties)
- was more environmentally friendly in terms of transport-related greenhouse gas emissions
- enabled better supply chain planning and logistics processes with the integration of logistics service providers
- improved (logistics) processes in production plants after relocation from road to rail transport

German rail freight development has benefited from a

Fig. 9
Major rail freight corridors in Europe evolved by interconnecting areas of major economic activity

Sources: Ten-Stac: Scenario, traffic forecasts and analysis of corridors on the trans-European network, D8 2004; ERTMS/ETCS-corridors (based on 2006 data)
number of market conditions, under which the industry could thrive. These include:

- increasing internationalization of trade
- increasing transport distances
- increased use of containers
- growing importance of energy efficiency in transport

However, Europe’s rail success was not achieved without government support. On-going government-led rail infrastructure (re-)development initiatives, such as those to remove bottlenecks in port hinterlands logistics, have been a key contributory factor to the success of rail in Europe. The funding and subsidies for combined intermodal transport solutions (including road, rail and waterways) have proven effective. As steps toward a Single European Transport Area progress, these subsidies are expected to be increased at the national level. Selected European countries already promote the construction and rehabilitation of private rail sidings to foster access to production plants. These countries include Germany (for the first time in the 1970s and again since 1994), Austria (since 1995), and Switzerland (since 1986). In Germany, shippers can apply for government funding to construct and upgrade railway sidings and in return they commit to providing the government a certain volume of rail transport for a predetermined period of time (at least five years). Based on this government incentive program, around 100 sidings were reactivated, expanded or rebuilt from 2005 to 2010.

**USA rail development**

USA transport development began in the late 1820s following the development witnessed in England. The first railway connected the East Coast of the United States to its West Coast, also known as the transcontinental railway and was inaugurated in 1869 linking the eastern network to California. Today, USA railways account for 43 percent of the total freight volumes between the cities making it the number one mode of transportation used in freight forwarding. Regarded as the most efficient freight service it accounts for over $250 billion per year sustaining around 1.2 million jobs. Given the sheer size of the country,
railway systems are used for the transportation of a wide variety of goods and materials from multiple industries. A large percentage of agricultural and food products are transported via rail including wheat, corn, animal feed, frozen chicken and sugar. This accounts for about 3 million carloads of products. Rail hauls 70 percent of America’s coal used in its electricity production and is a key transport mode for delivery of paper, lumber, and motor vehicles from automotive plants to the various dealers across the country.

With ports on both East and West coasts, railways play an important role in providing a “land bridge” for containerized ocean freight that travels significant distances over land towards its final target destination. This is critical to the country’s global trade and manufacturing. For example, transporting goods from Asia to Europe that require additional value-adding manufacturing in the United States. Ships can reach West Coast ports where containers are transported by rail to manufacturing sites, and onwards to the East coast, where they can be loaded again and shipped toward their final destination.

**Rail freight as an asset to the chemicals industry**

**BASF rail success story:** The criteria surrounding BASF’s decision to use rail as part of its intermodal freight network in Europe at the end of the 1990s is illustrative of the wide range of benefits available to chemical players. The motivation to seek a viable alternative to road was driven by the anticipation of; increasing levels of in-market competition, rising fuel prices, the introduction of truck tolls by national governments, increased road congestion on major highways and firmer EU driving and rest time regulations. Rail became an increasingly attractive alternative offering cost savings, improved safety and the long-term availability of reliable supply chain options for its diverse product range, which served a widely dispersed customer base throughout Europe. The advantages were clear, but accessing them did present a number of challenges, which they met through the activation of a “combined transport model”.

As the nearest logistics terminal in the region could not offer the capacity required to service BASF’s large volumes and complex distribution network in 2000, the chemicals company began developing its own intermodal terminal, next to its major production plant in Ludwigshafen. The key objective of the intermodal terminal was to combine and connect all of its transportation modes (including truck, rail and barge). BASF’s intermodal terminal enabled the operation of the combined transport model. This transport system used rail for the “main leg” transport route between intermodal hubs and road for both the “pre-leg” route (from Ludwigshafen to the rail-loading hub) and the “final-leg” route (from the unloading hub to the customer).
has eradicated the need for investment in infrequent used (small-scale periphery) railroad infrastructure and operations.

BASF has since expanded its intermodal terminal three times to a total throughput capacity of up to 500,000 truck load equivalents per year. The third expansion alone added six rail tracks leading to a new total of 13 and three gantry cranes leading to a total of eight. The terminal is also open to external carriers and shippers, which account for up to 60 percent of throughput.

BASF is working with the logistics service providers of the intermodal terminal and rail operators to continuously improve delivery capability and reliability across Europe (see figure 11). These interrelationships have promoted broader competition between the individual logistics service providers (intermodal) and alternative transport providers (intermodal). BASF anticipates further increases in the use of rail due to the rising use of containers.

Freight rail driving the USA chemicals sector

In the United States, railways are used as the main mode of transportation for chemicals due to the efficient connections available between the chemical producers and their customers; around two million carloads of chemicals are carried by United States’ railroads yearly.

In 2010, 23 percent of chemical tonnage was transported via rail constituting around 10 percent of total rail tonnage and approximately 8 percent of carloads. Based on the American Chemistry Council (ACC), around 800 million tons of chemicals were shipped at an estimated cost of $40 billion in 2010. The transportation cost of chemicals alone, excluding pharmaceuticals, constituted approximately 8 percent of the value of the shipments while rail costs were 1.5 percent of the value of the shipments. In the United States, the chemical industry and rail transportation go hand in hand.

Fig. 11
BASF is using an extensive intermodal network to improve delivery capability

Source: BASF SE; Allianz pro Schiene
Building an integrated GCC rail network clearly offers many benefits, but it will also present many challenges. To leverage maximum benefit, and create sustainable value for regional industry stakeholders, these need to be taken into consideration within the implementation program.

**Geographic characteristics and technical standards**

**Challenging geographic conditions and geographic sizes of nations and distances:** Building rail infrastructure over long distances in desert terrain demands consideration of very specific climatic conditions. These include shifting sand dunes and volatile ground surfaces. Many of the GCC countries, with the exception of Saudi Arabia and Oman, are small in terms of geographic size. Due to its nature, rail will create the highest value for all parties when all GCC countries as well as neighboring countries, are connected.

**Compatible technical standards:** Linking individual railways across countries to form a coherent GCC network will require close collaboration and continuous alignment by various stakeholders. In order to overcome this challenge, common specifications and standards should be agreed to in advance. This includes project scheduling; line, network and stations layout, access and connections design, rolling stock selection and, signaling system and type, number and frequency of trains, as well as environmental impact. The European Union is still struggling to overcome the challenges faced by independently developed national rail standards across Europe. For example, most of Europe is using the standard gauge. However, Spain and former member states of the Soviet Union have widespread gauge tracks. In addition, electrification systems of lines vary from country to country (adding another barrier to true interoperability) demonstrating multiple incompatible signaling systems.

**Commercial aspects, funding and business case**

Lessons learned from implementing greenfield rail networks globally show that commercial common sense needs to prevail in early stages of any rail project to ensure successful project completion. This extends to engineering and “political excitement.” Common reasons for project failure include:

- Scope creep due to overemphasis of technical and engineering requirements and de-emphasis of business model requirements and impact
- Overestimated passenger ridership forecasts without considering mode competition and overall passenger travel experience requirements (for example seamless interconnectivity of overall ‘door-to-door’ experience)
- Pure academic freight forecasts without fully
considering shippers’ decision levers and mode competition.
• Unrealistically short financial planning horizons and disparity between expansive service offerings and viable low fares.

Rail implementation requires significant investment in infrastructure equipment and material as well as on-going operations and maintenance. In order to ensure long-term value generation the business model for the rail project should include demand analyses (captured and induced), scenarios for intended operating and management models as well as an economic model to assess the overall economic impact. A financing plan (including sources and schedule) is as critical as project funding and financing in meeting on time delivery of large-scale infrastructure investments.

**Rail management and operating model, legal requirements and communication**

In addition to technical and commercial aspects, success or failure relies heavily on rail management, the operating model and the impact on regional economic development and diversification. The chosen management and operating model will impact all major stages of the rail value chain including infrastructure ownership and maintenance, rolling stock ownership, and operations and sales. Along this rail value chain, global best management practices and operating models vary from fully integrated to highly fragmented examples. For example, United States’ freight railroads are fully integrated along the complete value chain and privately owned. Examples of private companies include Union Pacific, Burlington Northern Sante Fe Railway and Canadian National Railway. The UK rail industry has a public owned rail network (infrastructure ownership) with private operators for the rest of the value chain. France and Germany focus entirely on public ownership and operations along the entire rail value chain. New high-speed rail systems in Spain and Portugal as well as in Belgium and the Netherlands are partly based on public private partnerships (PPP) with public and private infrastructure ownership and maintenance, as well as concessions for operations including leasing of rolling stock. All options have specific advantages and disadvantages that need to be considered and carefully evaluated in defining the best overall management and operating model for the GCC Railway. Furthermore, legal aspects including land restrictions, utilization protection and acquisitions, bid design and launch, as well as management model related contracts, need to be considered when implementing new rail developments.

All these activities should be supported by an effective communication and stakeholder engagement plan to build the required image and brand for long-term success.

**Competition with other transportation modes and reflection of shippers’ needs**

Successful rail developments should consider positioning versus other transportation modes and shippers’ needs. Usually, rail competes with road and marine transportation on multiple dimensions. These include:

• Differential line haul costs which can be relatively fixed and low for rail for long haul transportation and largely versatile and high for road transportation.
• Road transfer at either or both ends leading to additional handling and haulage costs. In addition, favorable fuel and labor costs for truck drivers can increase the competitiveness of truck versus rail for short haul transportation.
• There is usually only limited backhaul cargo for bulk transports. However, container based intermodal transportation usually offers backhaul opportunities, even if it only constitutes empty container repositioning. Availability of backhaul cargo depends on overall trade flows and segment specifics.
• Railcar wagon versus truck loading availability, weight restrictions and loading times: The conversion of one railcar wagon load to truck loads varies and depends on cargo and corresponding packaging types and requirements. Additionally, due to the typical high volume of cargo, rail transport might require relatively higher loading and unloading times.
• Subsidized diesel and gasoline prices in some member states is creating a competitive challenge for rail to compete with trucks for freight and to compete with cars and buses for passengers.

Rail projections must reflect shippers’ needs and offer price attractiveness. This means the sizing of the “rail eligible” market should be based on potential markets given distances, types of commodities and shipments sizes. Not all cargo flows can be considered for rail. In addition, cost of alternatives need to be assessed on competitive service levels for the shippers, for example cost of haulage by road, rail or ship should be compared to the required transit time and delivery reliability on a door-to-door basis. Potential future changes, such as growing or changing trade and cargo flows, additional infrastructure developments or other outlooks impacting shippers’ competitiveness, should also be considered when developing and quantifying realistic price volumes scenarios.
Untapped opportunities for GCC petrochemicals companies

There are additional opportunities, yet to be tapped, beyond the expected benefits surrounding freight rail discussed so far. These include multiple benefits for passenger networks, for example increased mobility and reduced costs for passengers. While rail offers higher speed together with increased reliability, based on statistics on accidents and casualties, it is also widely considered up to nine times safer than road.

Specifically for freight transportation, rail can become the transportation mode of choice due to its flexibility in terms of types of goods. Rail is capable of carrying almost any packaging type, including break bulk, solid dry bulk, liquid bulk as well as containers and even oversized cargo. Specifically for long haul transportation rail can open access to markets and materials across the Middle East and beyond, at competitive costs. Depending on the load and distance, rail-based cargo transportation can be considerably more cost effective than road transportation as average freight trains can carry up to 1,000 tons of cargo replacing around 50 truck movements.

General freight companies as well as petrochemicals companies can benefit from using rail transportation when integrating rail into their existing supply chains. As already experienced in Europe or the USA, using rail
transportation can add value to shippers by supporting existing transportation networks and creating new intermodal transportation opportunities. The benefits include increased choice and delivery flexibility, broader competition in the transport sector, and optimization of head haul and back haul by partnering with additional players. Rail also positively impacts the ability of petrochemical companies to manage their supply chain more effectively. This means meeting customer requirements and becoming more competitive - using rail can increase supply chain reliability, reduce supply chain volatility and risk, as well as shorten lead and delivery times. Rail transport is also reasonably resilient to disruptions due to changes in seasons or climatic conditions.

In addition, rail can support the growing sustainability efforts of Gulf petrochemical companies. Rail compares positively to truck transportation in all categories concerned with minimizing the environmental footprint of surface freight transportation-fuel efficiency, greenhouse gas emissions, accident and casualty rates as well as potential spills of hazardous material. Rail transportation is more fuel-efficient than road transportation. On average, trucks use more than double the energy per ton-km than trains - the higher the volume (mass) and the longer the distance, the bigger the difference (due to the high-energy consumption of the locomotive during the acceleration phase).

Rail transportation with diesel engines leads to about half the greenhouse gas emissions compared to road transportation with trucks. Statistically, rail transportation is significantly safer than road transportation. Rail cargo accidents are second only to marine transportation in terms of the ratio of fatalities to injuries per accident. About half of the accidents associated with trains are caused by rail crossings. Furthermore, rail transportation is safer than road transportation in terms of potential spills of hazardous materials. In the United States reports of spills and hazardous materials are tracked in a standardized way. The number of fatalities and total damage compared to the modal split are significantly higher for road transportation than for rail transportation.

Given the future economic development of the GCC petrochemical sector, additional benefits can be gained from rail when considering the possibility of container transport. The GCC petrochemical sector has already taken significant steps towards moving downstream, expanding manufacturing capabilities of commodity materials. Expanding these local manufacturing capacities to meet both local and international demand (for example for automotive components, paints and coatings as well as healthcare products) will lead to a demand for more volumes to be transported with smaller lot sizes and different packaging types (for example liquid ISO containers). These additional volumes can also be transported via rail.

From a strategic perspective, a fully connected GCC rail network could become invaluable to GCC petrochemical companies in the long term; it could enable unrestricted access to alternative ports for global marine exports outside the Arabian Gulf. Gulf petrochemicals companies can position themselves strongly today to capture the future value of these untapped opportunities benefiting their customers, industry stakeholders, and the broader community at large.
Getting ready to capture the future value of the GCC railway

In light of the GCC rail network development, GCC petrochemicals companies should determine the best overall transportation, logistics and supply chain concept, taking into account existing operations and new opportunities. Developing rail strategies requires a multi-phased approach. This includes significant effort and time to determine rail requirements as well as driving corresponding design and implementation of required changes to integrate rail into existing supply chain operations. Shippers activating greenfield rail operations or connecting to existing rail networks usually plan the following phases in developing rail strategies, assessing the general feasibility of rail and determining specific rail requirements.

Understand existing and forecasted future cargo flows
The first step for any petrochemicals company considering rail as a future mode of transportation is to analyze the status quo including relevant business units, production plants and product requirements. This includes understanding the relevant rail master plan for the overall GCC, as well as planned connections to its local production facilities such as planned developments and schedules, status of railway projects, proposed rail connections and sidings, as well as connections to inland hubs and seaports for marine exports.

An understanding of target markets, customer demands, destinations and requirements, as well as existing supply chain networks, current logistics operations and transportation modes, are just as important to determine current flows and simulate future volume flows. In addition, potential new business opportunities (for example potential new markets that could be reached by rail in the future) should also be considered. Petrochemicals companies should also verify their estimates of future developments (such as cargo
flows) based on sensitivity analyses. Potential drivers and metrics include GDP forecasts, demand and trade projections, and plans to develop new industries (for example downstream manufacturing). The intelligence gathered based on these analyses is critical to developing a sound understanding of approximate future freight flows (by business unit, products, packaging types and destinations).

Assess operational cost and determine modal split
Knowing the operational costs of the current supply chain, as well as estimates for the potential future supply chain including rail, is crucial to derive the ideal modal split by product and route and to determine potential financial support requirements to activate new rail infrastructure and operations. The assessment of cost structure and operational mode characteristics should include key cost positions (for example handling, shunting, labor, depreciation of rolling stock, inspection and maintenance, fuel and energy costs, potential rail network access fees and rail track utilization fees). It should also include operational assumptions (for example loading times and cycles, transportation times, maintenance frequency). Furthermore, the role of multiple stakeholders such as investors, operators and maintenance service providers also needs to be considered.

In order to determine the best future transportation model mix, such as how much road, rail and sea transportation to be used, shippers need to evaluate different transportation concepts (for example feeder, hub, ring road) as well as traffic types (for example wagon load freight, block train, combined traffic). Different combinations and scenarios of these concepts should be assessed in terms of operational feasibility, overall economics, safety, and emissions.

Define infrastructure and investment requirements
To integrate rail as a new transportation mode into existing supply chain operations, petrochemical companies need to recognize the infrastructure and investment requirements for rail integration at production plants, loading facilities, rolling stock, inland hubs, and customer unloading stations. This requires reviewing current logistics and product handling infrastructure (for example determining product handling requirements including; safety, operations, quality, costs, legal and customs requirements, and identifying available space for rail sidings and loading facilities).

Based on the understanding of current facilities and available space, requirements for new infrastructure (for logistics and product handling, road capacities, railway sidings and port connections) can be identified. The operational feasibility of the new integrated transportation concept, such as addressing how road and rail crossings will be used in parallel to nearby rail shunting facilities, needs to be assessed. In addition, rolling stock requirements (for example number and size of locomotives, railcars, and wagons) need to be determined. Based on these requirements, the necessary investments for typical rail infrastructure can be estimated.

Petrochemicals companies are advised to share their service and operation requirements with national and GCC rail authorities as early as possible to ensure operational feasibility and alignment to the rail network across the GCC. Petrochemicals companies and rail authorities will need to work hand in hand.

Developing a business case and prioritizing rail integration projects
Based on the investment requirements, business case assessments including net present value calculations can
be developed to prioritize key rail integration projects. When recommending viable implementation options, short- and long-term perspectives should be considered to evaluate the expected feasibility and value generation potential. Rail implementation projects are usually phased over time.

**Conduct EPC and ramp-up new operations**

In order to implement prioritized rail projects, infrastructure and operational upgrades at chemical production plants need to be designed and executed. This includes the development of detailed duty specifications as well as the management of FEED and EPC phases to ensure the successful integration of rail into existing supply chains. After mechanical completion and commissioning, the new infrastructure should be activated and ramped-up, based on a phased approach. During operations, intermodal logistics facilities and operations can be improved and optimized on a continuous basis to maximize overall supply chain performance and customer satisfaction.

The benefits and opportunities from integrated railway networks are manifold and extensive. Community contributions extend to safety, by contributing to reducing the number of road accidents, reduced air and noise pollution and improved quality of life. Rail brings with it direct and indirect benefits to GCC economies through increased investments in rail infrastructure and new industries, facilitating domestic and international trade and reducing the cost of business operation. Furthermore, it enables economic development and diversification along and beyond the rail value chain while promoting the build-up of local specialized talent, creating more jobs for the region. Rail will connect the GCC region and when it is completed will position the GCC favorably for the development of a strategic long-term railway hub between Europe and Asia.

Once fully operational it will be one of the best mitigations against any abnormality due to piracy or closure of the Strait of Hormuz. GPCA members are in the unique position to leverage the benefits of these developments as they control significant volumes traded between the countries and are already evaluating the feasibility of the GCC Railway for selected freight movements. The potential benefits are mutually attractive to both chemical producers and rail operators, as GPCA companies can provide the critical mass required to initiate successful rail operations.
About The Gulf Petrochemicals and Chemicals Association

The Gulf Petrochemicals and Chemicals Association (GPCA) is a dedicated and non-profit making association serving all its members with a variety of data, technical assistance and resources required by the petrochemicals and chemicals industry. GPCA's mission is singular and specific in that it intends to support the growth and sustainable development of the petrochemical and chemical industries in the Gulf in partnership with its members and stakeholders and be both a sounding board and a meeting point for debate and discussion. It is the first such association to represent the interests of the industry in the Middle East and it has brought a major dimension to its task by creating both a forum for discussion and a place where like-minded people can meet and share concepts and ideas. Since its inception in March 2006, the GPCA has earned the enviable reputation for steering the regional industry towards a whole new level of co-operation and raising the standard in terms of common ground interests.

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