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Global transportation analysis





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Executive summary

We live in interesting times for the transportation sector. Urbanization, the global economy, technological innovation, sustainability—these mega-trends will drive change, increase demand and create opportunity in the transportation sector. But, are government policy, delivery systems and the financial sector evolving such that the required new and rehabilitated transportation assets will be delivered? Or will decaying or insufficient transportation infrastructure hamper future progress?

In the hope of beginning to answer those questions, this report seeks to shed light on the broad variety of approaches to procuring, developing and upgrading transportation facilities by studying projects in various portions of their life cycles in 10 representative countries. Not surprisingly, there is little doubt that new and upgraded assets are needed for moving both people and goods. As a result, both the public and private sectors are pursuing projects around the world. However, two themes consistently emerge as impediments to the development of these much-needed projects: 1) political risk adversely influences every step of the development process; and 2) financing mechanisms are not keeping pace with the demand for projects. Currently, global transportation development is dominated by the Asia Pacific region. Led by strong population growth, the region accounted for 59% of development spending in 2013. Pricewaterhouse Coopers predicts that number will increase to 65% by 2025. Regardless of

market share, all regions of the world are expected to significantly increase spending over the next decade, with an estimated 200% growth in global spending. The strongest regions for growth are South America and Africa, which are each projected to increase spending by 250% between 2013 and 2025.

It is important to note the different emphasis on transportation sub-systems across the world. Europe spends roughly 10-15% more on rail development than the global average, while the same can be said for North America and the Middle East with respect to airports. In almost all instances, roads and rail are the top areas for spending. These regional development trends coincide strongly with the individual case studies.

Transportation infrastructure is affected by a multitude of factors, which can be distilled into four broad categories: political influences, economic environment, socio-cultural factors and technological advancements.

Transportation infrastructure is primarily a public commodity, which means its primary source of funding is the ruling government. This leaves development vulnerable to socio-economic instability and election cycles, since changing priorities may abruptly shift or halt ongoing infrastructure development. Globally, treaties such as the Trans-Pacific Partnership (TPP) continue to shift international trading routes, impacting the flow of imports/exports between airports and seaports.

There is a global deficit for infrastructure spending, which regularly exceeds \$1 trillion annually. The deficit will continue to increase as the impact of deferred maintenance grows and increasing populations demand increased infrastructure. More countries are turning to privatization to meet their development needs.

Climate change and sustainability are two of the most important issues facing the world today, and transportation plays a role in addressing both of them. Transportation accounts for 14% of greenhouse gas emissions. A two-pronged shift towards renewable power and mass transit can significantly reduce this number.

Innovations such as high-speed rail have the potential to transform the commuter experience. With 17,000 km of rail currently under construction, technology can improve efficiency beyond most current system

capabilities. One of the biggest challenges facing global infrastructure is antiquation. It is crucial to incorporate technology into new infrastructure development in order to avoid obsolescence and to achieve the targeted lifespan.

Projects such as the Panama Canal expansion will have a far-reaching impact across the globe due to their significant role in international freight travel. The global transportation horizon looks bright, with a strong pipeline of major projects underway or set to begin in the forthcoming years.

Methodology

This report was developed by the Global Leaders in Construction Management (GLCM) program, a research initiative established by Professor Ibrahim Odeh and Columbia University's Fu Foundation School of Engineering and Applied Sciences, with the generous support of Dentons.

The project team began their research in the fall of 2015 with an extensive literature review of the Malaysian construction market. At the beginning of 2016, the research team traveled to Kuala Lumpur, Malaysia, to conduct a week of hands-on research. During the week, the team conducted site visits to major construction projects and met with leaders from the industry in a series of workshops and question-and-answer sessions.

Upon their return, the team began to compile their analysis and formulated the Malaysian

case study. The team subsequently performed literature reviews for each of the case studies and conducted information gathering sessions with Dentons associates in almost all of the countries. After looking at the trends in individual countries, the team turned their attention towards the global transportation industry. Identifying the predominant trends and factors across the globe, the macro-trends were compared and contrasted to the case studies, and hypotheses were formulated for the successes and challenges of the various transportation sectors.

The ten countries examined are China, Colombia, Egypt, India, Malaysia, Mexico, Poland, South Africa, Turkey and the United Arab Emirates. These countries were strategically chosen because of their geographic locations and the unique challenges each country



faces. All of the countries have a need, and the potential, for strong infrastructure development in order to meet future economic and social goals. The various countries offer a glimpse into how different sub-sectors of transportation are prioritized and the creative methods in place to elicit project financing.

More details about the GLCM program and the research team can be found in the research team section at the end of this report.



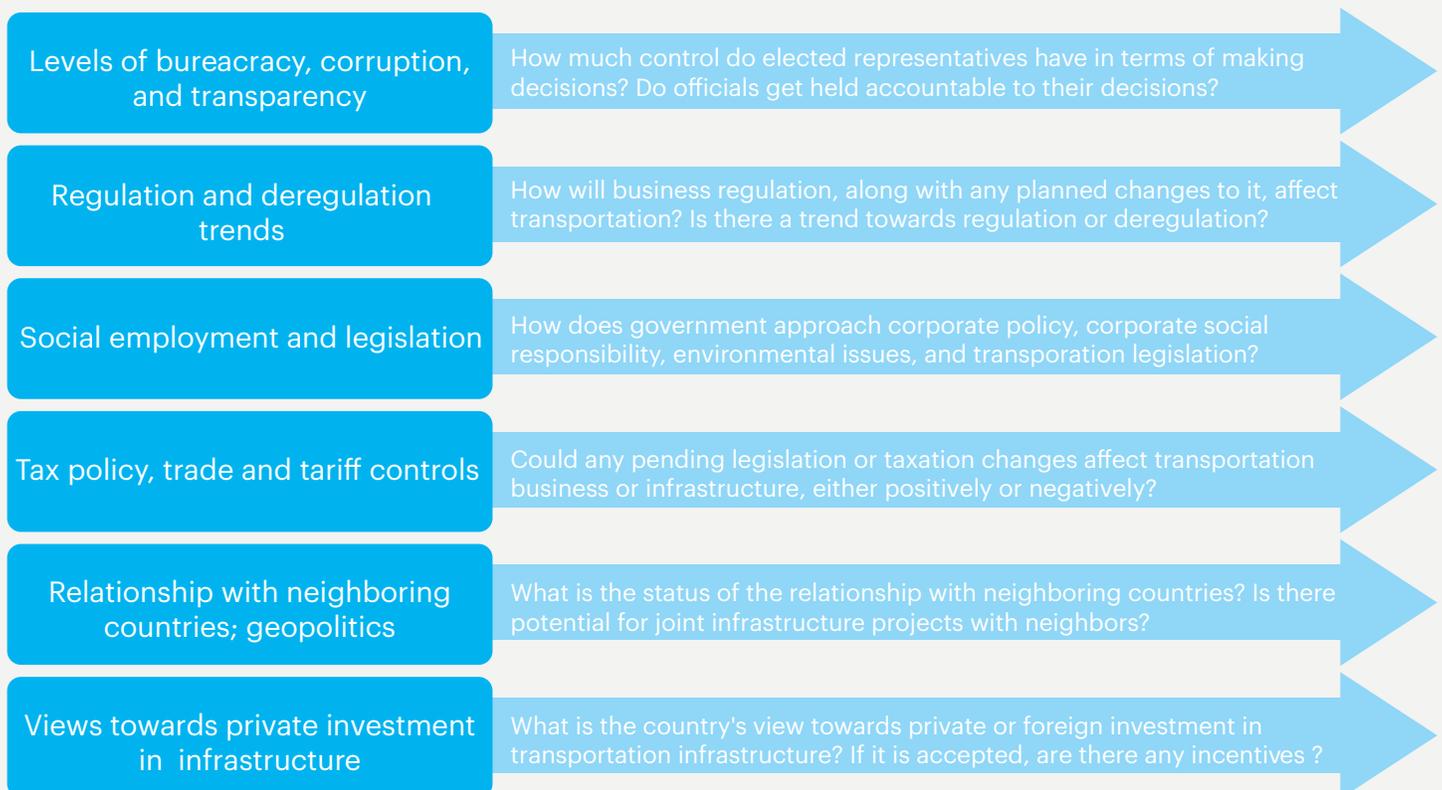
Politics and transportation infrastructure

The political scene across the globe is constantly changing, especially in developing countries. Governments that have lasted decades are being overthrown. Countries are changing the way they do business, especially when it comes to foreign investors. Furthermore, new alliances are forming and new rivalries are emerging.

Global trends occurring in politics play a critical role in how the world is connected between nations, and how nations are connected

internally. One prominent trend that drastically globalized the industry of transportation in North America is the North American Free Trade Agreement (NAFTA), which established the CANAMEX Corridor for road transport between Canada and Mexico through the United States, also proposed for use by rail, pipeline, and fiber optic telecommunications infrastructure.^[1] Similar trends can be observed in regions around the world such as South America, Europe, and Southeast Asia.

Figure 1. Political factors



This report highlights case studies of ten countries and contains a detailed political analysis of these countries. The analysis discusses how major political factors such as the role of government, tax policies and trade controls, and geopolitics are affecting transportation. Figure 1 highlights the political

factors that can contribute to the success or failure of transportation, and offers sample questions in order to better understand the politics in a country. Consequently, these factors affect private investors and their confidence in investing and partnering with governments.



Economics and transportation infrastructure

Transportation infrastructure is directly linked to a country's economic cycle. The movement of people, freight, and levels of accessibility are essential to this link. Economic opportunities are more likely to occur where transportation infrastructures are able to supply mobility needs and assure access to markets and resources. It is important to note that different parts of the world have been affected in different ways due to economic development, from the industrial revolution to globalization, up to the economic integration processes.

However, transportation investments are likely to have decreasing marginal revenues. While initial investments in infrastructures are likely to offer high returns, the more development in the system, the higher likelihood that added investment can cause lower returns. At a

specific point, the internal rate of return can be negligible or negative. Figure 2 provides proof that there is a gap between infrastructure supply and demand, which ranged from about US\$1 trillion to US\$1.5 trillion per year worldwide, according to a study by the Boston Consulting Group (BCG).^[2]

This gap explains why more and more governments are resorting to funding from the private sector and forming public-private partnerships. When managed well, such partnerships have major advantages over traditional public infrastructure projects, such as more rigorous project selection, relief for governments facing short-term budget pressures, and better cost-managed projects with maximum revenue.^[2]

Figure 2. Gap between infrastructure supply and demand
Sources: HIS; OECD; IEA; Economist IU; BCG analysis

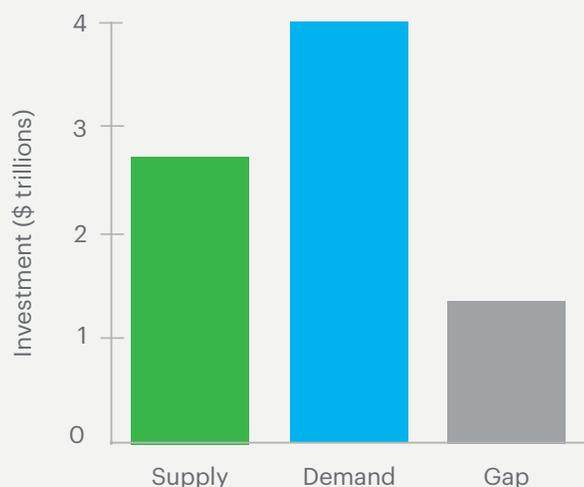


Figure 3. Economic factors



The detailed economic analysis of these 10 countries discusses how some economic factors such as inflation and interest rates, unemployment and labor, and commodity prices and currency movements are affecting

transportation. Figure 3 highlights the economic factors that can contribute to the success or failure of transportation, and offers sample questions in order to better understand the economy of a country.

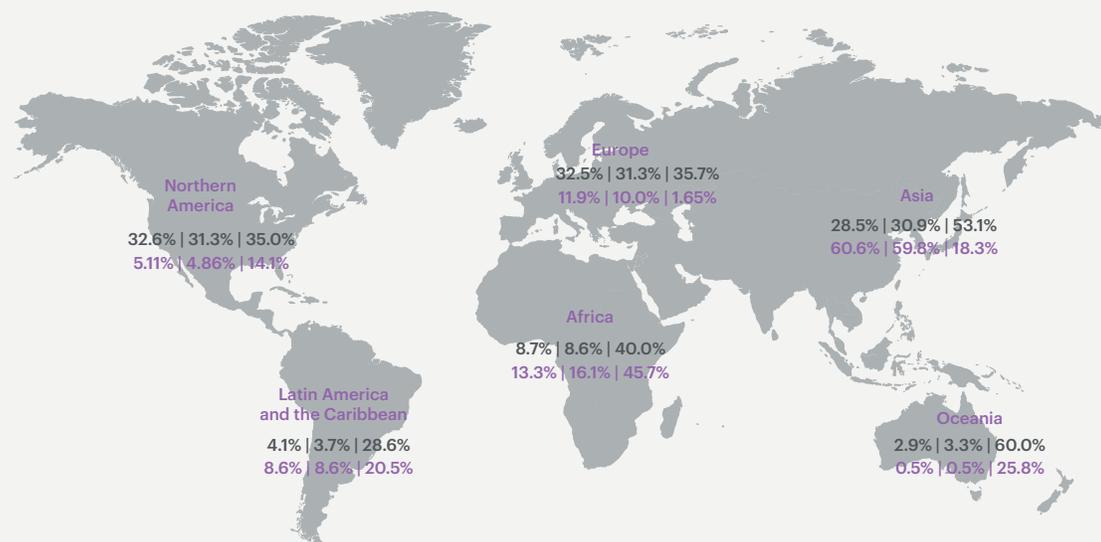
Society and transportation infrastructure

Transportation systems are a central component of societies, since they support intricate social interactions. Mobility is perhaps the utmost essential and significant characteristic of social activities, as it fulfills the simple need of moving from one location to another, a need which is shared by information, freight, and passengers. Locations do not share identical levels of mobility, as most are in various stages of development. As a result, economies that have a higher level of mobility have enhanced opportunities to develop compared to those with a low level of mobility. Reduced mobility hinders development, while superior mobility is a facilitator for development. Thus, the

level of mobility is a reliable determinant of development.

Mobility is affected by numerous factors. On the individual level, time confines the number and length of trips that can be done in a day. These constraints are, however, technologically, socially and economically distinct, since more efficient transport modes are supportive of more extensive mobility as well as higher levels of income. Thus, an individual's level of mobility is related to the available supply of transportation, the available budget, and the physical capabilities.

Figure 4. World population and international migrant population by region 2000 and 2015



Region

% intl. migrants 2000 | % intl. migrants 2015 | % growth 2000-15
 % World pop. 2000 | % world pop. 2015 | % growth 2000-15

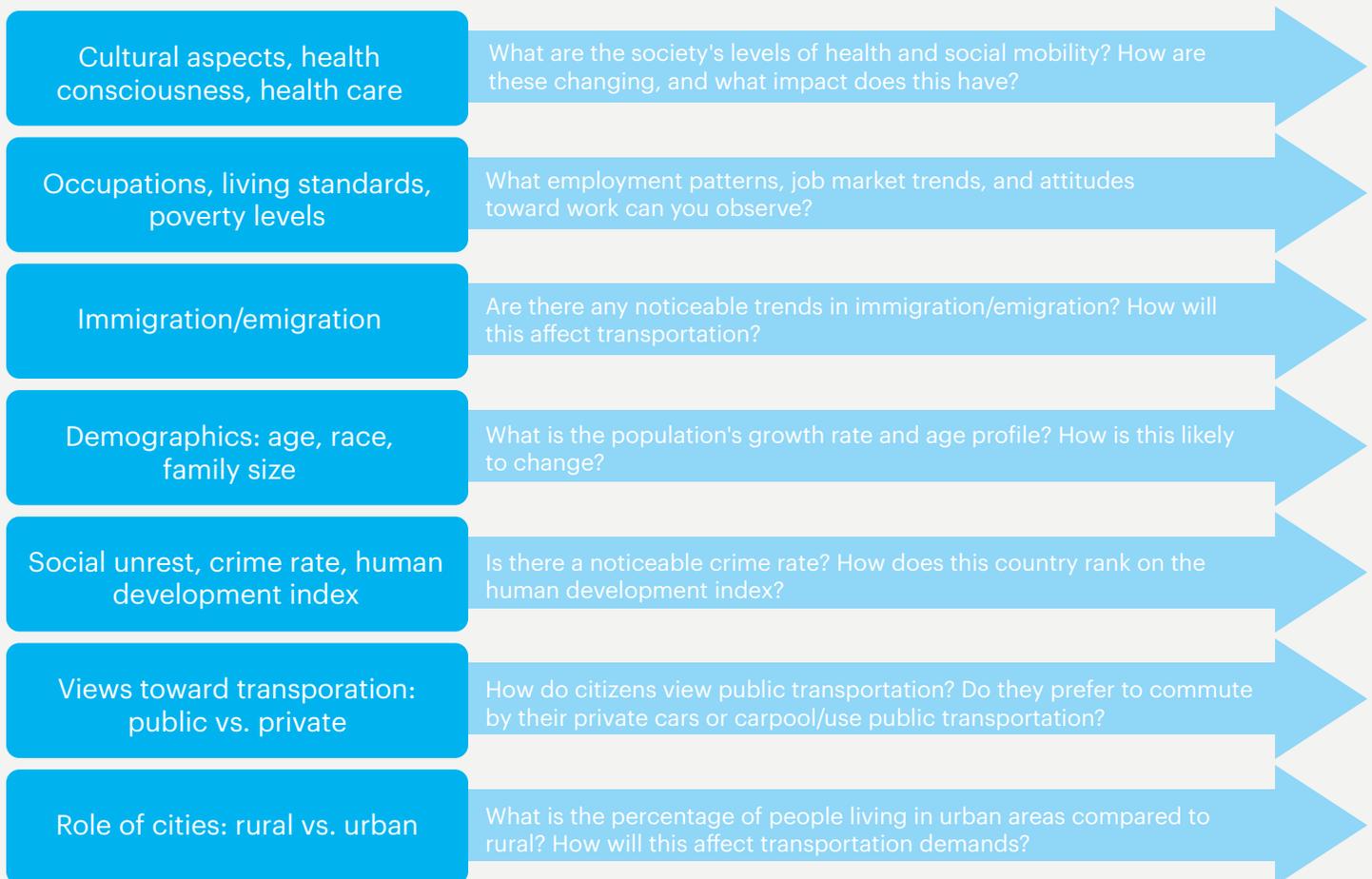
Source: UN International Migration Report 2015

Source: UN Population Division, World Population Prospects Data

Further, the social context of mobility is changing in part because of its impact. Mobility can cause weaker social interactions as it facilitates individuals to live further apart. At the same time, expanded mobility enables expanded social interactions that were not physically possible before. For example, long-distance interactions have increased due to the growth of air transport.

Global migration and population patterns have a tremendous impact on transportation infrastructure. The number of international migrants reached a record level of 244 million in 2015.^[3] This is a direct testament to the connectivity and ease with which the global transportation sector operates. In 2013, the US and Canada (5% of global population) housed 20% of international migrants, and Europe

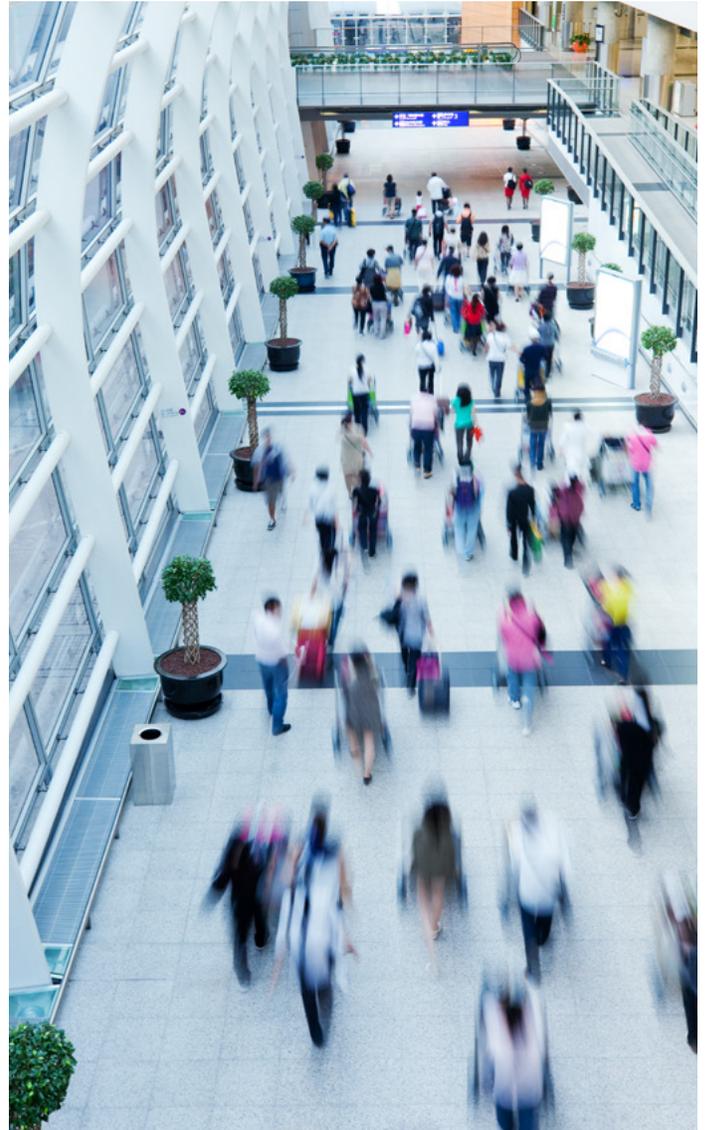
Figure 5. Social factors



(10% of global population) is home to nearly a third of the global migrant population.^[4] The number has only increased for Europe, with refugees from Syria and other Middle East countries traveling into the continent through the Mediterranean Sea. Figure 4 shows regional migration and population patterns as percentages of the global total.

The number of international migrants increased 41% between 2000 and 2015,^[5] but global population increased only 20% during that same timespan.^[6] As the number of international migrants continues to grow, social opinion towards public policy will shift, which will have a direct effect on infrastructure development.

This report highlights ten case studies in ten countries and contains a detailed socio-cultural analysis of these countries. The analysis discusses how some social factors are affecting transportation, such as living standards, immigration and emigration, and views towards transportation. Figure 5 highlights the social factors that can contribute to the success or failure of transportation, and offers sample questions in order to better understand the society in a country.



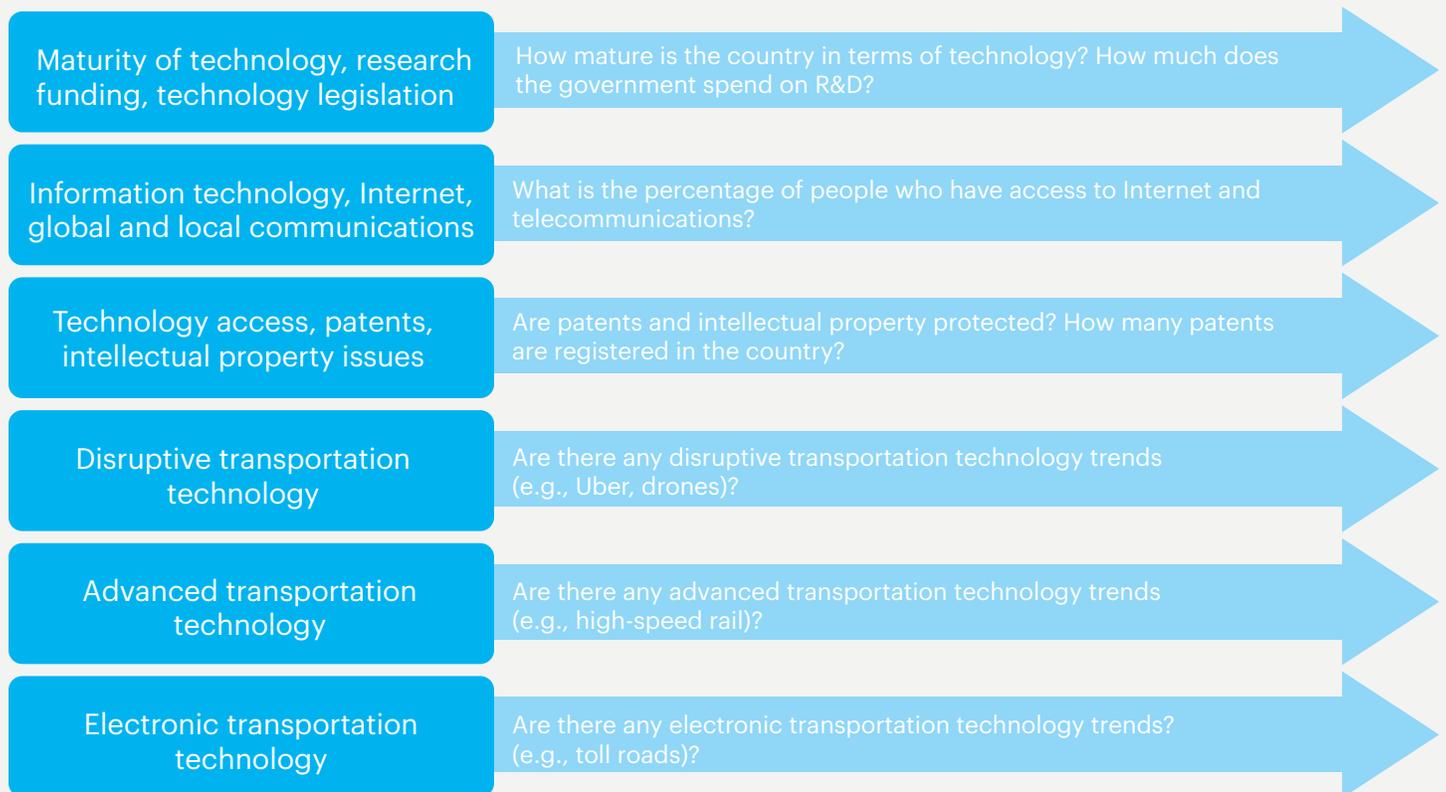
Technology and transportation infrastructure

All transportation is dependent on technology, whether it's the computer chip, the jet engine, or the wheel. Transportation is not just technology. Transportation is a system of money, people, energy, technology, and many more factors. However, advances in technology allow people to shape transportation systems and change how transportation infrastructure is built.

Innovations in transportation technology are creating new trends around the world, and are set to change the way people drive to work,

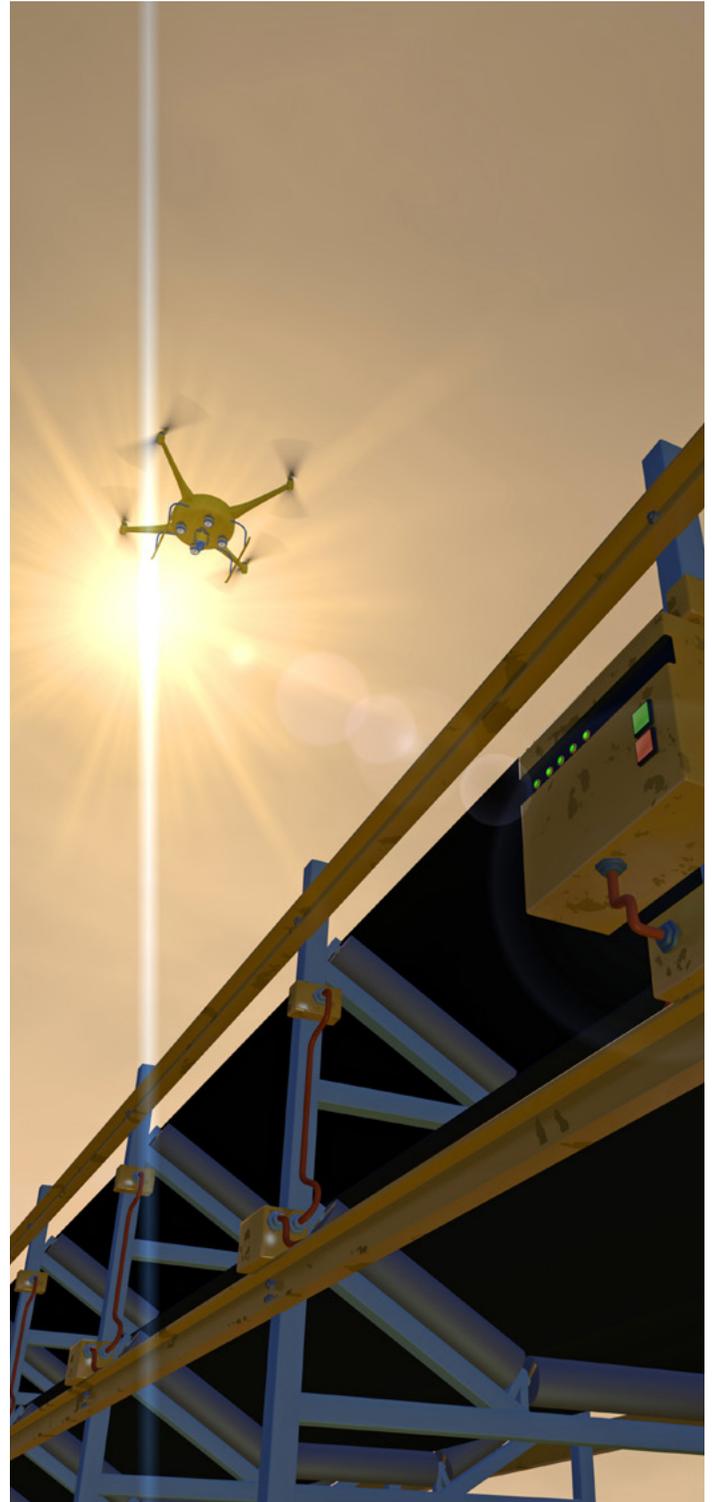
travel on vacations, or transport materials. The most striking fact is that these revolutionary technologies are not far-fetched, but are set to debut within the next 10 years or are already active. Examples of this are: the Hyperloop, which plans to transport people from Los Angeles to San Francisco in around half an hour, Maglev trains, autonomous vehicles, and urban transport pods. Some of these technologies are discussed in more detail later in the report. Other innovations, such as drones, are controversial and are still under review

Figure 6. Technology factors



and development due to potential concerns. For example, drones offer great advantages in imaging and transporting materials, but there have been rising concerns about their ability to invade privacy.

The detailed technology analysis of each of the ten case studies in this report discusses how some technology factors are affecting transportation, such as research funding, technology legislation, and disruptive or advanced transportation technology. Figure 6 highlights the technological factors that can contribute to the success or failure of transportation, and offers sample questions in order to better understand the technology of a country.



Rail

Global status

Rail infrastructure has been ranked globally by the World Economic Forum with an average of 3.34 in a scale from 1 to 7 in countries where there is regular train service.^[7] After breaking down the report by regions, only Western Europe and North America are high above the average. South America has the lowest ranking, with a score of 2.05, as noted in Figure 7. Our research has also isolated the countries we analyzed in the case studies, with Malaysia having the highest rank, followed closely by China, while UAE is not ranked yet because their freight service entered into service this past year. Table 1 shows the ranks and WEF scale for each of the countries studied.

The network size in each country does not relate equally to its rating. China has the second-

largest network in the world, and due to its aggressive expansion in recent years of its freight, conventional and high-speed networks, it has a high ranking among its peers. Malaysia, on the other hand, has a relatively small network, but the fact that the system is fairly new and well maintained has made Malaysia's system one of the highest-ranked. Moreover, Poland has one of the densest systems in the world, as noted in Table 2, but given that the system is old with many deficiencies, it received a poor grade in the ranking. Over the past years, with the use of financing schemes from the European Union, and following the Trans-European Transport Network goals to connect the entire continent efficiently, Poland has started to develop new infrastructure by adding high-speed rail and upgrading the existing network.

Figure 7. Regional quality of infrastructure
Source: Data from WEF

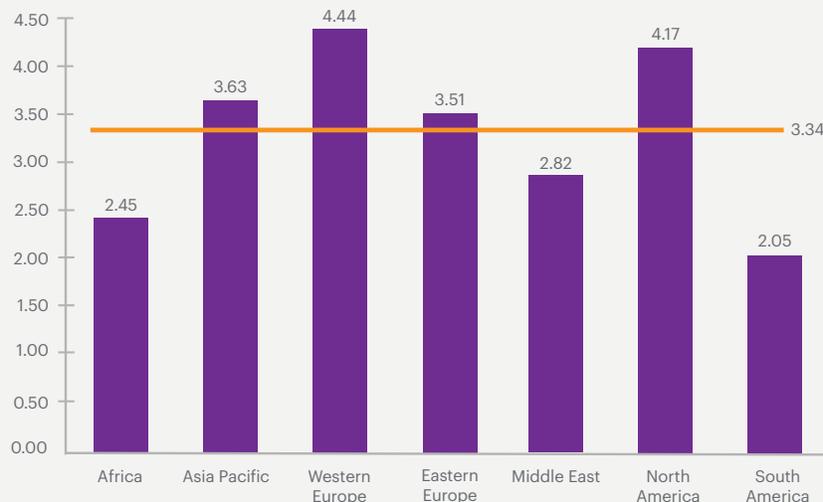


Table 1. Ranking and scale for each country within the research
 Source: Data from WEF

		China	Colombia	Egypt	India	Malaysia	Mexico	Poland	South Africa	Turkey	UAE
Quality of Railroad Infrastructure	Scale 1 to 7	4.48	1.5	2.4	4.2	5	2.8	2.9	3.4	3.1	N/A
	WEF	17	102	78	27	12	64	55	44	49	N/A

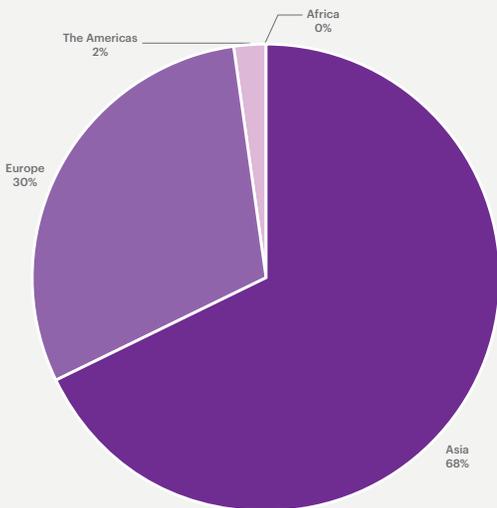
Table 2. Rail density in meters per square km
 Source: Case studies

Rail Density	China	Colombia	Egypt	India	Malaysia	Mexico	Poland	South Africa	Turkey	UAE
in meters per km ²	10.97	0.79	9.71	22.13	5.58	13.74	76.51	16.90	13.11	3.19

High-speed rail (HSR) infrastructure

For the last decades, high-speed connections between cities and commercial centers have received major attention by governments worldwide. More than 35,000 km of high-speed lines are being used presently, with the majority located in Asia, followed by Europe and the Americas.^[8] Figure 8 shows the distribution of high-speed rail by global regions. Currently there is no operating high-speed infrastructure in Africa or Oceania; however, Morocco is building a 200 km project to connect Casablanca with the city of Tangier. There are more than 17,000 km of high-speed rail projects currently under construction. Asia is leading with almost 14,000 km. Figure 9 shows

Figure 8. High-speed rail distribution globally
Source: Data from GoEuro



the breakdown of projects under construction globally; notice there are none in Oceania.

In the future, major high-speed infrastructure developments will begin globally. A large number of projects are in planning stages across the world and will almost double the infrastructure that is already built or being built.^[8] Figure 10 shows that 41% of the planned HSR will be developed in Asia, followed by Europe with 32%, Africa 12%, the Americas 10% and Oceania with 5%.

Figure 9. High-speed rail under construction globally
Source: Data from GoEuro

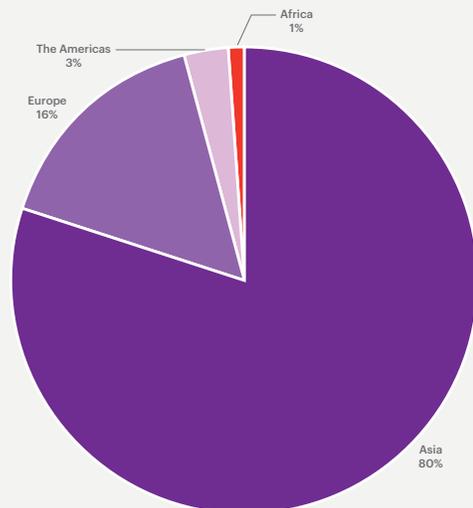


Figure 10. High-speed infrastructure being planned globally in km
 Source: Data from GoEuro

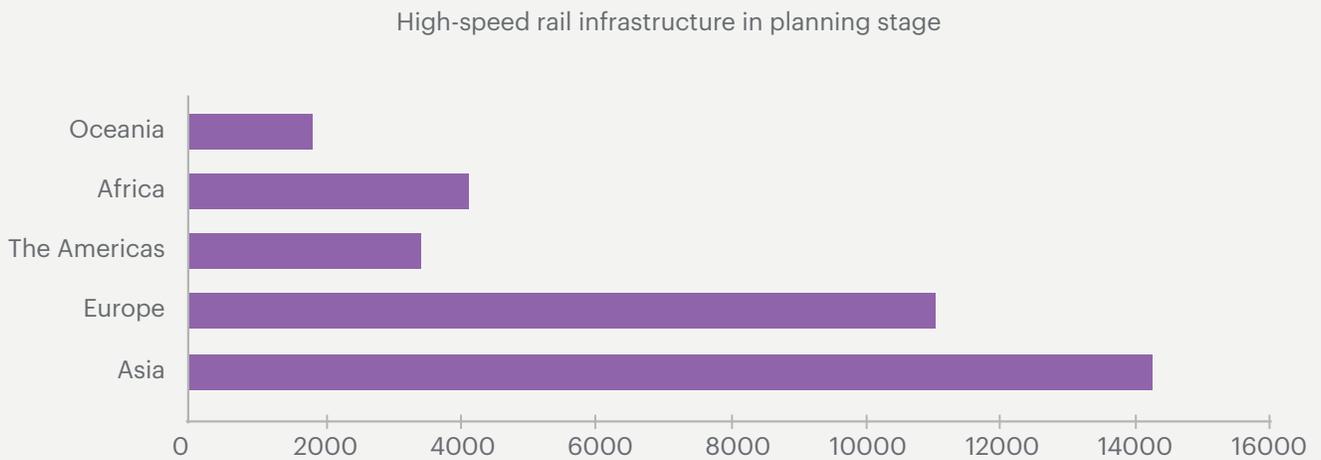
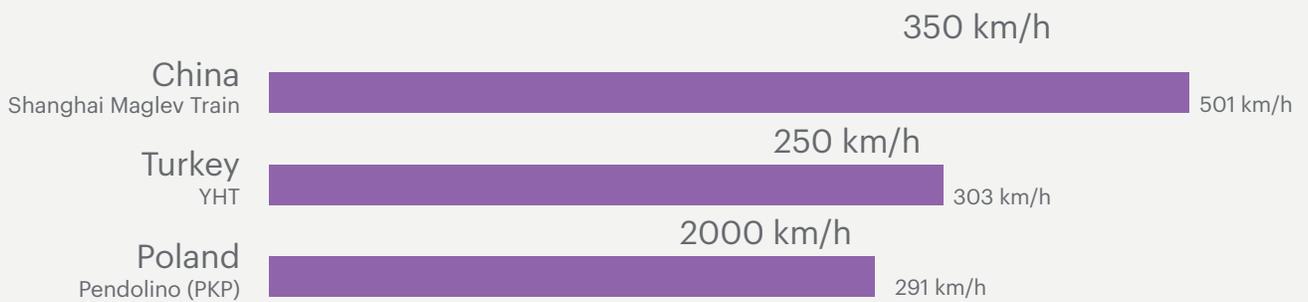


Figure 11. World's fastest high-speed trains (blue = operating speeds; black = record speed)
 Source: GoEuro



Operating speed is the fundamental criteria of high-speed rail. China's high-speed rail has the fastest operating speed in the world, with Shanghai Maglev running at 350 km/hr as seen in Figure 11. Normally a rail system is considered high-speed when the operating speeds are equal to or more than 200 km/hr. Mature systems such as those in Japan, France and Spain run at 320 km/hr, while, following the case studies, Turkey's system has an operating speed of 250 km/hr and Poland's Pendolino Intercity Lines go up to 200 km/hr.

Improvement of rail infrastructure

A study made by BCG in 2010 estimated that in the next 20 years, US\$1.3 trillion will be required to satisfy the need for rail infrastructure development. BCG also noted that in the best-case scenario, governments will be able to fund half the capital requirements for the infrastructure development.^[9] The gap in funding creates a wide range of opportunities for private investors looking to exploit their capital. Countries such as Turkey, one of the case studies, have already developed policies to attract private investment either solely in the financing of new developments or for public-private partnerships, where investors will build and operate new rail alignments for a period of time, as a build-operate-transfer (BOT) delivery method.

Global trend

A study made by Roland Berger identified six major trends that have affected the rail infrastructure sector over the past years.^[10] Despite slow global economic growth and, in most countries, public deficit problems, the world supply of rail industry-related products will increase 2.7% per year over the next years, as shown in last year's UNIFE World Rail Market Study. Latin America will have a higher increase of market supply for the 2017-2019 period, with an approximate 6% increase, in contrast to 2011-2013. Asia follows with approximately a 4% increase in orders, and NAFTA with a 3.5% increase. Western Europe, Eastern Europe and CIS will have 2%, 1%, and 1% increases, respectively. The number of orders in regions such as Africa and the Middle East will remain approximately the same as at present.^[11] Figure 12 shows a world map with these trends.



Urbanization and increased mobility



Overall economic growth



Deregulation and liberalization



Increased government support



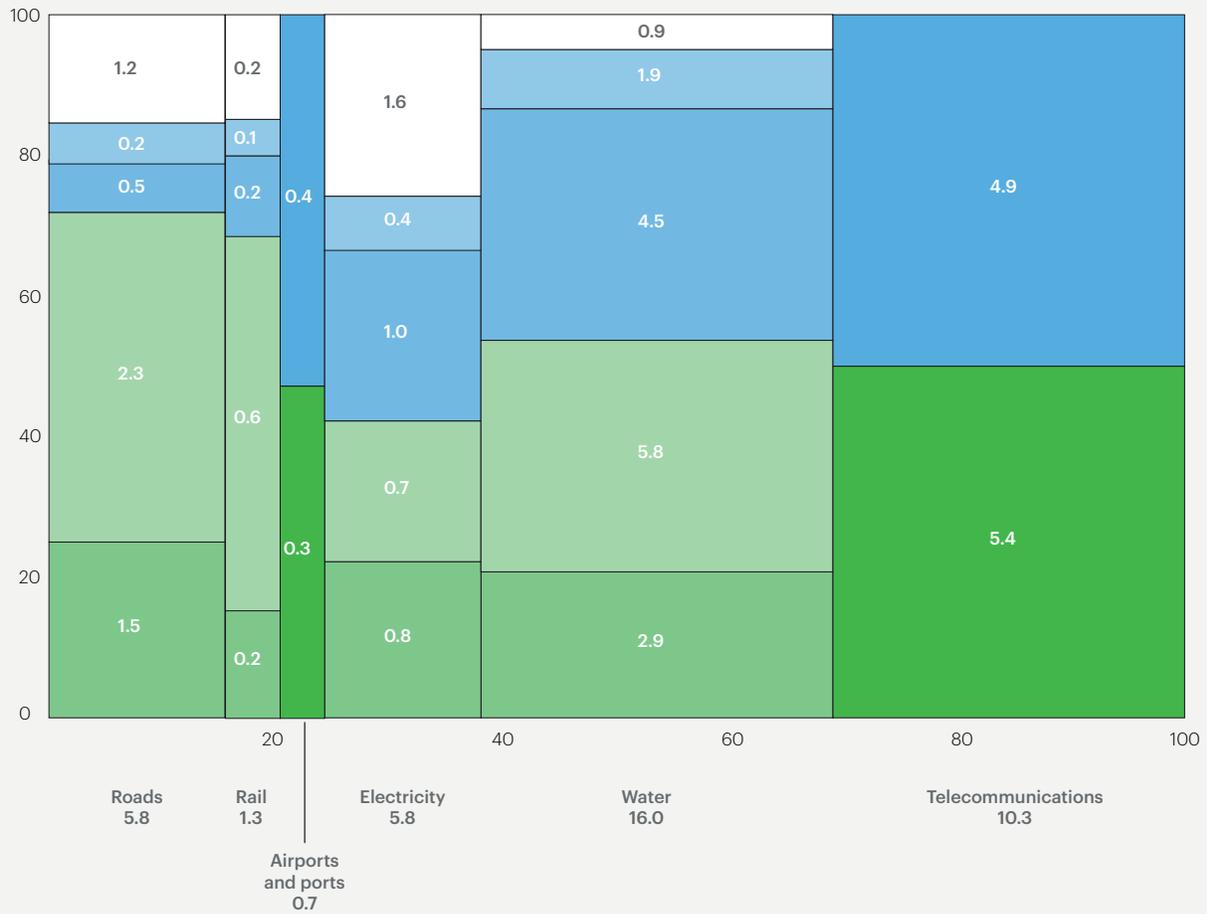
Energy scarcity and environmental concerns



Train protection technologies

Type of investment, by industry (%)

Cumulative investment needed by 2030 (\$ trillions)



Sources: Organisation for Economic Co-operation and Development (OECD); BCG estimates; BCG analysis. The data for water refer to the world mapped by OECD (all OECD countries, as well as Brazil, China, India and Russia)

Rail freight over road freight

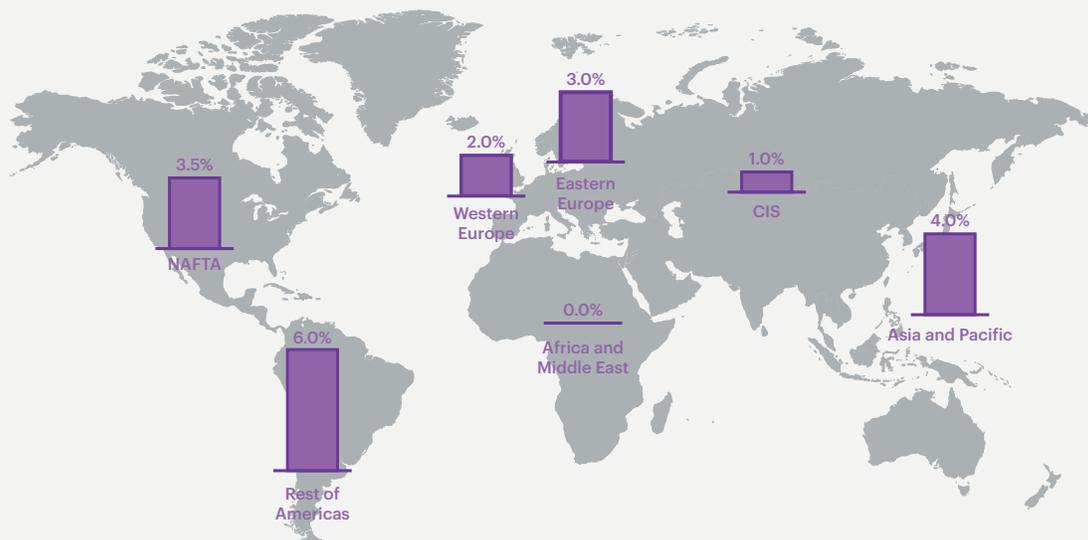
The use of rail freight instead of road freight has been mentioned in almost all case studies. Governments have started to incentivize freight transportation using the existing rail networks instead of the more common road transportation. This serves one main purpose: the less trucks on the roads, the longer the roads will last. Taking the large freight transportation loads off the roads will mean that less maintenance will be needed for existing road networks; thus, governments can utilize the capital to improve other services or extend the existing roads or rail networks. Lastly, the road users will benefit from this shift in policy

because the result will be less congested roadways, fewer potholes, and ultimately a safer road to travel.

Sustainability

Rail transportation is a more sustainable method to mobilize goods and people between locations. According to a study made by UNIFE (the European rail manufacturing industry), from the almost 22% of total energy-related carbon emissions made by transport modes (cars, truck, ships, airplane and rail), only 0.7% was generated by rail. At the same time, rail met 9% of the global mobility demand, making rail one of the more sustainable types of transportation

Figure 12. World map with rail market supply annual variation 2017 to 2019
Source: Data from UNIFE



currently available. The use of rail transportation supports the COP 21 goal of reducing CO₂ emissions by at least 40% in 2030 compared to 1990 levels. At the same time, the commission is focused on electrification of the rail sector to reduce greenhouse gases and create a more decarbonized transport sector.^[12]

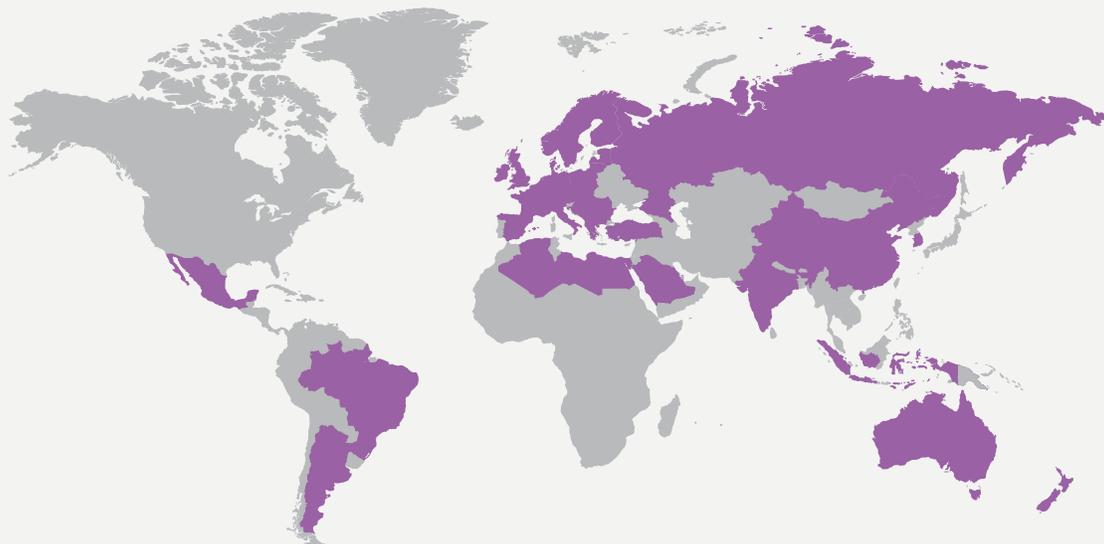
Technology and innovation

Safety

The safety improvements over the years in the rail sector have made rail one of the safest transportation modes, second only to airplane transportation. The technology has improved drastically in the past decades due to the open-border policy in the European Union. This policy

called for a standardization of safety measures across Europe; the European Train Control System (ETCS) was thus created. With three different levels of compliance, routes are safer than with legacy safety systems. Now trains are automatically prevented from going too fast or getting too close to another train, while performance and reliability are also improved. The European Rail Traffic Management System (ERTMS)—the parent company of the ETCS—continues to improve its system by generating new levels of compliance. A new Level 3 is being developed that will increase the overall safety of trains. The ETCS standard is now present in more than 45 countries and is growing continuously, as seen in Figure 13.^[13]

Figure 13. ETCS system globally
Source: Data from ERTMS as of May 2014



Hyperloop

The Hyperloop is a revolutionary method of transportation similar to a high-speed train. Using a vacuum tube with almost all air removed, a capsule carrying passengers or cargo is pushed through the tube, while a series of electromagnets stabilizes the capsule as it moves through the tube. This technology will have an average speed of almost 760 mph, as seen in Figure 14. Tracks have already started being built for testing the capsules, and a limited number of companies are directly involved with the program. The Hyperloop was first introduced as an open-source design in 2013 by Elon Musk, the founder of Paypal, Tesla and SpaceX.^[14]

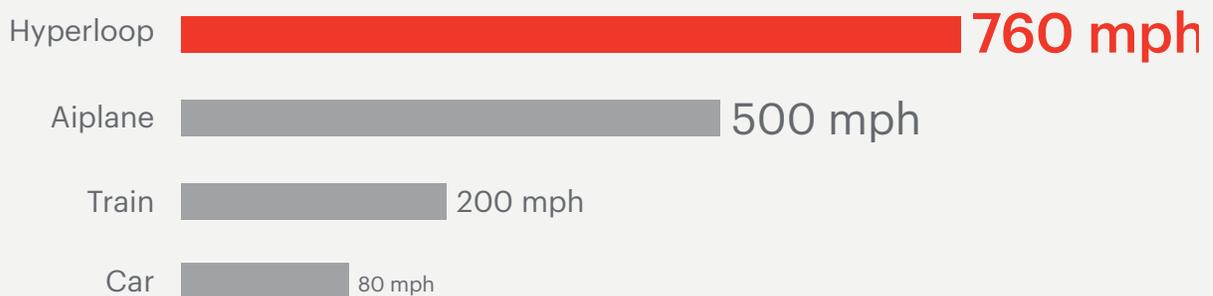
Challenges

After evaluating all case studies, a series of common challenges has been identified. These challenges might not be strictly addressed in all countries, but they will function as a guideline to determine the potential of business in any country or region.

Monopoly and bureaucracy

Governments monopolize operation of the rail industry in every country, with a few exceptions such as Colombia and Mexico. Local and/or foreign companies trying to enter the rail transportation market will have difficulties if the country does not have open policies. Additionally, some countries such as China have strict laws regarding the participation of foreign companies in the rail market, although recently,

Figure 14. Hyperloop speeds
Source: HTT



the Chinese government opened the market by allowing foreign companies to hold railway bonds and participate in the supply chain of rail components for the country. Furthermore, governments such as Egypt's welcome foreign countries to invest in the rail industry, but companies trying to invest will face bureaucracy problems in legal and property transactions.

Old infrastructure

Countries that have had rail infrastructure for decades now face the challenges of an aging infrastructure, such as lack of proper safety regulations in all of its tracks, lack of maintenance, and different gauges. Countries are now trying to standardize their networks at all possible levels. However, the amount of capital needed to bring the infrastructure up to current safety standards has made governments such as Colombia's pursue public-private partnerships, where the government allows the investor to build and operate the network for a period of time in return for its investment.

Weather

The specific weather of a region may affect the choice of location and route of a rail system. For example, a system located in the United Arab Emirates, with its close proximity to the desert, will have challenges in withstanding sandstorms and high fluctuations of temperature. As another example, Colombia rail infrastructure systems may be damaged by floods during the rainy season.

Environmental concerns

The creation of new routes for conventional and high-speed rail has been difficult in certain countries. The environmental permits required for the construction of new lines could impose a challenge. Since rail transportation, both for passengers and freight, is more environmentally friendly than any other type of transportation available, governments, in alliance with local authorities, need to consider this to sustain their arguments for and facilitate the creation of new and more efficient networks.

Funding

All countries in the case studies have cash-constrained economies, where the search for new types of funding is a constant challenge. With the drop in oil prices, countries such as UAE have put on hold many rail-related projects. For example, UAE has stopped developing phase 2 of their rail network, which will bring high-speed rail to the country and will also connect the network to neighboring countries. Also, commodities such as coal have dropped in price, creating economic difficulties for countries such as South Africa and Colombia, who rely on coal exports. Countries have started to welcome private and foreign investors to be part of the rail infrastructure development. Turkey, for example, has included these premises in their national transportation plan. Moreover, India also encourages private investment in their infrastructure, but the rail network needs more subsidies than other sectors; thus, a way to effectively reduce the gap is needed. World lending agencies such as

the World Bank, and regional lending agencies such as the European Bank, are involved in the financing of the rail sector around the world. The European Union is deeply involved in Poland's rail infrastructure development, with the creation of a high-speed train service called Pendolino, which serves the goal to have a fully European high-speed rail network by 2030.

Population

The most important factor when developing new infrastructure is population, because governments develop their infrastructure plans for the benefit of the population. For example, Europe has a vast rail network because their urban centers are dense and located relatively near to each other. Thus, feasibility studies generally support the development or upgrade of infrastructure. Another factor is the aging

of population, which in China has influenced the abandonment of the "one child policy." China has recently realized that to keep up with recent spending, they need to have a high percentage of productive population. Moreover, Poland is experiencing a slow decline in their total population because they are following the trend, mainly European or from developing countries, of having a low birth rate. This trend may jeopardize economic growth across the European continent.

Politics

Another factor related to population is politics. Politics plays an important role in determining which projects will go forward. When politicians control the taxation funding for projects, there may be a bias in funding projects that benefit reelection campaign purposes.

Roads and highways

Table 3. Status and key indicators for selected countries

China	Population 2015	GNI (PPP*) per capita 2014	% GDP growth 2015	Total road network (2012)
	1,401,586,609	13,170	71	4,106,387
	Road density km/1000 km ²	427.882	Motor vehicles/km road	22.6
	Paved road (2012)	3,453,890	Annual facilities (2013)	261,367
	Motorway km/1000 km ²	72.26	Annual facilities per 100,000 pop	72.26
Colombia	Population 2015	GNI (PPP*) per capita 2014	% GDP growth 2015	Total road network (2012)
	49,529,208	12,910	4.5	20.5
	Road density km/1000 km ²	197,223	Motor vehicles/km road	15.8
	Paved road (2012)	40,971	Annual facilities (2013)	8,107
	Motorway km/1000 km ²	-	Annual facilities per 100,000 pop	15.6
Egypt	Population 2015	GNI (PPP*) per capita 2014	% GDP growth 2015	Total road network (2012)
	84,705,681	10,280	3.5	137,430
	Road density km/1000 km ²	1,373	Motor vehicles/km road	27.2
	Paved road (2012)	126,742	Annual facilities (2013)	10,466
	Motorway km/1000 km ²	11.44	Annual facilities per 100,000 pop	13.2
India	Population 2015	GNI (PPP*) per capita 2014	% GDP growth 2015	Total road network (2012)
	1,282,390,303	5,630	6.4	4,699,024
	Road density km/1000 km ²	1,429.14	Motor vehicles/km road	4.6
	Paved road (2012)	283,102	Annual facilities (2013)	261,367
	Motorway km/1000 km ²	1	Annual facilities per 100,000 pop	18.9
Malaysia	Population 2015	GNI (PPP*) per capita 2014	% GDP growth 2015	Total road network (2012)
	30,651,176	24,770	5.2	144,403
	Road density km/1000 km ²	439.37	Motor vehicles/km road	70.1
	Paved road (2012)	116,169	Annual facilities (2013)	7,129
	Motorway km/1000 km ²	73.42	Annual facilities per 100,000 pop	24.9

Mexico	Population 2015	GNI (PPP*) per capita 2014	% GDP growth 2015	Total road Network (2012)
	125,235,587	16,840	3.5	377,660
	Road density km/1000 km²	202.88	Motor vehicles/km road	85.4
	Paved Road (2012)	137,544	Annual facilities (2013)	15,062
	Motorway km/1000 km²	11.44	Annual facilities per 100,000 pop	14.7
Poland	Population 2015	GNI (PPP*) per capita 2014	% GDP growth 2015	Total road Network (2012)
	38,221,584	24,430	3.3	412,035
	Road density km/1000 km²	1354.24	Motor vehicles/km road	51.8
	Paved Road (2012)	280,719	Annual facilities (2013)	3,931
	Motorway km/1000 km²	7.46	Annual facilities per 100,000 pop	11.8
South Africa	Population 2015	GNI (PPP*) per capita 2014	% GDP growth 2015	Total road network (2012)
	53,491,333	12,700	2.3	747,014
	Road density km/1000 km²	615.1	Motor vehicles/km road	16.2
	Paved Road (2012)	158,952	Annual facilities (2013)	13,273
	Motorway km/1000 km²	47.82	Annual facilities per 100,000 pop	31.9
Turkey	Population 2015	GNI (PPP*) per capita 2014	% GDP growth 2015	Total road network (2012)
	76,690,509	19,560	3	385,754
	Road density km/1000 km²	501.22	Motor vehicles/km road	32.6
	Paved Road (2012)	352,268	Annual facilities (2013)	8,758
	Motorway km/1000 km²	2.61	Annual facilities per 100,000 pop	12
UAE	Population 2015	GNI (PPP*) per capita 2014	% GDP growth 2015	Total road network (2012)
	9,577,128	67,720	4.5	4,080
	Road density km/1000 km²	48.8	Motor vehicles/km road	271
	Paved Road (2012)	4,080	Annual facilities (2013)	1,021
	Motorway km/1000 km²	580	Annual facilities per 100,000 pop	12.7

NB: Indicators are the same as those selected by International Federation of Roads but the data has been updated. Road Density km/1,000 km² = total road network length^[14] X 1000 / (total land area of selected country)

Global trends

Global travel

The International Energy Agency (IEA) has analysed infrastructure, using a mobility model (MoMo), showing that over the next four decades global passenger and freight travel is projected to increase by 100% from the 2010 levels (Figure 15). The IEA has also defined a projection scenario, based on fulfilment of current promises and steps taken by nations

globally, called 4DS (4 degree scenario, Energy Technology Perspective 2012). Under 4DS, nearly 25 million paved road-lane kilometers are expected to be added globally, or a 60% addition from the 2010 levels, to sustain the global passenger and freight travel increase by 2050. Investments under the 4DS are expected to reach US\$45 trillion by 2050, which accounts for 0.7% of the global GDP (consistent with the present numbers).^[18]

Figure 15. Expected global travel growth for roads under 4DS
Source: IEA data and analysis

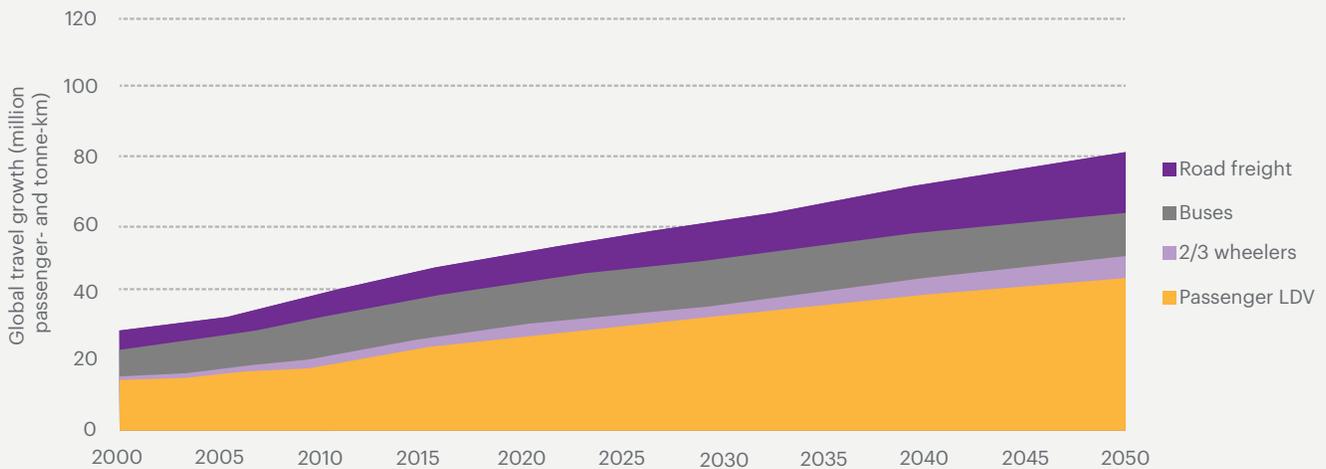
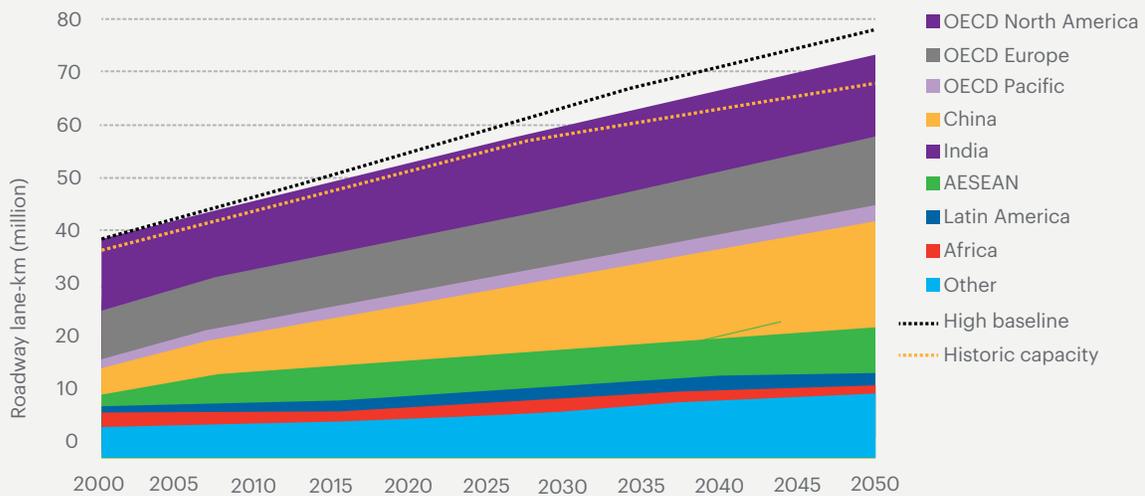


Figure 16. Historic paved roadway lane-km (left); Year 2050 paved roadway lane-km projection (right). Source: IRF 2012, EMBARQ, IEA 2012



Paved road

The last decade (2000-10) has seen a network length increase of 12 million lane-km globally, with more than 50% of this increase from India and China. The majority of this growth was from non-OECD nations. In fact, some OECD nations, like

Australia, had slight losses in the road network length. Also, the paved lane-km has increased by more than 7% of the total road lane-km in the last decade. They are likely to grow by 25 million lane-km by 2050 under current policies, requiring nearly US\$80 trillion (Figure 16).^[18]

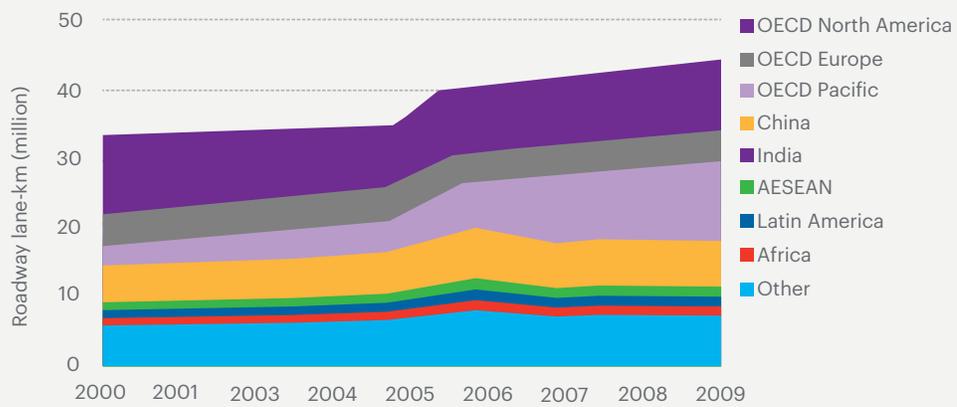
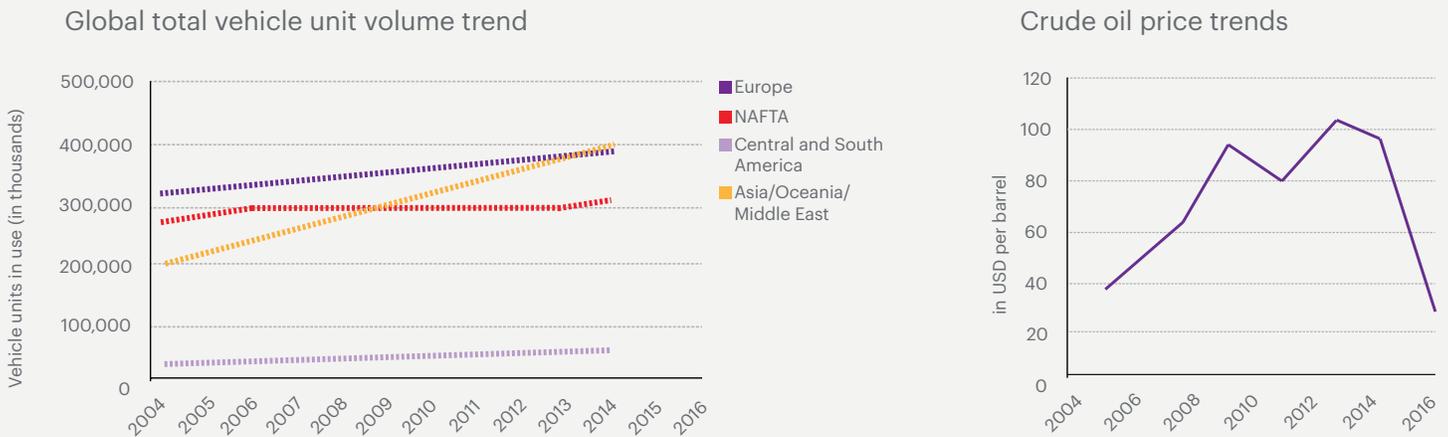


Figure 17. Annual growth in use of registered vehicles (left) and annual trend in oil price in USD per barrel (right)
 Source: IRF 2012, EMBARQ, IEA 2012

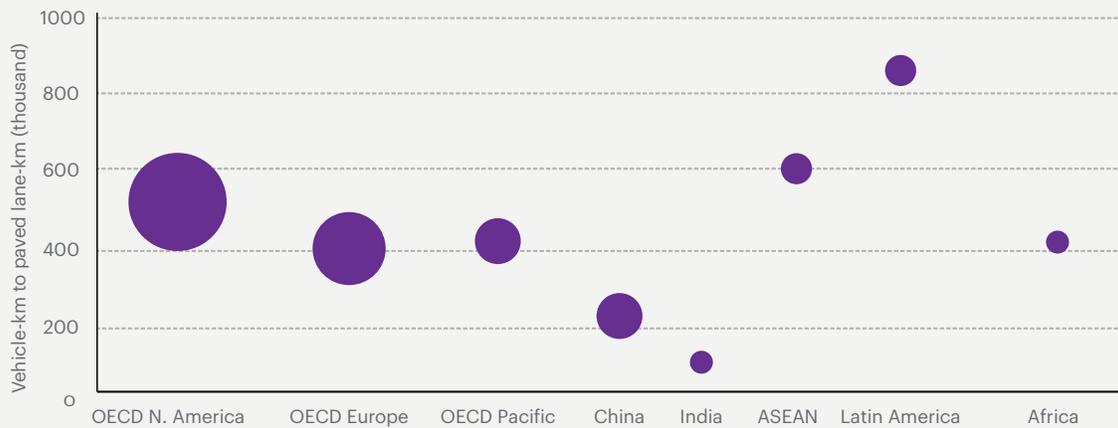


Trend in motor vehicles

Studies from OICA indicate an almost steady increase of the total vehicle usage in each region. The steepest increase in total vehicle usage was found in the Asia/Oceania/Middle East regions (Figure 17). Further analysis also showed a 33% increase in the aggregate global vehicle usage between 2004 and 2016.

From the chart above we can see that the decrease or increase in oil prices has not affected the annual growth in use of vehicles. This indicates that use of vehicles might always increase steadily due to factors like urbanization and population growth, if the current trend continues.^{[17] [30]}

Figure 18. Average historic roadway occupancy levels for several global regions between 2000 and 2010



Source: IRF (2012), IEA (2012)

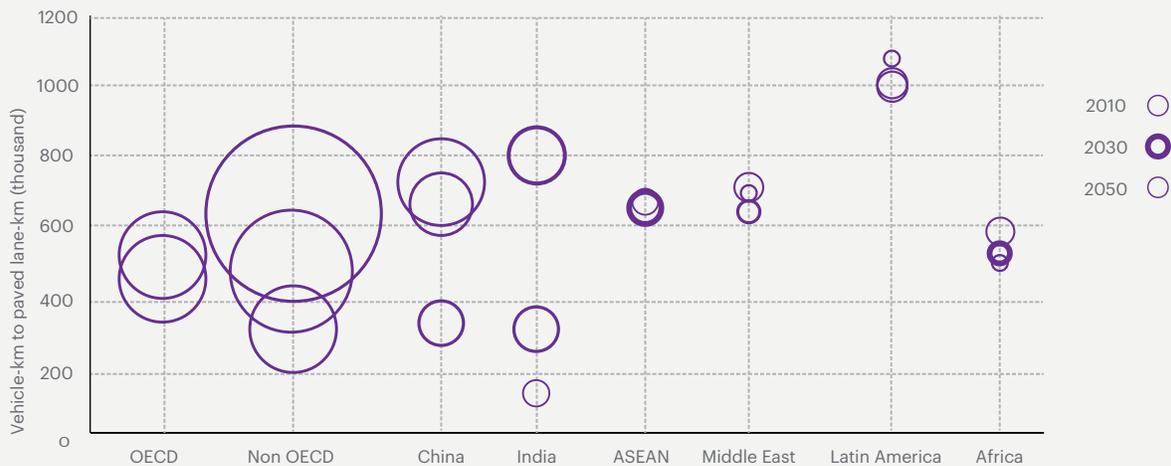
Note: Bubble sizes indicate average annual historic vehicle travel (vkm) between 2000 and 2010

Road occupancy

Figure 18 indicates that countries with increasing occupancy levels and congestion levels experience a high congestion rate. The occupancy levels for different regions was collected by the IEA and the International Road Federation in 2012.^[18]

Roadway occupancy levels, with the current use of vehicles and current policies in place, is expected to increase significantly (Figure 19) in India (650% increase from 2010 levels) and China (150%). In contrast, occupancy levels in Latin America are set to slightly decrease, because it is expected that infrastructure

Figure 19. Roadway occupancy levels for 2050 (the bubble size for 2010 levels in China represents 200 million vehicles)
 Source: IEA 2012



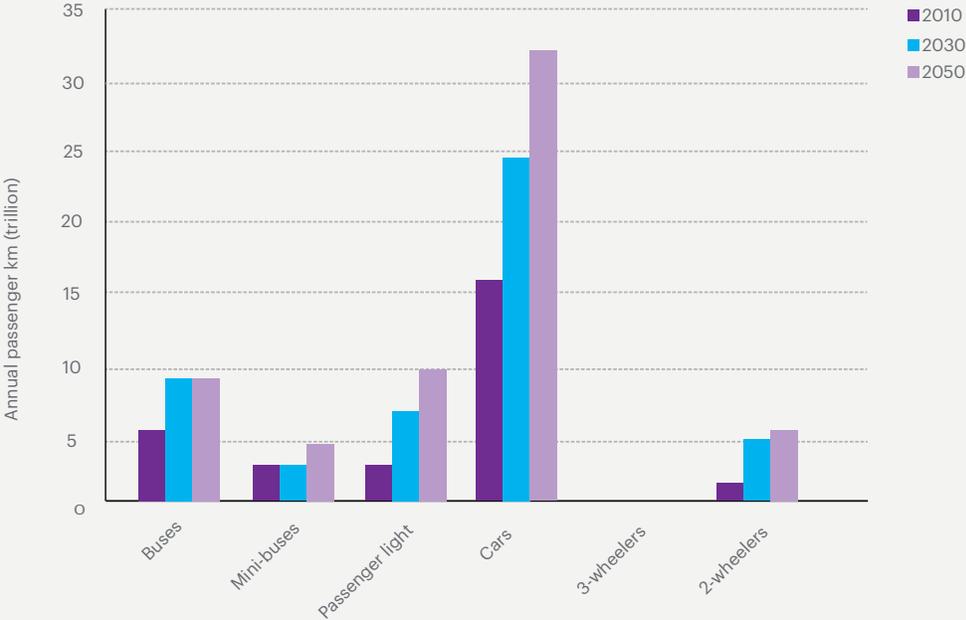
additions will catch up to travel demand. ASEAN countries also seem to be moving in the same direction as Latin America. Estimates of the levels for 2050 were made based on current policy and vehicle use (Figure 19).

To better understand the share in mode of transport used for passenger travel, Figure 20

shows numbers in terms of trillion annual passenger-km. One passenger-km is equal to a passenger traveling (being carried) one km.

According to projections, we can assume that passenger travel will be dominated by cars.^[18]

Figure 20. Modal share trends for passenger travel



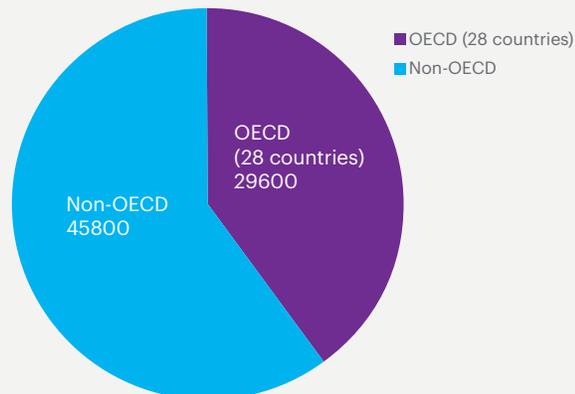


Global investment trends

Figure 21. Trend in road investment and maintenance 1992-2008 (top) and projections for additional road expenditure by 2050 (bottom)
 Source: IEA (ETP 2012)



Road expenditure addition 2050 (US\$ billion)



Challenges

Congestion

As already observed from the global trends for roads in the previous section, the number of motor vehicles in use is continually rising. Various research and data from ITDP, IEA, WEF, World Bank and the International Roads

Federation suggests the same. After analysis from individual countries' data on production and utilization rates, it was found that several regions in Asia and the Middle East overshoot the production capacity locally (Figure 23), and have to rely on imports. Such extreme demand needs to be dealt with.^[30]

Figure 22. Comparison between change in use (right Y-axis) and increase/decrease in production in that region 2013-14
Source: OICD

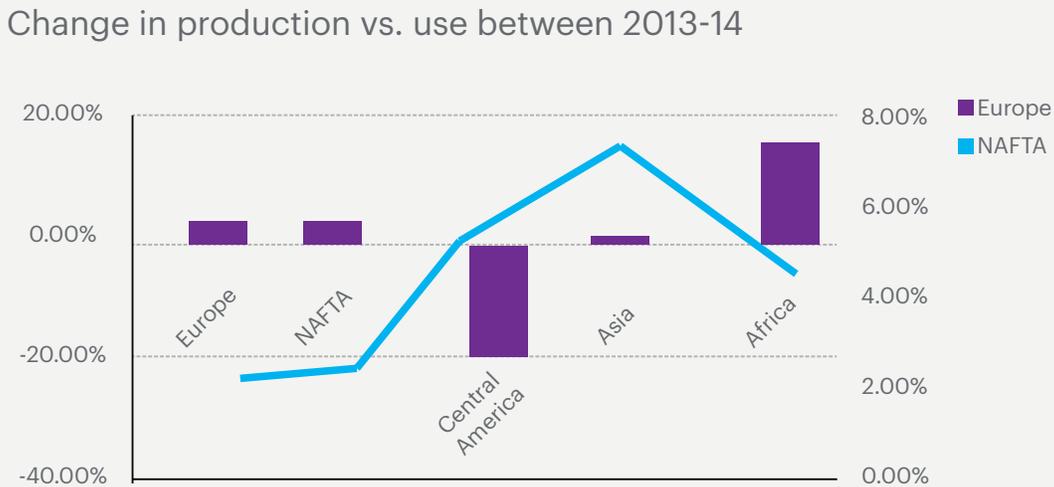
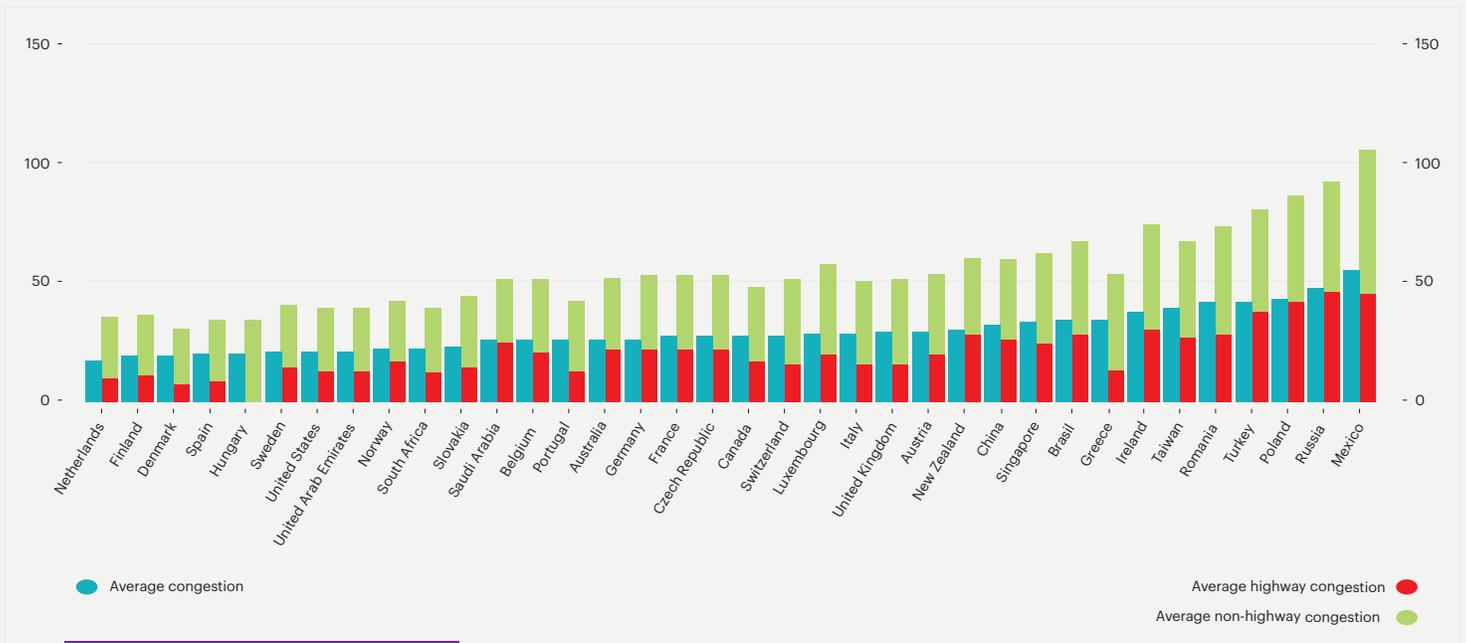


Figure 23. Highway and non-highway congestion by country



Ranking of most congested cities 2016

1	Mexico City	59%
2	Bangkok	57%
3	Istanbul	50%
4	Rio De Janeiro	47%
5	Moscow	44%
6	Bucharest	43%
7	Salvador	43%
8	Recife	43%
9	Chengdu	41%
10	Los Angeles	41%

Figure 24. Traffic index for selected countries



Traffic index can be defined as a composite index of time consumed in traffic, estimation of time consumption dissatisfaction, CO₂ emission estimation in traffic and overall inefficiencies in the traffic system.^[19]

After various data collection, it was found that Egypt has the worst traffic index globally

(Figure 24). Its inefficiency index of 293.47 had a major contribution to its overall traffic index of 249.5. Data from TomTom in 2016 showed that Mexico City (Figure 23) topped Istanbul to become the most congested city in the world. Data revealed that drivers in the Mexican capital spend 59% extra travel time at any time of the day because of traffic delays.^{[19] [20] [24]}

Road safety

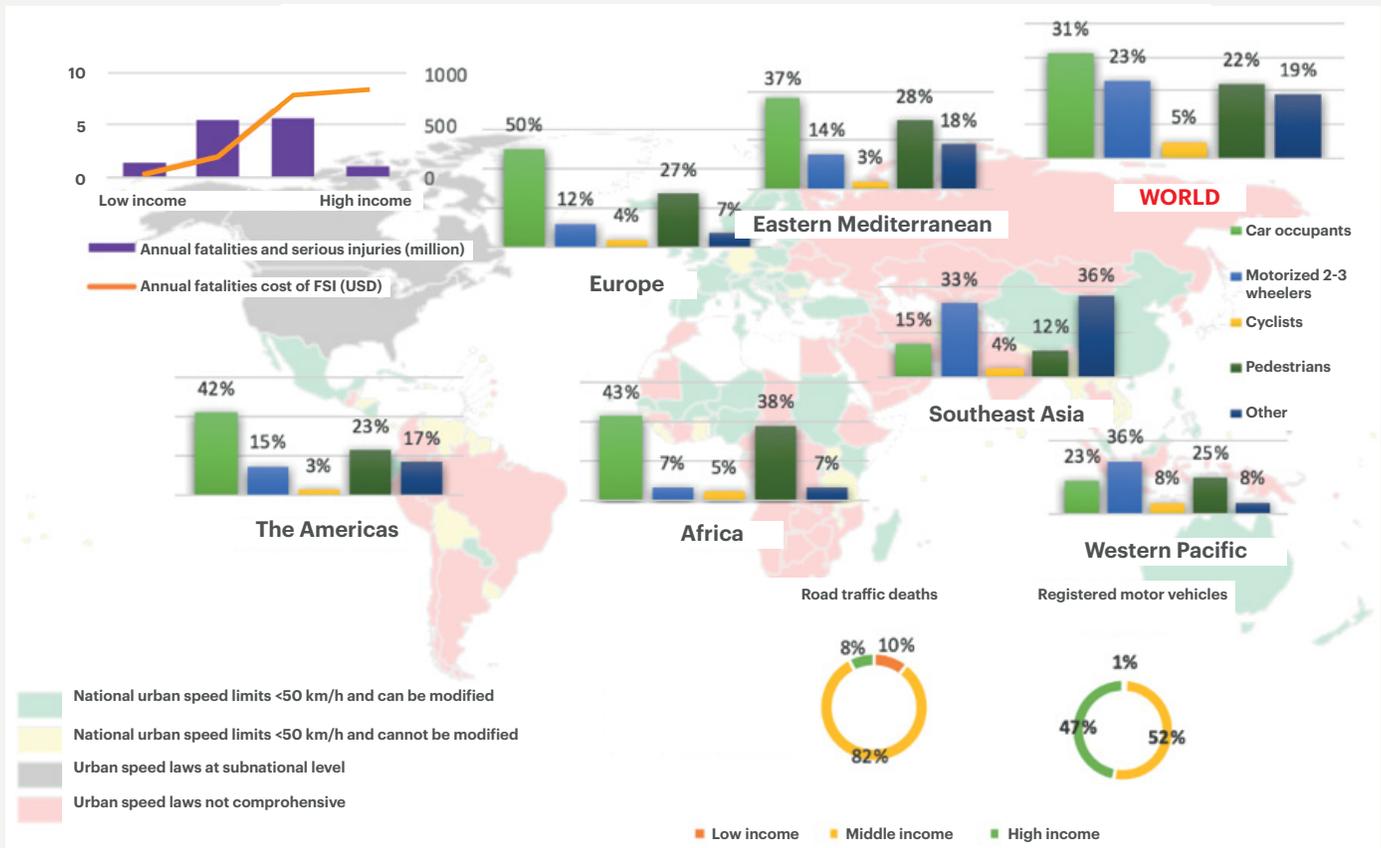
Annually, road crashes contribute to 1.24 million deaths worldwide, with many more injured. Road traffic injury is ranked as the ninth-leading cause of death across all age groups. This is particularly becoming rampant in low- and middle-income countries where urbanization, gentrification and motorization are associated with rapid economic growth (Figure 25).^[27]

Half of the global traffic deaths occur among motorcyclists, pedestrians and cyclists. It is also important to look at the income status within the region (often masked by global analysis). For example, the Americas region has 42% in car users' deaths, ranging from 22% in Venezuela to 75% in Colombia. Thus, a distribution as a function of income status is given (correlate with number of registered motor vehicles).

New comprehensive road safety legislation has been passed in 35 countries (7% of the global population). The major challenges to road safety, as identified by WHO, are as follows^[26]:

- The pace of legislative change is too slow.
- Consideration of the needs of pedestrians, cyclists and two-wheeler users requires more focus.
- Only 59 countries, covering 39% of the world population, have implemented an urban speed limit of ≥ 50 kmph, and allow local authorities to reduce these limits further.

Figure 25. Cost of road fatalities/income group (top left), road traffic deaths by type of road user (colored bars), urban speed laws (color-coded map) and deaths by income status (donuts)
 Source: World Health Organization



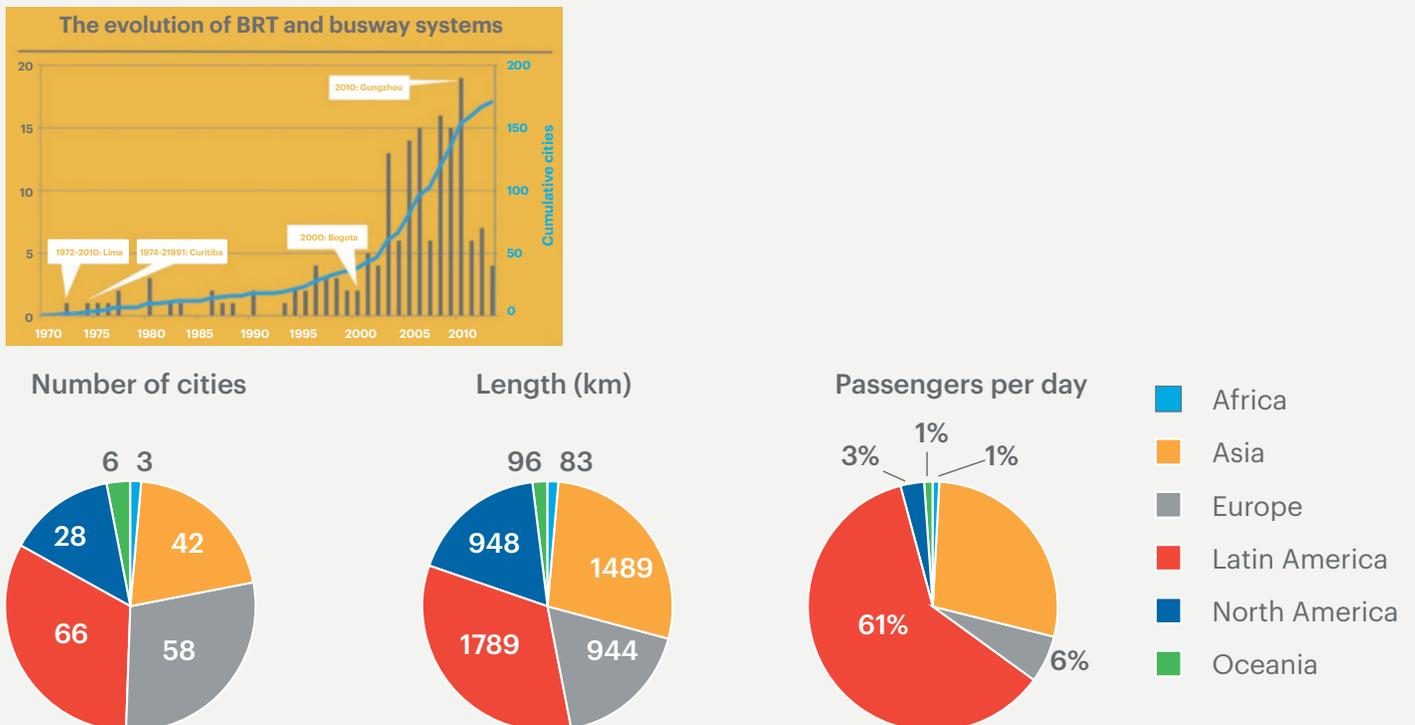
Technology and innovation

The major opportunities, as observed from the above data, are to design roads for safer use and improve on current road congestion levels. The governments of the studied countries, and most other countries globally, are trying to achieve this through encouraging the use of mass transit (e.g., as in India and South Africa), building safer roads, implementing strict regulations and using technology (such as the biggest electronic toll collection system, Salik, in UAE).

Bus rapid transit (BRT)

Safe public transport systems are being encouraged and invested in by governments to improve mobility safety in areas with increasing traffic congestion. More than 100 countries have national or subnational policies to invest in public transport (Figure 26).^[15] This is considered safer than private car travel in high-income nations, but not for low-income nations. BRT systems are safe, accessible and affordable.^[16] The large footprint required could be problematic, but this can be compensated by the annual passenger kilometers contributed by the BRT system (see South Africa case study).

Figure 26. Bar chart with trend of annual network addition (top), pie charts showing status in global regions. Source: EMBARQ



Technology implementation
(intelligent transportation systems
—electronic toll collection)

The trendiest market that all road technology providers are looking at is open-road tolling using electronic toll collection systems (ETC). This is a cashless tolling system implemented in urban highways. It helps to efficiently manage

traffic on highly congested highways through the use of technology like RFID, GPS/GNSS, DSRC and video analytics. The ETC provides a much-needed safer commute for vehicles and reduces congestion at the toll booths. Xerox ETC providers found that ETC roads had a lower fatality rate than average roads in the US. The market size for ETC is poised to

Figure 27. Market size (US\$ billion)

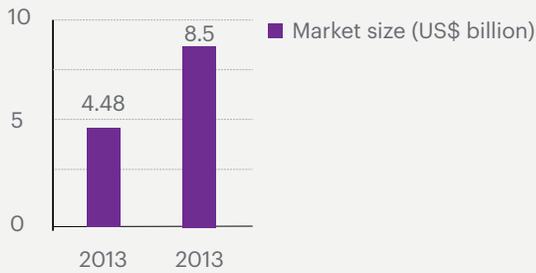
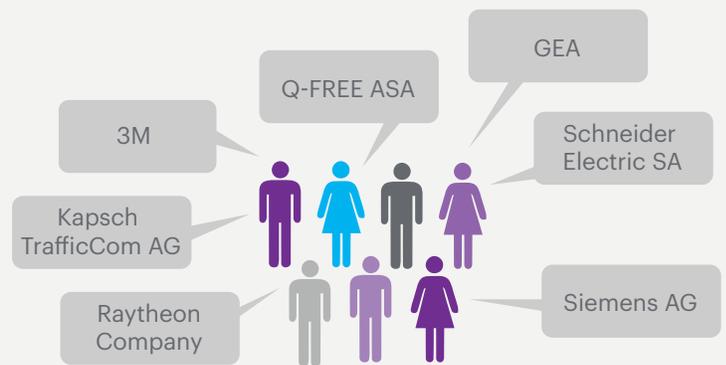


Figure 28. Key players in ETC
Source: Strategy



grow at CAGR 10.93% between 2015 and 2020 (analysis)^[23] with projections to reach US\$8.5 billion by 2018 (Figure 27). Funding, available through WHO's Road Safety Fund (est. 2011) for countries like India, China and other developing nations, is encouraging government authorities to prioritize intelligent transportation systems (ITS), which might create a huge opportunity

for technology providers who already have a foothold in such markets globally. In ETC, the United States has the highest market and China (Figure 29) has the fastest-growing market (CAGR 19.5%).^[27]

Figure 29. Opportunities in intelligent transport systems globally
Source: Strategy



NO 50-55
CONGESTION



Challenges

- Cuts in government spending
- Privacy concerns
- High installation/implementation upfront costs

Trends and drivers

- Modernization of roadways
- Government debt and focus on alternative funding options for ITS
- Low penetration in fast-growing economies points towards huge potential
- GPM/GSM-based toll collection opens new doors in road user fees
- Focus on reducing carbon emissions brings this technology into the spotlight
- Manual toll plazas process 200-400 vehicles/ lane/hr, while ETC processes 2,500 vehicles/ lane/hr. This increase means an increase in revenue stream. Also congestion pricing is easily implemented and is preferred by two out of three users (according to a survey by Xerox).

Public-private partnerships

Europe

The greenfield project pipeline is not as well funded as it used to be, with a decrease of €12 billion between 2006 and 2014. Germany, Ireland and Turkey are poised to grow. In particular, Turkey is expected to continue tendering mega road projects, with 2015 seeing the tendering of Ankara Nigde Motorway PPP project (US\$1.5 billion), among other motorway and ring road projects.^[22]

Africa

Most countries here lack a well-structured PPP model, but this is bound to change as the continent is motivated to use PPP to fill their US\$93 billion infrastructure gap (World Bank). Ghana and Kenya have seen the highest growth in PPP programs, with Ghana to tender three PPP projects in 2016 and Kenya soon to tender a couple of brownfield road projects. Locations such as South Africa and Egypt do not provide as huge an opportunity as in Ghana and Kenya, but there is still potential.^[22]

Asia Pacific

In 2014, China established a central government PPP Center, but most opportunities remain closed to foreign investors. International investors can get local presence through acquisition of newly formed PPP portfolios. The government of India has announced plans to award 5,000 km of road projects worth US\$3.2 billion in 2016, with a special objective to encourage international investors. There is also opportunity to invest in stalled road projects, through new legislation. Expectations for increased opportunities in other markets, like the Philippines, Japan, Thailand and Australia, are high as well.^[22]

Central and South America

Colombia is currently tendering its second wave of 4G road concession scheme. Government is looking at private initiatives because it lacks resources to afford more PPP projects. Private initiatives have the ability to recover investment without government involvement. Even Mexico, in late 2015, started a tender process for three road concessions, the RFP submission for which was in April 2016.^[22]

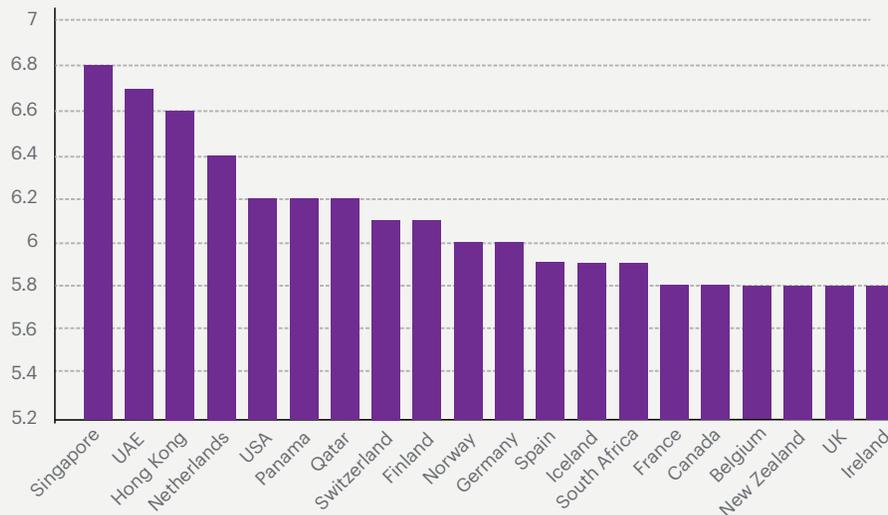
Airports

Global status

Economic indicators show that the global aviation market is changing due to traffic returning, fuel prices falling and the impact of new technology and business models aiding a return to profitability. If the aviation industry was a country, it would rank 21st in the world in terms of gross domestic product (GDP), generating US\$610 billion of GDP per year, which is approximately the same as Switzerland's GDP,

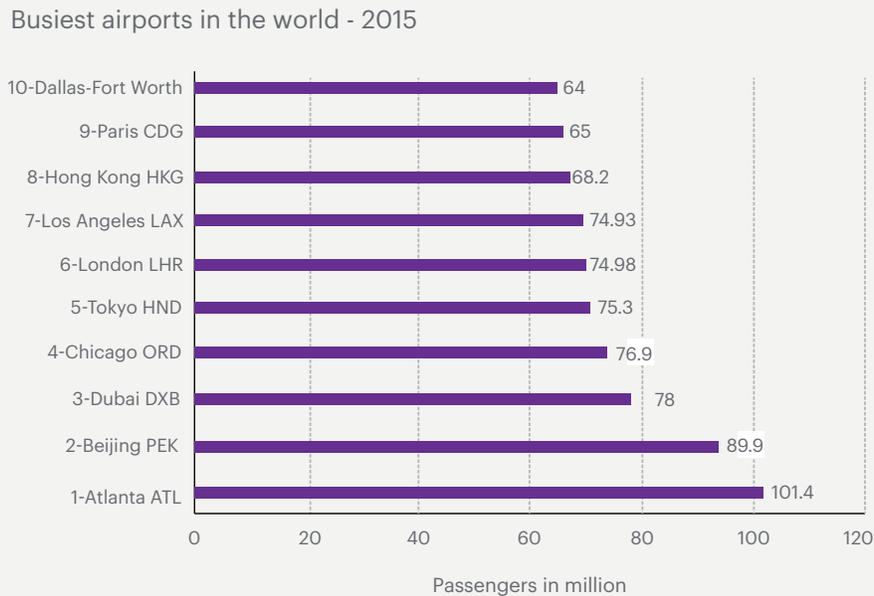
and even larger than some members of the G20. By 2025, aviation would contribute US\$1 trillion to world GDP, according to the Air Transport Action Group (ATAG). Worldwide, the amount contributed to the global economy by aviation jobs is roughly three and a half times higher than that contributed by other jobs.^[30] Singapore (Figure 30) ranks first as the country with the best quality of air traffic in 2014/2015. In the southeast region, Singapore is followed

Figure 30. Ranking of countries with the best quality of air traffic in 2014/2015
Source: World Bank Data 2015^[31]



by Hong Kong, which epitomizes the dynamism of the region today. UAE, which ranks second overall, also illustrates the growing and largest impact of the Middle East region in the aviation industry. The busiest airport, in terms of number of passengers, remains Atlanta International Airport, with 101.4 million passengers (Figure 31). Beijing and Dubai are increasing their importance internationally and regionally, giving significant weight to these regions.

Figure 31. The world's busiest airports 2015
Source: Airport Council International Preliminary Report^[32]



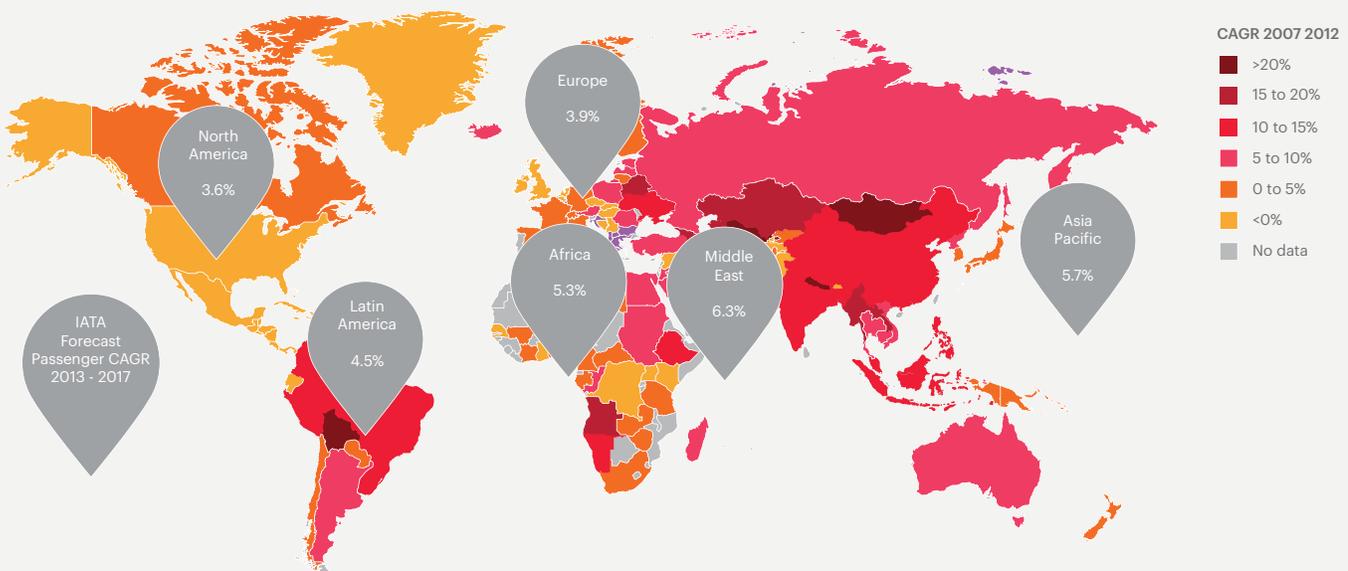
Global trends

Asia and the Middle East markets are strong, while the European market has been less favorable. What PWC's analysts call the pivot to Asia is happening in the aviation industry.^[33] This has been triggered by a strong demographic and economic growth and has not only enhanced Asia's connection to the world, but it has also strengthened crucial connections among regional and domestic markets. The Middle Eastern hub is expected to take the top spot within the next decade since its growth

rate is still increasing. It experienced an increase of 10.7% in 2014. Atlanta International Airport remains the busiest, with 100 million passengers per year. India is today a strong market. Its 10 million passengers and its growth of 17% (year-on-year) ensured India's position as Dubai's single largest destination country in 2015.

Growth in air passengers and propensity to fly
Trends for private sector funding, foreign investments as well as their restrictions, and evolution in the so-called "propensity to fly" phenomenon affect demand for air travel

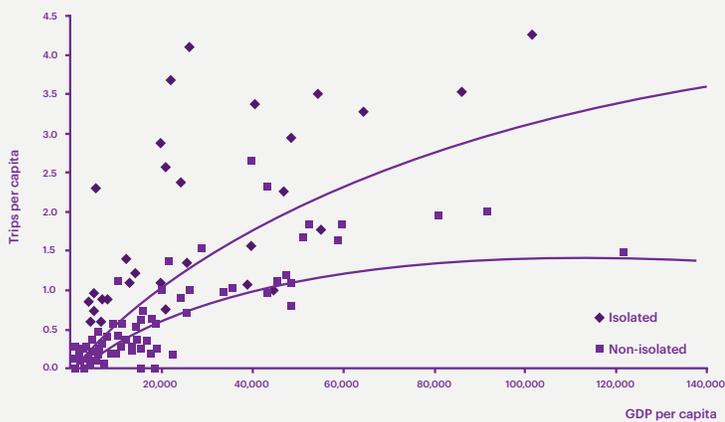
Figure 32. Growth in air passengers
Source: PWC, IATA 2015



and guide the need for investment in aviation infrastructure (Figure 32). This report focuses on the “propensity to fly” parameter, which offers interesting long-term insights. Figure 33 demonstrates that while GDP increases, propensity to fly also increases, and reaches saturation when GDP peaks.^[34]

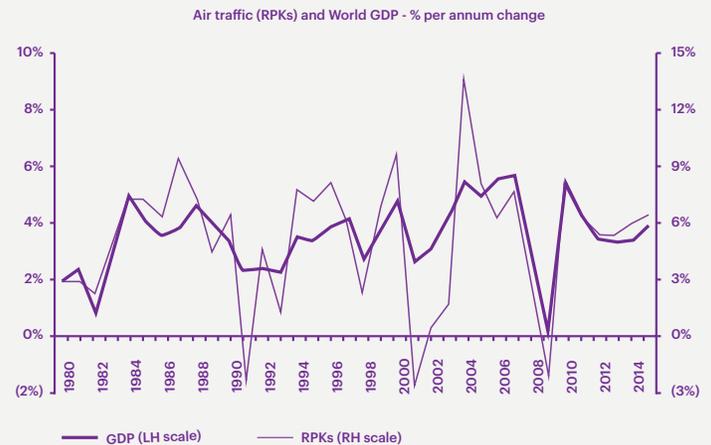
Brazil, Russia, India, China and South Africa (BRICS) are usually prioritized by investors; nevertheless,

Figure 33. Correlation between GDP per capita and global air trips per capita in 2013
 Source: BMI Sabre Air Transport Intelligence, PWC Analysis



there are numerous emerging markets that equally attract investors. The main force generating revenue growth is primarily passenger growth and thus propensity to fly. The Philippines, India and Indonesia are promising potential investment markets that must be targeted. As well, Europe, the US and BRICS still deserve consideration. Figure 34 illustrates the correlation between air traffic and the world GDP. The evolution of the GDP drives and leads air traffic.^[35]

Figure 34. Global growth drives air travel
 Source: IMF and ICAO/ IATA



Airports per million inhabitants and average airport capacity

Asia has just 0.22 airports per million inhabitants, the least of any region in the world, as seen in Figure 35. Nevertheless, in Asia, airports have seen 1.75 million passengers, which is considerable compared to the mature aviation markets of North America and Europe.^[36]

Growth in cargo and freight (and transit freight) air traffic in 2015

Air freight growth slowed to 2.2% in 2015. The International Air Transport Association (IATA)

analysis for the global air freight markets states that cargo volumes measured in freight ton kilometers (FTKs) expanded 2.2% in 2015 compared to 2014.^[37] Asia, with Hong Kong and Shanghai, dominates the cargo freight market (Figure 36). Of interest is the increasing growth rate of Africa, which is the highest predicted, at 6.9% (Figure 37). The Middle East, Asia and Latin America have the most passengers (Figure 37).

Figure 35. Airports per million inhabitants and average airport capacity in 2013
Source: World Bank Group, Airbus, Strategy and Analysis

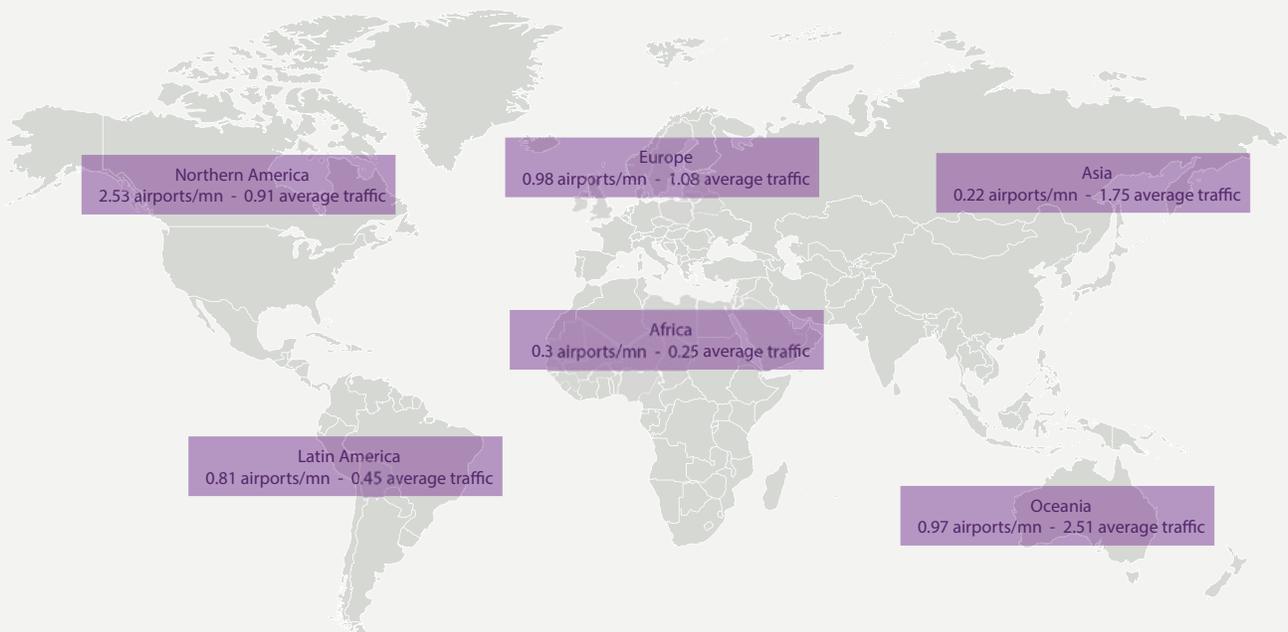
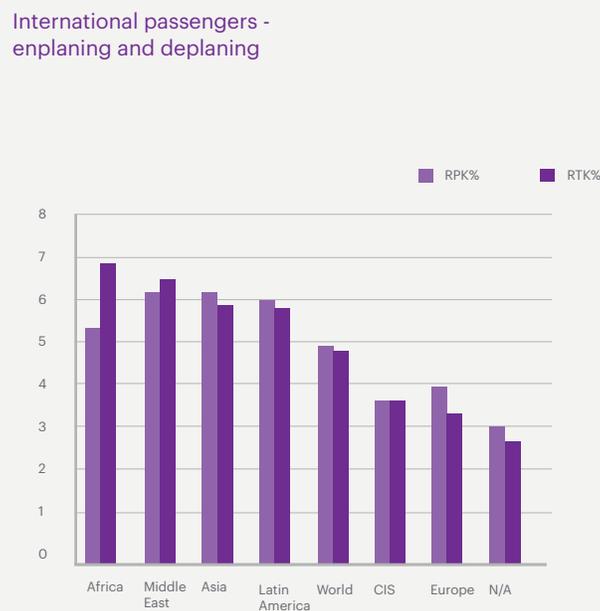


Figure 36. Growth in cargo and freight (and transit freight) air traffic in 2015^[38]



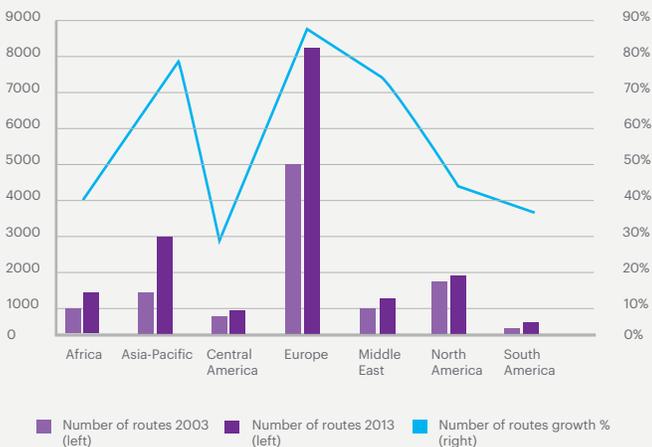
Figure 37. Estimated annual growth rates for passenger Revenue Passenger Kilometres (RPK) and cargo air traffic - RTK - from 2015 to 2034 by region. Source: IATA^[39]



Connectivity

The aviation sector is directly linked to globalization and national competitiveness, as well as regional economic developments or tourism. Connectivity would enable the aviation industry to achieve profitable growth if networks and control costs improve. When new routes are created between well-established countries and developing countries, aviation operations increase, and thus profitability increases (Figure 38).^[40]

Figure 38. Number of international routes by region in 2003 and 2013
Source: Milanamos, PWC Analysis^[10]



Investment trends

Airport investments are expected to slow down to an annual growth rate of 2.6%, according to PWC and Oxford Economics Transport Infrastructure Spending Analysis, 2014. Investors do not make investments in airports for short-term gain. Furthermore, governments ask for privatization deals.

Potential investment regions

Indonesia, Australia, the Philippines, and Russia will experience an increase in air travel in the near future, according to the PWC report, Connectivity and Growth Directions of Travel Airports Investments. Furthermore, Indonesia is expected to surpass the UK and would rank as the fifth-largest global air travel market, while India aviation activity would slow down. Air-traffic growth is expected to increase in China, as a result of the government's plans to focus on aggressive investments. India's government allows foreigners to invest significantly in local companies, and investments in greenfield airport developments are planned. India's aviation infrastructure might have better investment opportunities in a few years.

Positive trends in emerging countries' aviation markets are of benefit to developed countries, as no market share is taken away from established developed countries' airports. To the contrary, investments in emerging

countries would foster inter-airport connections and enhance cross-border networks. Thus, developed economies' aviation projects must not be ignored by investors, because such infrastructures would benefit emerging economies' growing airport projects.^[41]

Privatization

The largest global airport groups in 2013 and their privatization status are listed in table 4, as well as the largest privatized airport groups in 2012.

There has been a worldwide trend to privatize airports, but the degree and characteristics of the privatizations can vary greatly depending on the country. Privatized airports offer prices which are regulated and varying fees.^[42]

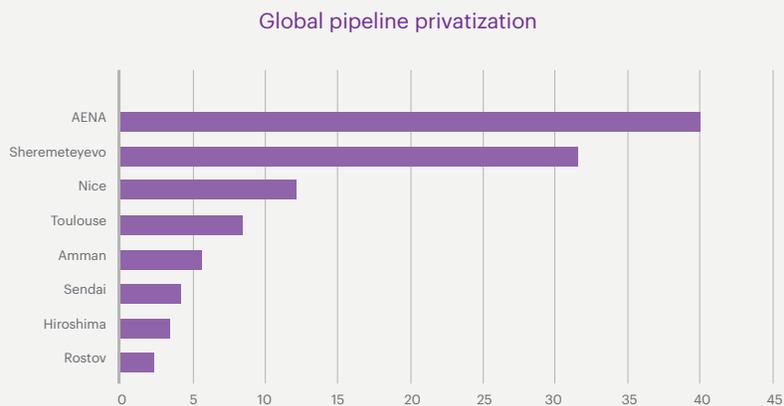
Since January 2012, growth in privatization of airports in South America has been tremendous, accounting for almost US\$17 billion from 2012 to 2014. For instance, in Brazil, airport concessions were awarded in Sao Paulo, Rio Grande do

Table 4. Privatization status of airports and operators

Source: Private Lives, Gunter Endres, Airlines Business November 2013

Operator	Country	Airports	2012 Passengers	Privatization Status	Airport Group	Global Main Airports Rank*	2012 Revenue (\$M)	Privatization Status	
AENA Aeropuertos	Spain	70	250 million	To be privatized	AENA	1	Madrid, Barcelona	4,267	In process
Infraero	Brazil	65	194 million	Concessions for largest airports	Heathrow Airport Holdings	2	London Heathrow	3,923	Full
Airports Authority of India	India	125	160 million	Concessions for largest airports	Aeroports de Paris	3	Paris de Gaulle and Orly	3,406	Partial
Aeroports de Paris	France	29	139 million	Part-privatized	Fraport	4	Frankfurt	3,150	Partial
Fraport	Germany	13	100 million	Part-privatized	TAV Airport Holding	14	Istanbul & Ankara	1,418	Full
Schiphol Group	Netherlands	7	90 million	Corporatized	Incheon International	15	Seoul	1,417	Planned
Heathrow Airport Holdings	UK	4	82 million	Privatized	Malaysia Airports Holdings	17	Kuala Lumpur	1,154	Partial
TAV Airports	Turkey	10	72 million	Private	GMR Infrastructure	19	New Delhi, Hyderabad	1,123	Partial
Flughafen Zürich	Switzerland	11	67 million	Privatized	Beijing Capital International	21	Beijing	1,089	Partial
Corporacion America	Argentina	60	50 million	Private	Southern Cross Airports Holdings	22	Sydney	1,079	Full
Global Infrastructure Partners	UK/US	3	47 million	Private	Flughafen Zürich	23	Zürich	1,017	Full
Vinci Airports	France	23	40 million	Private	Airports of Thailand	24	Bangkok	980	Partial
Vantage Airport Group	Canada	11	34 million	Part-privatized	New Kansai International Airport Company	25	Kansai, Osaka	947	Planned
HNA Airport Group	China	13	25 million	Part-privatized					
ADC & HAS	US/Canada	3	19 million	Part-privatized					

Figure 39. Global pipeline privatization
 Source: PWC Analysis



Norte, Distrito Federal and Belo Horizonte. Colombia and Panama also saw great airport privatization initiatives. Saudi Arabia, Turkey, Puerto Rico and Croatia have also seen an increase of privatization. In Europe, the trend is in favor of privatization, especially because of the unstable economic situation. Thus, countries such as Spain and Portugal are potential candidates for privatization (AENA, now ENAIRE, ranks first; Figure 39). Some privatized airports are undergoing new ownership structures.^[43]

Challenges

Congestion

Airport congestion is a reality. Five trends emerged at congested airports, according to a McKinsey & Co study.^[44]

Passenger growth decreases

Figure 40 shows that when an airport faces slow-down, the closest airports do not benefit.

Larger aircrafts

In Beijing, China, once the airport's capacity was reached, airlines decided to use bigger planes but for shorter flights. From 2002 to 2005, the use of wide-body planes decreased (Figure 41). However, the need and demand for flights to smaller Chinese cities started increasing from

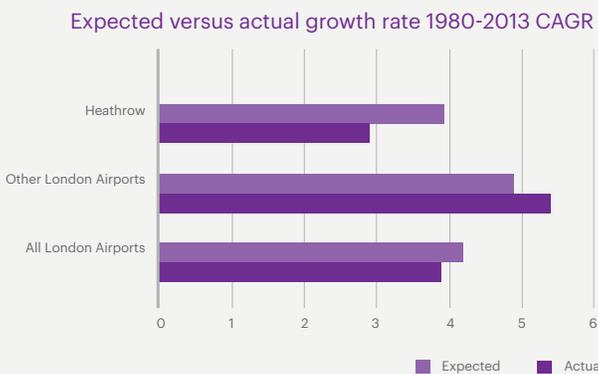
2011 to 2014, and the Beijing Airport increased the use of wide-body planes.

The use of wide-body planes could become an environmental challenge if the increase in use continues.

The remaining trends are:

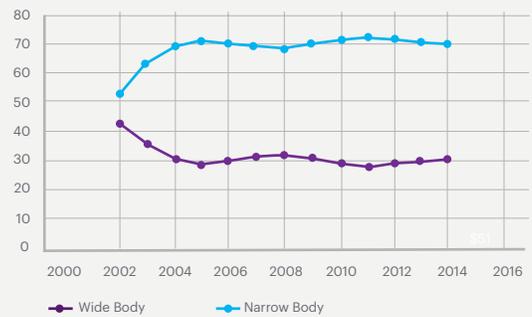
- Decrease in network connectivity
- Increase in significance and profitability of slot trading
- Increase in ticket prices

Figure 40. Expected versus actual growth rate 1980-2013 CAGR
Source: HIS Global Insight UK Civil Aviation Authority



Jakarta, Indonesia’s Soekarno-Hatta International Airport was able to handle a little less than 25 million passengers a year; however, in 2013, it accommodated more than 50 million. Moreover, in 2014, the Guangzhou Baiyun International Airport in China was 15-20% above its capacity. Major cities such as São Paulo and Hong Kong experienced great saturation during busy travel time; this is expected to continue.

Figure 41. Outbound seats on short haul flights (less than 1490 miles) from Beijing Capital International Airport %
Source: OAG





Focus on Asia

The rapid growth in the commercial aviation industry has helped cause fast and significant growth of the region. By 2020, it is expected that Asia will have the highest growth rates in the world. Figure 42 depicts the passenger capacity of the Asian hub and illustrates this trend.

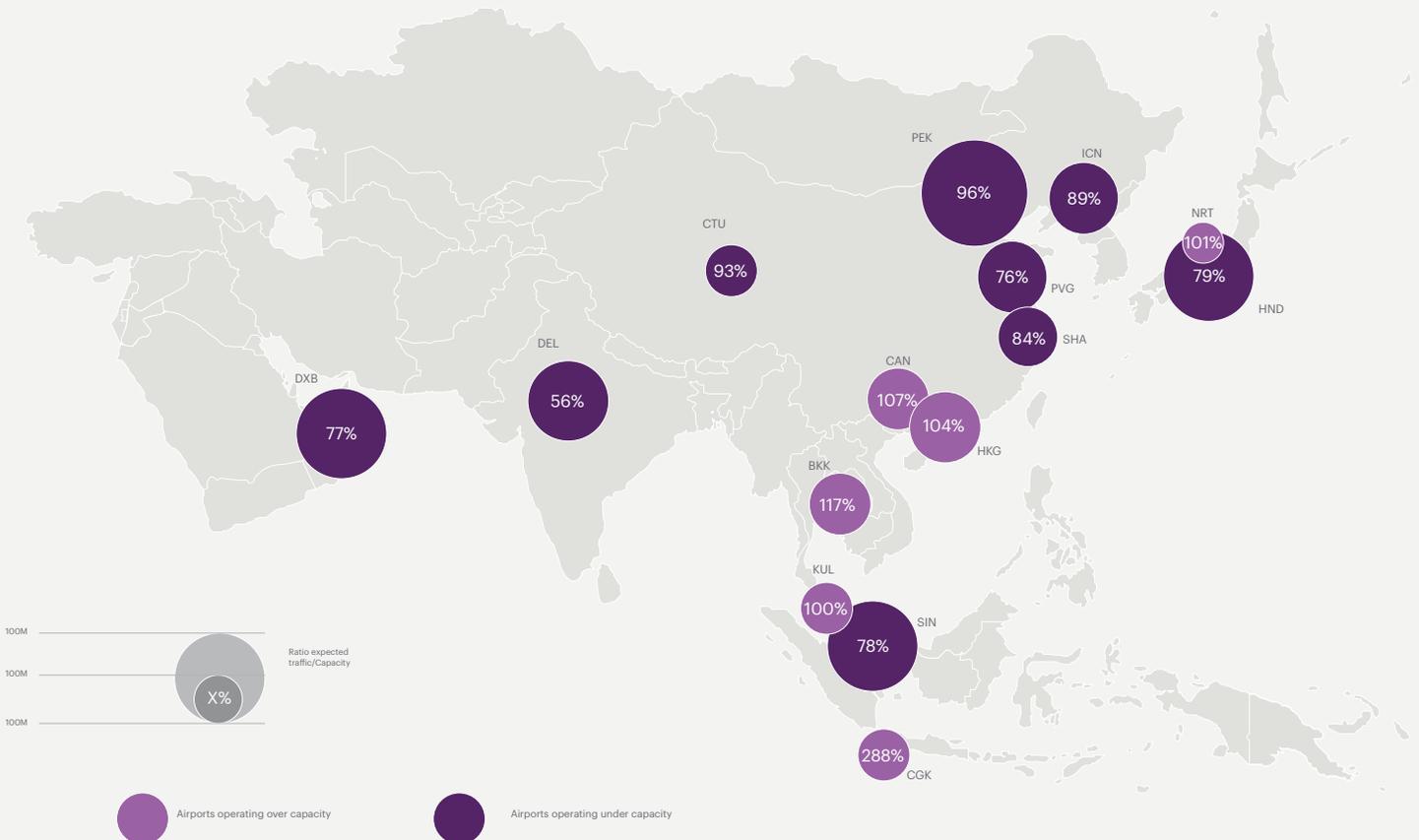
Asia's aviation infrastructure faces many challenges as many airports exceed their

capacity, leading to travel delays. Mega projects are planned but not achieved; small and mid-sized airports should be prioritized. Asian aviation infrastructures must acquire operations, and planning skills are needed to curb the intrinsic scale diseconomies of Asian mega-hubs.

Environmental challenges

More than 700 million tons of CO₂ were produced in 2013. Humans produce 36 billion

Figure 42. Asia hub's passenger capacity in 2012
Source: IATA, Strategy & analysis



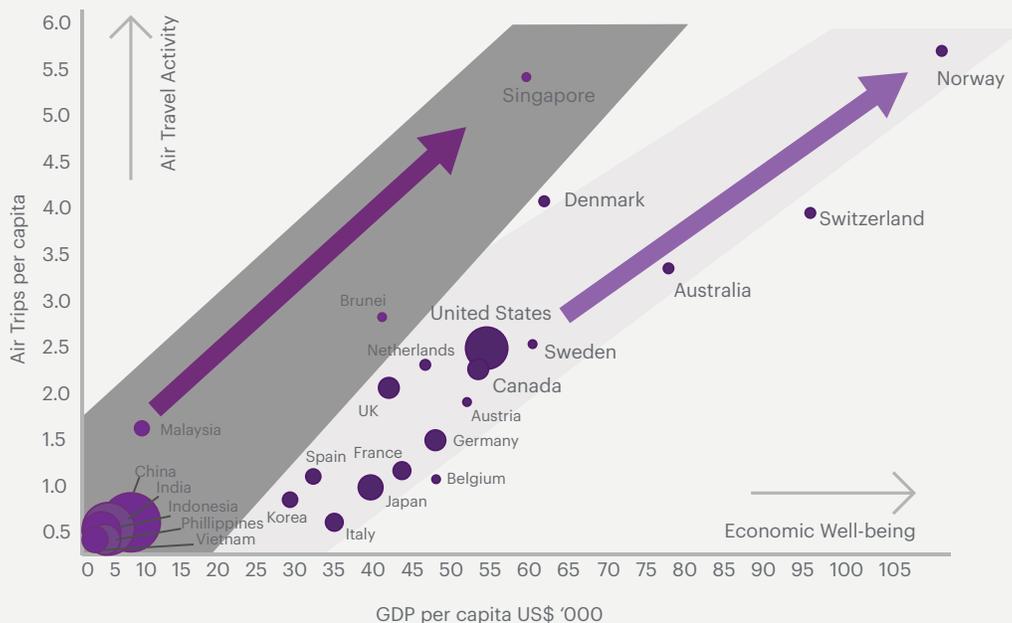
tons of CO₂, while less than 9 million people work directly in the aviation industry. In addition, 2% of all the CO₂ emissions are triggered and produced by the aviation industry, which is 12% of the CO₂ emissions generated by the transportation industry.^[45]

Alternative fuels such as sustainable biofuels would help achieve the industry sustainability goals. IATA's experts claimed that if commercial aviation used 6% of its fuel supply from biofuel, by 2020 the carbon footprint would decrease by 5%. Nevertheless, 80% of aviation CO₂ emissions

are emitted from flights of over 1,500 km, for which there is no practical alternative mode of transport, according to IATA studies.

Growth in aviation travel triggers pollution from aircraft manufacturers, airlines and airports. Increasing the commercial aircraft fleet would trigger an increase in aircraft noise, air quality issues around airports, and greenhouse gas emissions. Remediation of these environmental consequences would lead to increased costs for the industry and air travelers.

Figure 43. Air travel as function of economic capabilities (GDP per capita)



Innovation and technology: major opportunities

Multimodal airport

Airports developed innovative and state-of-the-art multi-modal facilities. Urban transit and rail systems have been integrated into airports, which increases connectivity to cities. Airports are also well integrated into highway and road networks, which facilitates cargo transportation as well. An optimized understanding of data would enhance connectivity.^[46] In 2013, the McKinsey Global Institute stated that around US\$400 billion a year could be saved if existing infrastructure's management and maintenance were improved. Thanks to digitization and big data technology and management in the infrastructure sector, better forecasting, reliability, and efficiency would be observed, according to a McKinsey and Co. study.^[46] For instance, in Brazil, aviation traffic is booming—the annual passenger traffic is expected to double by 2030 (around 300 million passengers per year); thus, airspace congestion is becoming a crucial issue. Brazilian airports are working on a system utilizing GPS data to optimize the use of available airspace. Planes preparing to land would line up in an airborne queue. Each plane would be assigned its own flight path, then the distance, speed, and capabilities of each aircraft would be analyzed to give the shortest flight path.

Smarter and “greener” airports

The use of renewable energy methods such as solar panels, green parking lots, and the use of local composting systems are some examples that make airports greener. The use of biofuel must be taken into consideration as well, although it would have a huge impact on construction and logistics. Furthermore, the increasing use of automation at airports such as gate systems and adding automatically closing and reflective blinds, for example, can strengthen sustainability.

The EU-funded European Commission developed a software and sensor system called CASCADE to reduce carbon emissions and energy costs in airports by 20%. Pilot testing is currently happening in Italy in Rome's Fiumicino and Milan's Malpensa. The new system is said to save approximately 6,000 MWh, which is equivalent to 42,000 tons of CO₂ and €840,000 / \$970,000 a year.^[47]

Furthermore, the new EU research and innovation program, Horizon 2020, will inject €80 billion / US\$92 billion over the next seven years (2014-2020). For instance, Germany, Italy, Ireland and Serbia are helped by €2.6 million / US\$3 million of EU funding to implement such a system. The Airports Council International Europe, which includes more than 450 airports in Europe, has shown its support for the project, which has resulted in wider use of this new system since 2015.^[47]

Seaports

The performance of ports and terminals is significant since it affects the competitiveness of a country's trade. The performance of ports and terminals can be determined based on labor relations, number and type of cargo-handling equipment, highway and railroad connectivity, quality of backhaul area, port access channel, land-size access and customs efficiency, as well as concessions to international operators. Ports have to face

several economic, environmental and social challenges. Among these challenges, which can turn into opportunities, are the increasing traffic volumes triggered by "mega ships," as well as the tremendous amount of money needed to adapt infrastructure to such innovations. Furthermore, the maritime sector faces several limits on budgeting by the public sector, as well as volatility in energy prices, and is more likely to utilize new energy and alternative fuels.

Figure 44. Main trade routes, main ports and exporters/importers in the world. Source: Nicolas Rapp for *Fortune* magazine

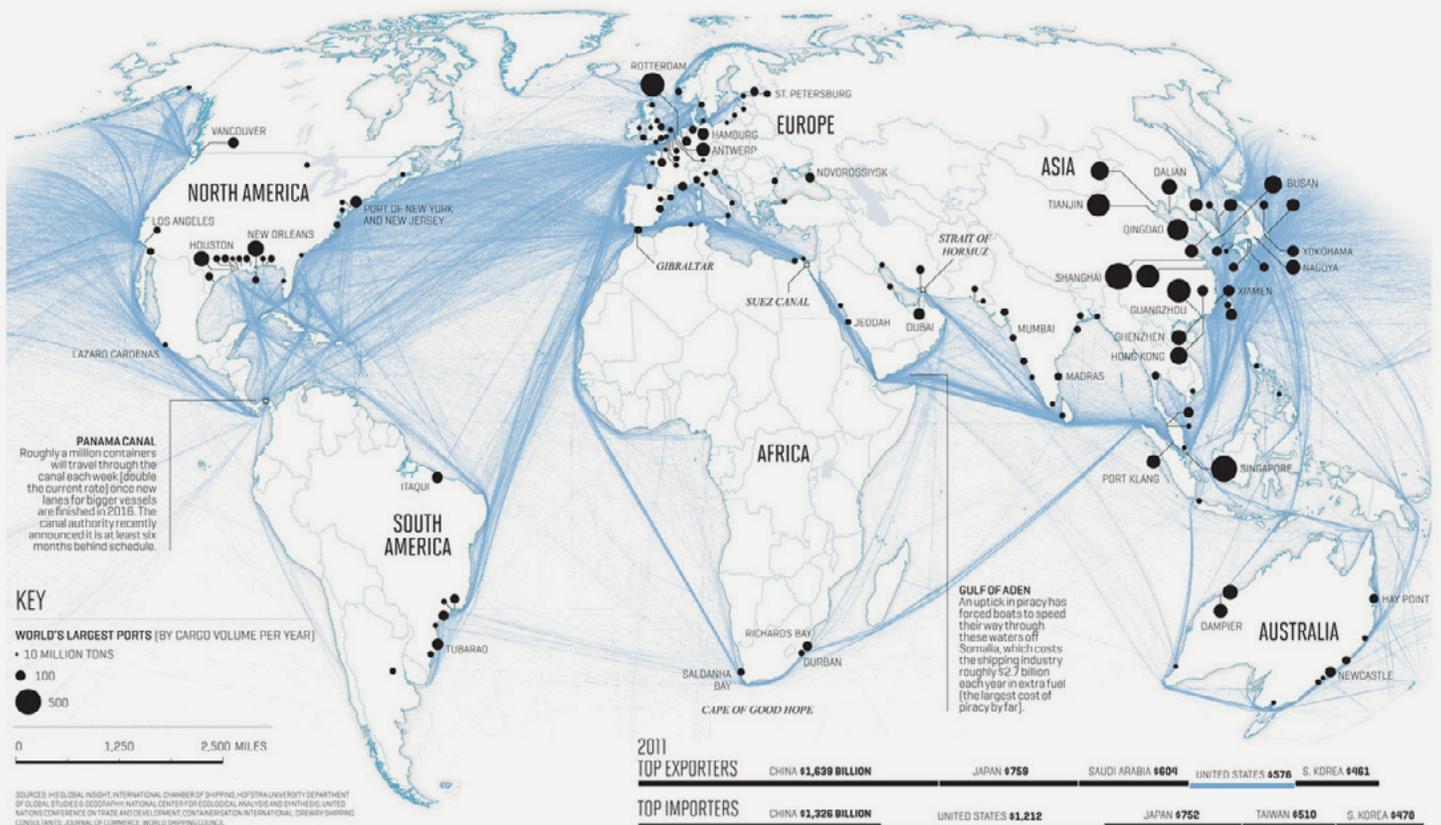


Figure 44 illustrates the complexity of world shipping routes and the location of the world's largest container ports. Almost 90% of all goods traded around the world travel in part by sea.^[48] The most active sea route is between China and the West Coast of the US, and the fastest growing route is in Asia, since all the goods leaving this continent account for 45% of all sea trade, according to IHS Global Insight.^[49] New trade and regulation policies, as well as the use of container

shipping, reshaped the sea industry. Container shipping greatly reduced the time needed to load and unload ships, and the development of large container ships also contributed to increasing efficiency of international and intercontinental shipping. The map also illustrates major shipping points: one around Malaysia and Singapore, and the other around the Red Sea. Geopolitical instability in these areas could likely trigger significant disturbances to the shipping industry.





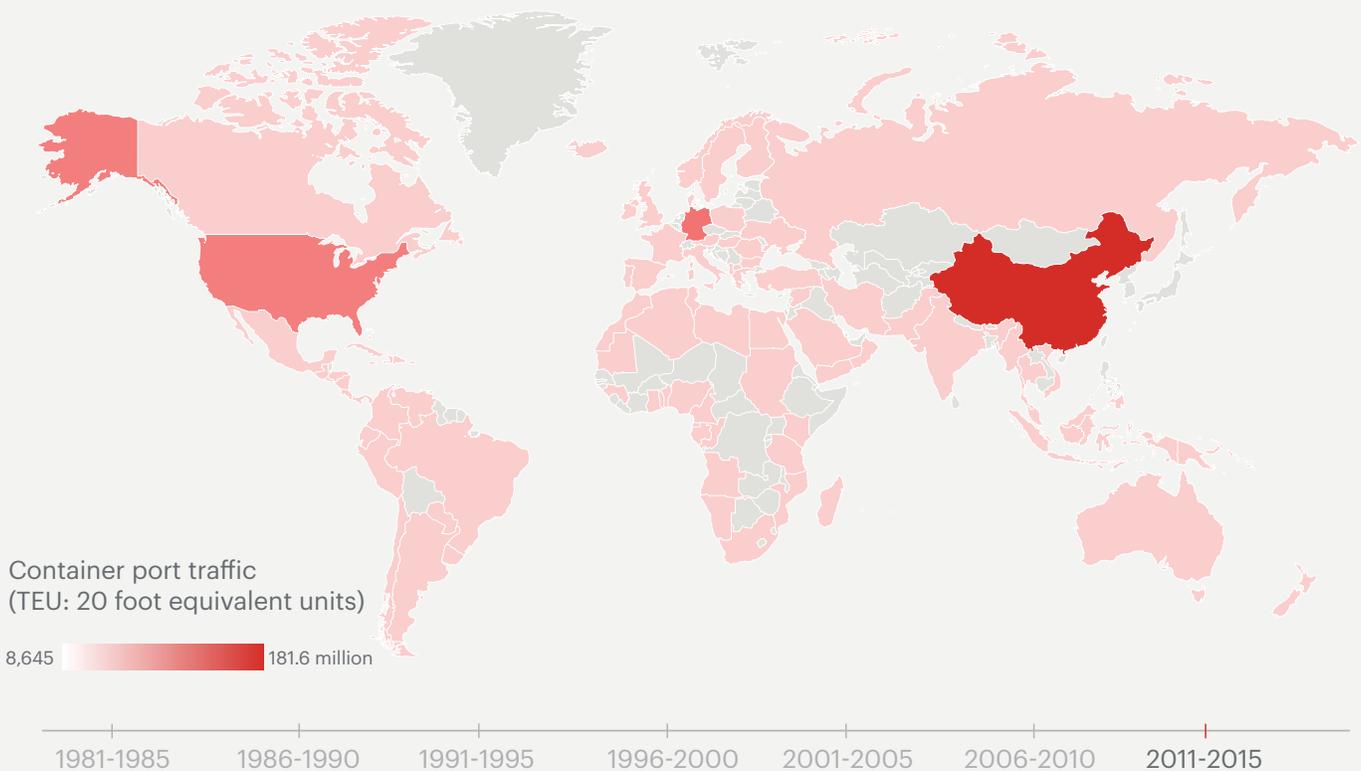
Global status and key indicators for selected countries

Container port traffic and quality of port

By definition, port container traffic measures “the flow of containers from land to sea transport modes, in twenty-foot equivalent units (TEUs), the standard-size container. Data

refer to coastal shipping as well as international journeys.”^[50] The following chart shows the data gathered concerning the container port traffic. China is not included in the graph because it would have changed the representation, since the figures concerning China are proportionately much higher: 182,000,000 TEU (Figure 45).

Figure 45. Container port traffic 2011-2015



On Figure 46 it is clear that Malaysia and UAE dominate the Middle East and Southeast Asia.

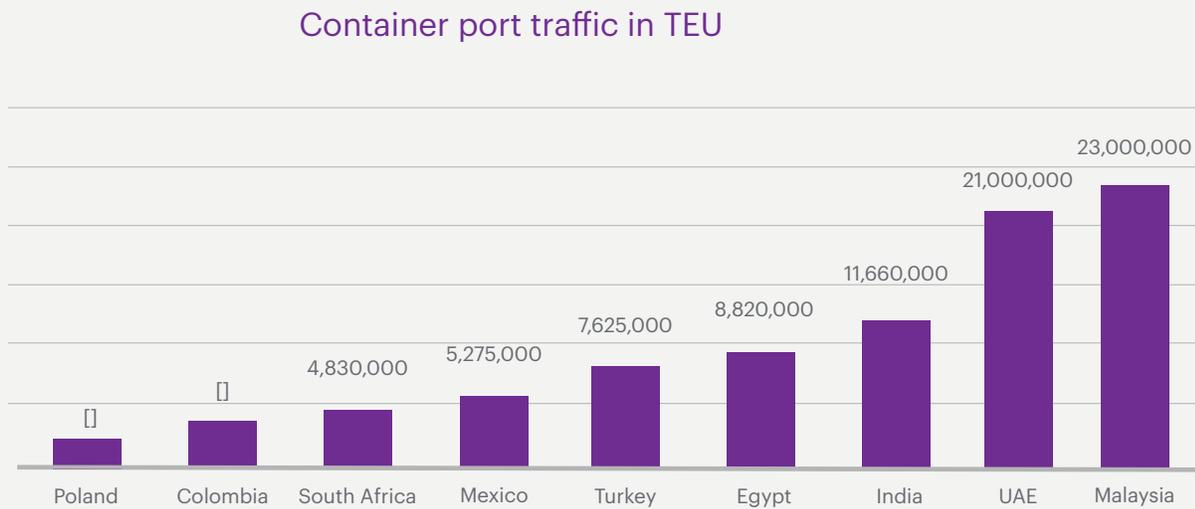
Quality of ports

By definition, the quality of port infrastructure of a country is determined by the observation and analysis of port facilities by its major business leaders. According to the World Bank's method, scores range from 1, "if port infrastructure are

considered extremely underdeveloped", to 7, "if port infrastructure are considered efficient internationally."^[51] Figure 47 represents the quality of ports of the 10 countries selected.

The Middle East and Asia are the two dominant hubs of maritime transportation. The UAE ports' infrastructure and activities are more than well established and dominate the Middle East region.

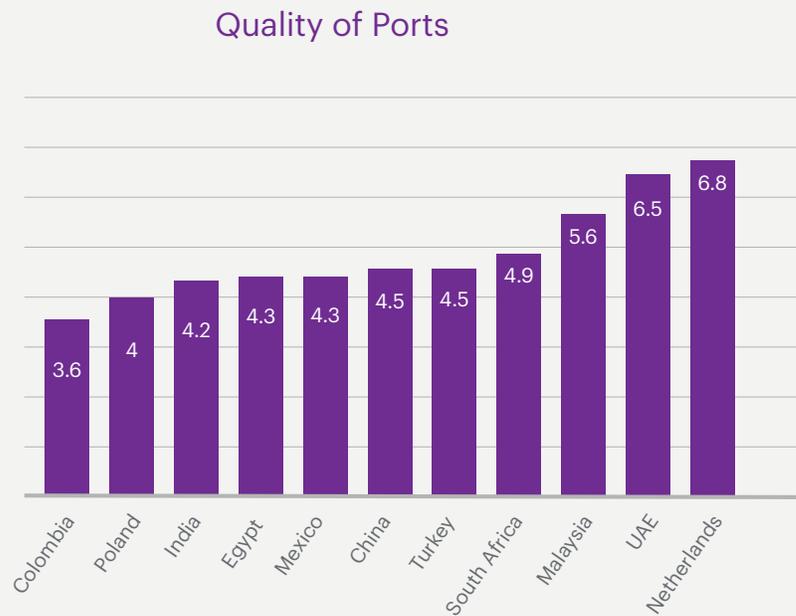
Figure 46. Container port traffic in the ten selected countries (except China)
Source: World Bank Database 2015



For instance, Dubai's Port Jebel Ali, which is the world's largest man-made harbor and the biggest and the busiest port in the Middle East, is linked to Dubai's expressway system and to the Dubai International Airport Cargo Village. The port's infrastructure in the Cargo Village allows the handling of cargo; thus it is possible to make a four-hour transit from ship to aircraft.^[52]

Mainland China ports account for 70% of the top 10 ports in the world.^[53] For years, Singapore was known as the world's largest container port, but today it is, in terms of shipping tonnage, the world's second-busiest port. Moreover, it also trans-ships a fifth of the world's shipping containers, half of the world's annual supply of crude oil, and is the world's busiest transshipment port. But today, with 35,300,000

Figure 47. The quality of port infrastructure in the 10 selected countries
Source: World Economic Forum 2015



TEU in 2014, Shanghai's port ranks first as the largest container port, and is followed by the Singaporean port with 33,870,000 TEU.^[53]

Also worth mentioning are the cruise ports, which are essential to understanding the impact of tourism activities on the economy. The port of Miami was the busiest cruise port in the world in 2014 (Figure 6) and makes this region extremely "sea-dynamic." The European ports of Spain, Greece and Italy are vital to the dynamism of the maritime sector in these countries.^[54]

Figure 48. Busiest ports in Asia

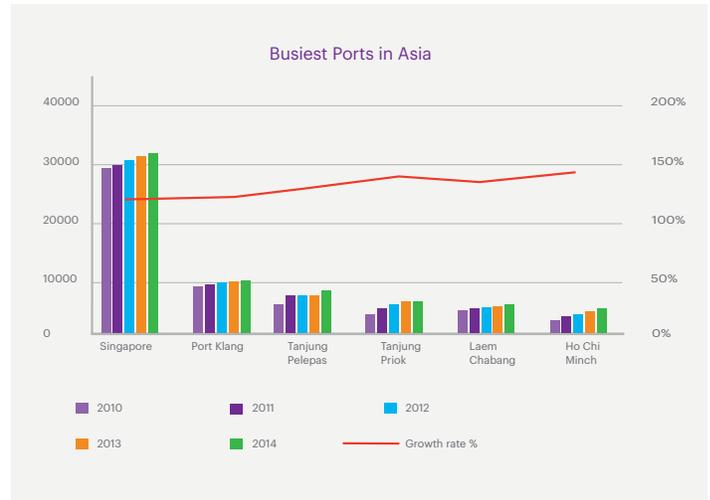
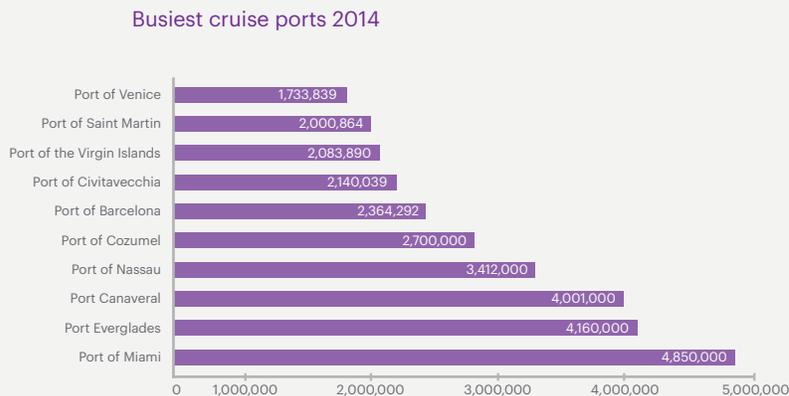


Figure 49. Busiest cruise ports in 2014
Source: Data from the website of each port



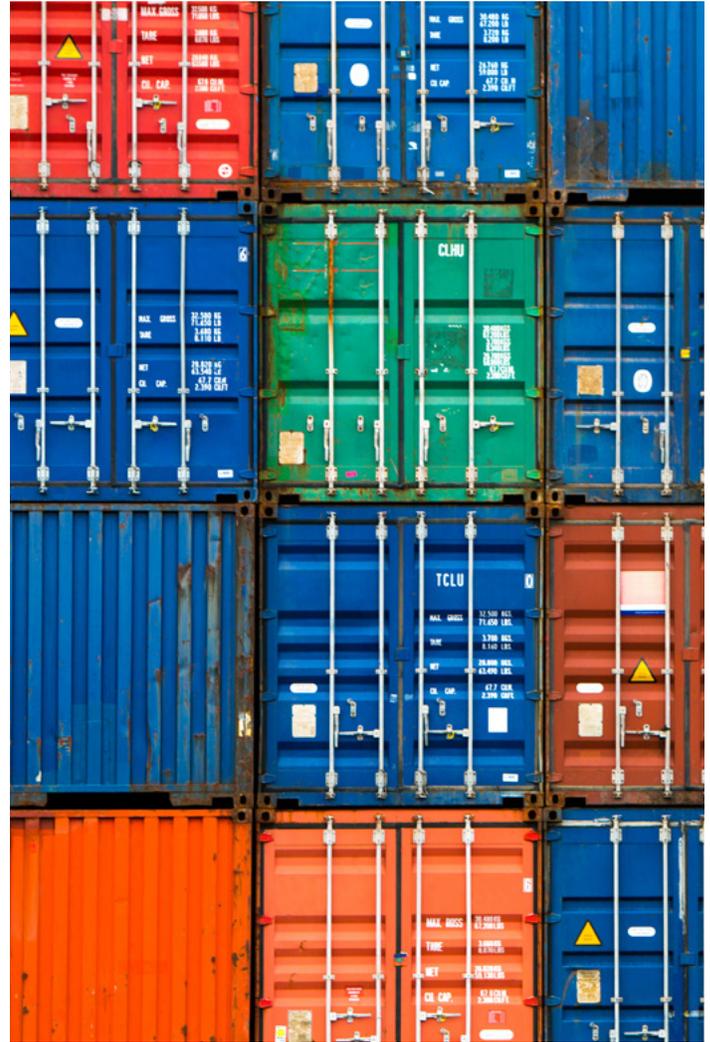
Global trends

Overview

In 2015, 214 new container ships were delivered globally. By the end of 2016, the global fleet's total capacity will have increased by 8.5% to 19 million 20-foot equivalent units. An order for 255 more vessels in 2015 was given, with an estimated value of US\$20.2 billion, 98% higher than in 2014, even though there is a severe imbalance between demand and supply.^[55] The world's fleet capacity grew by 1.72 million TEUs in 2015, while only 200,000 TEUs were deleted as a result of scrapping conversions or casualties. The strong growth in capacity proved to be unsustainable with the idle fleet targeting 1.36 million TEUs by the end of 2015, from just 230,000 TEUs at the beginning of the year. Spot freight from China declined 32% over the past year, and ship charter rates fell by 23% year-over-year.^[56]

Port operational performance and productivity

Port infrastructure performances can be evaluated and described by the number of cranes, maximum draught and storage area at origin and destination ports. Factors influencing productivity are physical, institutional and organizational. Physical limiting factors include the area, shape and layout of the terminal, the amount and type of equipment available, and the type and characteristics of the vessels



using the terminal. Lack of cranes, insufficient land, oddly shaped container yards, inadequate berths, inadequate gate facilities, and difficult road access are all physical limiting factors and may constitute future challenges.^[57]

Port efficiency can be modified by policymakers. Thus, improving port efficiency, productivity and implementing new technology and optimized design, as well as implementing planning measures to improve efficiencies may encourage policymakers to consider new initiatives.

Many African and Oceania developing countries, as well as those in Latin America and the Caribbean, must face transport infrastructure blockages. The largest ships that can be accommodated in most of these two regions' ports are far smaller than those at ports in other regions.^[58]

Figure 50. Top global terminal berth productivity, 2014 container moves per ship, per hour on all vessel sizes

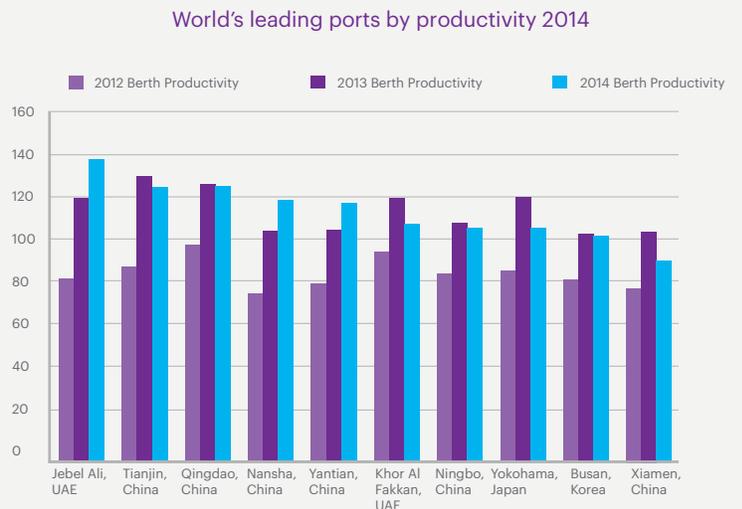
Source: JOC Port Productivity Database 2015



Operational performance

Port congestion is usually cited as the new barrier to international trade. Figure 51 illustrates the productivity ranking of ports in 2014 and the change over the preceding two years. Some ports have several operators, which provide intra-port competition. For example, the port of Tianjin, ranked second, has numerous international terminal operators, such as APM Terminals, China Merchants Holdings International, COSCO Pacific, CSX World Terminals OCCL, PSA and DPW.

Figure 51. World's leading ports by productivity, 2014 container moves per ship, per hour on all vessel sizes
Source: UNCTAD 2015



Intermodal connectivity

Figure 52 shows that major ports in Europe and the European rail network are highly connected; the intermodal connectivity is mandatory. Ports must be related to other modes of transportation in order to insure trade and humans' mobility.^[60]

Seaborne trade

Figure 53 illustrates the breakdown of the international seaborne trade, which is dominated by crude oil. UNCTAD studies indicate that global seaborne shipments have witnessed an increase of almost 3.5% in 2014 and an additional 300 million tons, to 10 billion tons.^[61]

This performance is explained by the slowdown in BRICS and emerging developing economies, the heterogeneous recovery of the developed countries, the oil price volatility and new refinery capacity developments. Figure 54 shows that world seaborne trade represents a significant part of the world merchandise trade.^[63]

Seaborne trade is dominated by Asia (41-58 tons) for unloaded and loaded trade, while the Americas are far behind (22-16 tons) (Figure 55). Merchandise trade and seaborne activities are projected to increase progressively during the years to come.^[62]

Figure 52. European ports and major rail network in Europe
Source: MARAD 2015

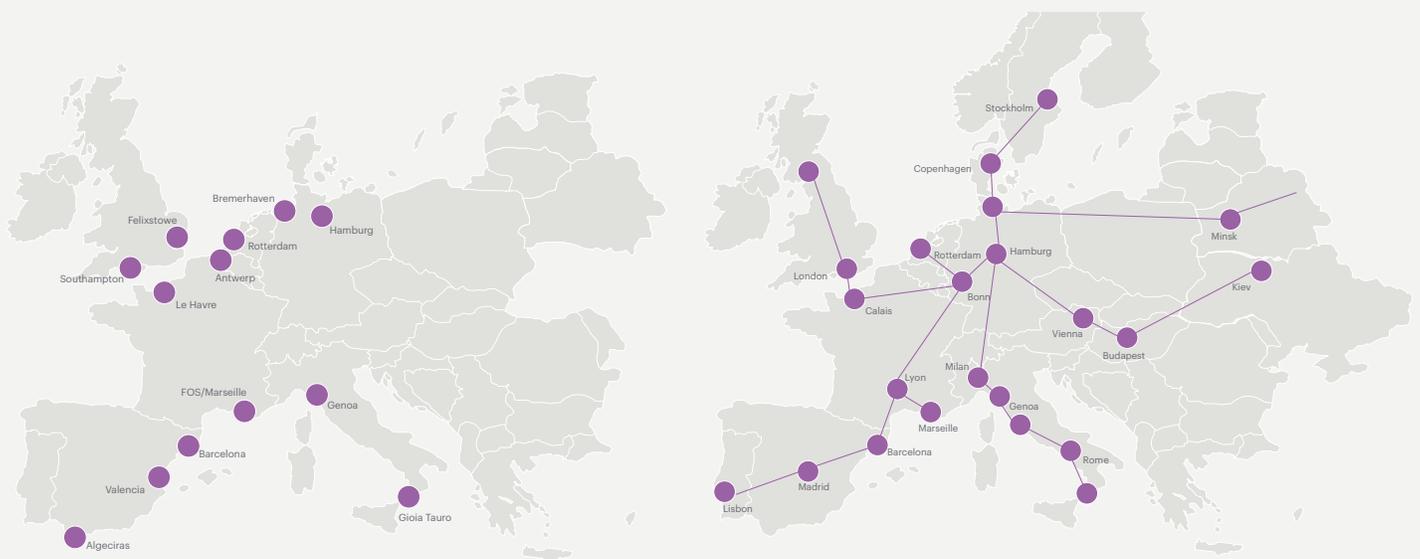


Figure 53. Structure of international seaborne trade

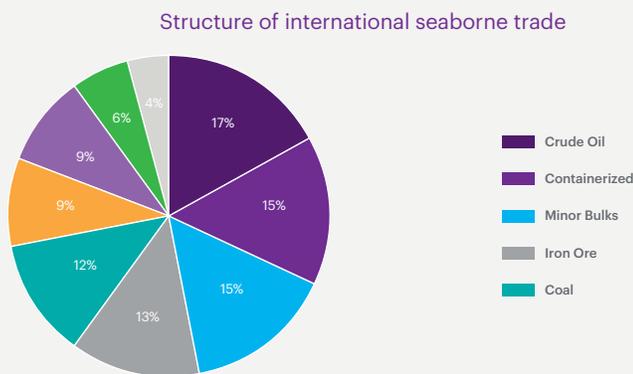


Figure 54. World merchandise trade, world seaborne trade and Source: OECD industrial production index UNCTAD 2015

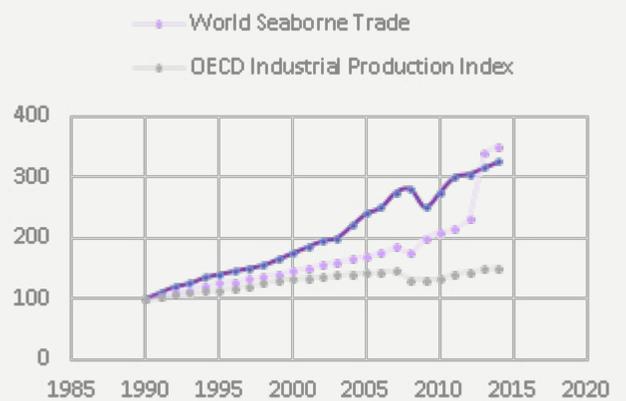
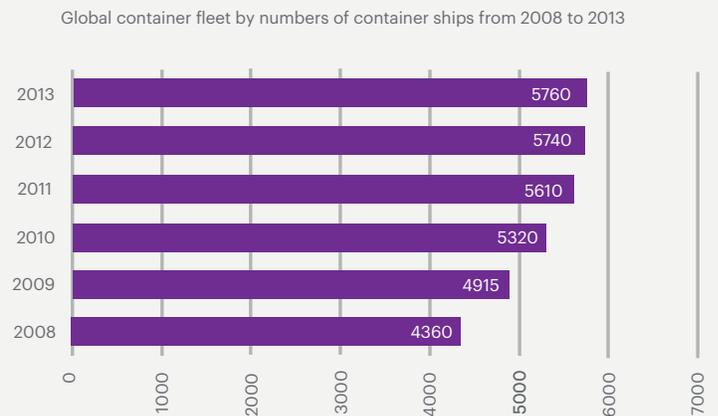


Figure 55. World seaborne trade by region 2014 (% share in world tonnage) Source: UNCTAD 2015



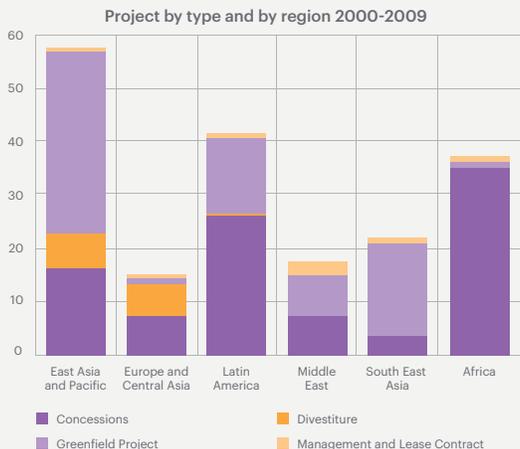
Figure 56. Global container fleet by number of container ships from 2008 to 2013 Source: Clarkson Research Services - HypoVereinsbank- Statista 2016



Global investment trends

Private participation in investments (PPI) provides the financial support and expertise that many ports might need for their commercial and social objectives. PPI improves performance. Privatization is usually considered as the best and most efficient way to increase port efficiency and throughput. Private funding is encouraged for large work projects in order to foster economic recovery and job creation. This was seen in all the countries studied—job opportunities heavily increased with all the projects launched. The following model shows four steps that lead to the increase of investments in ports and the infrastructure supporting ports. This model has been replicated

Figure 57. Project by type and by region released from 2000-2009
 Source: PPI World Bank, Pipal Research Analysis



in all the countries studied. It shows that in the transportation industry, roads, rails and ports are heavily dependent on each other.^[64]

In Figure 57, greenfield projects represent the major type of project in the seaport sector. Approximately US\$20 billion was spent on 75 greenfield projects in Asia, the Pacific, Latin America and the Caribbean through the last decade. Concession deals represent an investment of US\$15.5 billion for 97 projects. Management and lease projects, meanwhile, received a total of US\$305 million for 11 ventures. For many terminals, an inflow of capital has been triggered by the separation of port authority from port operator. Such operations call for large-scale personnel management, as well as heavy machinery and infrastructure investments. Concessions are generally awarded on a leasehold basis for between 20 and 50 years. Investments tend to range from stakes of 20% or 30% to total financing, depending on the host country and port authority.^[65]

Technology and innovation: major opportunities

Mega-ships: larger, faster, better?

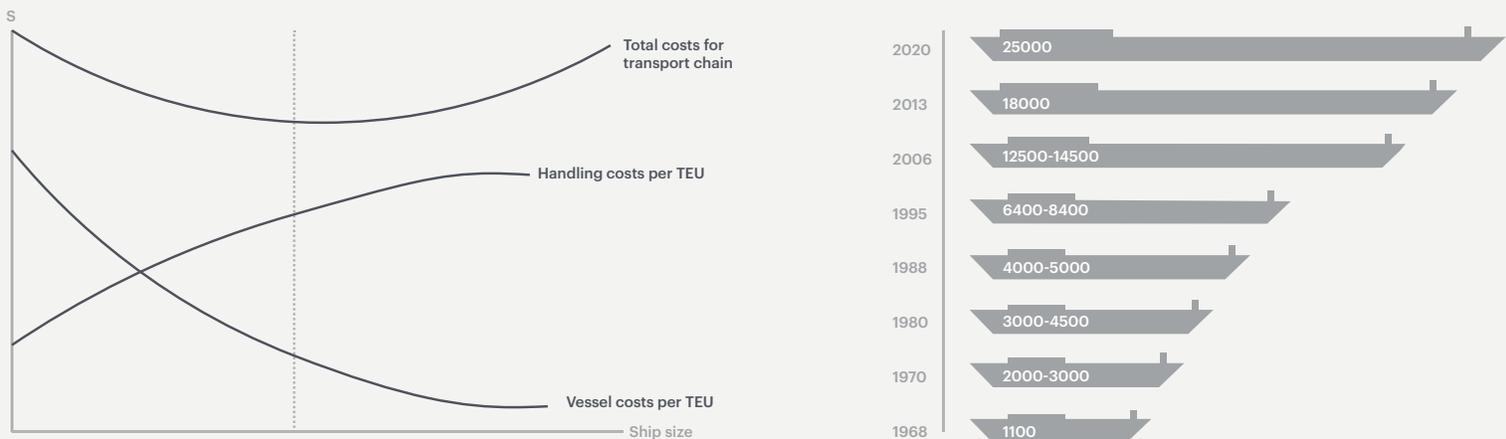
Vessels' sizes have not stopped increasing, ranging from 1,100 TEU to 25,000 TEU, and may continue to increase in future years. Countries compete through the size of their vessels; nevertheless, increasing the size creates several issues with logistics, supply chain, costs, and the environment.^[66] Thus, the real question today is: Are we facing an unbalanced situation between costs and benefits of mega-ships? One of the key elements that must be studied carefully is the relation between ship size and handling costs.

Handling cost refers to "the cost of the remaining part of the transport chain related to handle these large container vessels."^[67] Vessel costs per TEU decrease with size, whereas handling costs per TEU increase. Per Figure 58 (left side), the total transport costs are shown (by the addition of vessel costs and handling costs).^[67]

Shipping lines Maersk (18,100 TEU, 2013), China Shipping (19,100 TEU, 2014), MSC (19,200 TEU, 2015) as well as MOL (20,000 TEU, 2017) are competing for the biggest vessel. Figure 58 shows the evolution of vessel sizes. In 2017, the OOCL shipping line is expecting a 21,100 TEU vessel.

Figure 58. Evolution of cost as function of ship size; evolution of ship size since 1968

Source: OECD Analysis



Mega ships highlight several logistical, political and economic issues, listed below.^[68]

Bigger ships progressively lose their cost-saving advantages

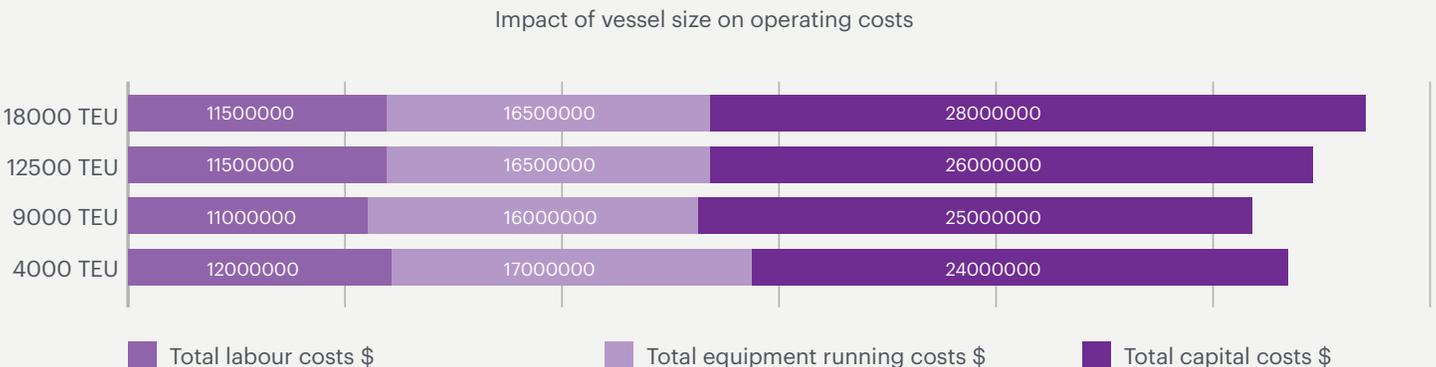
Today cost savings of mega-ships are decreasing: cost savings are four to five times smaller than the savings from the previous oversized ships. The total vessel cost per transported container has reduced by a third during the last decade, while the maximum container ship size has doubled. The increasing number of engines, rather than the size of the ship, allow savings of approximately 60% of the cost of container ships. The growth of containerized seaborne trade has

not slowed down the mega-ship expansion, but rather has led to oversupply.

Larger ships imply larger costs

Figure 59 shows there are extra costs as a result of the bigger size of new ships, e.g., the need to modify existing infrastructure such as bridge height, river width and depth, quay wall strengthening, berth deepening, canals and locks. Port equipment also presents a concern, with issues such as crane height. The expansion of infrastructure would increase physical yard and berth capacity, and the cost of infrastructure and inland connections would, in many countries, be attributed to the public sector.

Figure 59. Impact of vessel size on operating costs
Source: TBA 2014



Larger ships call for innovative, state-of-the-art and costly supply chain, logistics and operations

Supply chain, logistics and operations are much more complex and expensive. New technologies would be quickly needed to address these issues.

Public policies are essential to the functioning of the process

Regional or national collaboration is needed among several factors implicated in the transport industry. How much of the cost of mega-ships is the public sector willing to assume? Are the incentives to expand infrastructure in alignment with public interests?

Cascading effect: Reshaping the transport industry

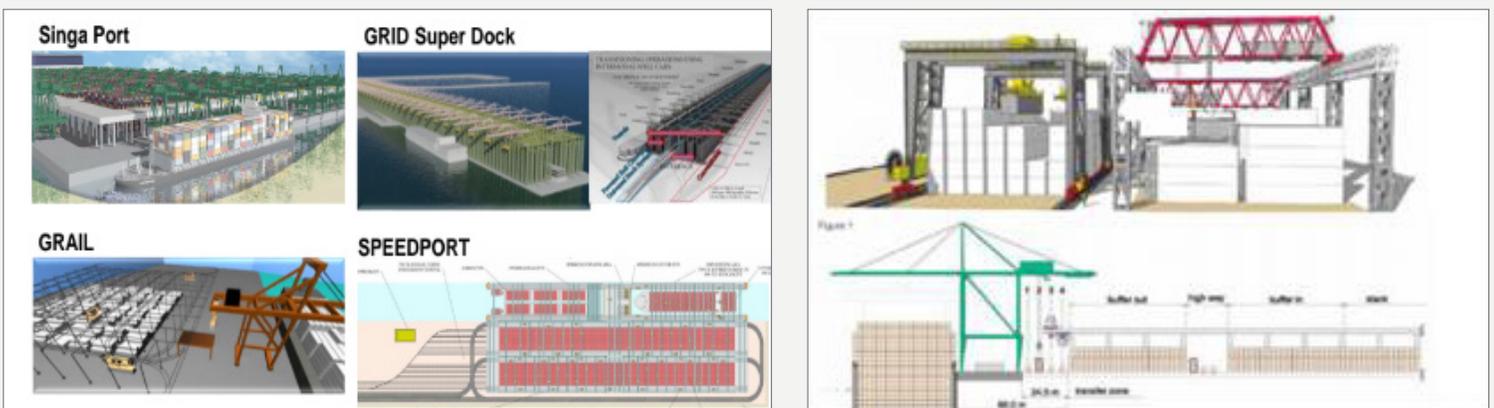
Mega-ships not only increase prices within the port industry, but also in the transport industry

globally. By 2020, for instance, the introduction of new 24,000 TEU ships would necessitate tremendous investments in Southeast Asian and European ports, and would foster the implementation of 19,000 TEU ships in North American ports or 14,000 TEU ships in Africa and South America.

In order to reduce operations costs and save working time, several new technologies and automation (industrial Internet) have been implemented in state-of-the-art ports such as in Netherlands-Rotterdam and China, Yangshan, Qingdao and Xiamen. Furthermore, new concepts of container terminals have been implemented such as GRID Super Dock, SpeedPort or Grail (Figure 60).

Figure 60. New concept of container terminals (left) and in handling mega-ships (right).

Source: Kosh Consultancy Group 2015



Greener and more sustainable regulations

New regulations require new environmental technologies to curb environmental issues, but in the long term these would save costs.

New safety regulations

Safe operation of ships and safe handling of cargo are mandatory for shipping companies. Companies focus not only on the safety of their own operations but also take steps to respect and protect public health. Safety in shipping has improved in the last decade. According to a recent report, *Safety and Shipping Review 2014*, issued by Allianz Global Corporate & Specialty, losses have been reduced by 50% since 2005.^[69] This review focuses on key developments in maritime safety and analyzes shipping losses (of over 100 gross tons) for 2014.

Energy port sector faces unprecedented demand

In 2016, project cargo operators will experience growth due to the energy port sector's growth. For instance, the Abbot Point Coal Terminal in Australia, as well as numerous greenfield port projects in Africa and North America, will need liquefied natural gas (LNG). The export of LNG is driving the high demand for massive and traditional cargoes, while the cost of transport of such substances decreases. Furthermore, these greenfield projects illustrate the huge Asian demand for fuel. By 2040, the International Energy Agency claims that Asia will import two out of three barrels of crude traded worldwide. Greenfield energy ports are currently considered one of the most significant infrastructure projects.^[70]



Challenges

Social challenges

The main social challenges facing ports today include safety, security and reliability.^[71]

Labor issues are the most complex to tackle. The most important challenge is how to provide employment as automation and digitalization are significantly increasing. Safety issues for remote project cargo carriers also need to be considered. Greenfield projects are often located in developing nations and remote areas where few resources are available and hard to reach. Thus, handling dangerous cargoes becomes an issue. The combination of skills, experience and the use of technology are vital to the success of nearly every greenfield port

project, and to the growth of roads, railways and infrastructure.

Drop in oil price

The impact of the drop in oil prices since June 2014 goes beyond the energy markets and the world economy. The shipping and seaborne trade industry—mostly the tanker trade—is also highly impacted. Furthermore, sectors related to maritime transport services are also affected by the volatility of the price of oil. Production costs, economic growth, income and purchasing power of oil producers or exporters and consumers or importers, terms of trade, and investments in oil and gas, as well as investments in alternative fuels and fuel efficient technologies are all parameters affected by

Table 5. Major producers and consumers of oil and natural gas, world market share in % 2014

Source: UNCTAD, June 2015

World Oil Production	Share%	World Oil Consumption	Share%
Middle East	32	Asia Pacific	34
North America	18	North America	22
Transition Economies	16	Europe	15
Developing America	12	Developing America	10
Africa	9	Western Asia	9
Asia Pacific	9	Transition Economies	5
Europe	3	Africa	4

such volatility. Table 5 illustrates the world oil production and world oil consumption by region and by share. Production is dominated by the Middle East, while consumption is dominated by the most populated continent, Asia.^[72]

Ports have long life cycles; thus, long-term sustainability and flexibility are real issues. The need for optimized equipment and operations could be costly.

Emission of CO₂

By 2050, the international shipping carbon emissions could increase 50-250%. Figure 61 shows the contributions of the busiest ports to the worldwide CO₂ emission. Singapore, which for years has been the busiest port in the world, ranks first.^[73]

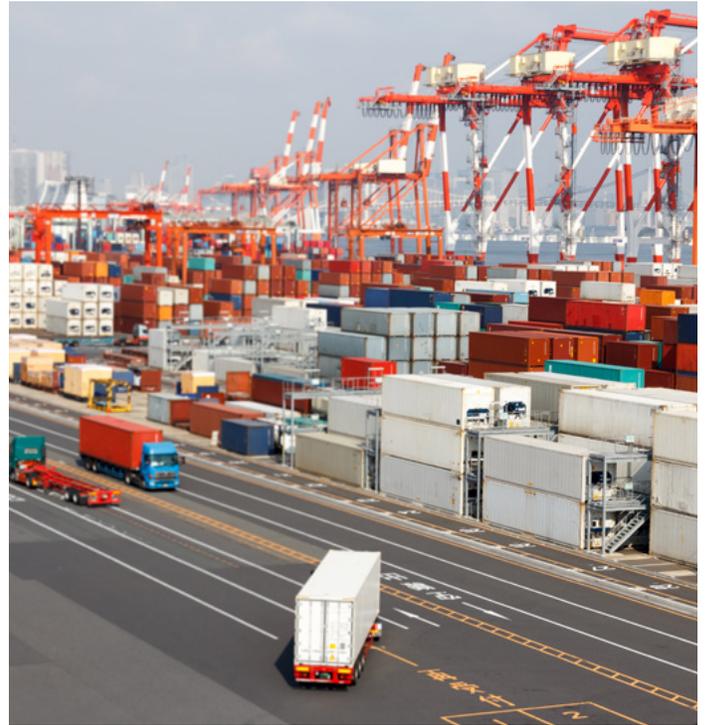
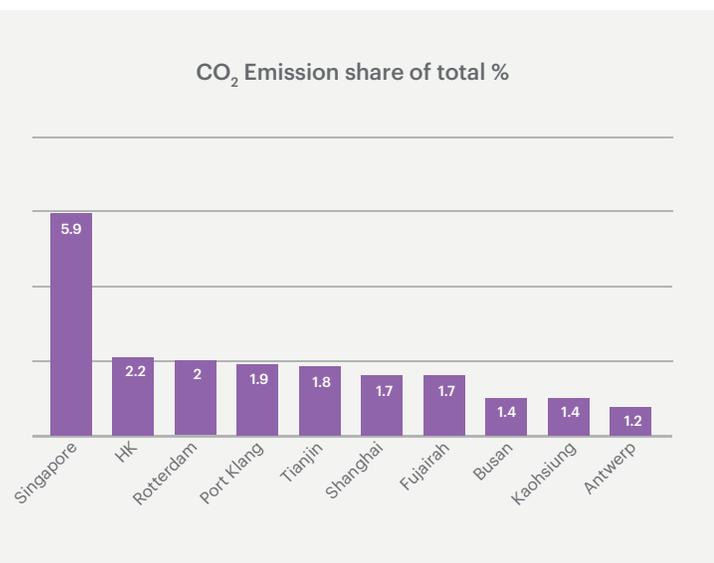


Figure 61. CO₂ emission share of total % in busiest ports



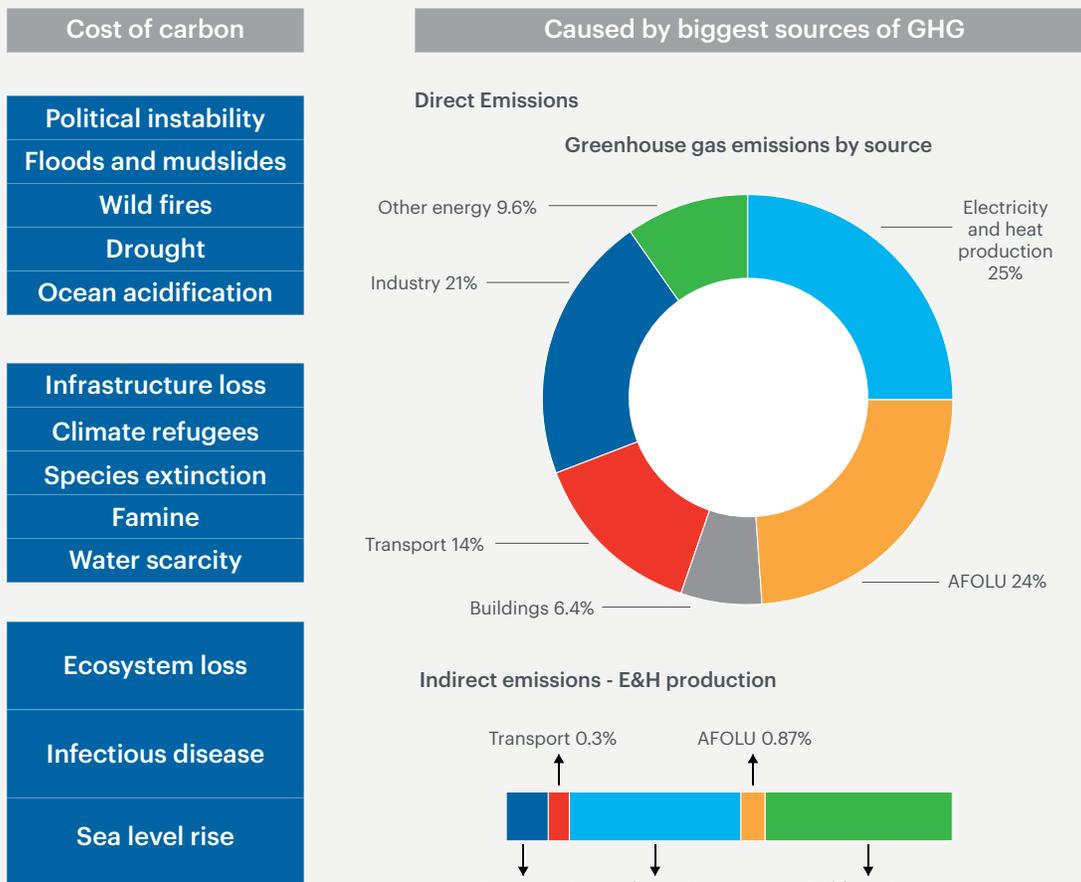
Sustainability

This section focuses on transportation's role in achieving sustainable development milestones set by the United Nations, and revolving initiatives supporting the UN's 2030 agenda target 11.2. When addressing sustainability and the triple bottom line (social, economic and environmental), it is impossible to ignore climate change. The report sheds light on the different sources of climate change, and further

elaborates on the consequences of the change in weather conditions in the past few years. The report also discusses the different initiatives undertaken globally to reduce projected future consequences.

Global greenhouse emission gases can be classified by the different sectors contributing them. Figure 62 categorizes emissions in two

Figure 62. Cost of global emissions (IPCC 2014)



groups, direct and indirect. The direct emissions are mainly caused by industry, such as transport, buildings, electricity and heat, AFOLU and other energy sectors. The sectors' contribution to greenhouse gases are shown under direct emissions in Figure 1. Notably, indirect electricity and heat emissions are produced as a consequence of the demand of each of the industries. These sectors produce carbon in their general activities, and also require electricity to run. They also contribute to the carbon emissions produced by the electricity and heat industry.^[74] Electricity and heat are produced by the burning of coal, oil and other natural gas resources. The industry burns fossil fuels on their site to deliver their goods and services, separate from the electricity needed to operate the facility itself. Agricultural forestry and other land uses contribute 24% of greenhouse gases, which is mostly produced from agricultural and deforestation activities.^[75] Transportation involves the burning of fossil fuels to operate different infrastructure assets such as road, rail, air, and marine transportation. Greenhouse gases contributed from buildings are primarily produced by fuels burned for heat.^[76]

It is important to emphasize the effects of greenhouse gases on the triple bottom line: social, economic and environmental. Consequences affecting society were demonstrated in different catastrophes across the world such as: climate refugees, infectious diseases, and political instability. Consequences to the environment are ecosystem loss, sea level rise, water scarcity, species extinction,



ocean acidification, storm damage, drought, wild fires, and many floods and landslides.^[77] To substantiate that these consequences exist, different data were collected by scientists across the globe to show the increase in damage to the triple bottom line. Global carbon emissions have risen significantly since the 1900s (Figure 63). Following World War II, the emission rate has risen exponentially to 10,000 million metric tons. Insurance companies have had decreased profit margins due to the different weather catastrophes that affect valuable assets insured by those companies. Meteorologists and weather experts have noted unconventional weather patterns occurring in various geographical areas across the globe. In 2015, more than 400 weather events (storms, floods and mudslides) were recorded, the highest number of events since 1980. Figures 63 and 64 show the parallel between the rise in the number of climate change events and the increase in CO₂ emissions in 1980. Both figures imply that consequence and causality

is a nonlinear growth, and establish time as a critical parameter. The systematic causation is the extra heat penetrating through the ozone layer, and extracting water as vapor into the atmosphere, causing drought. Hence, those same catastrophes are endangering scarce resources essential for the survival of the human race. This extra energy trapped as heat is the main cause of the melting of the polar ice cap, which is causing sea levels to rise. One of the foreseeable consequences of rising sea levels is the eradication of current coastal zones. Major cities may be exposed to floods and contamination of aquifers and soils, endangering many species. Figure 65 monetizes the assets at risk in the current top 10 cities in the world at year 2070. In Miami,

more than US\$3 trillion are subject to loss in the year 2070. New York ranks third at around US\$2 trillion of assets subject to loss from the rise of sea level by 2070. The occurrence of climate refugees is another phenomenon that may arise from climate change crises if not mitigated, where people are forced to move due to extreme weather catastrophes that prevent them from enjoying a secure environment, and deprive them of basic elemental resources. Such possible catastrophes include the rise of sea level, droughts, desertification, and disruption of seasonal weather patterns. These data have prompted private and public entities to shift their sources from carbon-based energy to clean, low-carbon energy. According to the World Bank, public entities have invested

Figure 63. Global carbon emissions
Source: Boden, T.A., Marland, G., and Andres R.J., 2015

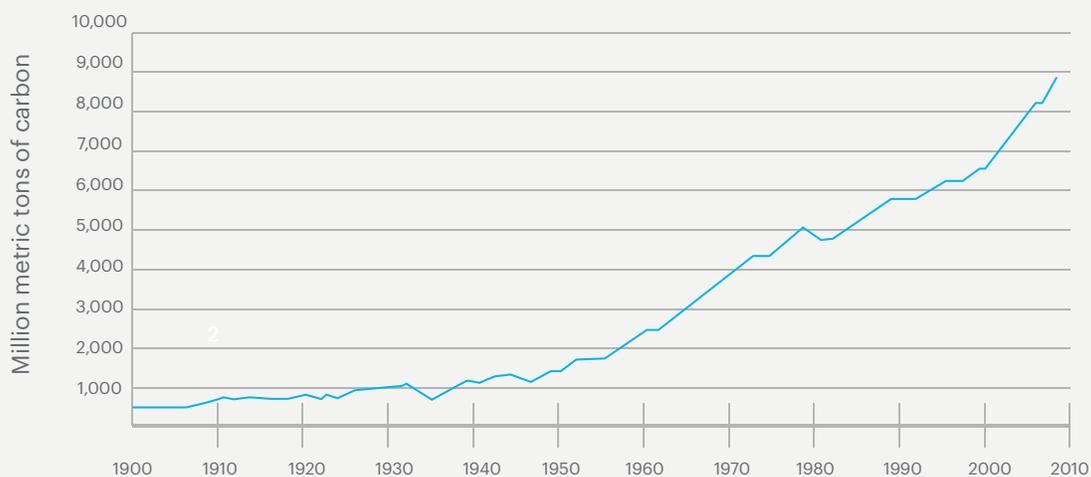


Figure 64. Worldwide weather catastrophes
 Source: Insurance Information Institute, 2016

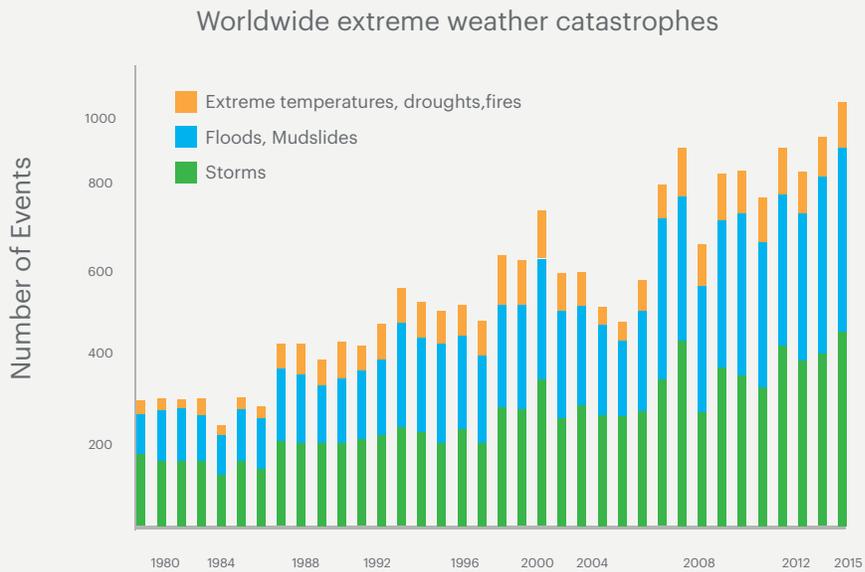


Figure 65. Top 10 cities assets at risk in 2070 in US\$ trillion
 Source: Nicholas et. al. OECD, 2007

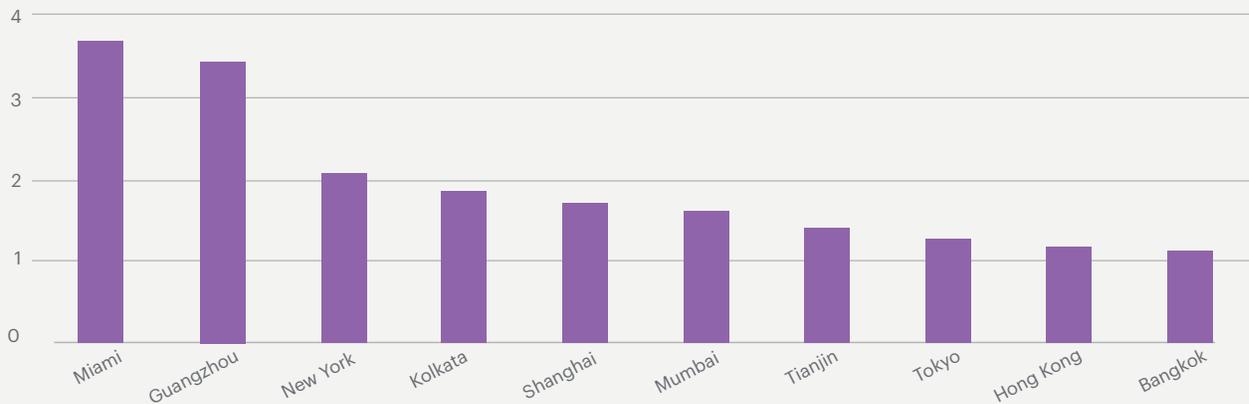
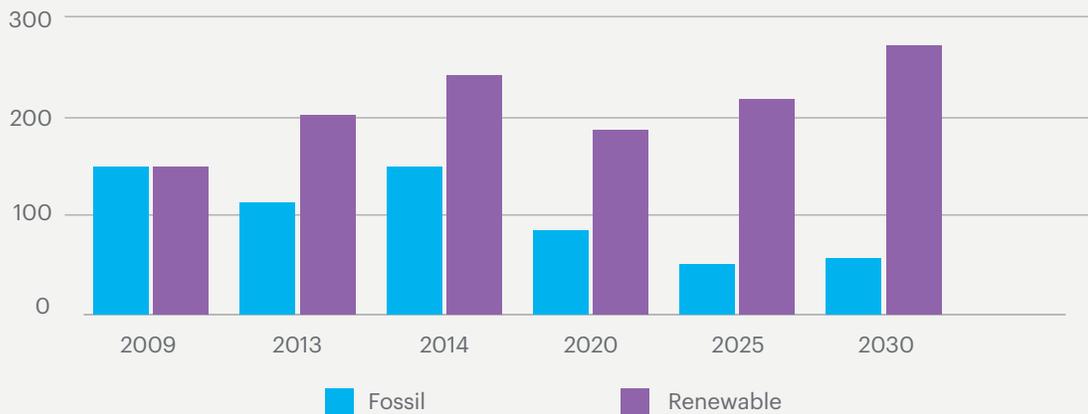


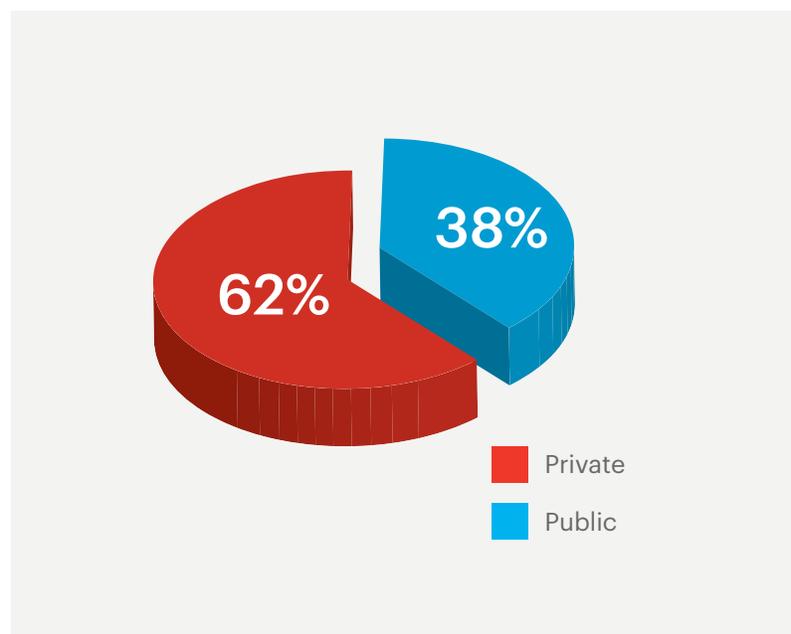


Figure 66. Total energy investments in US\$ billions
Source: World Bank



around US\$148 billion in clean energy, while the private sector has surpassed that amount with US\$243 billion (62% of total investments) in clean energy (Figure 65). Globally, investments in renewable electricity generation surpassed fossil fuel investment, and the gap continues to grow, although burning of fossil fuel receives 40% more subsidies than renewable energy (Figure 66).

Figure 67. Investments in clean energy
Source: BNEF, 2014

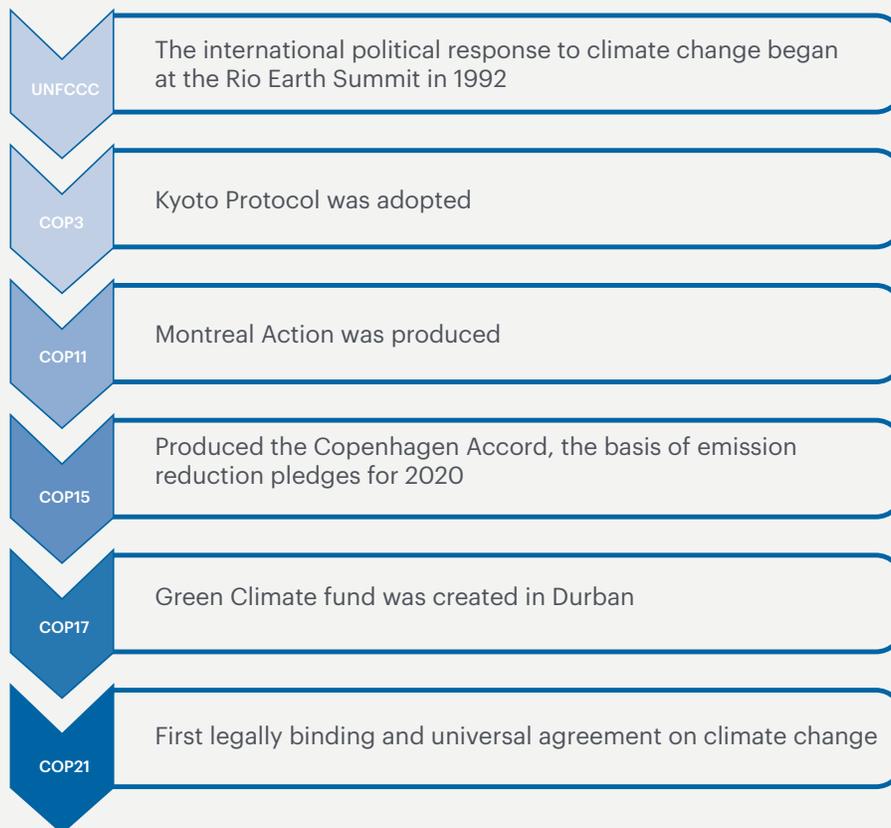


Twenty-first annual Conference of the Parties (COP 21)

The UNFCCC is the global agreement targeting climate change, reached at the 21st annual Conference of the Parties in Paris in December 2015. COP 21 set a record in climate history by achieving a legally binding global consent for action against climate change (Paris Agreement). The ultimate objective was to limit global warming to less than two degrees Celsius compared to pre-industrial levels. The two-degree cap is driven by the need to overcome

climate change and promote resiliency in the triple bottom line economies. These efforts must encompass each country's specialized needs and capacities, while implementing the agreement in 2020. The agreement will require sustainable investments of efforts in order to foresee long-term change. The first recognized response targeting climate change was in the Rio Earth Summit in 1992, where a framework for action was established.^[78] Since then several key COP meetings have resulted in these key achievements:

Figure 68. COP 21 historical key achievements, 2015



COP 3 adopted the Kyoto Protocol, which complements the first-ever recognition in 1992 of climate concerns. In COP 11, the “Montreal action” was taken to protect the ozone layer by halting the production of various substances depleting the ozone layer. Initiatives taken to guarantee our existence require substantial funds to implement and execute actions pertaining to climate change.^[79] The Green Climate Fund (GCF) is a fund within the UNFCCC allocated to support developing countries in their efforts against climate change. It is

operated by a board of 24 members reporting to the UNFCCC secretariat.

The Paris climate conference adopted a four-pillar framework in order to achieve a two-degree Celsius cap on global warming. The first pillar is the commitment of the government in signing the legal agreement, which will be applicable to all and implemented in 2020. The second pillar is the country contributions, submitted prior to the convention, to exhibit commitment toward their objective. The third

Figure 69. COP 21 key initiatives
Source: COP 21, 2015

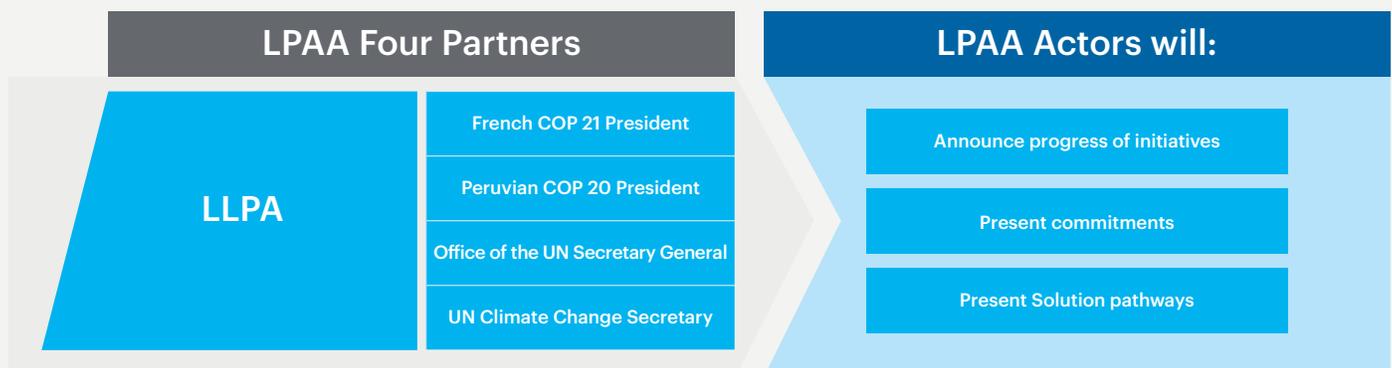


pillar is the mobilization of finance by public and private sources in an effort to fund a transition to a low-carbon and resilient environment. Finally, the action agenda exhibits climate actions and support from business and non-state actors committing to the Paris agreement. The Lima-Paris Action Agenda (LPAA) is comprised of four partners: the French COP 21 president, the Peruvian COP 20 president, the Office of the UN general, and the UN Climate Change Secretariat.^[80] The COP 21 will be structured to encourage interaction between governments and non-state actors, which will accelerate the goal of nations through 2020 and beyond. LPAA realized the huge impact of the private sector, which occupies the majority of the sectors contributing to greenhouse gas emissions (buildings, AFOL, industrial, etc.). LPAA has seen numerous initiatives in key sectors in an effort to cap global emissions.

Transportation

The climate debate and action often focuses on energy and industrial activity as the key sectors contributing to emissions. However, the transportation sector, which is responsible for one-fifth of energy-related CO₂ emissions worldwide (Figure 71), must be included in any commitment or agreement pertaining to climate change.^[81] Furthermore, sustainable transport must be integrated in every strategy affecting the triple bottom line. Caution should be used in decisions regarding transport, as they have long-term effects on the urban environment. Decisions undertaken by governments today need to coexist with the existing infrastructure. Sustainability in transportation has been a focus in different initiatives globally.^[82] The United Nations has initiated its commitment and has since worked on different milestones (Figure 72). Transport and climate change were first

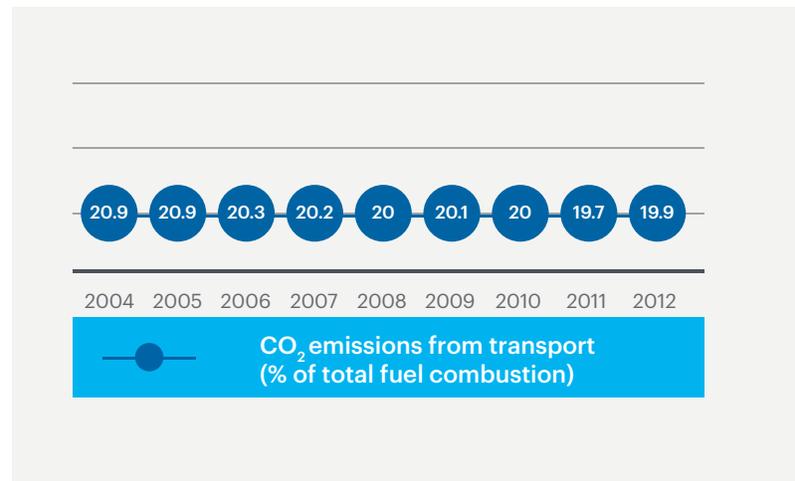
Figure 70. Lima-Paris Action Agenda
Source: COP 21, 2015



considered together in the 1992 Summit, and thereafter mentioned in the resulting Agenda 21.

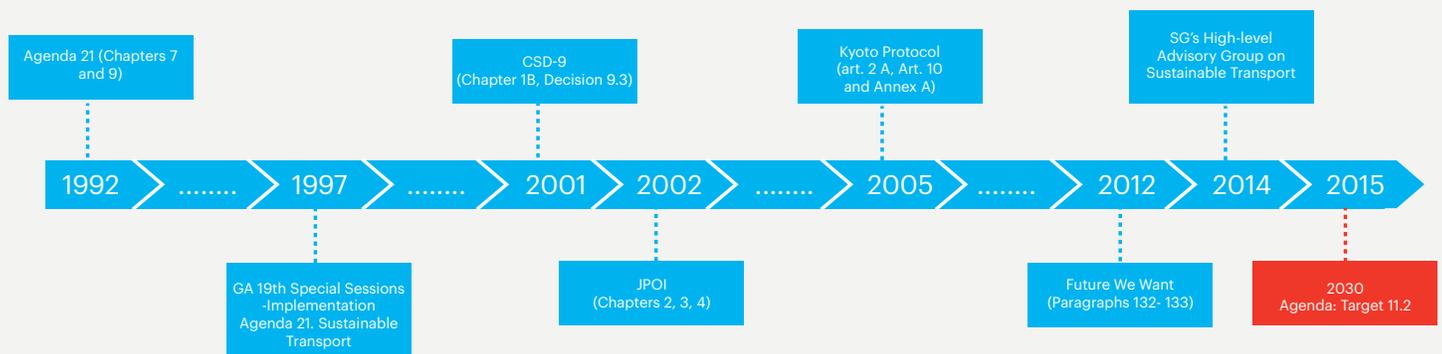
In 1997, the General Assembly reviewed the Action Agenda and noted that transportation affected the extensive use of energy. In 2002, transport data was captured in the Johannesburg Declaration. The result was a document of the 10th Anniversary “World Summit” on Sustainable Development, which formed a basis for a mobility policy benefiting the environment. Thus, the Kyoto and Montreal Protocols later recognized the importance of programs to reduce CO₂ emissions linked to transport.^[83] Leaders across the globe issued a book entitled *The Future We Want*, which stressed that transportation is the backbone of sustainable development and recognized the importance of the role

Figure 71. CO₂ emission from transport
Source: World Bank, 2016



of governments in achieving sustainable development. Moreover, as part of the Action Agenda, announced in early 2012, the UN Secretary General acknowledged

Figure 72. Timeline on sustainable transport milestone United Nations, 2016



transportation as a major component of sustainable development. In August 2014, the UN Secretary General announced the creation of a High-Level Advisory Group on Sustainable Transport (HLAG-ST), whose members include government leaders, to address the different aspects of transportation systems in an effort to counteract the dangers of climate change.^[84] Policies will be developed by the HLAG-ST and will be published in a global report on sustainable transport. Sustainable transport is now realized by the world to have a tremendous impact on achieving the UN Sustainable Development Goals (SDG) complementing the

Action Agenda. Although sustainable transport is not represented by a standalone SDG, it is captured within numerous SDGs pertaining to social, economic and environmental factors impacted by a non-resilient infrastructure.^[85]

Global sustainable transportation initiatives

The United Nations has been successful in starting the movement to address global issues. The timeline previously discussed demonstrates the efforts within the United Nations from the point sustainable transport was first recognized until the development of the HLAG-ST and its latest 2030 Agenda, with target 11.2 focusing

Figure 73. Examples of initiatives supporting UN’s 2030 Agenda



on sustainable transport. Ever since the UN launched its movement to address sustainable transport, many organizations and partnerships have been established to deliver on the 17 SDGs, such as those listed below.

- **Transforming Transportation** is a conference held each year in assistance with EMBARQ. The event invites leaders from public and private entities to reflect on the SDGs' impact, with an emphasis on emissions and investments to achieve their goals.^[86]
- **The C40** is a unification of different organizations around the globe to deal specifically with GHG emissions. The C40 Cities Climate Leadership Group includes 80 great cities acting on capping GHG emissions.^[87]
- **EMBARQ** works on creating sustainable solutions for transportation sectors to limit the use of energy and motivate less reliance on emission-generated assets of infrastructure. EMBARQ collaborated with authorities on all levels across the globe, along with private institutions, to create a safe and healthy system.^[88]
- **The Technical Working Group on Transport (TWG)** prepared an analysis of the transport relevance of each of the 17 SDGs for the secretary generals.
- **Sustainable Low Carbon Transport (SLoCaT):** The Partnership on Sustainable, Low Carbon Transport (SLoCaT) promotes the implementation of sustainable solutions in policies. SLoCaT consists of efforts spanning more than 90 organizations.^[89]
- **The Rio+20 Voluntary Commitments on Sustainable Transport:** The SLoCaT partnership facilitated the submission of voluntary commitments by stakeholders to sustainable transport, which implemented concrete policies, plans, programs, projects and actions to promote sustainability.
- **The Global Partnership for Sustainable Transport (GPST)** brings "companies and industry associations from all modes of transportation together with other stakeholders." The GPST fosters collective action and sustainability collaboration in support of the vision of the 2030 Agenda.
- **International Transport Forum Summit** invites political leaders from around the globe to motivate interaction between public and private entities and promote collaborative action towards climate change.^[90]
- **COP 21:** While transport was directly addressed in the agreement, the Paris Agreement builds on the LPAA (Lima-Paris Action Agenda), which addresses several topics related to transport. More than 60% of the countries' national climate plans in COP 21 have set plans to mitigate emissions from the transport sector. The conference has seen 15 initiatives related to transport by the LPAA and UITP (International Association of Public Transport).^[92]

- **World Climate Summit:** The summit spans 300 speakers, 100 private and public partners and includes access to a 1,500 journalist database.^[91]
- **UITP** is known for its engagement in advancing the sustainable urban mobility policy agenda, and is also known to collectively work with public stakeholders to act on all sustainable transport modes.
- **The PPMC** (Paris Platform on Mobility and Climate) is a platform that openly invites all entities that support effective action on transport and climate change to join the process.
- **The IPCC** (Intergovernmental Panel on Climate Change) assesses the political and economic impacts of climate change using an objective technical and scientific approach.^[94]
- **The ITDP (Institute for Transportation and Development Policy)** works with cities worldwide to bring about transport solutions that cut greenhouse gas emissions, reduce poverty, and improve the quality of urban life. Most recently, ITDP has been instrumental in designing and building the best bus rapid transit systems in the world.^[95]

Global projects pipeline

The volume of world trade and the global population are constantly growing, and with them, the demand for transportation. From 2014 to 2030, the global GDP is expected to almost double. A huge contributor to the GDP is the transport sector, which is estimated to grow at about 4.7% annually on an average throughout the world.^[96] Figure 74 shows the intensity of the projects globally.

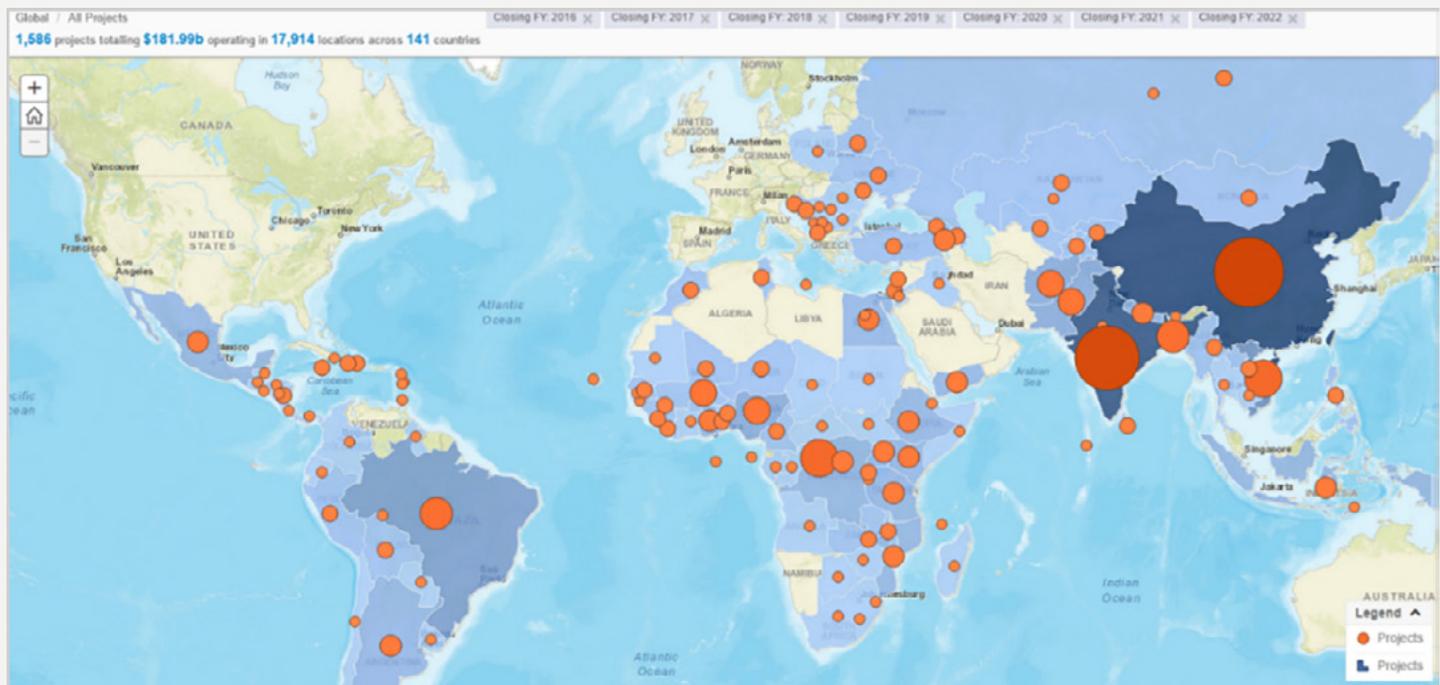
The Asia Pacific region is experiencing a major boom in transportation infrastructure projects. It is noteworthy that countries and regions like

Mexico and South America are also becoming interested in the development of transportation infrastructure. There has always been steady growth in Europe, South Africa and Southeast Asia, due to external funding by international treaties like the European Union, Asian Development Bank, World Bank, etc.

In South Asia and Southeast Asia, the projects are limited to enhancing connectivity in the country itself, but there are plans for regional integration between South and Southeast Asia. An estimated investment of about US\$62.6 billion is predicted

Figure 74. Global map with the infrastructure projects intensity closing FY 2016 to 2022

Source: Global Reach, World Bank





for the new regional transport projects—road and rail connections among Cambodia, Bangladesh, India, Myanmar, Thailand and Vietnam, and ports in the Bay of Bengal.^[97]

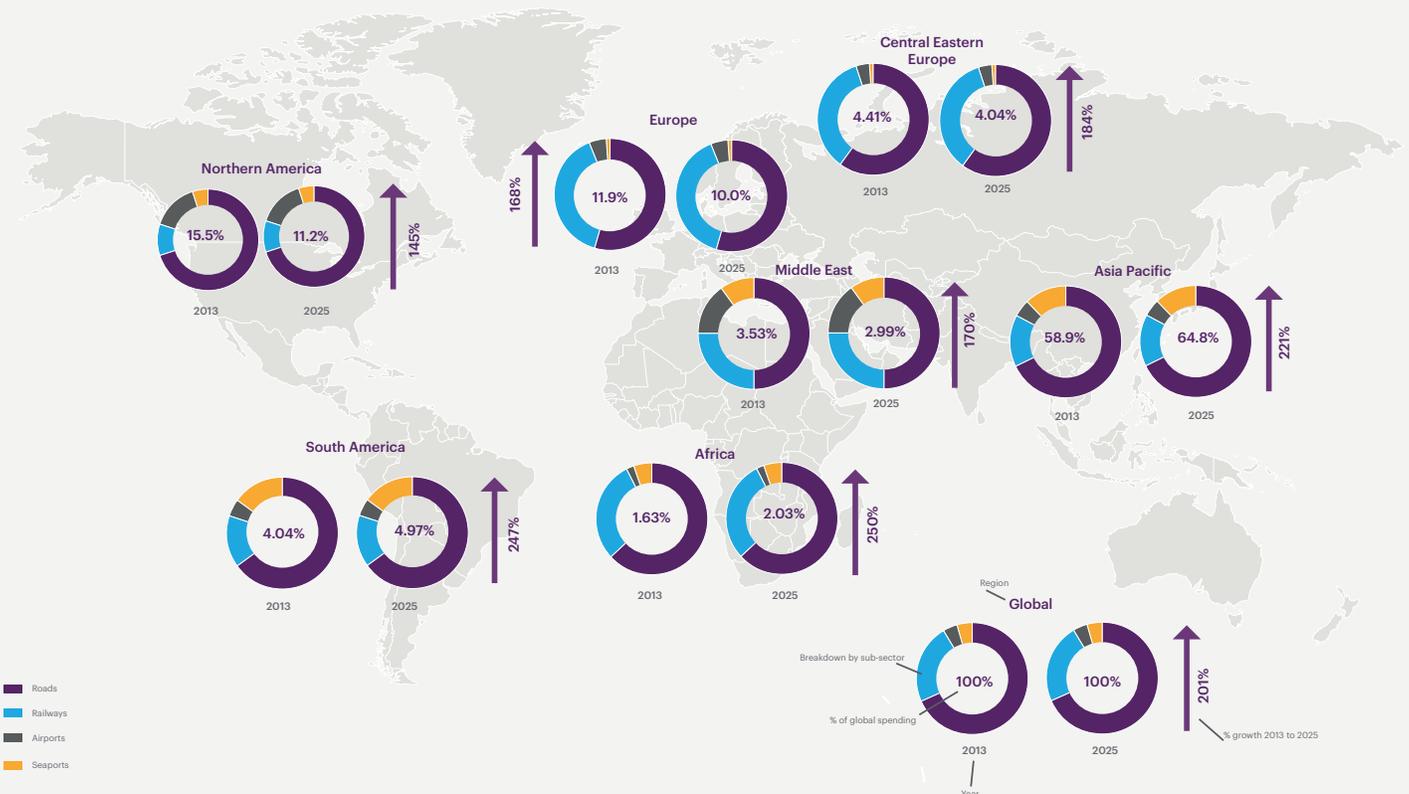
Europe implemented a new EU Transport Infrastructure Policy in 2014, to develop an integrated network that will link 38 key airports with rail, 94 main European ports with road and rail, will upgrade 15,000 km of railway line to high speed, and includes 35 cross-border projects.^[98]

Transportation infrastructure is developing at a tremendously high rate globally, in various ways in different regions in the world.

Global infrastructure needs

The global infrastructure needs mainly depend on the current infrastructure and the growth in demand. The global need to invest in transport infrastructure is determined to be around US\$330 billion, excluding the road networks, as per the OECD report. Figure 34 illustrates the growth in spending on transportation

Figure 75. Transportation infrastructure worldwide
Source: PWC and Oxford Economics



Source: PWC and Oxford Economics

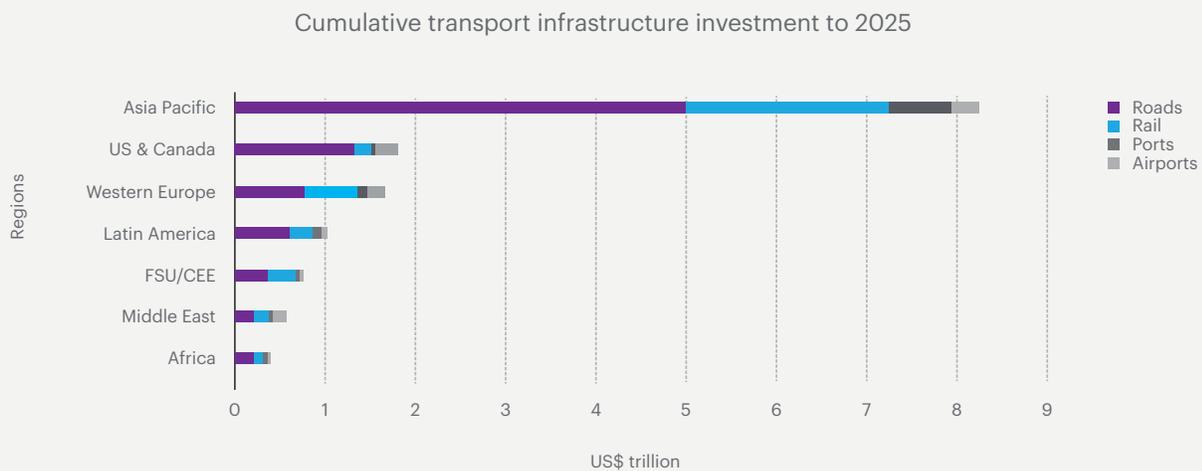
infrastructure in different regions worldwide. Asia Pacific, South America and Africa have the highest amount of investment in infrastructure growth, with the Asia Pacific region being one of the largest infrastructure investment markets in the world (Figure 76).

The dominant sector in the transportation infrastructure is the roadways. Of all the sub-sectors, seaports are predicted to grow at the fastest annual average rate of about 5.8%,

while the airport growth rate is predicted to be reduced to 2.6%.

Railways are estimated to have a better scope for development in economies with a large public transportation market like that of Western Europe. Roads will most likely remain the biggest market for investment in the transportation infrastructure, especially in the Asia Pacific region.

Figure 76. Cumulative transport infrastructure investment to 2025
 Source: Oxford Economics, PWC

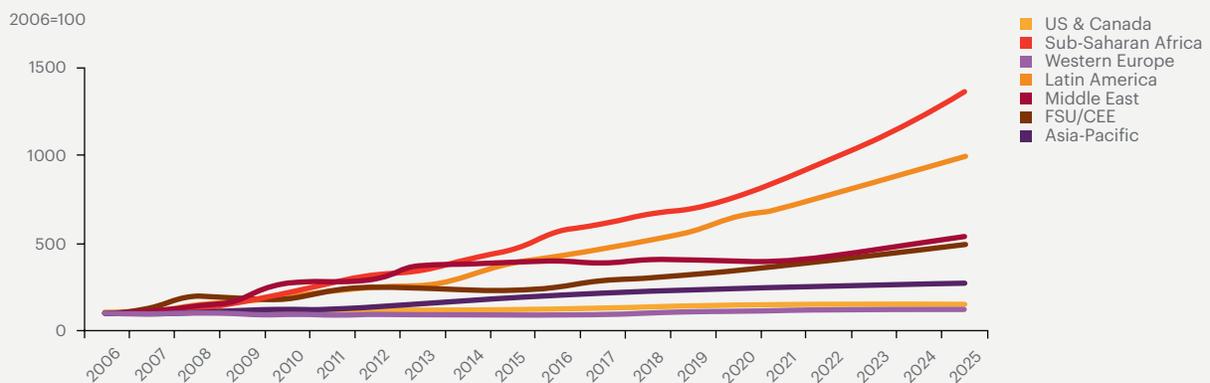


As can be seen in Figure 77 and the predictions stated by PWC in the report, “Assessing the global transport infrastructure: Outlook to 2025,” the transport infrastructure in Western Europe is already advanced and growth is expected to be modest in the near future. The region is seeking more infrastructure projects in the social segment, especially health care. Road development is only predicted to take place for reducing traffic congestion, whereas the rail infrastructure is set to grow. Spain, for example,

is planning some crucial investments in railways between 2016 and 2025. The European Union plays a very important role in the funding of transportation infrastructure in the European countries. The transport infrastructure spending in Western Europe is to remain almost the same—from 11% in 2014 to 10% in 2025.^[99]

The same applies for the United States and Canada. With a well-advanced infrastructure already in place, the annual average growth rate

Figure 77. Growth in transport infrastructure spending to 2025
 Source: Oxford Economics, PWC



is predicted to be just 3%.^[100] There are some projects like the Second Avenue subway line in Manhattan, Chicago's Loop Link BRT, and the Gateway project from New York to New Jersey, which are the biggest transport infrastructure projects in the region.

In contrast to these regions, Asia Pacific has some of the greatest developing transportation networks highlighted in the appendices of the report. There is an evident gradual "shift in economic power from West to East."^[99] Countries like India and China have major road projects planned in the near future, such as the Silk Route and the Delhi-Mumbai Industrial Corridor, which call for huge development in railways and roads specifically. The Silk Route is one of the largest projects, with a goal of linking the regions globally. It is established under the US\$1 trillion initiative, "One Belt, One Road," China's effort to build trade over land and sea between Europe and Asia.

Similarly, the Delhi-Mumbai Industrial Corridor is a mega-project worth US\$90 billion, covering a length of around 1,500 km between Mumbai and Delhi in India, the details of which are mentioned in Appendix – India. These are some of the projects contributing to the extensive development in the Asia Pacific region.

Latin America has rising wealth levels capable of advancing transport infrastructure development

in the region. Colombia's 4G (Fourth Generation) program aims to consolidate the national road network. The program aims to build a US\$25 billion network of more than 2,600 km of two-lane highways by the end of 2018 (see Appendix – Colombia). Additionally, Mexico has a major high-speed rail project between Mexico City and Queretaro City, to be completed by 2017.

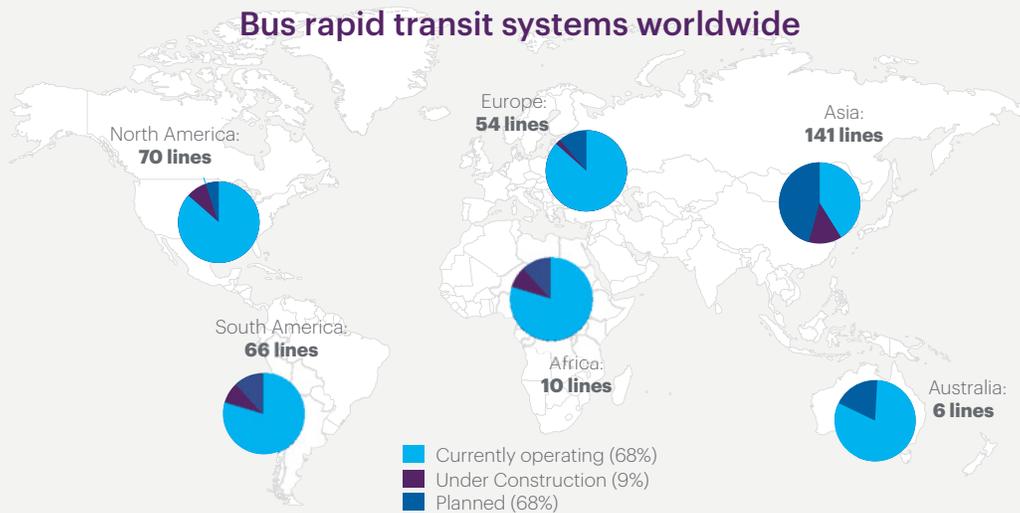
Road networks are a major subsector of development in the Middle East, even though there is development of Riyadh Metro and the Qatar airport. The Etihad Rail Project, UAE, spans across 1,200 km from the border of Saudi Arabia to the border of Oman. Even the Dubai New Metro (Route 2020), which involves the 14.5 km expansion of Dubai Metro, contributes to the expected rapid growth of the region. (See Appendix – UAE.)

The Central Eastern Europe region is expected to undergo a gradual development in transportation infrastructure as compared to the global average. Some of the brownfield projects in Poland include the S7 and S8 carriageway construction and rebuilding the terminal of the Krakow Airport. The Port of Gdansk expanded its intermodal container terminal in January 2016, and the construction of a second berth at the port will be completed in the third quarter of 2016. Spending on ports in this region is set to increase by 10% annually from 2014 to 2025. (See Appendix – Poland.)

Some of the signature projects being adopted in many countries, such as bus rapid transit (BRT), high-speed rail, metro, monorail, etc., are having substantial impact on regional development.

BRT is a bus-based mass rapid transit system, aiming to combine the capacity and speed of a light rail or metro system with the simplicity of the bus system. A total of 31.7 million passengers use BRT worldwide every day, of which 19.7 million passengers ride daily in Latin America, where it first began.^[100]

Figure 78. Bus rapid transit systems worldwide
Sources: [101]-[106]



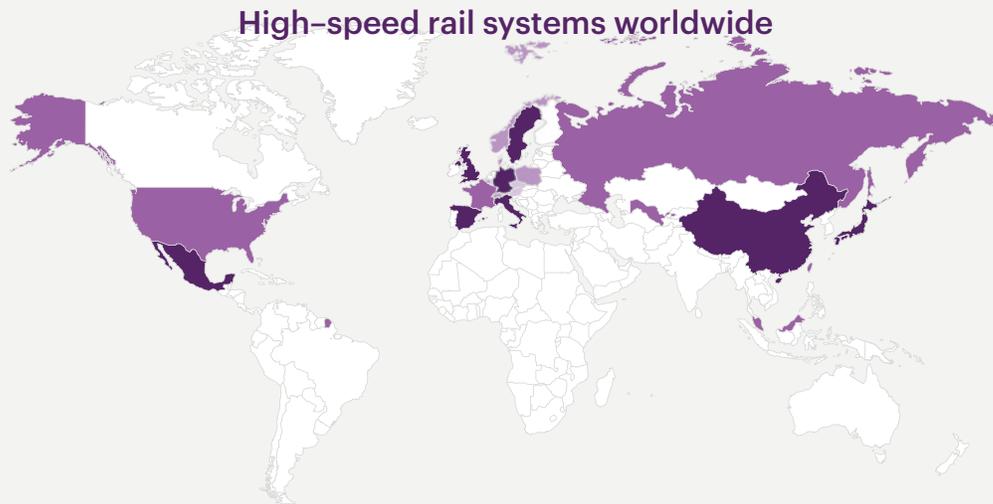
Many countries have developed BRT systems, the highlight being Tshwane Rapid Transit System in South Africa (see Appendix – South Africa).

High-speed rail systems are needed as a faster means of transport, using an integrated system

of customized rolling stock and tracks. The new lines operate at a speed of about 250 km/h, while existing lines operating in excess of 200 km/h are categorized as high-speed rails.

Countries like Egypt, Malaysia, Mexico and many more have operating and/or planned

Figure 79. Presence of high-speed rail systems worldwide
Sources: [107]-[109]



high-speed rail systems. The details of the projects are mentioned in the corresponding appendices. The Kuala Lumpur–Singapore High Speed Rail project is the landmark project, with an investment of about US\$11 billion, reducing travel time to 90 minutes (see Appendix – Malaysia).

Figure 80. Global 20 transportation infrastructure projects

Global 20 – Transportation infrastructure projects

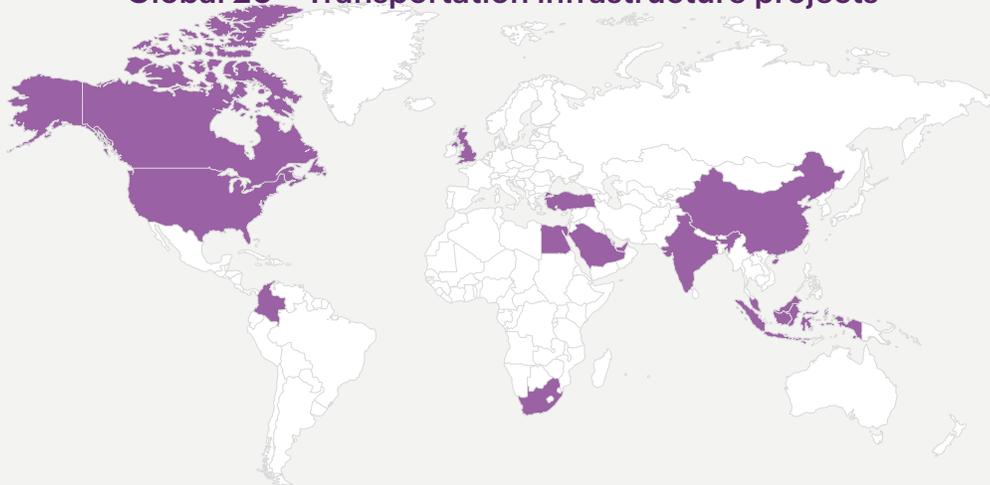


Table 6: Top 20 global transportation infrastructure projects
Source: KPMG and CGLA

Country	Region	Sector	Project name	Project sponsor	Project stage	Value USD MM
UAE	Middle East	Airport	Dubai World Airport	Dubai's Department of Civil Aviation	Under construction	33000
UK	Europe	Airport	Thames Estuary Hub Airport	UK Airports Commission		78000
Colombia	South America	Airport	Barranquilla Airport Phase 2	The Ministry of Transport of Colombia	Bidding	130
Turkey	Europe	Airport	Istanbul New Airport	Minister of Transport and Communication	Under construction	30500
USA	North America	Airport	LaGuardia Airport Terminal	Port Authority of NY & NJ	Construction / Procurement	255
Malaysia	Southeast Asia	Highways & Bridges	Kinrara-Damansara Expressway	Malaysian Highway Authority	Ongoing	2300
Bahrain	Middle East	Highways & Bridges	Qatar Bahrain Friendship Bridge	Qatar and Bahrain Causeway Foundation	Feasibility study	4500
India	Asia	Highways & Bridges	Gujarat PPP Highway Project	Cabinet Committee on Economic Affairs & National Highways Development Project	Approved	105
Canada	North America	Highways & Bridges	New bridge for the St. Lawrence	Transport Canada	Contracts awarded, RFP	5000
Saudi Arabia	Middle East	Highways & Bridges	Egypt - Saudi Arabia Causeway	Arab Contractors & Saudi Binladin Group	Concept/Planned	3800
India	Asia	Ports and Logistics	Delhi-Mumbai Industrial Corridor	Government of India	Operations	9000

Country	Region	Sector	Project name	Project sponsor	Project stage	Value USD MM
Qatar	Middle East	Ports and Logistics	New Doha Port	New Port Project Steering Committee	Under construction	8200
Egypt	Africa	Ports and Logistics	Suez Canal Development Project	Suez Canal Authority	Concept	3500
Saudi Arabia	Middle East	Ports and Logistics	Saidi Ports Authority/King Abdul Aziz Port	King Abdul Aziz Port Expansion	Ongoing/ Multiphase	914
UK	Europe	Ports and Logistics	Dubai Ports World	Dubai Ports World	Construction/ Procurement	2000
UAE	Middle East	Railways	Etihad Rail	Etihad Rail DB Operations	Phase 1- Under construction Phase 2 - Tendering Phase 3 - Planned	11000
Colombia	South America	Railways	Metro de Bogota	Ministry of Transportation of Colombia	Feasibility study	2000
China	Asia	Railways	12 Beijing Metro lines	Beijing NDRC	Financing planned	13000
Saudi Arabia	Middle East	Railways	Mecca and Medinah Railway Stations of the Haramain High speed rail project	Yapi Merkezi - Saudi Bin Ladin Group Consortium - Saudi Arabia Railway Organization	Under construction	16100
India	Asia	Railways	Mumbai	Indian Railway	RFP/RFQ	3200

Project procurement and delivery

EPC: (Engineering Procurement and Construction contract) is one of the most common forms of contract used by the private sector in complex infrastructure projects. Under this, a contractor delivers a completed contract for a fixed price by a certain date.^[111]

EPCM: Under an engineering, procurement and construction management contract, the contractor provides such services. Other contractors may be contracted for construction service and are managed by the EPCM contractor.^[112]

Alliancing: The owner, contractor and professionals form an “alliance” responsible for the full scope of the EPC/EPCM contract.^[116]

Concessions/PPP: The private entity partners with a government entity to form a public-private partnership. The private entity may be responsible for the financing of the project, which they can in turn recover by operating the asset and charging user fees, until the termination of their lease on the asset.^[113]

IPD: Integrated Project Delivery of projects is relatively new. It is becoming popular in North America (in the United States especially). Here the owner, constructor and design professional align their business interests, tying stakeholder success to project success and motivating collaboration.^[117]

DBB: Design Bid Build is the most common type of project delivery, where the design and construction processes are not integrated. This

is the most popular method in almost all global regions. Both the design and construction entities have separate contracts with the owner.

DB: This is an integrated one-stop shopping service for owners, where design and construction services are provided by a single entity who has a single contract with the owner. They provide all services except operation and maintenance of the facility.

PFI: The Project Finance Initiative approach is used in Europe and is now becoming more popular in places like Colombia and Malaysia, where the government is unable to afford even a PPP process of delivery. Complete control of a project is given to a private entity under this system, with no government control. The contractual private entity is responsible for design, construction, material and equipment procurement, operation, maintenance and management—basically all services throughout the project life.^[115]

CMAR: The Construction Manager At Risk approach binds the construction manager to deliver the project within a certain guaranteed maximum price. The construction manager acts as a consultant to the owner during the design phase, and as the general contractor during the construction phase. This eliminates the low bid method. It integrates the estimating and budgeting process for the contractor with the design phase, to balance cost, schedule and scope of the project. This method is being used increasingly and will soon be popular in the United States and globally.^[114]

From the case studies of the ten selected countries, it can be observed that many countries like Mexico, Malaysia and India are increasingly becoming open to foreign investment, either due to capital monetary needs or assistance with new technology. For instance, India is planning to start building a high-speed rail network for bullet trains, for which it has assistance from China and Japan. Malaysia is using Sukuk financing (Islam financing, see Malaysia case study) and is offering investments in its infrastructure projects to foreigners.

The same cannot be said for countries like China, which at the moment is building the Silk Road corridor to Europe to enhance international trade, but is reserved regarding foreign investment and ownership of its assets. Similarly, even Poland has been termed too

bureaucratic by EU who have worked there (some of whom have become bankrupt) (see Poland case study).

All regions have tried to be creative in using project delivery systems with varying successes and failures. There is no clear preference for a particular delivery method. The only evident trend is the use of DBB, which is still the most popular everywhere, but has conceded some of its share to alternate delivery approaches. Most important is the transparency of the government during procurement systems. (The most problematic factors for doing business, under the umbrella of transparency, are attached as a report for each selected country.)

Figure 81. Common delivery methods in different regions
 Source: McKinsey & Company [110]





Country profiles

A one-page profile was developed for each of the ten case studies, which outlines key information relevant to a nation's development and infrastructure well-being. The profile is broken into three sections, which cover economic trends, competitiveness rankings

including quality of infrastructure, and problematic factors for conducting business. The profile is intended to serve as a quick reference sheet and can be utilized as a primer or supplemental summary for the in-depth case studies.



China

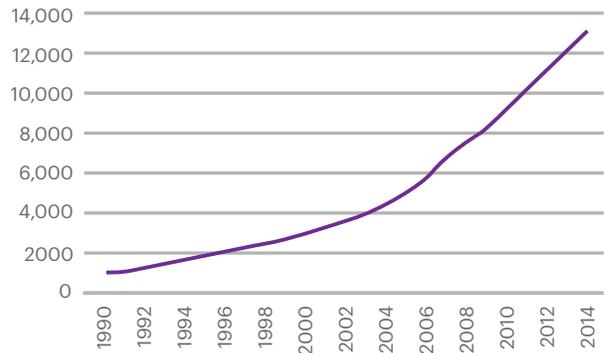
Development indicators, 2014

Population (millions)	1,367.8
GDP (US\$ billions)	10,380.4
GDP per capita (US\$)	7,589
GDP (PPP) as share (%) of world total	16.32

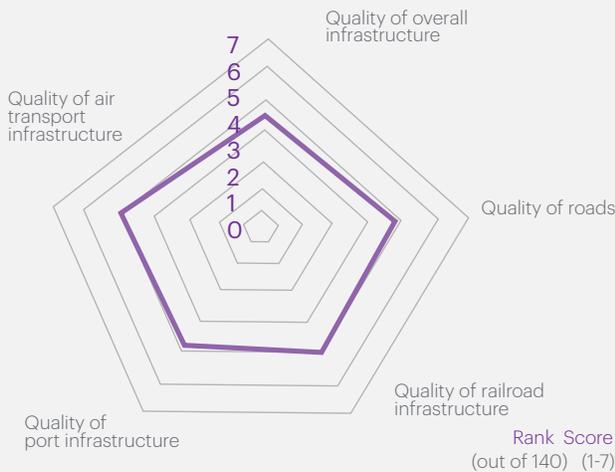
Stage of Development



GDP (PPP) per capita (Current Int'l \$)

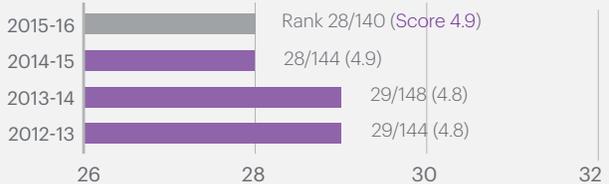


Quality of Infrastructure



	Rank	Score
	(out of 140)	(1-7)
Overall	51	4.5
Roads	42	4.7
Railroad	16	5.0
Port	50	4.5
Air Transport	51	4.8

Global Competitive Index



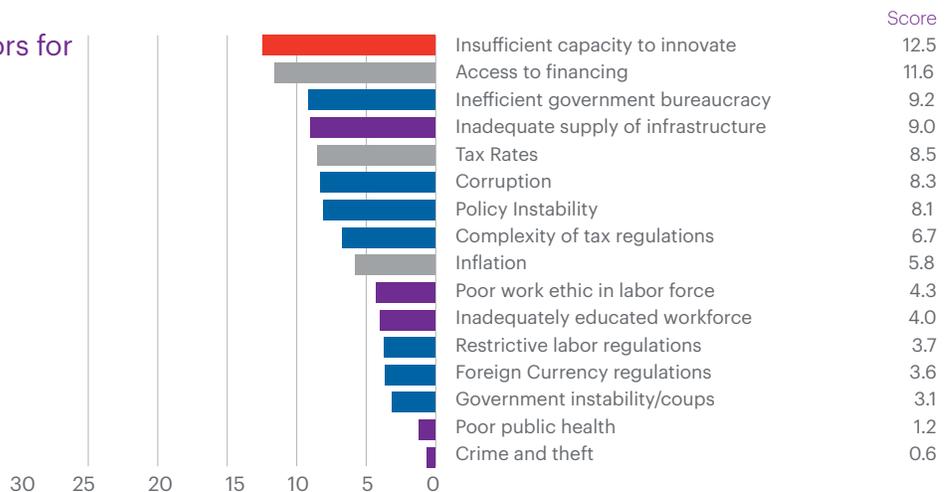
Other Factors

	Rank	Score
	(out of 140)	(1-7)
Transparency of government policy making	36	4.5
Ethical behaviour of firms	61	4.0
Business impact of rules on FDI	61	4.6
Intensity of local competition	36	5.4
Ease of access to loans	21	3.7
FDI and technology transfer	69	4.4
Company spending on R&D	23	4.2
Strength of investor protection, score 0-10	110	4.5
Total tax rate, score as % profits	128	6.6

Most problematic factors for doing business

Type of Factor

- Political
- Economic
- Social
- Technological



Source: World Economic Forum Global Competitiveness Report 2015-16

Colombia

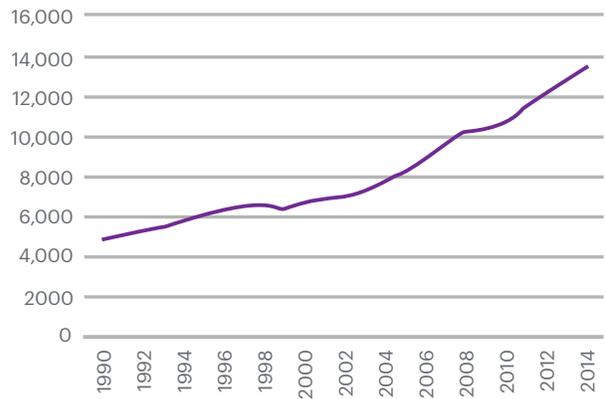
Development indicators, 2014

Population (millions)	47.7
GDP (US\$ billions)	384.9
GDP per capita (US\$)	8,076
GDP (PPP) as share (%) of world total	0.59

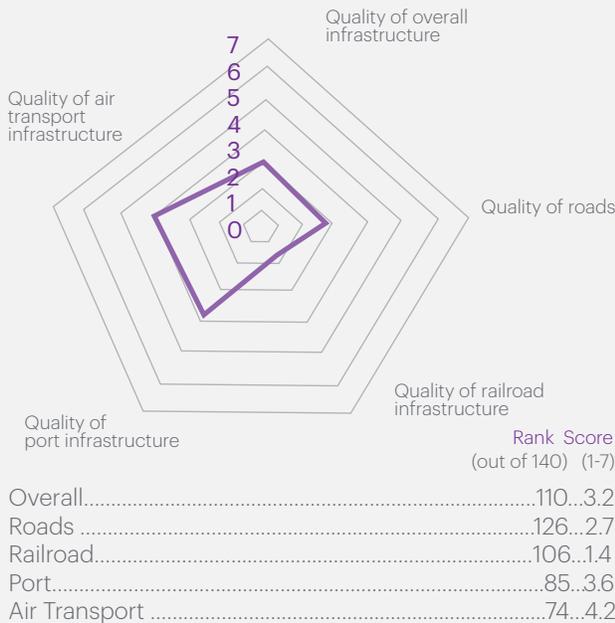
Stage of Development



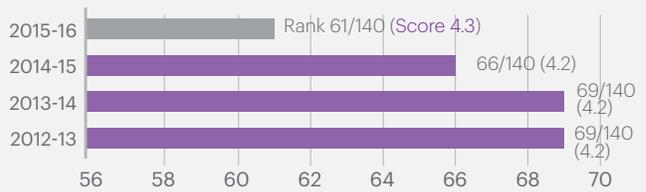
GDP (PPP) per capita (Current Int'l \$)



Quality of Infrastructure



Global Competitive Index



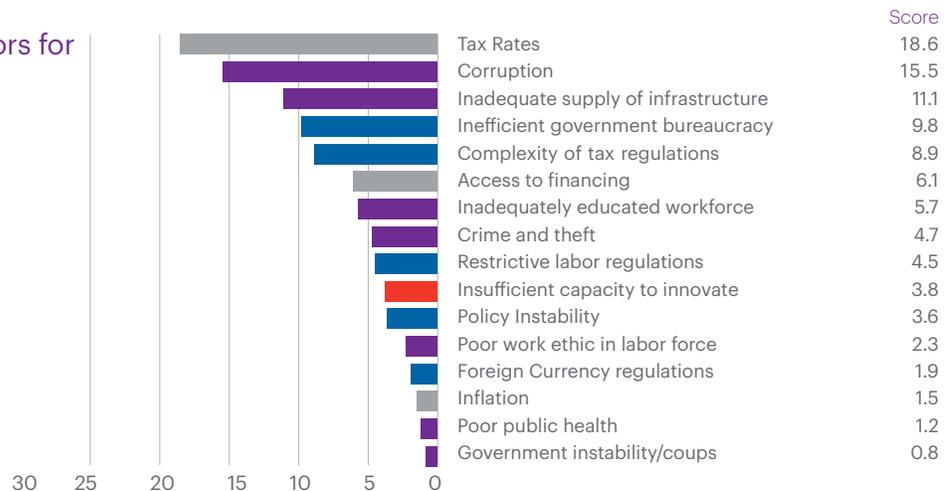
Other Factors

Factor	Rank (out of 140)	Score (1-7)
Transparency of government policy making	86	3.9
Ethical behaviour of firms	109	3.5
Business impact of rules on FDI	68	4.5
Intensity of local competition	35	5.4
Ease of access to loans	77	2.8
FDI and technology transfer	57	4.6
Company spending on R&D	96	2.9
Strength of investor protection, score 0-10	10	7.2
Total tax rate, score as % profits	137	75.4

Most problematic factors for doing business

Type of Factor

- Political
- Economic
- Social
- Technological



Source: World Economic Forum Global Competitiveness Report 2015-16

Egypt

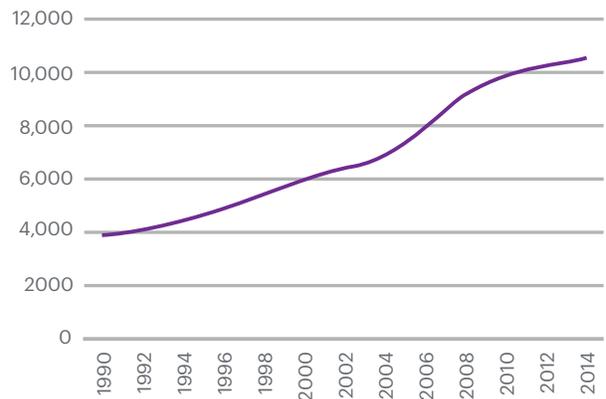
Development indicators, 2014

Population (millions)	86.7
GDP (US\$ billions)	286.4
GDP per capita (US\$)	3,304
GDP (PPP) as share (%) of world total	0.87

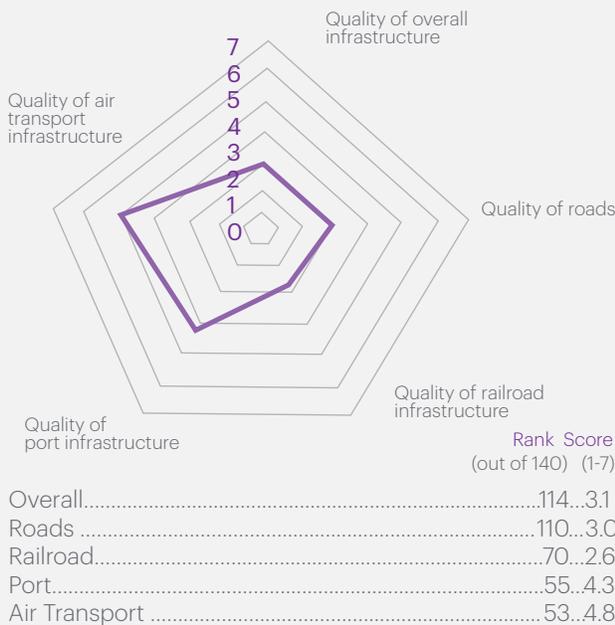
Stage of Development



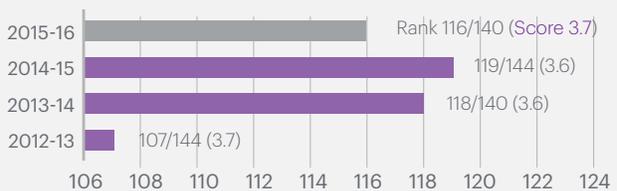
GDP (PPP) per capita (Current Int'l \$)



Quality of Infrastructure



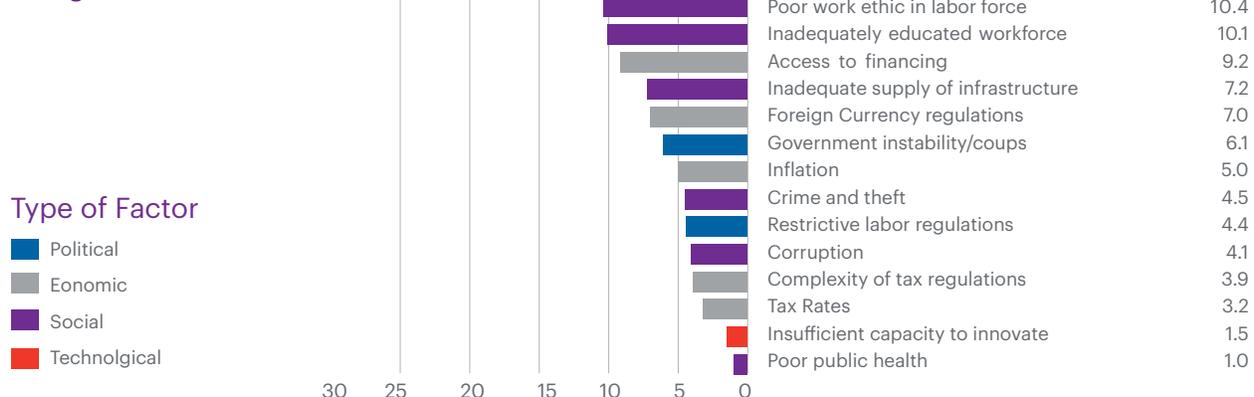
Global Competitive Index



Other Factors

Factor	Rank	Score
Transparency of government policy making	99	3.7
Ethical behaviour of firms	81	3.8
Business impact of rules on FDI	113	3.8
Intensity of local competition	128	4.2
Ease of access to loans	128	1.9
FDI and technology transfer	75	4.4
Company spending on R&D	133	2.4
Strength of investor protection, score 0-10	113	4.4
Total tax rate, score as % profits	98	4.5

Most problematic factors for doing business



Source: World Economic Forum Global Competitiveness Report 2015-16

India

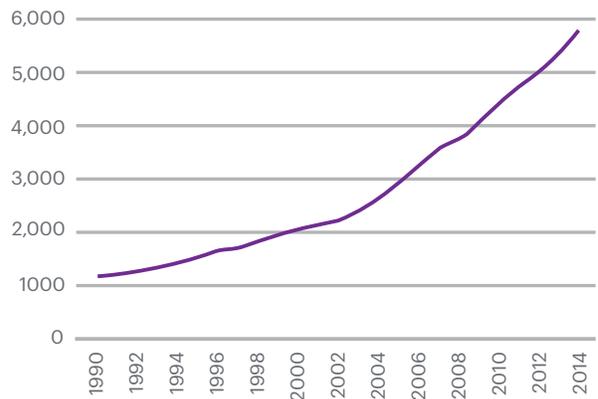
Development indicators, 2014

Population (millions)	1,259.7
GDP (US\$ billions)	2049.5
GDP per capita (US\$)	1,627
GDP (PPP) as share (%) of world total	6.84

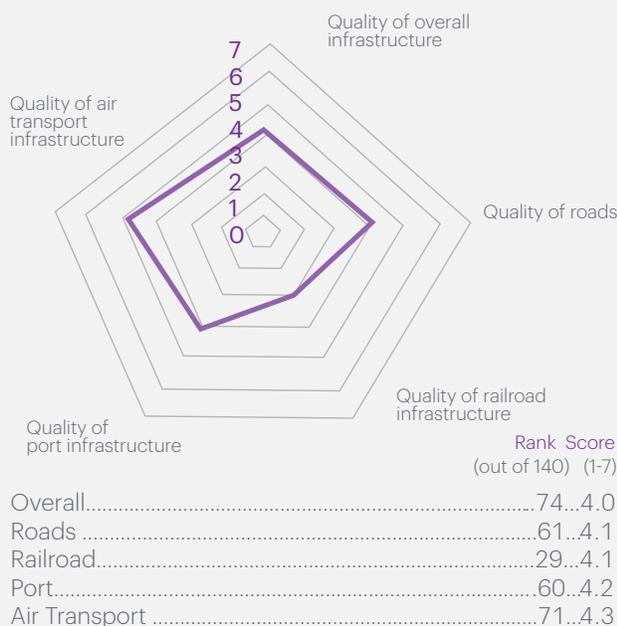
Stage of Development



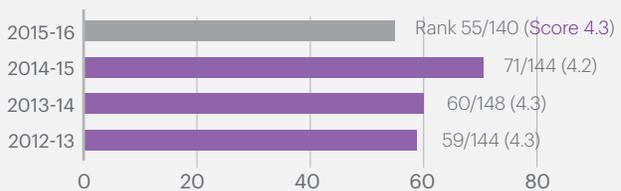
GDP (PPP) per capita (Current Int'l \$)



Quality of Infrastructure



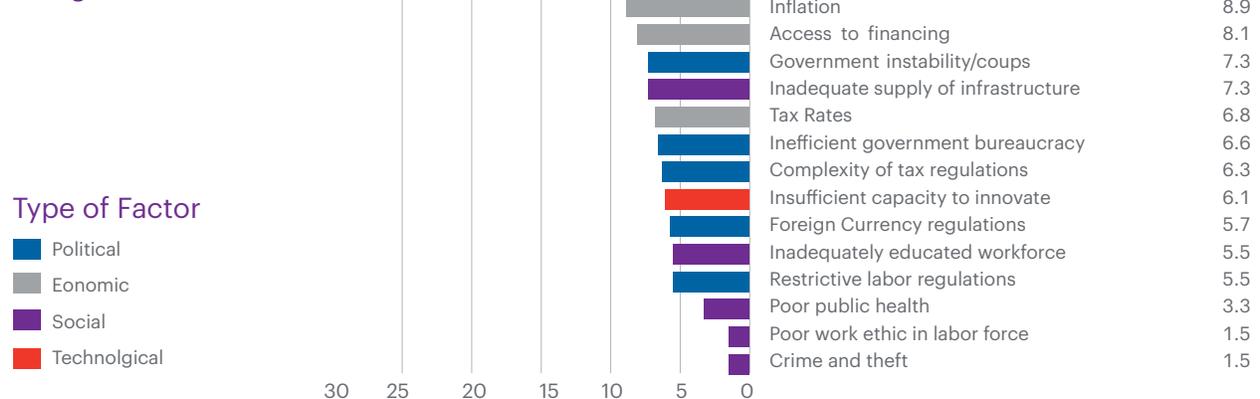
Global Competitive Index



Other Factors

Factor	Rank (out of 140)	Score (1-7)
Transparency of government policy making	58	4.2
Ethical behaviour of firms	44	4.2
Business impact of rules on FDI	92	4.3
Intensity of local competition	101	4.6
Ease of access to loans	29	3.6
FDI and technology transfer	92	4.1
Company spending on R&D	31	3.9
Strength of investor protection, score 0-10	6	7.3
Total tax rate, score as % profits	123	6.17

Most problematic factors for doing business



Source: World Economic Forum Global Competitiveness Report 2015-16

Malaysia

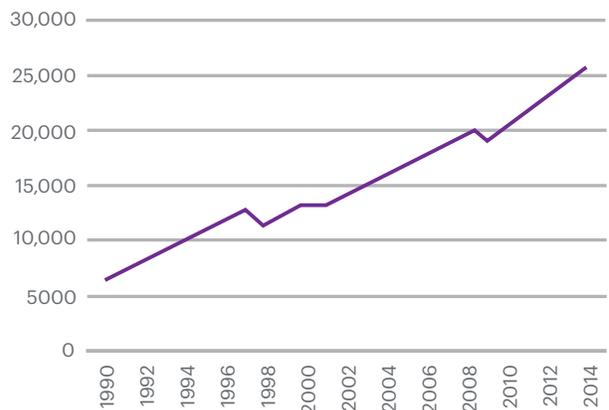
Development indicators, 2014

Population (millions)	30.3
GDP (US\$ billions)	326.9
GDP per capita (US\$)	10,804
GDP (PPP) as share (%) of world total	0.69

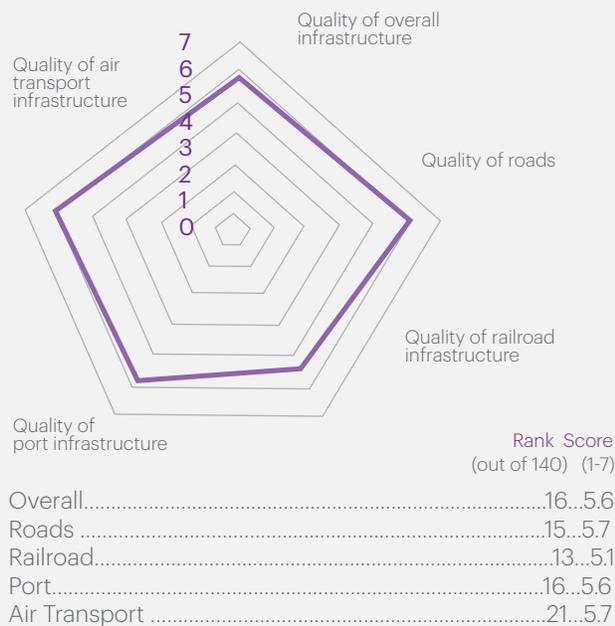
Stage of Development



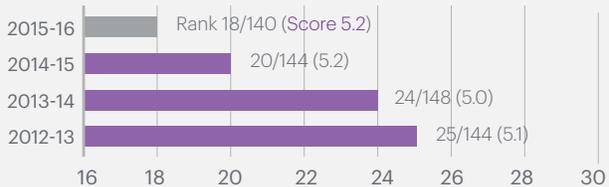
GDP (PPP) per capita (Current Int'l \$)



Quality of Infrastructure



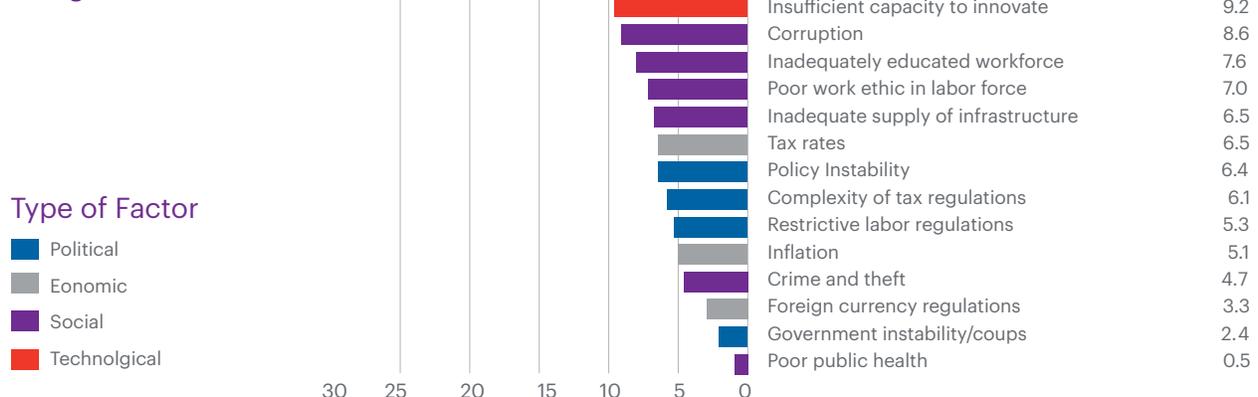
Global Competitive Index



Other Factors

Factor	Rank	Score
Transparency of government policy making	17	5.3
Ethical behaviour of firms	23	5.2
Business impact of rules on FDI	18	5.3
Intensity of local competition	37	5.4
Ease of access to loans	2	4.8
FDI and technology transfer	5	5.5
Company spending on R&D	8	5.3
Strength of investor protection, score 0-10	5	7.4
Total tax rate, score as % profits	76	39.2

Most problematic factors for doing business



Source: World Economic Forum Global Competitiveness Report 2015-16

Mexico

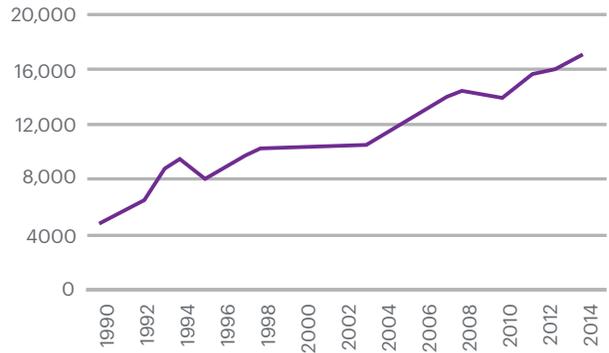
Development indicators, 2014

Population (millions)	119.7
GDP (US\$ billions)	1,282.7
GDP per capita (US\$)	10,715
GDP (PPP) as share (%) of world total	1.98

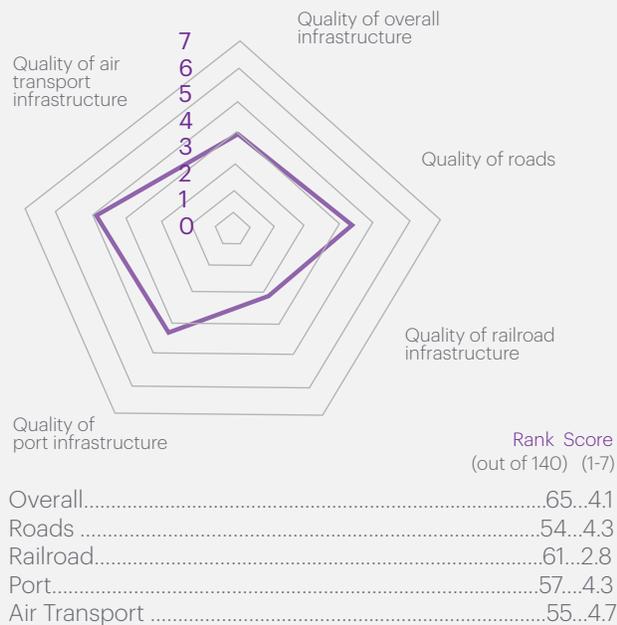
Stage of Development



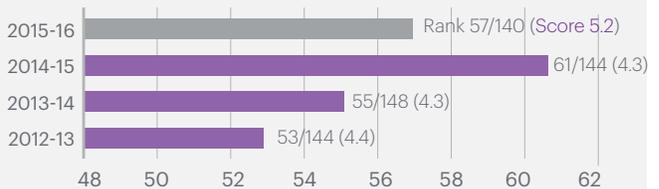
GDP (PPP) per capita (Current Int'l \$)



Quality of Infrastructure



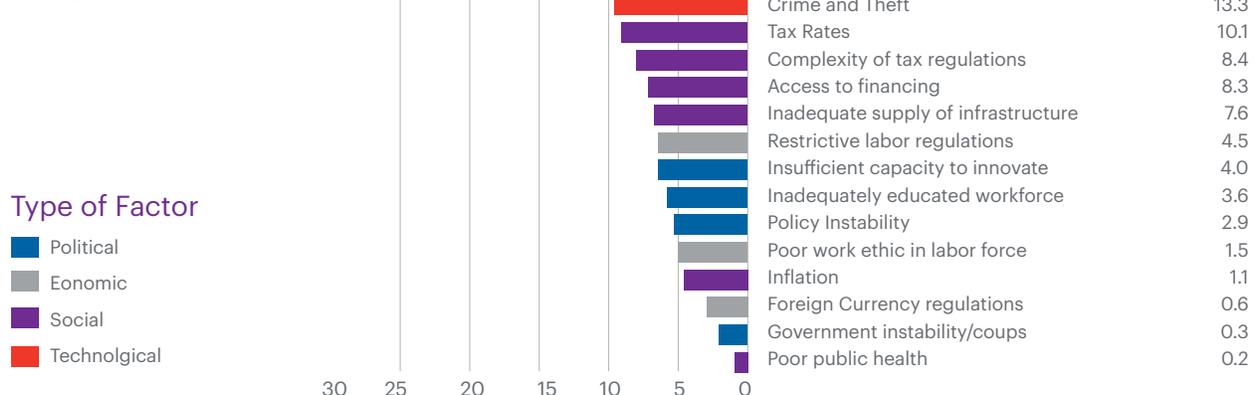
Global Competitive Index



Other Factors

Factor	Rank	Score
Transparency of government policy making	72	4.1
Ethical behaviour of firms	111	3.5
Business impact of rules on FDI	41	4.9
Intensity of local competition	59	5.2
Ease of access to loans	106	2.4
FDI and technology transfer	20	5.1
Company spending on R&D	73	3.2
Strength of investor protection, score 0-10	55	5.8
Total tax rate, score as % profits	115	51.8

Most problematic factors for doing business



Source: World Economic Forum Global Competitiveness Report 2015-16

Poland

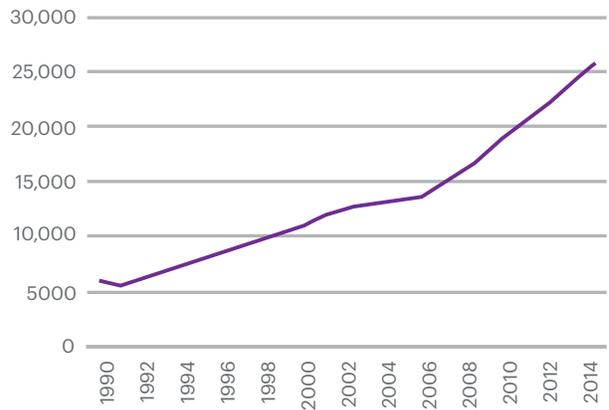
Development indicators, 2014

Population (millions)	38.0
GDP (US\$ billions)	546.6
GDP per capita (US\$)	14,379
GDP (PPP) as share (%) of world total	0.88

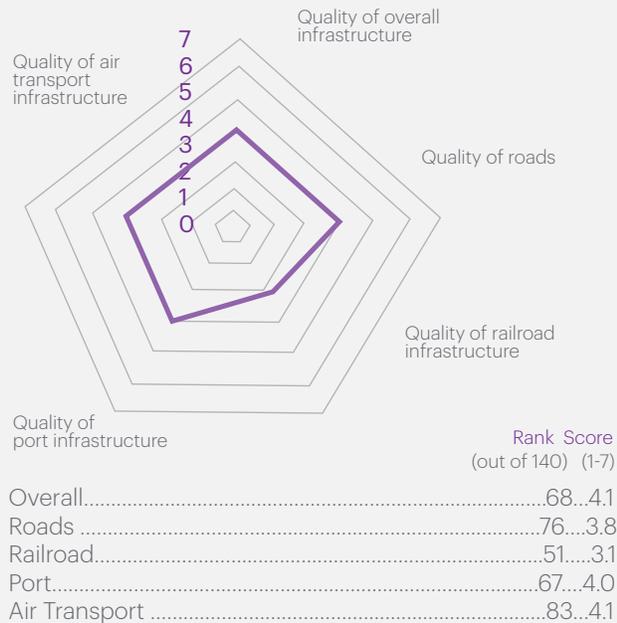
Stage of Development



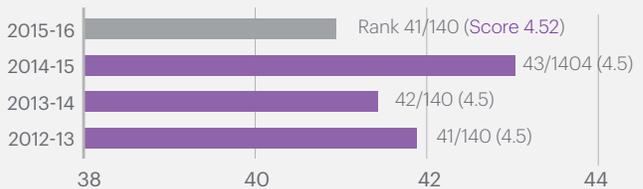
GDP (PPP) per capita (Current Int'l \$)



Quality of Infrastructure



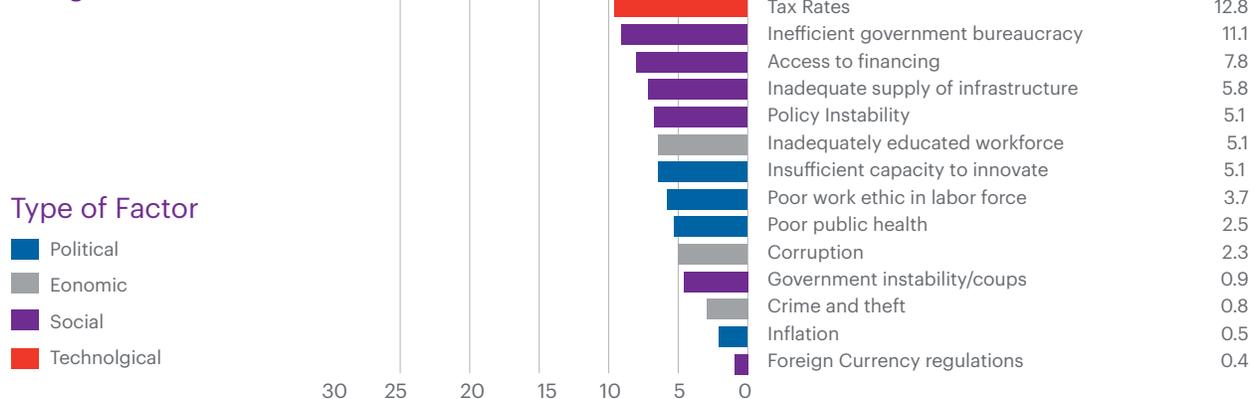
Global Competitive Index



Other Factors

Factor	Rank	Score
Transparency of government policy making	106	3.6
Ethical behaviour of firms	55	4.1
Business impact of rules on FDI	64	4.6
Intensity of local competition	48	5.3
Ease of access to loans	89	2.6
FDI and technology transfer	63	4.5
Company spending on R&D	84	3.1
Strength of investor protection, score 0-10	32	6.3
Total tax rate, score as % profits	72	38.7

Most problematic factors for doing business



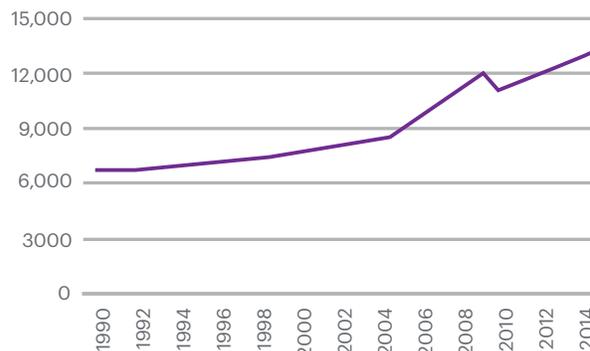
Source: World Economic Forum Global Competitiveness Report 2015-16

South Africa

GDP (PPP) per capita (Current Int'l \$)

Development indicators, 2014

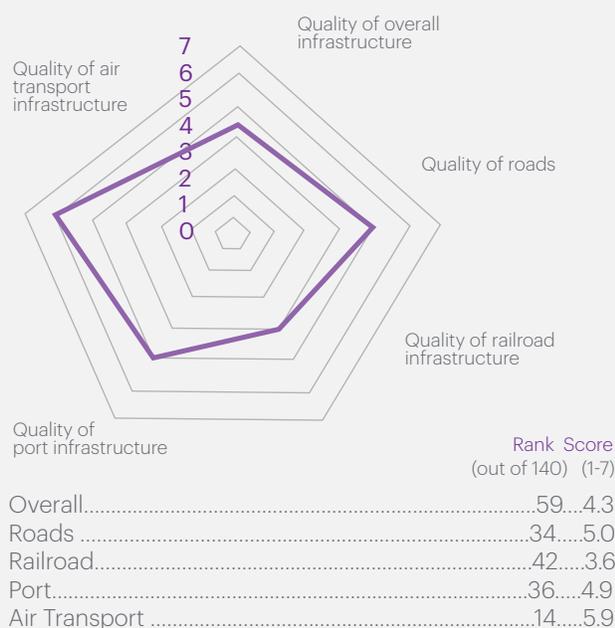
Population (millions)	54.0
GDP (US\$ billions)	350.1
GDP per capita (US\$)	6,483
GDP (PPP) as share (%) of world total	0.65



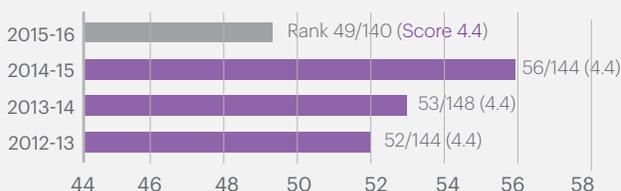
Stage of Development



Quality of Infrastructure



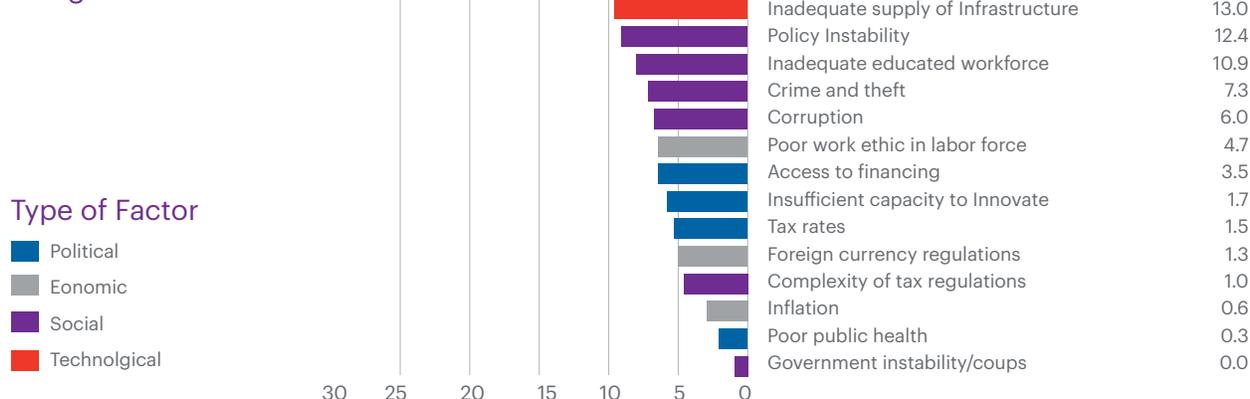
Global Competitive Index



Other Factors

Factor	Rank (out of 140)	Score (1-7)
Transparency of government policy making	39	4.5
Ethical behaviour of firms	38	4.4
Business impact of rules on FDI	99	4.1
Intensity of local competition	43	5.4
Ease of access to loans	32	3.5
FDI and technology transfer	64	4.5
Company spending on R&D	32	3.8
Strength of investor protection, score 0-10	14	6.8
Total tax rate, score as % profits	32	28.8

Most problematic factors for doing business



Source: World Economic Forum Global Competitiveness Report 2015-16

Turkey

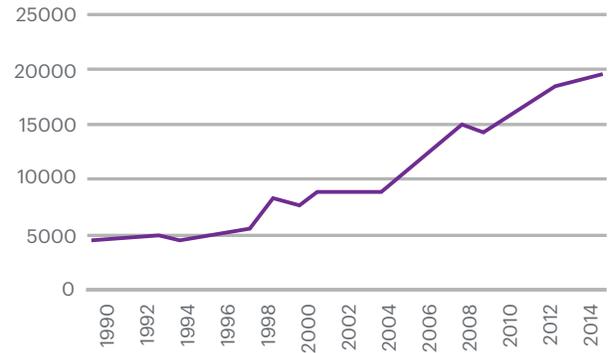
Development indicators, 2014

Population (millions)	76.9
GDP (US\$ billions)	806.1
GDP per capita (US\$)	10,482
GDP (PPP) as share (%) of world total	1.4

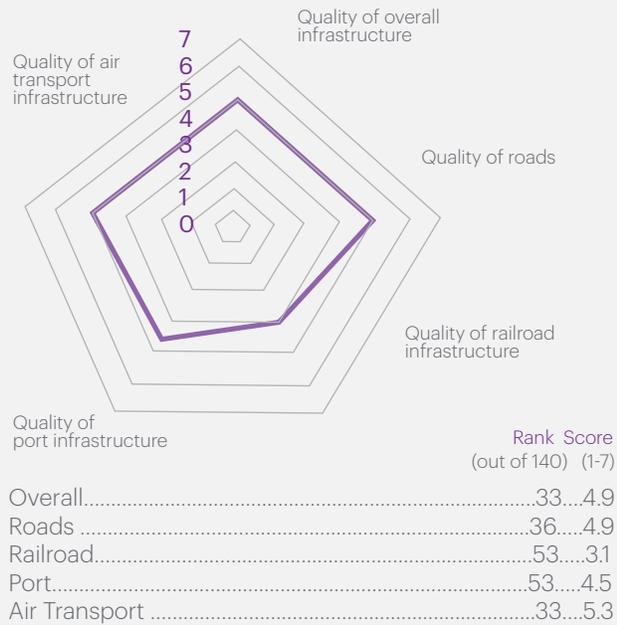
Stage of Development



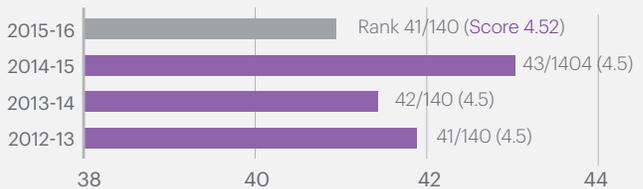
GDP (PPP) per capita (Current Int'l \$)



Quality of Infrastructure



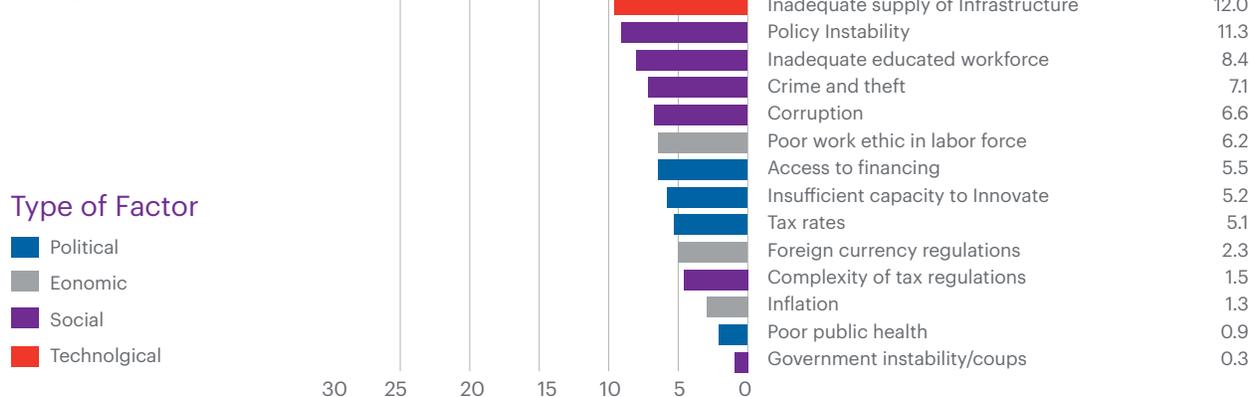
Global Competitive Index



Other Factors

	Rank	Score
	(out of 140)	(1-7)
Transparency of government policy making	41	4.4
Ethical behaviour of firms	99	3.6
Business impact of rules on FDI	62	4.6
Intensity of local competition	10	5.9
Ease of access to loans	65	2.9
FDI and technology transfer	52	4.7
Company spending on R&D	79	3.1
Strength of investor protection, score 0-10	13	6.9
Total tax rate, score as % profits	82	40.1

Most problematic factors for doing business



Source: World Economic Forum Global Competitiveness Report 2015-16

United Arab Emirates

GDP (PPP) per capita (Current Int'l \$)

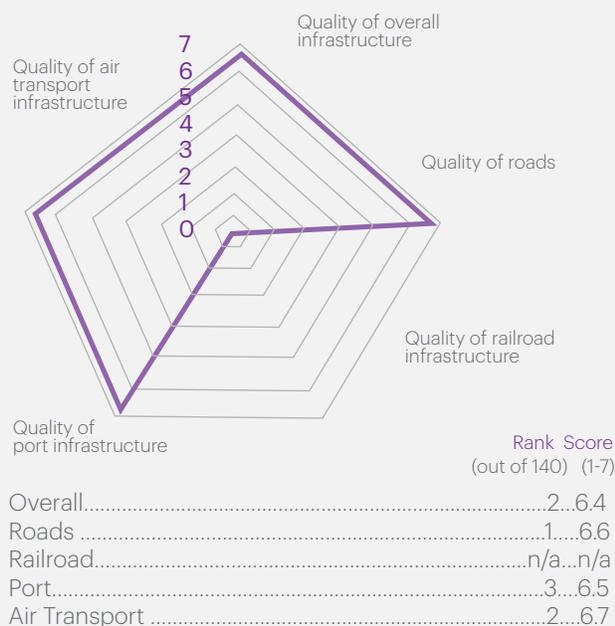
Development indicators, 2014

Population (millions).....	9.3
GDP (US\$ billions).....	401.6
GDP per capita (US\$).....	43,180
GDP (PPP) as share (%) of world total.....	0.56

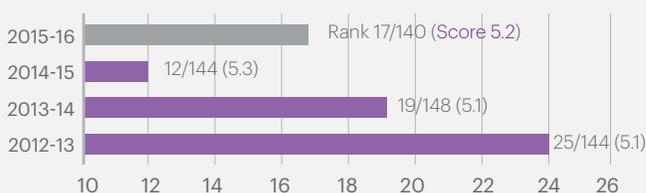
Stage of Development



Quality of Infrastructure



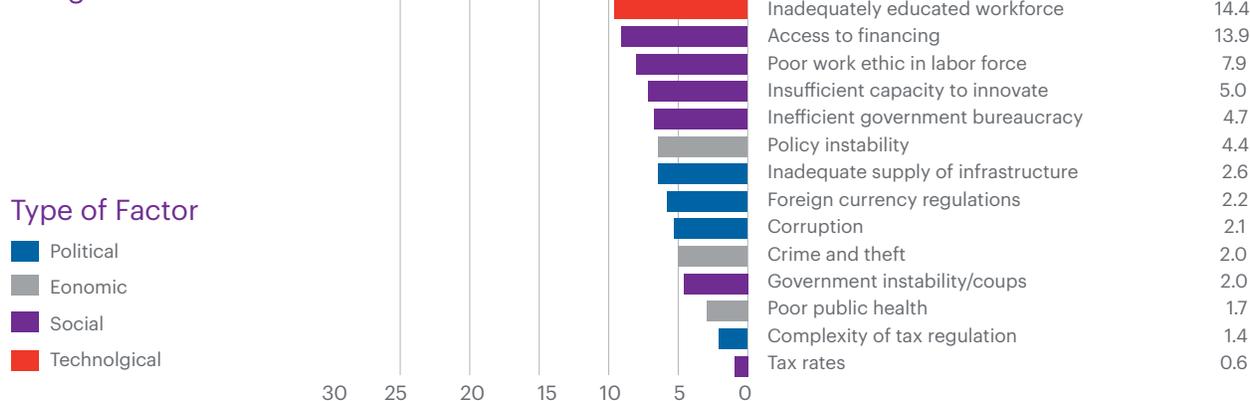
Global Competitive Index



Other Factors

Factor	Rank (out of 140)	Score (1-7)
Transparency of government policy making	16	5.4
Ethical behaviour of firms	10	5.8
Business impact of rules on FDI	7	5.7
Intensity of local competition	8	6.0
Ease of access to loans	3	4.7
FDI and technology transfer	3	5.8
Company spending on R&D	22	4.3
Strength of investor protection, score 0-10	42	6.1
Total tax rate, score as % profits	7	14.8

Most problematic factors for doing business



Source: World Economic Forum Global Competitiveness Report 2015-16

China



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Introduction

China is one of the world's first civilizations and has grown to be the largest country by population and second largest by land area.

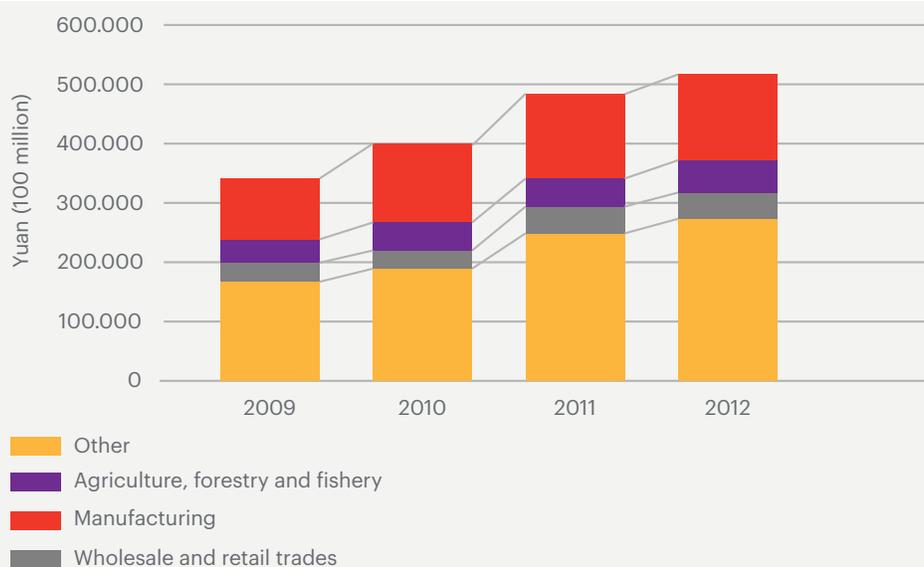
China boasts the second largest GDP in the world, second only to the USA. The GDP is dominated by manufacturing (31 percent) but otherwise is very diverse. The GDP is also one of the fastest growing in the world, experiencing more than 7 percent growth for the last five years.

The robust manufacturing sector enables the country to keep unemployment at a satisfactory level, consistently under 5 percent. The

population has been steady over the years, in part due to the government's one-child policy. This regulation has been removed; therefore the potential exists for a shift in population trends in the near future.

Although the country has an overall population density of about 143 people per sq. km, it is no indication of the country's urban trends. Over half the population lives in urban settings, and China's main cities of Beijing, Shanghai and Shenzhen all have densities well over 10,000 people per sq. km. Multi-modal transportation

Figure 1: GDP by sector at current prices
Source: Statistics South Africa



systems must be coordinated to sustain such population density, especially during peak

commute hours. Extremely congested rail stations struggle to cope with demand.

Table 1: Economic development indicators for China
Source: World Bank

	2010	2011	2012	2013	2014
GDP at market prices (current US\$ millions)	6,039,660	7,492,430	8,461,620	9,490,600	10,354,800
GDP per capita (current US\$)	4,515	5,574	6,265	6,992	7,590
Inflation, GDP deflator (annual %)	6.94	8.14	2.39	2.23	0.85
Labor force, total	781,054,640	790,183,028	795,863,202	801,790,592	806,498,521
Population, total	1,337,705,000	1,344,130,000	1,350,695,000	1,357,380,000	1,364,270,000
Population density (people per sq. km of land area)	142.49	143.17	143.87	144.58	145.32
Population in urban agglomerations of more than 1 million	278,116,789	287,340,155	296,585,631	306,176,213	316,153,747
Unemployment, total (% of total labor force)	4.20	4.30	4.50	4.60	4.70
Urban population (% of total)	49.23	50.57	51.89	53.17	54.41

PEST analysis

Political

- Single-party state governed predominantly by the Communist Party of China.
- Stable government due to the single-party system.
- Loosened government regulations that restrict foreign businesses.
- Ranked 72nd out of 179 countries in Transparency International's Corruption Perceptions Index.
- Tax policy for foreign investments is becoming more encouraging.

Economic

- GDP of \$11.31 trillion (16.7% of the world economy) and a GDP growth of 7.3% (ranks second in the world).
- Thirty percent tax rate for foreign investments, 3% for local production businesses, and 20% for others.
- Labor force of 797.6 million distributed mainly over agriculture (34.8%), industry (29.5%), and services (35.7%).
- Ranked first in exports (\$2.21 trillion) and third in imports (\$1.77 trillion).
- Direct and indirect government control over banks and financial institutions.

Social

- Baby boomers' generation aging with more than 70% of the population older than 24.
- Adjustment of one-child policy and eventually its termination.
- Largest population of the world with 1.357 billion (20% of world population).
- Diversity in religions: Buddhism, Taoism, Christianity, and Islam.
- State-owned lands, but individuals and firms may own and transfer long-term leases.

Technology

- Vast Internet connectivity with 389 million Internet users and 20.6 Internet hosts.
- Biggest telephone network in the world with 278.8 million land lines and 1.1 billion mobile phones.
- High spending of government in R&D (second in the world).
- Many government plans and strategies in developing the R&D sector such as Torch Program and Scaling Heights Program.
- Innovative and world-class transport technology such as the high-speed rail and the world's first Maglev train.

Status of transportation

Railways

China's rail network is the second-largest in the world with 103,100 km of operational railways.

^[1] It covers extensively the east side of the country, as seen in Appendix A5 but is sparse to the west and southwest of the country. The system is mainly managed by the China Railway Corporation for commercial activities. The Ministry of Communications is the planning and policy-making entity, and the State Railways Administration oversees other administrative functions.^[2] The network is mostly standard gauge with meter, broad and narrow gauge in lesser proportion.

For the past 10 years, the average distance traveled by passengers and freight transport has remained constant. The average distance for passenger travel is 510 km,^[4] while the average distance for freight transport is 730 km.^[5] With the Twelfth Five Year Plan, China is looking to increase its capacity and level of service of its tracks by upgrading the transport safety, comfort, and uniformity.^[6]

High-speed rail is composed of four north-south and four east-west corridors located in the east of the country. There is a high-speed line located in the west side of the country connecting Ürümqi in the northwest to Lanzhou in the central part of the country, as seen in Appendix A5. The lines are built next to existing low-speed lines, which are now used only for freight transportation.

There is a mix of high-speed and freight lines connecting important cities along the coastline that previously were not connected. Maglev technology is also present in China, connecting Pudong International Airport to Shanghai and its metro system. The train covers a 30.5 km distance with operational speed of 430 km/hr. Extensions of the system are on hold because of a rival high-speed train between Shanghai and Hangzhou, where the extension was planned.

It is important to notice that the network is mainly used for local domestic shipping. International rail cargo is less than 2% of the overall freight tonnage.^[7]

Challenges

- Foreign companies are not permitted to have controlling interest in rail infrastructure operations.^[3]
- Foreign companies look to recapitalize their investment in three to five years, while in the Chinese market the return cycle is usually between 15 and 20 years.^[3]
- Foreign companies are limited to opportunities that are not directly related to the construction or operation of new or old tracks, but rather to components and control equipment.^[3]
- The China government, with China Railway Corporation, has a monopoly on everything related to rail.^[3]

Opportunities

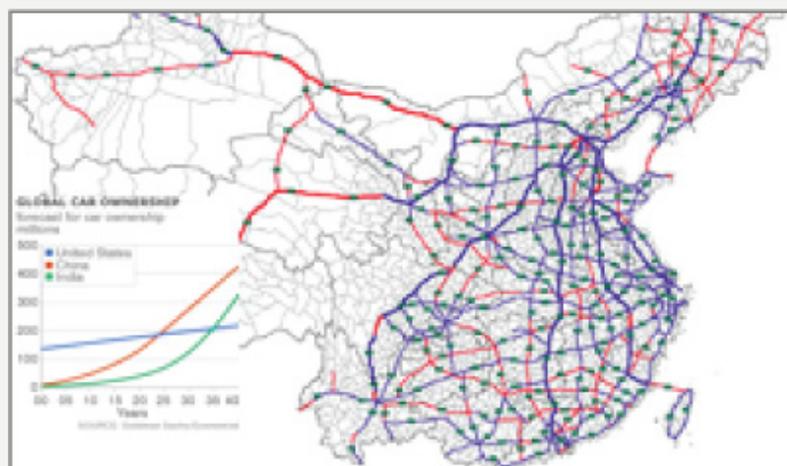
- China sees rail freight transport as a lower carbon-emission mode of transport.
- The west part of the country is underdeveloped; “Go West” policy to build new and effective transport links.^[3]
- Opportunities for private local companies to invest, with new equal market entry access given by the government agencies.^[3]
- Building and operations of segments of track can be done by private local firms.^[3]
- Foreign companies are now allowed to hold railway bonds and are allowed to supply componentry.^[3]

- With new dedicated high-speed rail tracks for commuters, track capacity is freed for freight transportation.^[3]

Roads and highways

China has one of the largest road networks in the world, ranked third and just behind India and the United States, and holds 70% of the world’s toll roads.^[8] China boasts a 4.46 million km road network, of which 123,000 km are expressways. To reach this status, China had placed heavy focus on the National Trunk Highway System, which is now recognized as an outstanding national achievement. This program has delivered an expressway network of 85,000 km,

Figure 2: The NTHS network and car ownership (red line in graph is China)



as well as 68,000 km of Class-I highways and 320,000 km of Class-II highways. This network of highways has now become the backbone of China's network of transportation. This is also known as the 7918 network and comprises nine north-south and 18 east-west expressways. The construction began in 1990, and the program will terminate in 2020 after reaching the desired goal to develop 300,000 km of roads in rural areas with an estimated investment of \$240 billion for the entire program. The design standards for many roads under this program were taken from the American Interstate Highway Systems. Initially designed four-lane roads were expanded to six lanes to cope with the growing traffic congestion.^[9] The graph in Appendix A6 shows the growing number of vehicle units being sold in China.^[11]

For construction and maintenance of these roads, China derives funds from multiple sources. The government prefers "the user pays is better than everyone pays" system.^[8] Other methods are appropriation of taxation by various government levels, loans from domestic or foreign banks, and the use of public-private partnerships for such projects.^[10]

Opportunities

- Government's encouragement for PPP (under which the NTHS was built) in the form of BOT concessions for foreign firms.
 - The increasing number of car units (Figure 2) is increasing the demand for an even bigger road network.
- Increased investment to develop provincial roads.
 - Only eastern China is extremely well connected by roads. Development in the western region is anticipated (with the Gansu, Guizhou, Qinghai, Shaanxi, Sichuan, and Yunnan provinces contributing to 19% of the economy as of 2009).

Challenges

- China has relied too much on the tolling system, which makes it difficult for the banks to assist development in financially poorer regions that have limited capacity to repay.^[12]
- The number of car units are increasing with the middle class getting richer. This contributes to congestion and an increased amount of CO emissions. The recent (Oct. 2015) congestion on their 50-lane highway, due to a new checkpoint, shows that the operators are unable to efficiently handle excessive traffic.^[14] Thus, China needs to now consider green infrastructure and electric cars.
- The graph in Appendix A7 shows positive signs of decrease in road fatalities; however, the WHO reported four times the fatality rate reported by the Chinese government, claiming 200,000 road fatalities. Thus, the Global Road Safety Partnership is being implemented in Dalian, Suzhou and Jinhua.^[13]

Seaports

The ports of China are the gateways through which the international community conducts the majority of trade and business with China. China is a major player in worldwide sea-trade. The world's biggest and busiest ports are found in China (Tables 3 and 4). China has approximately 175 major individual sea and inland ports, with a combined total of 32 thousand berths. Its landscape is characterized by a relatively long duration of export and import procedures, but at comparatively lower costs.^[49] There are three core economic coastal areas in China, where the largest and busiest ports are located (Figure 13). The three biggest ports (in terms of container throughput) are in Shanghai, Guangzhou and Tianjin. The main activities of Chinese ports are transportation of containers, coal, iron, grain, crude oil, liquid chemicals and petroleum products.^[50] ^[51] China has developed an export-led growth strategy: The growth of ports was connected to China's economic development model, which for the last three decades has significantly increased export-led growth. The export and import of goods and services accounted for approximately 30% and 29%, respectively, of China's gross domestic product (GDP) in 2011.^[52] The structure of ports illustrates the fact that China is undoubtedly focusing on exporting and manufacturing and is a leading manufacturer in the global market. The domestic consumption market has triggered considerable growth of its total port container traffic (TEU). The composition of China's merchandise exports is dominated by manufactures (93%), which is considerably higher than the other countries,

except for Japan (with 89% of its merchandise exports allocated to manufactures) (World Bank 2013). China's imports are more balanced and include mainly manufactures (57%), fuel (17%), ores and metals (15%).^[49] Moreover, port capacity has been substantially expanded in order to facilitate the significant increase of container and cargo traffic and volume. Port capacity refers to the amount of docking berths; thus, deep-water berths are essential. Additional key criteria are deep-water access and roll-on/roll-off operations.^[49] The logistical network in China is an important point to consider. The Chinese port sector is a crucial piece of the entire network combining transport, storage and distribution activities over land, air and water.^[49]

Challenges

- Logistics costs account for almost 20% of China GDP, whereas in most OECD countries it is close to 10%. The logistics sector scores low on quality indicators (Table 5). Expanding its logistical capacity and improving the quality levels of infrastructure and logistical services is one of China's major challenges.^[52]
- The 2016 economic situation and the oil price fluctuations have decreased export and import activity. Domestic throughput growth, as well as the total national container throughput, both significantly fell.^[53]

Opportunities

- The Chinese government will invest US\$250 billion by 2035 to improve the country's infrastructure level. Moreover, for international trade and logistics firms, there are business

opportunities in China's dynamic port sector. Several port expansion and redevelopment projects are taking place, and "smart port" and "eco-port" trends have emerged,^[54] involving sustainability integration, high efficiency and intelligence management.

- The involvement of foreign firms with significant expertise in logistical efficiency enhancement would help China in establishing cost-effectiveness improvement and enhance the quality of its port sector infrastructure and logistic network.^[55]

Airports

China leads the airport construction field in Asia. In 2015, there were around 210 civil airports. There are, according to the CAPA Airport Construction & Cap Ex Database, 56 airports under construction, which depicts a budget of US\$60 billion, including Beijing's Daxing Airport (US\$13.1 billion).^[56] The increase of GDP over the last decade helped fuel and increase air travel. Domestic and international passenger traffic is growing quickly, leading to an increase in regional airport use (Appendix A12)^[57].

In the early '90s, the government of China initiated commercialization by slowly relaxing airports' investment regulations. Corporatization of airports and the commoditization of their services were allowed. The management and operations of all Chinese airports were transferred to either provincial or municipal

governments.^[58] Improvements in regulations and policies have led to progressive separation of the ownership, management and regulatory functions in China. The Chinese Aviation Administration of China (CAAC) has become an independent regulator in charge of policy formulation and enforcement.^[58]

Investments in the airport sector were simplified mainly for airlines. China's airport ownership has changed, thanks to the flow of domestic and foreign capital injected into the airport industry. Private investors may own 100% of regional airports, with the exception of those in large cities. Private investments airport management and investment facilities have been enhanced. Foreign investors are allowed to take up to 49% equity interest in the construction and operation of airport activities. China's airports have authorized foreign private investments from operational investors such as Hong Kong Airports Group, Aeroport de Paris and Singapore Changi Airport.^[59]

Opportunities

- Major projects: Beijing Daxing Airport, under construction, will include four runways and a terminal building covering 700,000 sqm with a passenger capacity of 45 million in 2020, 72 in 2025 and 100 million in the longer term.^[60] ^[61]
- Several projects aim at developing small regional airports: new constructions are launched at least every month in the remote provinces of Qinghai, Inner Mongolia,

Yunnan, Guizhou and Jilin. Furthermore, along the Yangtze River, new airport projects were launched around June 2014 to boost the region's economy and activity.^[61]

- Traffic growth would increase because of China's huge demographic power and dynamic. Since 2000 the average amount of air traffic has increased approximately 5% or 6% per year. Significant investment returns would result from such a growth.^[62]

Challenges

- Difficulty with generating revenues from activities such as commercial leases, car parking and advertising because of the cultural and traditional Chinese customs.^[62]
- Mass air traffic is significant but not homogeneous. There is a slow enhancement of non-aeronautical revenue streams in airports (slightly more than 20% of airport revenues in China compared to 33% in Germany and 50% in the US). This shows that several sources of revenues are said to increase.^[63]
- Timing of investment is related to the capital expenditure period and has a fundamental impact on the level of risk that investors could take: there might be a delay or disruption of cash inflow when large airport projects are at stake.



SWOT analysis

Strengths

- One of the strongest infrastructure sectors in emerging countries; China's 13th five-year plan 2016-2020 will focus on innovation in infrastructure.
- The government has done a better job than most emerging markets in putting in physical infrastructure required to support the rapid industrialization.
- There are many highly educated workers; even the uneducated laborers have a reputation for hard work and productivity.
- China's authoritarian system allows decisions to be made and implemented quickly.

Opportunities

- The "Go West" policy to build new and effective transportation in underdeveloped western China.
- Opportunities for private local companies to invest with new equal market entry access by government agencies.
- Foreign companies are now allowed to hold railway bonds and supply componentry.
- Government's encouragement for PPP (under which the National Highway Traffic System was built) in the form of BOT concessions for foreign firms.
- The Chinese government will invest US\$250 billion by 2035 to improve the country's infrastructure level.

Weaknesses

- Foreign companies are not permitted to have controlling interest in infrastructure operations.
- There are long return cycles (15-20 years) for foreign investors.
- The lack of convertibility of the Chinese Yuan is a drawback to doing business in and with the country.
- Systemic risks like corruption are a major problem. Similarly, the quality of major institutions like the judiciary is compromised by political interference.
- There is high reliance on the tolling system for roads and highways, which makes it hard to build projects in poor regions.

Threats

- Government intervention is found on all infrastructure projects, which might discourage investors.
- As large as China's labor force is, labor costs are rising rapidly and China is losing its competitive edge in many industries.
- Losing control of intellectual property is the concern that foreign high-tech manufacturers often express when it comes to investing in China.
- China has relied too much on the tolling system, which makes it difficult for the banks to assist development in financially limited regions.

Geographical analysis

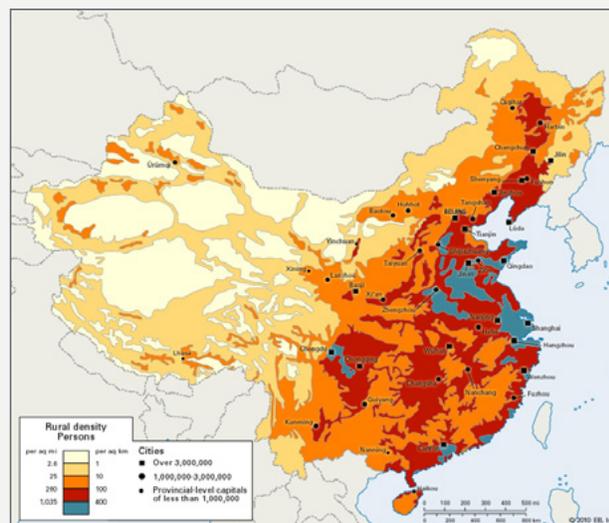
Located in East Asia, China is the second largest country geographically in the world.^[19] Due to its extensive mainland, it shares borders with 17 countries. The most notable are: Russia to the northeast; North Korea to the east; Vietnam and Myanmar to the south; India and Nepal to the southwest; Pakistan to the west; Kazakhstan to the northwest and Mongolia to the north. China has an extensive coastline of approximately of 18,000 km, an important economic feature to the country. China has more than 140,000 km of navigable inland waterways that are mainly used for freight transportation.^[20] (A chart of the freight transport allocation can be seen in Appendix A3.) As shown in Appendix A4, China

comprises multiple topographic regions with elevated terrains in the west and lowland plains and basins to the east.

Population density

China is the most populated country in the world with 1.36 billion people, and with 53.73% of the population considered urban from 2013 estimates.^[15] Its urban population grows an average of 2.9% each year; however, growth has been declining from 4% to the current average in the last 10 years.^[16] The distribution of the population generally follows available natural resources, as shown in Appendix A4 and Figure 3, and is also near the coastal zones.

Figure 3: Population density. Source: Encyclopedia Britannica



Three of the most important cities in China are in the top 10 world's largest metropolitan areas: Shanghai with 24,150,000 people,^[15] followed by Guangzhou with 23,900,000 people^[18] and Beijing with 21,150,000 people.^[15]

Infrastructure

Infrastructure in China has experienced significant improvement in the past years due to the government's commitment to the National Development Plan.

The road network is well developed in the east region of the country, interconnecting cities and industrial centers. Due to the roughness of the west region, the network is not well developed.

The rail network follows the geography and there are only limited routes in the southwest of the country, while there is an extensive network in the east from north to south. The system interconnects the most important

cities and industrial centers with either regular speed tracks or high-speed tracks. The system interconnects Russia, Mongolia, Kazakhstan, North Korea and Vietnam.

Ports are located either in the inland waterways or in the coastal zones. The biggest ports are located near the navigable rivers' outlets.^[25] Due to the extensive coastline and important economic centers located across the coastline, there are more than 200 ports, of which more than 100 are opened to international trading.^[26]

Airports are located all across China, with more than 180 commercial airports. Following the National Development Plan, more than 24 new commercial airports or expansions will be built in the next years.^[27]

Sustainability

The accelerating growth of urbanism is generating expansion of the transportation assets in Beijing, China. The extensive growth of demographics calls for strategically planned and executed sustainable transportation systems to provide a healthy environment along with resilient infrastructure. New initiatives are the focal point of attention for improving the quality of living. The majority of initiatives should be transportation-related, given its considerable impact on society. Reduction of air pollution caused by congestion is embodied in the Work Plan for Vehicle Emission Control 2013 – 2017. Sustainable transport is needed to address the increase in GHG emissions from transport modes. Leaders in Beijing are addressing this issue and are setting records with regards to innovation and sustainability. Beijing was the first to build an innovative subway and to implement congestion pricing. Neighboring cities started following Beijing's example to achieve sustainable transport. In March, China published a new urbanization plan for 2014 to 2020. This vision is embodied in China's 13th Plan describing China's status in the years to come. The Ministry has directed its citizens towards public transport, which now serves 50% more of its recent travelers. The country is leading the implementation and execution of the BRT in the whole continent. Plus, dozens of cities shifted to less reliance on pollution-related transport. Hangzhou has built the most

innovative bike system in the world. However, all of these achievements are neutralized by persistent negative views towards sustainability. These negative views are seen in environmental laws and regulations where poor management persists, and environmental protection efforts are thus weakened. Merely stating the problem does not strengthen sustainability; thus, China has initiated responses to address its negative viewpoints towards sustainability, and has considered strategies to address climate change while providing a safe and healthy environment with the scarce resources at hand. These strategies involve environmental policies such as increasing the cost of fossil fuels, and making energy efficient and renewable sources more accessible and logical. These well-planned strategies have led China to set bold promises to cap its contribution to global warming. In 2009, China reported its first accurate promise on climate change, and now aims to reduce carbon emissions by 40% per GDP by 2020. The 13th Plan confirms China's commitment to conquer global warming while presenting innovative sustainable solutions incentivized by their call to act. These strategies will be further communicated and maybe exported to deal with fighting climate change across the globe.

Project pipeline

Transport in China has experienced significant growth in the past years. Many more projects in railway, roads and airport construction are planned for the next decade.

In October 2015, the construction of eight major infrastructure projects was announced, with an estimated investment of US\$15 billion. The National Development and Reform Commission (NDRC) gave approval for the construction of two railways—the northwestern Xinjiang Uygur Autonomous Region and the other connecting southwest China’s Guizhou Province and central China’s Hunan Province. Of all the remaining projects, a major one is a 244 km expressway in northwest China’s Gansu Province, with an estimated investment of US\$5.67 billion.^[28]

In 2014, China began construction of a new international airport, Beijing Daxing International Airport. Official approval for construction of seven proposed new runways, six for civilian purposes and one for the military, was granted in January 2013. The airport aims to have a capacity of handling 75 million passengers by 2025, with an estimated completion date in September 2019. A new rapid transit line is also being proposed that will connect the airport to Beijing South Railway Station. The combined cost of the airport with the 37 km rail link is estimated to be around US\$11 billion.^[29] However, the work for this project was behind schedule as of December 2015.^[30]

A new Beijing East Railway Station is also being planned, to be located in the northeast of Guoyuan Roundabout in Tongzhou District. With

an estimated completion date in 2020, the aim of establishing this station, along with the other three major and two branch railways in Beijing, is to increase the convenience of living in Beijing. The Beijing-Shenyang passenger-dedicated line, approved by NDRC, will also depart from the new east station.^[31]

The Shanghai Airport Authority (SAA) plans to build the world’s largest airport terminal satellite concourse at the Shanghai Pudong Airport (PVG). The concourse will have more than 100 boarding gates when completed. The PVG currently operates two terminals with 28 and 42 gates, respectively, but in order to keep up with the increasing traffic and the financial pace of the city, the airport is planning to expand exponentially. By 2020, the airport aims to have a handling capacity of more than 80 million passengers and 4.7 million tons of cargo annually, making it Asia’s primary aviation hub.^[32] US Architect Corgan, in association with its Chinese partner IPPR, was awarded the design contract, winning over six other bids. The budget for the program, however, is yet to be announced.^[33]

Additionally, under the 13th Five Year Plan, Beijing plans to construct a 3.5 km ring road (28 km length) to ease the traffic pressure, connecting the capital’s existing infrastructure with various other areas like an administrative center in southwestern Tongzhou district, the new Beijing Daxing International Airport and many more.^[34]

China Railway is also proposing a Silk Road high-speed rail link carrying both passengers and cargo between China and Iran under “One Belt, One Road,” which is China’s plan to build trade over land and sea in Europe and Asia, announced in 2013. The initiative requires future investment of about US\$1 trillion and has two components—the Silk Road Economic Belt and a sea component called the Maritime Silk Road.^{[35] [36]}



Delivery methods

For more than 200 years, the western countries have been working on improving their procurement system. China's economic reforms and changes to improve the procurement efficiency in construction have arisen only in the last century, with the greatest increase since 1980.^[37] The commonly used method was the traditional design bid build until the 2000s. In 2005, only 10% of the projects were procured using design-build (DB) and management contracting. Since the 1980s, the government has been working to make DB and BOT systems more popular. The status for infrastructure projects by 2010 can be observed in the histogram (developed by Cesare Zilio), where 48% of infrastructure projects opted for alternate delivery methods (see Appendix A14).^[40]

Emphasis has been placed on project financing through the BOT approach. New regulation articles are in place to make it easier for foreign investors to participate in such projects.^[41] The procurement system has undergone significant change, from government assignment in the past to competitive tendering currently. But even now, this system is not without flaws. Sufficient time to evaluate tenders was not given, in many observed cases. Sometimes the evaluation criteria was set after calling for tenders. There was no audit system in place to review the award of contract through such tendering practices.^[39] The BOT approach is gradually growing in popularity, after beginning

its growth from the power sector in 1996 under officially sanctioned guidelines. The Guiyang-Duyun Expressway was carried out by Guizhou CCCC Guiyang-Duyun Expressway Construction Co., Ltd in the form of BOT. But it is not without risks to investors. Also, the risk allocation mechanisms available in other countries are not the same as those available in China, due to restrictions (the government is barred from providing an ROI guarantee to investors and is prohibited from providing any security for project financing).^[38] Thus, the Chinese government realized the importance of involving alternate delivery methods and foreign investors, and has been working towards smoother delivery of projects using alternate procurement structures.

Conclusion

China has one of the most well-developed infrastructure systems in the world. It has the second-longest network of railways and the third-largest of roads. It is home to the largest airport network in Asia, and its port system is capable of handling the massive exports and imports which fuel the country's large GDP.

A wealthier middle class and an extremely large population have put the system at risk, crippling roads with congestion. Toll roads were used to grow the roadway system in previous years; however, it has left poorer regions underdeveloped. Regulations limiting foreign investment and long payback cycles have limited outside investment into the systems.

China has set forth on a promising path and begun to address some of these issues. The "Go West" policy promotes transportation activity

in the underdeveloped western region of the country. Foreign investors have been granted more freedom lately, including the ability to own railway bonds. Perhaps most importantly, the nation has made a qualitative commitment to sustainability. Known for its infamous smog, China ranks as one of the worst countries in regard to greenhouse gas emissions. The curtailment of carbon emissions will have a wide-ranging impact on the remainder of the infrastructure system.

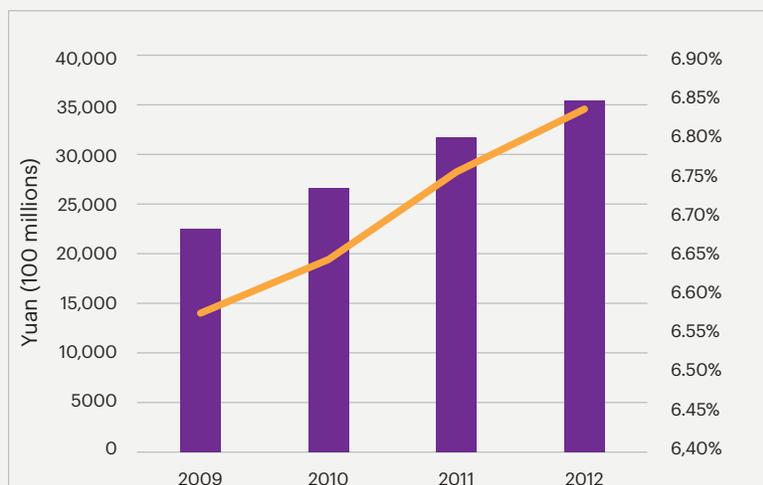
Large investments in airports and strong transportation objectives outlined in the Twelfth Five-Year Plan indicate a bright future for the country. It remains to be seen how a sluggish global economy in 2016 affects the country and if it will alter the nation's investment in infrastructure.

Appendix A1: GDP statistics

Table 2: Detailed GDP by sector in hundred million of Yuan at current prices.
Source: National Bureau of Statistics

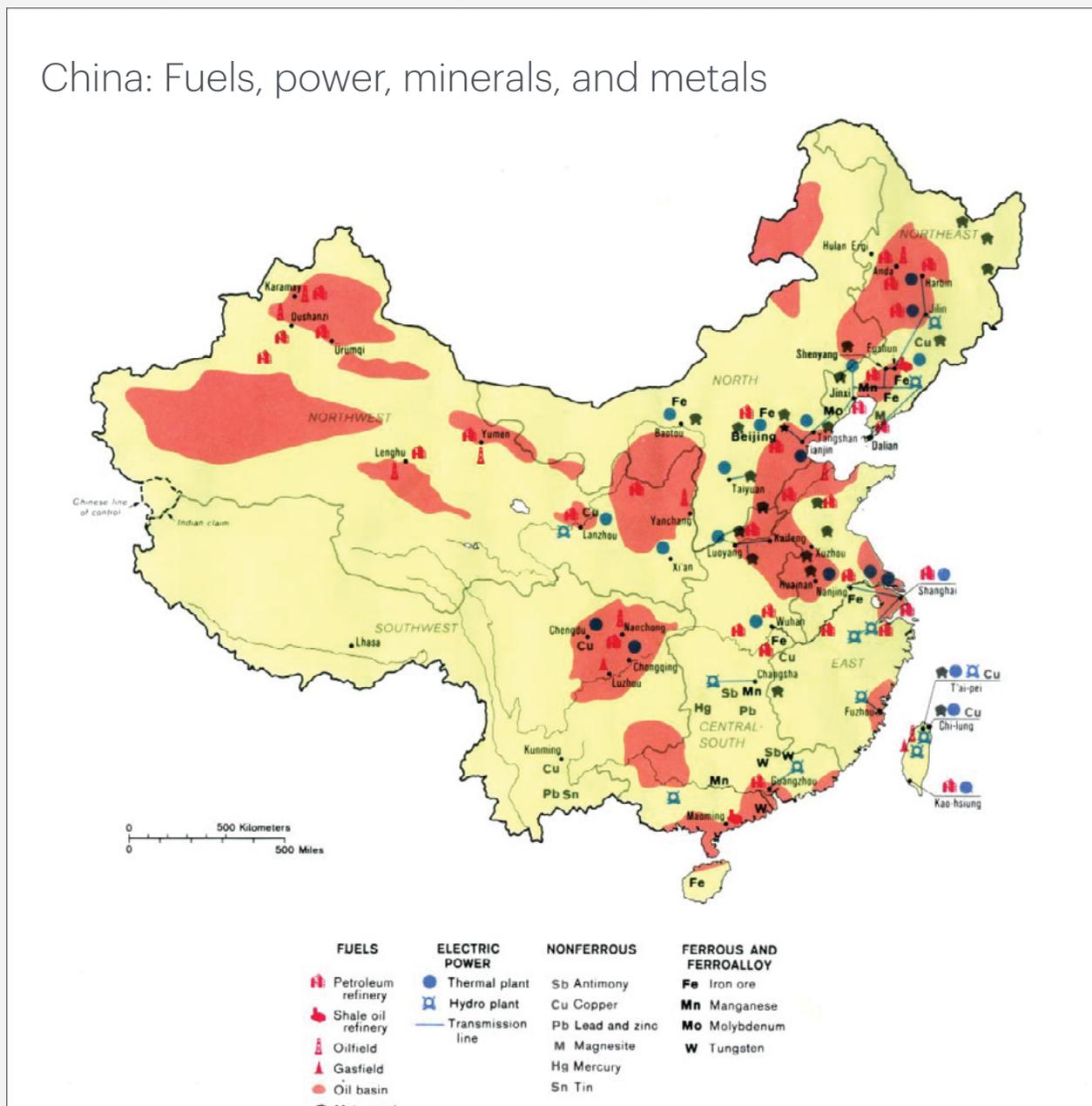
	2009	2010	2011	2012
Agriculture, Forestry, Animal Husbandry and Fishery	35,226	40,534	47,486	47,486
Mining	16,726	20,937	27,226	27,226
Manufacturing	110,118	130,325	150,597	150,597
Production and Supply of Electricity, Gas and Water	8,395	9,461	10,647	10,647
Construction	22,399	26,661	31,943	31,943
Transport, Storage and Post	16,727	19,132	22,433	22,433
Information Transmission, Computer Services and Software	8,164	8,882	9,780	9,780
Wholesale and Retail Trades	28,984	35,746	43,445	43,445
Hotels and Catering Services	7,118	8,068	9,173	9,173
Financial Intermediation	17,768	20,981	24,958	24,958
Real Estate	18,655	22,782	26,784	26,784
Scientific Research, Technical Services and Geologic Prospecting	6,191	7,785	9,407	9,407
Management of Water Conservancy, Environment and Public Facilities	4,722	5,637	6,966	6,966
Services to Households and Other Services	1,480	1,752	2,040	2,040
Education	5,271	6,102	7,281	7,281
Health, Social Security and Social Welfare	10,482	12,042	14,429	14,429
Culture, Sports and Entertainment	5,083	5,981	7,496	7,496
Public Management and Social Organizations	2,231	2,496	3,007	3,007
Total	15,162	16,210	18,006	18,006
	340,903	401,513	473,104	473,104

Figure 4: GDP by construction at current prices
Source: National Bureau of Statistics



Appendix A2: Natural resources map

Figure 5: China's natural resources map
Source: University of Texas^[22]



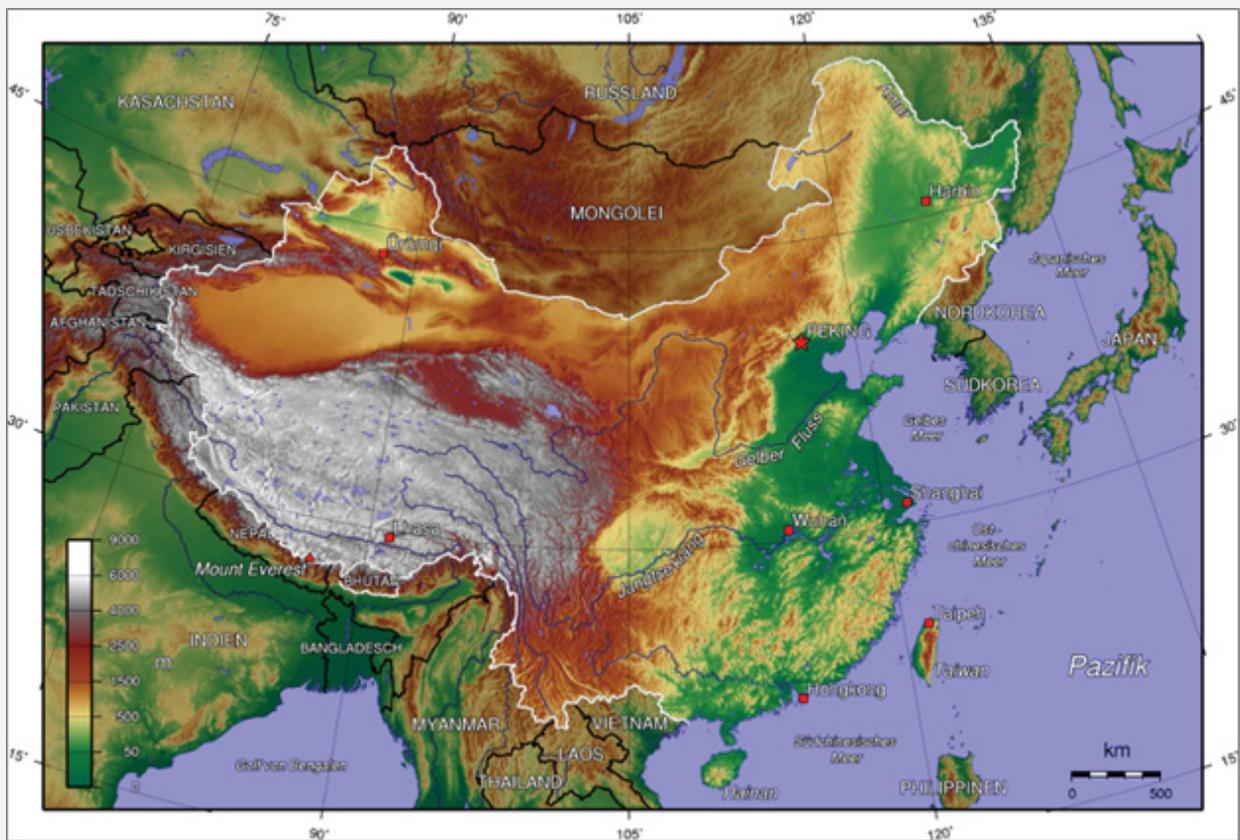
Appendix A3: Waterway allocation

Figure 6: Inland waterway freight allocation
Source: WWINN^[21]



Appendix A4: Topography

Figure 7: Topographic map
Source: WikiCommons^[23]



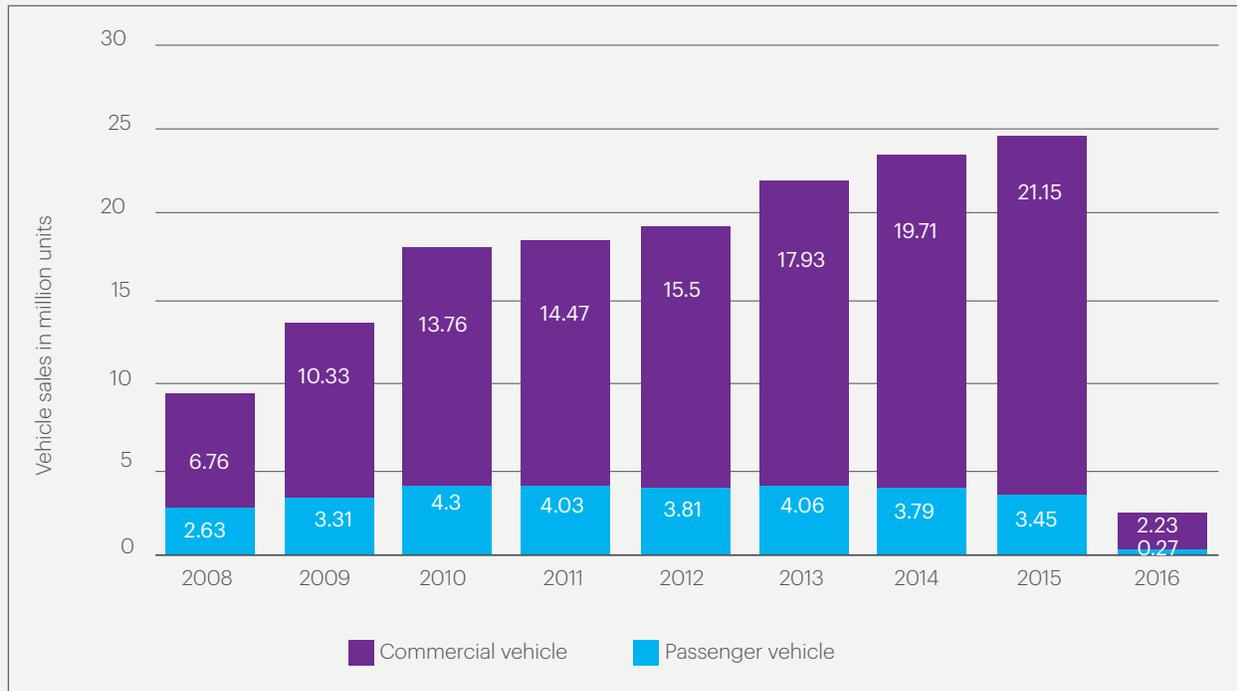
Appendix A5: Railway network

Figure 8: Rail network of China
Source: WikiCommons^[24]



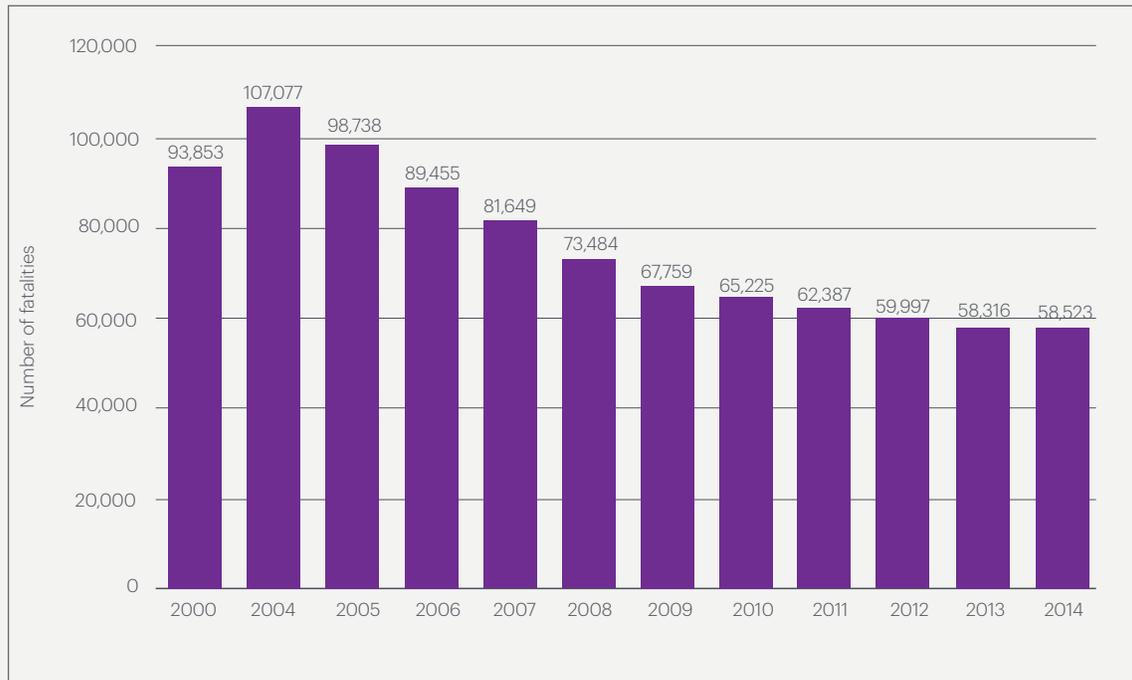
Appendix A6: Vehicular trends

Figure 9: Number of vehicles per year
Source: Statista



Appendix A7: Roadway fatalities

Figure 10: Road fatalities per year
Source: WHO



Appendix A8: Seaport statistics

Table 3: Top Chinese seaports per cargo volume

Top seaports per cargo volume	Rank in the world	Tons
Shanghai	1	697000
Tianjin	3	478000
Guangzhou	4	473000
Qingdao	5	450000
Ningbo	7	400000
Dalian	9	320000

Table 4: Top Chinese seaports per container volume

Top Chinese seaports per container traffic	Rank in the world	TEUS
Shanghai	1	34,000,000
Shenzhen	3	24,000,000
HK	4	23,000,000
Ningbo	6	17,400,000
Qingdao	7	15,500,000
Guangzhou	8	15,300,000

Appendix A9: Seaports map

Figure 11: Map of Chinese seaports



Appendix A10: Main seaports

Figure 12: Characteristics of main ports in China
Source: Netherlands Economic Network in China



Appendix A11: Quality indicators for logistics sector

Table 5: Quality indicators for logistics sector
Source: World Bank

	China	NL	USA
Overall quality	3.52	4.02	3.93
Infrastructure quality	3.61	4.51	4.14
Efficiency of customers	3.25	3.85	3.67
Logistics services	3.47	4.05	3.96

Appendix A12: Airport statistics

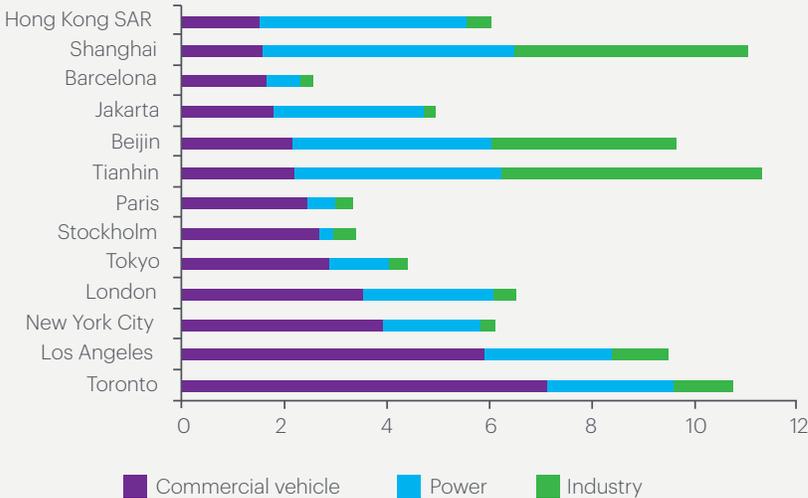
Table 6: Characteristics of main airports in China

Source: CACC 2014 Reports

Leading airports in China	Cargo in tons	Number of passengers in millions	Aircraft
Beijing Capital International Airport	1,850,000	87	582,000
Guangzhou Baiyun International Airport	1,500,000	54	412,000
Shanghai Pudong Airport	3,180,000	51	402,000
Shanghai Hongqiao Airport	433 000	38	253,000
Chengdu Shuangliu International Airport	545, 000	37	270, 000

Appendix A13: Carbon emissions per capita

Figure 13: Carbon emissions of select Chinese cities
Source: World Bank



Appendix A14: Traditional versus alternate delivery methods used

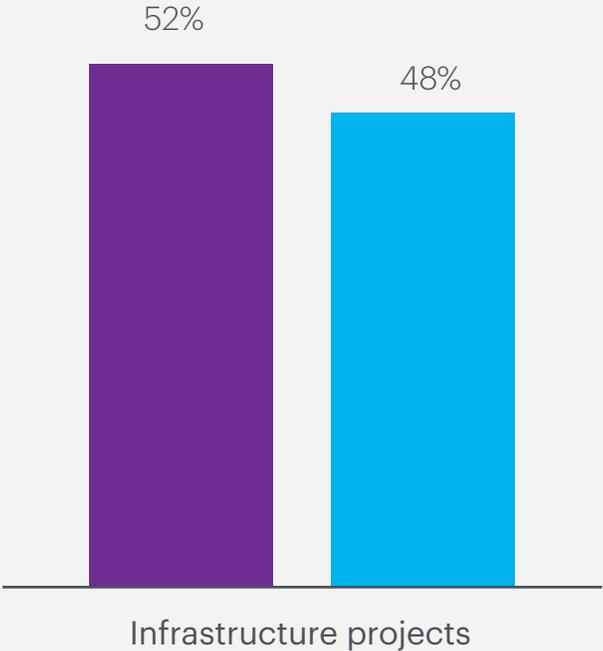


Fig. Histogram for % alternate delivery projects ⁽⁴⁾

Colombia



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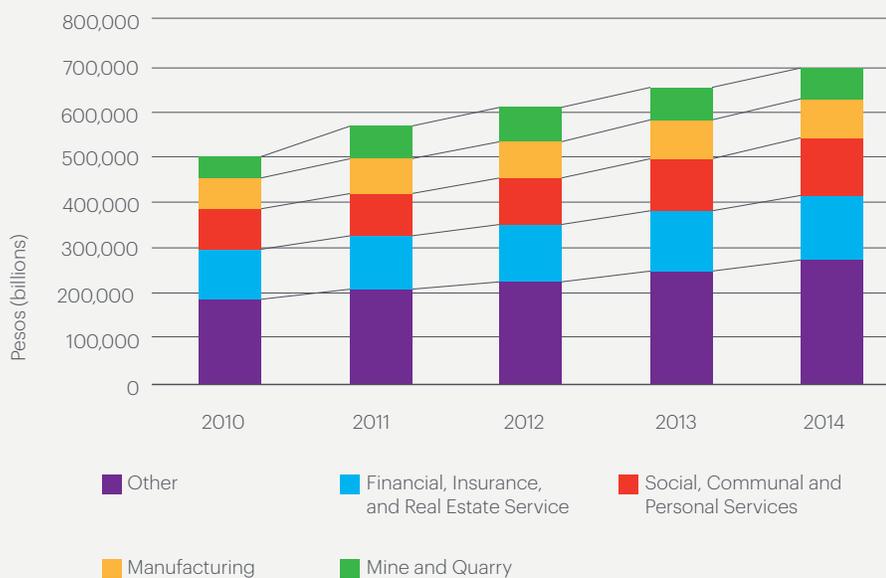
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Introduction

Colombia is situated in the northwest section of South America and is the only South American country that shares a physical border with Panama, and subsequently Central America. This is critical because any goods that originate in Panama and are destined for South America via land must use the country's transportation systems. Its geography encompasses plains, rainforests and the Andes Mountains. This diverse collection of landforms has played a leading role in how the country and its infrastructure has been developed.

Colombia's infrastructure is sub-par compared to other countries of similar size and wealth. This is changing, however, as Colombia has averaged strong GDP growth over the last five years, and construction has continually contributed to that growth. The services sector accounted for almost 40% of Colombia's GDP in 2014. Manufacturing and mining and quarry were other considerable contributors to GDP, averaging 13% and 11%, respectively, of the total over the last five years.

Figure 1: GDP by sector at current prices. Source: Central Bank of Colombia



Over the years, urban centers have primarily developed in six regions. This dichotomy of disjointed urbanism necessitates a balance between dense multi-modal transit and a sprawling network of interconnecting pathways. Initiatives such as the 4G Highway Plan and the Bogota Subway seek to meet this demand.

These projects will not only transform the transportation profile of the country but have the potential to reduce inequality and violence, which have historically burdened the country.

Table 1: Key statistics for Colombia. Source: World Bank

	2010	2011	2012	2013	2014
GDP at market prices (current US\$ in millions)	3.52 287,018	4.02 335,415	3.93 369,659	3.47 380,063	3.47 377,739
GDP per capita (current US\$)	6,251	7,228	7,885	8,028	7,904
Inflation, GDP deflator (annual %)	3.86	6.73	2.99	1.90	1.83
Labor force, total	22,679,417	23,102,781	23,507,707	23,900,105	24,290,685
Population, total	45,918,101	46,406,446	46,881,018	47,342,363	47,791,393
Population density (people per sq. km of land area)	41.39	41.83	42.25	42.67	43.07
Population in urban agglomerations of more than 1 million	18,323,753	18,789,023	19,266,501	19,756,515	20,259,405
Unemployment, total (% of total labor force)	12.00	11.10	10.60	9.60	10.10
Urban population (% of total)	75.04	75.32	75.60	75.88	76.16

PEST analysis

Political

- Political system is a republic with separation of powers into executive, judicial and legislative branches.
- Stressed relations with Venezuela due to conflicting interests.
- Striving towards becoming an opened economy not only with the United States, but also with other South American countries.
- Ongoing peace talks between the Colombian government and leftist rebel group the Revolutionary Armed Forces of Colombia, or FARC.

Economic

- South America's second largest economy (over 4% growth).
- Construction industry shows great promise (ranked first in job creation, contributes to 16% of GDP).
- Abundant natural resources (agricultural and mineral).
- Economic liberalization with tariff reductions, financial deregulation, tax reform, and adoption of a more liberal foreign exchange rate to ease import restrictions and open most sectors to foreign investment.
- Colombia has nearly half of its population living below the poverty line and currently has an unemployment rate of 8.6%.

Social

- Ranks as the third most populated country in Latin America.
- Striking disparities in income, wealth, and living standards remain among regions and socioeconomic groups.
- The educational system is still developing; quality varies in some regions and schools are overpopulated; some people have access to free public schools while others don't.
- Colombia has had drug trafficking issues due to the presence of drug cartels.

Technology

- Only 5.8% of companies in the country have an R&D department within the corporate structure, employing only 0.9% of the workforce.
- Colombia still doesn't present the technological strength of a developed country.
- Seventy percent of Colombians have access to Broadband internet access.

Status of transportation

Railways

Colombia's rail network is mainly used for the transportation of goods from the coal and oil sector. These economy industries are located in the central regions of the country; thus the goods need to be transported to the nearest ports for exportation. The rail network is the link between the ports and where Colombia's hard and soft commodities are located. This network is comprised of a total of 874 km active railways, of which 724 km are narrow gauge and 150 km are standard gauge. The main reason for the use of narrow gauge is the local conditions—narrow gauge allows sharper turns than standard.

The system is antiquated, and there has been national initiative for the restoration of the system as a whole. The National Agency of Infrastructure (Agencia Nacional de Infraestructura – ANI) has two active private concessions: 380 km to Ferrocarril del Pacifico SAS and 266 km to Fenoco S.A. These companies are responsible for the rehabilitation, maintenance, operation and the exploitation of railway transport infrastructure assigned to each. There are other contracts for the rehabilitation, maintenance and operation for smaller sections of the system.

Colombia only has one subway system, which is located in Medellin—the second-largest metropolitan area. The system is 31.3 km long, and when integrated with an aerial cable train called Metrocable, is 40.7 km long; it gives the system an additional 9.4 km.

Challenges

- Rain season represents an important factor for the operation of the rail system.
- During and after rain season a full maintenance of the system is required.
- Previous cases of corruption have delayed projects for long periods of time.
- Leftist–Communist guerrillas or paramilitary forces have threatened the development of projects in regions controlled by these groups. Contractors have to deal with this challenge when working in Colombia.

Opportunities:

- The Bogota Municipality Major created a company dedicated entirely to the development of the Bogota Subway System.
- An extensive length of the system is already built, but needs to be reactivated by private or public concessions.
- Connections to neighboring countries such as Venezuela and Peru will require substantial investment, but at the same time will benefit the economies of such countries.
- US\$7 billion is estimated to be required for the construction of the Bogota Subway—a 27 km project.^[2]
- The restoration of the “Tren Cercanías de la Sabana de Bogota” commuter train that will link adjacent municipalities to Bogota, a 90 km project, is in discussion.
- Only one Colombian city has a subway system, thus creating the opportunity for other metropolitan areas to develop their own network.

- The government has placed importance in the investment and use of rail network for the transport of goods in their 2014–2018 National Development Plan.^[3]

Roads and highways

Colombian geography poses many challenges to the construction of roads and highways. Even the transportation of required materials is difficult, which places a heavy premium on road construction. The Colombian government is trying its best to update the current nexus of roads through its Fourth Generation Highways initiative, which covers 7,000 km at a cost of US\$20 billion. The intention is to build on the road network while increasing safety and involving private financing. This will also help Colombia take advantage of the trade agreements they have signed. The main highways currently are Western Trunk, Magdalena Trunk, Caribbean Transverse, Buenaventura Transverse, Central Trunk and Carretera Marginal de la Selva.^{[14] [15]}

Figure 2: Future infrastructure projects



Challenges^[12]:

- Land acquisition causing delays and cost overruns due to ownership issues.
- Environmental permits take too long (over 18 months).
- Previous consultation with traditional Afro-Colombian communities is required by law.
- Performance of work and allocation of risks and costs to relocate networks.
- Poor quality of existing road network as shown by the World Economic Forum.
- Historical lack of investment has now created a huge gap to fill.
- Given the high risk involved, American companies are not enthusiastic about investing in the 4G program.

Opportunities:

- The 4G Highways initiative which is already in progress.^[13]
- Change of terms to reduce time for getting environmental permits by Infrastructure Law.^[17]
- Negotiation and signing of free trade agreements leading to stability and economic growth and advantages in professional services.^[15]
- Strong protection for US investors under FTA regarding transparency, dispute settling, etc.^[15]

Seaports

Eighty percent of Colombia's international trade is realized by the 12 most important ports on the Pacific and Caribbean coasts. The port sector investment represents around US\$1.7 billion.^[40] Seaports represent slightly more than 55% of export operations and around 70% of import operations.^[41]

Since privatization of port facilities in 1993, cargo-handling effectiveness has significantly increased under the management and operation of private concessionaires. These ports were given to regional port entities established under company law. Free competition at each port has been triggered by the ban of restrictive labor practices and by the dockworker services. The public

sector share was divided among the national government (3%), the state government (12%), and the municipality (15%).^[42] Privatization and competition in Colombia have increased productivity levels compared to other South American countries. These improvements have been developed with small investments first in shore-side equipment and then in infrastructure expansion.^[42]

With the expansion of Colombian ports, environmental issues have become an important concern. Environment must be a consideration of the ports, and the central government's main concern.

From Table 2 below we observe that most ports have been located in the Atlantic coast.

Table 2: Characteristics of main ports in Colombia. Source: Hong Kong HKTDC

Port	Location	Imports (Tons)	Containerized imports (Tons)	Exports (tons)	Containerized exports (Tons)
Buenaaventura	Pacific Coast	7,600,000	3,000,000	2,500,000	1,600,000
Barranquilla	Atlantic Coast	3,000,000	800,000	1,400,000	600,000
Cartagena	Atlantic Coast	1,500,000	1,600,000	1,300,000	1,300,000
Santa Marta	Atlantic Coast	1,800,000	150,000	5,000,000	330,000
Total		13,900,000	5,550,000	10,200,000	3,830,000

Challenges

- Oil price and regional competition.
- Political situation—FARC and the Colombian government are trying to end more than five decades of armed conflicts.
- Member of CAN, Colombia respects Common Tariff Nomenclature of the Andean Community (NANDINA), which can be a deterrent to foreign investments.

Opportunities

- There are 21 pending port concessions in addition to 80 active permits for future ports.^[40]
- Colombia is investing approximately US\$1.5 billion to enhance the navigability of a 565-mile stretch of the Magdalena River, between the town of Puerto Salgar and the Caribbean port city of Barranquilla.^[40]
- Foreign investments: First, there is a Singaporean company is developing the Aguadulce Port in Buenaventura, on the Pacific Coast. Second, the Palermo Tanks joint venture of a US and Colombian company is investing approximately US\$50 million in the construction of a multi-product liquids terminal in the Colombian port of Barranquilla.^{[43] [44]}
- Free trade agreement with China and with Chile, Mexico and Peru in 2012 was set to establish the Pacific Alliance to reach out to the Asia Pacific zone as a united force.^[45]
- In 2006, establishment of the Federal Trade Area with the US led to double-digit increase in imports.^[45]

Airports

The Colombian air transport sector illustrated one of the most significant growth rates of all transport segments. It has increased by 12%, reaching 19 million passengers the first half of 2015, according to Association del Transport Aereo en Colombia.^[46] Thirty-two percent are international passengers and 68% are domestic passengers. During the past decade, growth rates have risen quickly from 12 million in 2005 to 31 million in 2014. According to ATAC, for each peso on air transport industry, an additional US\$4 is spent on the entire economy.^[46]

El Dorado International Airport was ranked as one of the 50 busiest airports in terms of passenger traffic in 2013. It ranked first in cargo traffic in Latin America in 2013, 33rd worldwide. It ranked second in traffic movement in Latin America, and 45th worldwide.^[47]

Challenges:

- There is a correlation between the oil price fluctuation and the Colombia peso, which has increased the pressure on the cost structure of the airline industry. Between 2014 and 2015, US dollar inputs increased by 70%. Whereas the average dollar-denominated inputs account for 60% of the aviation costs, this increase will have harmful impacts on the industry.^[48] If no other variables interfere, such as the replacement for GDP income, the Colombian peso would dramatically lose power against the US dollar, possibly resulting in double-digit inflation.^[49]
- Political instability

Opportunities:

- Privatization: From 2012 to 2014, South America has been the main region for airport privatizations, accounting for 80% of the US\$20 billion globally dedicated for it; Colombia and Panama are the two countries most affected by privatization.
- New projects: According to the Ministry of Transport's "Infrastructure for Prosperity" plan, US\$560 million have been injected in a new concession for Barranquilla's airport, civil works projects in Cali's airport in 2014, and the construction of the Ipiales airport. This budget also includes the improvement of around 20 other local airports and the structuring of two projects: one for Bogota's alternate airport and another for the Flandes airport.^[50]

Two main projects

1. Barranquilla airport: The value of the project was US\$32 million.^[50]
 2. Bogotá alternate airport: Colombia's civil aviation authority studied the development of a second airport in Bogotá. Currently Bogotá is served by El Dorado International Airport. It ranks after São Paulo-Guarulhos International Airport and Mexico City's Benito Juárez International Airport. The project required an investment of at least US\$375 million.^[51]
- Competition in the local as well as international market: increasing access to air travel for Colombians and a decrease in prices by 15% in two years (2011-2013). Today Colombia, after Brazil, has the second most competitive fares in Latin America. The average price per km per passenger is \$0.14 in Colombia, whereas it is \$0.17 in Argentina and \$0.40 in Ecuador.^[53]

SWOT analysis

Strengths

- As part of the government's policy to open the economy to international markets, the country's four main ports have been privatized and modernized.
- The Colombian labor force is among the most skilled and competitive worldwide.
- Colombia boasts 12 modern international airports that serve airlines from Latin America, North America and Europe.

Weaknesses

- Colombia's infrastructure ranks 84/148 in the world and ranks as the worst in Latin America, according to the World Economic Forum.
- Cities are poorly connected to both internal and external markets, largely because of the extreme topography of the country.
- Historical lack of investment has now created a huge gap to fill.

Opportunities

- 4G Highways initiative, which covers 7,000 km and costs \$20 billion, is attracting foreign investors.
- Colombia's National Infrastructure Agency (ANI) plans to award concessions for a total of US\$100 billion until 2021 for new highways, railways, navigable waterways, renovation, modernization, and extension of airports and seaports.
- Colombian government encouraging public-private partnerships in transportation projects.
- \$561 million have been invested in a new concession for Barranquilla's airport, civil works projects in Cali's airport, and the construction of the Ipiales airport.
- Colombia is investing \$1.3 billion to improve the navigability of a 565-mile stretch of the Magdalena River, between the town of Puerto Salgar and the Caribbean port city of Barranquilla.

Threats

- High crime rates related to transportation.
- Poor maintenance of roads, highways, and airports.
- The devaluation of the Colombia peso has increased the pressure on the cost structure of the infrastructure industry.
- Guerilla groups pose issues on infrastructure projects, which adds burden on contractors and has threatened projects in Colombia.

Geographical analysis

Colombia is located in the northwest region of South America, which shares borders with Panama at the Northwest, Venezuela and Brazil to the east, and Ecuador and Peru to the south. It has access to the Pacific Ocean and the Caribbean Sea. Colombia has five predominant natural regions across the country: the Andes, which divides the country in half, is a mountainous region that starts in Venezuela and ends in Argentina; the Pacific coastal region; the Caribbean coastal region; the Llanos—a tropical grassland plain—and the Amazon rainforest region. Additionally, Colombia has 30 volcanoes, which are located within the Andes region, and have influenced the location of nearby towns.

Population density

Colombia holds approximately 48 million people; the majority reside in the western part of the country, mainly because of the Amazon rainforest, which is located to the southeast. Additionally, the population tends to gather in the valleys that are formed within the Andes region. Approximately 76.2% of the population is considered urban, and it has been stable for the past five years. The population is concentrated mainly in six metropolitan areas where the population is larger than one million persons each. Bogota—by far the largest—has almost 10 million people, followed by Medellin, Cali, Barranquilla, Cartagena and Bucaramanga. Cucuta, which is located near the Venezuelan border, is the most important link of commerce between the two countries.

Infrastructure

Infrastructure in Colombia has been shaped by its geography, the economic influence of each region and national conflicts that have occurred in the past.

The road network is also affected by the geography, mainly because of the Andes region. The west side of the country is well developed, especially between the West and East Andes and the Caribbean region. It has two important links with Venezuela; one located to the north near the town of Maicao, which is two hours away from Venezuela's second-largest city, and Cucuta to the northwest, where an important international commerce exchange occurs every day. To the south there is a direct link to Ecuador near the town of Ipiales, which is mainly used for commerce and commuters. There is no direct link to Panama or Brazil because of the difficult geography and rainforest in that region.

The rail network is mainly used for commerce, specifically to transport coal, oil and cement from the central region of the country to its ports. Major routes are located between East and Central Andes and target the coal mines that are in the region as well as oil fields—even though there are pipelines that transport oil from their fields to ports or refineries.

Ports are located strategically in the Caribbean because of its proximity to the coal mines. There are others used mainly for coffee, oil-related products and tourism. Only two important ports are located in the Pacific Ocean; they are used

mainly to export oil and grains. Their location is advantageous because of their proximity to the southern oil fields and coastal plains.

Airports are located all around the country and are the most important mode of transportation and communication with the rest of the country

for small towns in the rainforest area or on the borders with Brazil and Venezuela. Additionally, the two biggest cities—Bogota and Medellin—are located within the rugged Andean landscapes, making their operations more difficult.





Sustainability

An efficient BRT system was successfully implemented in Bogota, Colombia, in order to meet the triple bottom line. Additionally, Bogota constructed 300 km of cycle lanes to continue to meet its promise towards sustainability. Cyclists were encouraged by the changes, and their use of those lanes has resulted in improved air quality and decreased traffic incidents. Municipalities declared a car-free day on Sundays to encourage less reliance on motorized vehicles.^[4] Bogota went beyond expectations to provide cost-effective strategies for achieving their sustainability goal. In addition to the BRT, the government has discouraged the use of motor vehicles through innovative policies such as travel restrictions during potential congestion periods.^[5]

Bogota is the sustainability hub for 10 South American countries, all of which signed the Bogotá Declaration on Sustainable Transport Objectives (BDSTO), which promotes strategies addressing the social, economic and environmental issues pertaining to infrastructure and transportation. National agencies of environment and transportation sectors from Argentina, Brazil, Bolivia, Chile, Colombia, Ecuador, Mexico, Paraguay and Uruguay, gathered in Bogota, Colombia, on June 23 and 24, 2011, for the first regional Forum on Sustainable Transport (FTS), and adopted the declaration. The BDSTO can be used as a guide to further stimulate a low carbon resilient environment complementing the present infrastructure assets. These 10 countries understand the importance of transforming their transportation systems

to sustainable systems that will ameliorate the current levels of GHGs. Moreover, this declaration ensures the new transportation systems being built will support Colombia in meeting its sustainability objectives and in providing a resilient adaptive society.

Figure 3: Bogotá declaration on sustainable transport objectives (BDSTO)

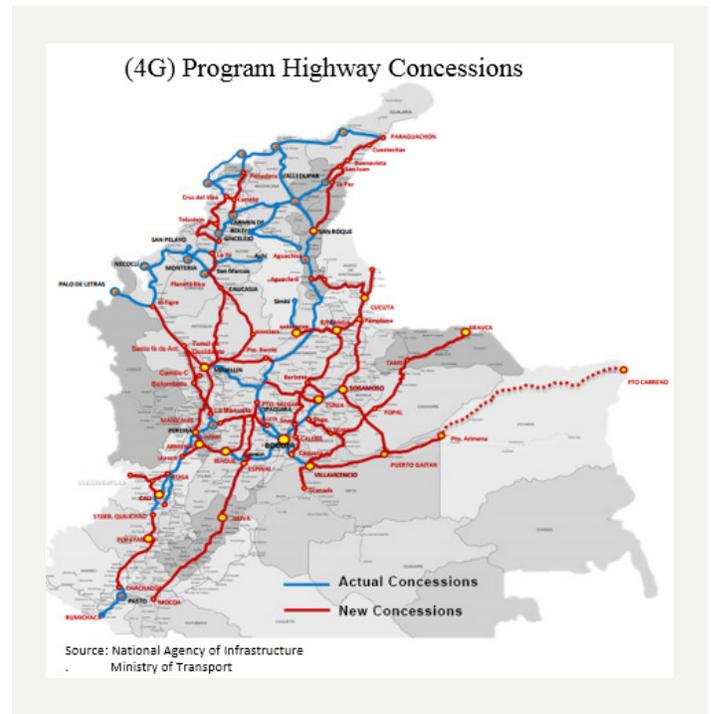


Project pipeline

Colombia has had remarkable economic growth, despite the lack of sufficient infrastructure in the country. The country is now planning to implement the largest infrastructure plan in its history for economic expansion and traffic management.

Colombia concentrates primarily on roadway infrastructure now; the execution of the Fourth Generation (4G) of the Road Concessions Program will establish a \$25 billion road network throughout the country, with 40 concession agreements. The organization developing the program is Colombian National Infrastructure Agency (ANI). ANI has stated that after this project, the roads under concession will increase from 6,000 km to 11,000 km. The first and second stages were awarded in 2014 and 2015, respectively, incorporating 17 projects underway for ANI, each at different stages. Bogota and Medellin shall be connected with the ports at Pacific and Atlantic oceans via 47 new highway routes. The 176-km Autopista al Mar 1 constitutes a major portion of the 4G program. It includes construction of 41 bridges and 17 tunnels and improvement of the existing road, at a cost of \$0.8 billion. The PPP has been awarded to the Estructura Plural SAC 4G Consortium for the construction and management of Autopista al Mar 1 for 25 years.

Figure 4: 4G highway concessions



In addition to the roadworks, in October 2013, ANI selected 10 groups to bid on concessions for five airports in the cities of Barranquilla, Armenia, Neiva, Popayan, and Cartago, with the goal to improve and expand the airports over the next two decades, increasing the number of passengers by 3.7 million. The Barranquilla Airport, in its third generation concessions, was retendered in 2015 to Grupo Aeroportuario del Caribe.

Another significant project is the improvement of navigability of the Magdalena River, at a cost of US\$1.3 billion. Goals of this improvement are to decongest freight transport by reducing the

truck traffic on the roads, stimulate economic growth by gradual establishment of industries in the surrounding region, and increase the river transport to 10 million tons annually by 2029.

Airports and ports are also areas of importance for the country. In November 2013, the Colombian government announced it would use US\$60 million to dredge and widen the canal at the Port of Cartagena to accommodate larger ships. APM Terminals established a joint venture investing US\$200 million in upgrading and expanding a container terminal in Colombia's largest port.





Delivery methods

The most popular delivery method in Colombia is the traditional design bid build method, as evidenced when, under a PPP program, the first two 4G projects, Girardot-Puerto Salgar highway and the Conexión Pacífico 1 project, each received just two offers. The private entities were not ready to finance risks involving social and environmental issues. Thus came new laws to support this cause.^[18]

Project financing started becoming popular after economic liberalization in 1991 and later became a customary way of financing government projects. There are a number of structures used with toll roads following BOT structure, implemented through concession

agreements with a term between 10 and 20 years, depending on project size. Colombia has also formed institutions like the National Infrastructure Agency (ANI)^[19] and national system of competitiveness and innovation to assist in smooth project delivery with private project partners.

Thus Colombia is ready to adopt new systems and is also considering the implementation of integrated project delivery, but there are cultural, technological, legal and financial barriers.^[20]

Figure 5: Project delivery chart ^[21]



Conclusion

Holistically, Colombia's infrastructure can be considered in a mixed state. The railway networks are limited, and those that do exist cannot accommodate current demand. Roadways are degrading due to poor maintenance, and the country's topography causes an escalation in construction costs due to the struggles of transporting materials and equipment. El Dorado Airport is one of the most widely used in Latin America; studies are underway to see if a second airport will be necessary to handle capacity. Seaports, however, can be considered the exception to this trend. Since signing the Free Trade Agreement with the United States in 2006, Colombia has seen a double-digit increase in imports. Privatization of seaports in 1993 allowed the industry to keep pace with the growth, taking advantage of innovative efficiencies unavailable to the public sector.

Despite these challenges, the future looks bright for Colombian infrastructure. Long subject to conflict with local militias, the government hopes to reach a bilateral truce with the FARC faction soon. The move should help bring stability to the country, with foreign investors hopefully following. Government spending on infrastructure is on the rise, including a

US\$1.3 billion investment into the Magdalena River and a US\$1.8 billion investment into an array of aviation projects. A strong foundation of natural resources benefits the country, and recent efforts to liberalize the economy have helped to stimulate GDP growth.

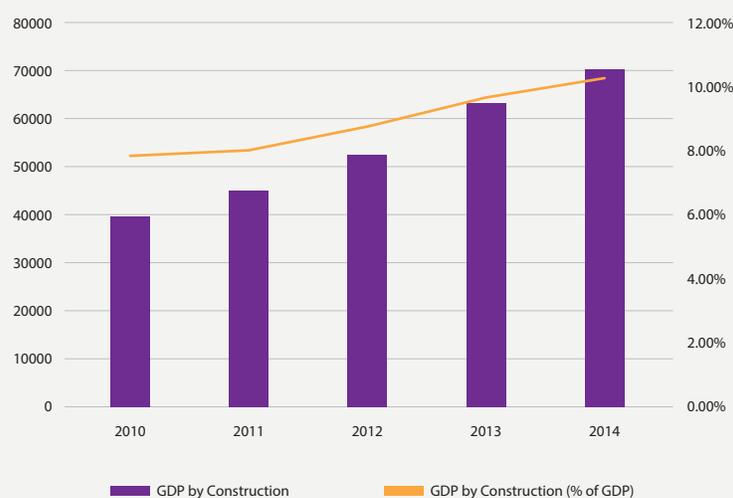
If Colombia follows through with its proposed infrastructure plans, private investment should follow thereafter, especially if the political situation stabilizes. This could prove critical for the country as a whole. Medellin is the perfect example of how infrastructure investment can transform a city from a disregarded wasteland to a center of economic activity. The development of national infrastructure will play a key role in determining whether the transformation of Medellin serves as the baseline, or is deemed the exception.

Appendix A1: GDP statistics

Table 4: Detailed GDP by sector in billions of pesos at current prices.
Source: Central Bank of Colombia

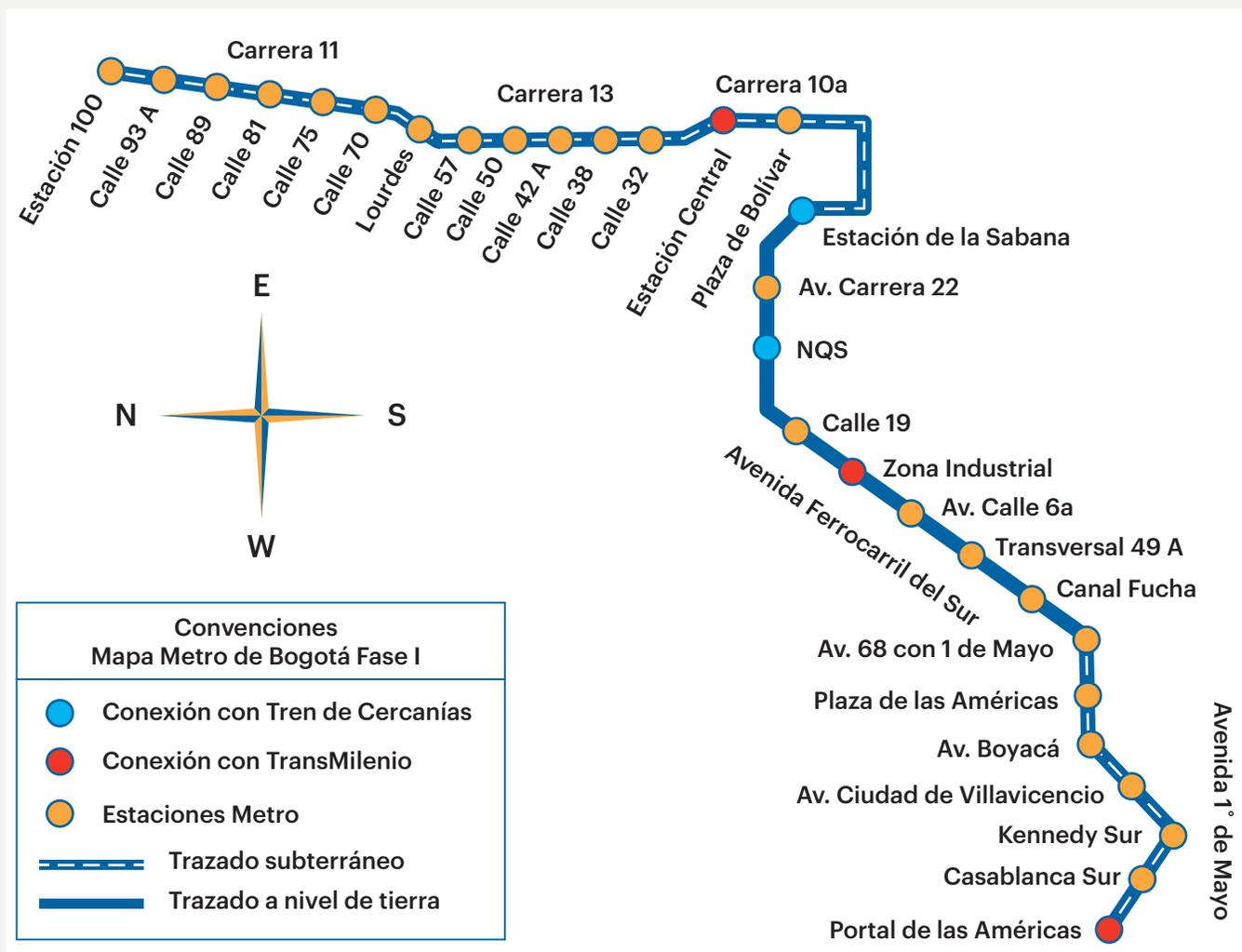
	2010	2011	2012	2013	2014
Agriculture, Cattle Ranch, Forestry, Hunting and Fishing	35,431	38,722	38,451	38,978	43,589
Mine and Quarry Exploitation	45,960	68,943	73,052	72,731	68,409
Manufacturing	69,527	76,497	81,186	84,041	84,978
Electricity, Gas and Water	19,658	21,146	22,416	23,758	25,772
Construction	39,340	45,866	52,988	62,702	70,931
Commerce, Repairing, Restaurants and Hotels	63,210	70,332	75,194	82,012	87,514
Transport, Storage and Communication	34,681	36,199	37,567	42,830	45,993
Financial and Insurance Establishments, Real Estate and Company Services	105,048	113,878	123,883	132,601	142,500
Social, Communal and Personal Services	86,280	93,796	103,020	114,264	124,849
TOTAL	499,135	565,379	607,757	653,917	694,535

Figure 6: GDP by construction at current prices.
Source: Central Bank of Colombia



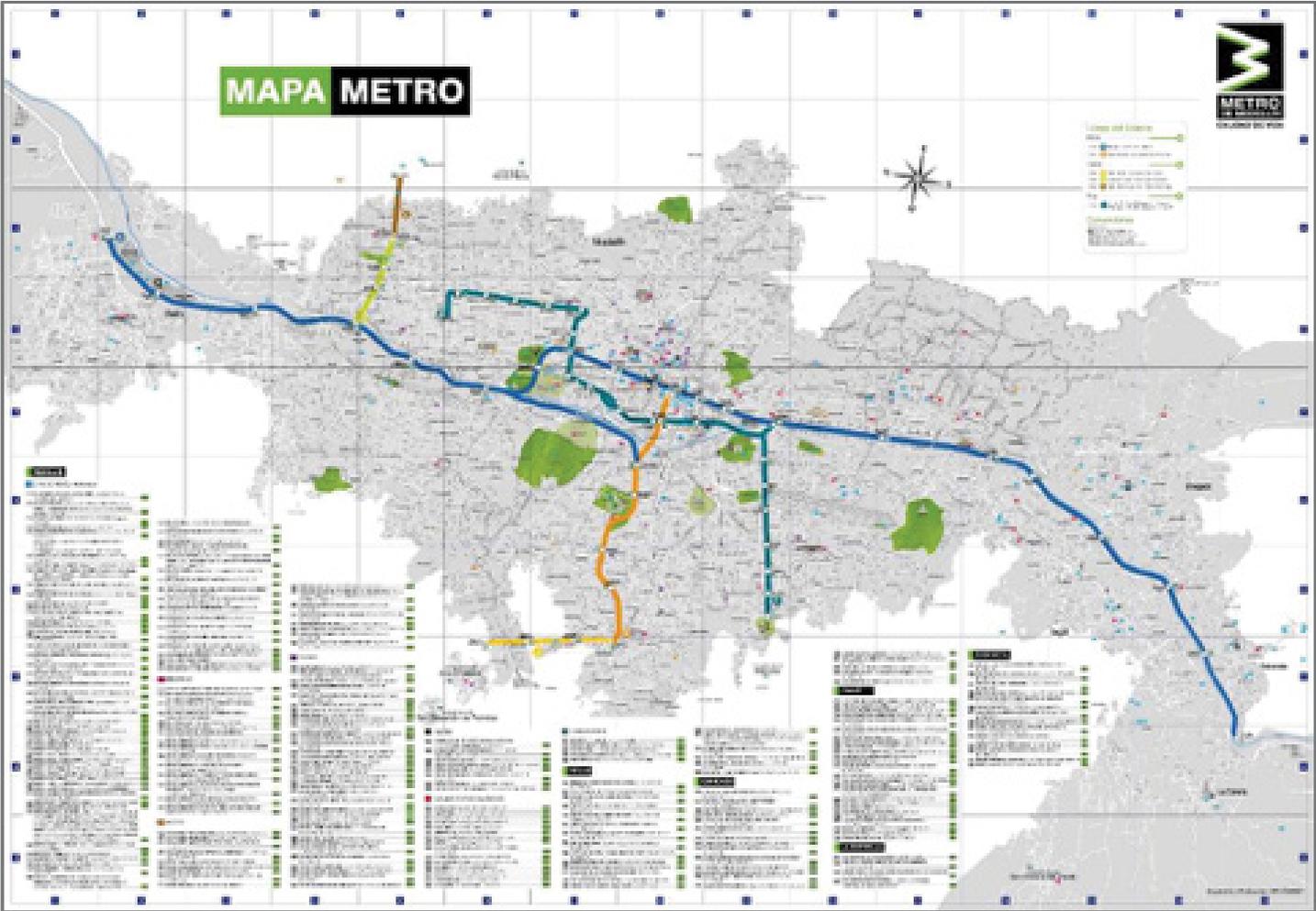
Appendix A2: Bogota subway map

Figure 7: Possible alignment for the Bogota subway system. Includes stations that might not be in the final proposal plan.



Appendix A3: Medellin subway system

Figure 8: Map of Medellin subway system



Appendix A4: Various concession routes

Figure 9: Concession route Central La Dorada Chiriguana

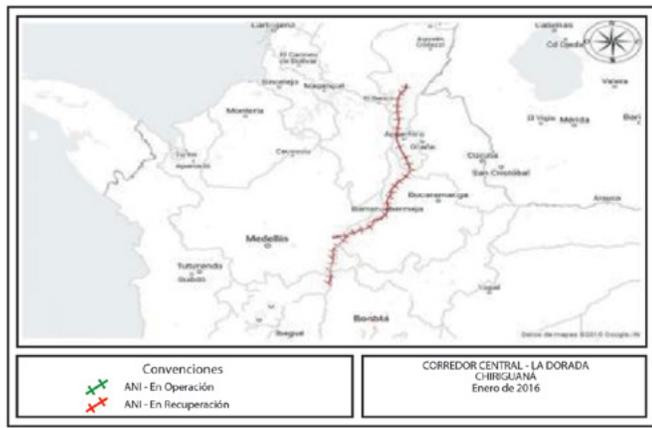


Figure 10: Concession route Bogota Belencito

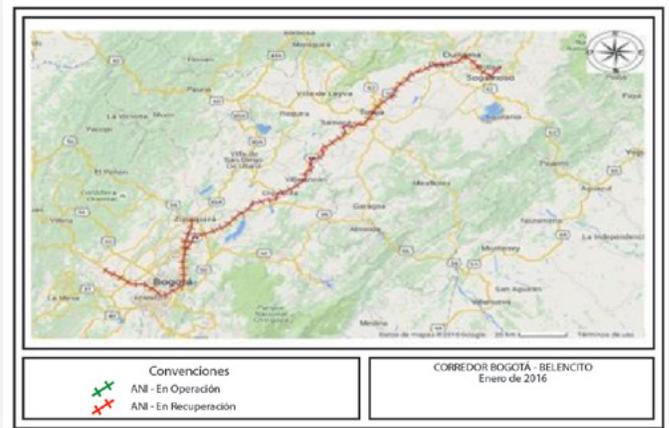
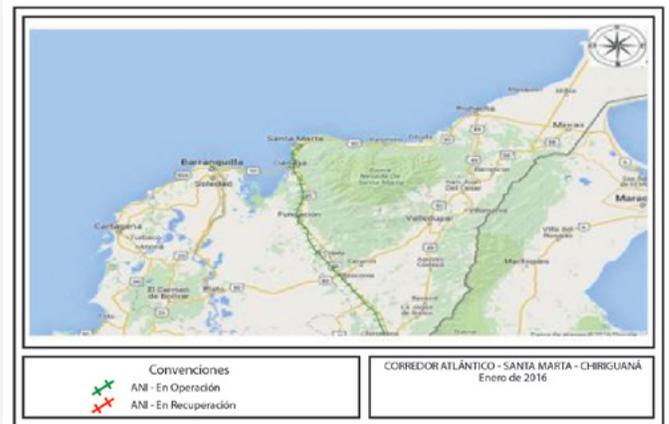


Figure 11: Concession route Ferreo Buenaventura La Tebaida

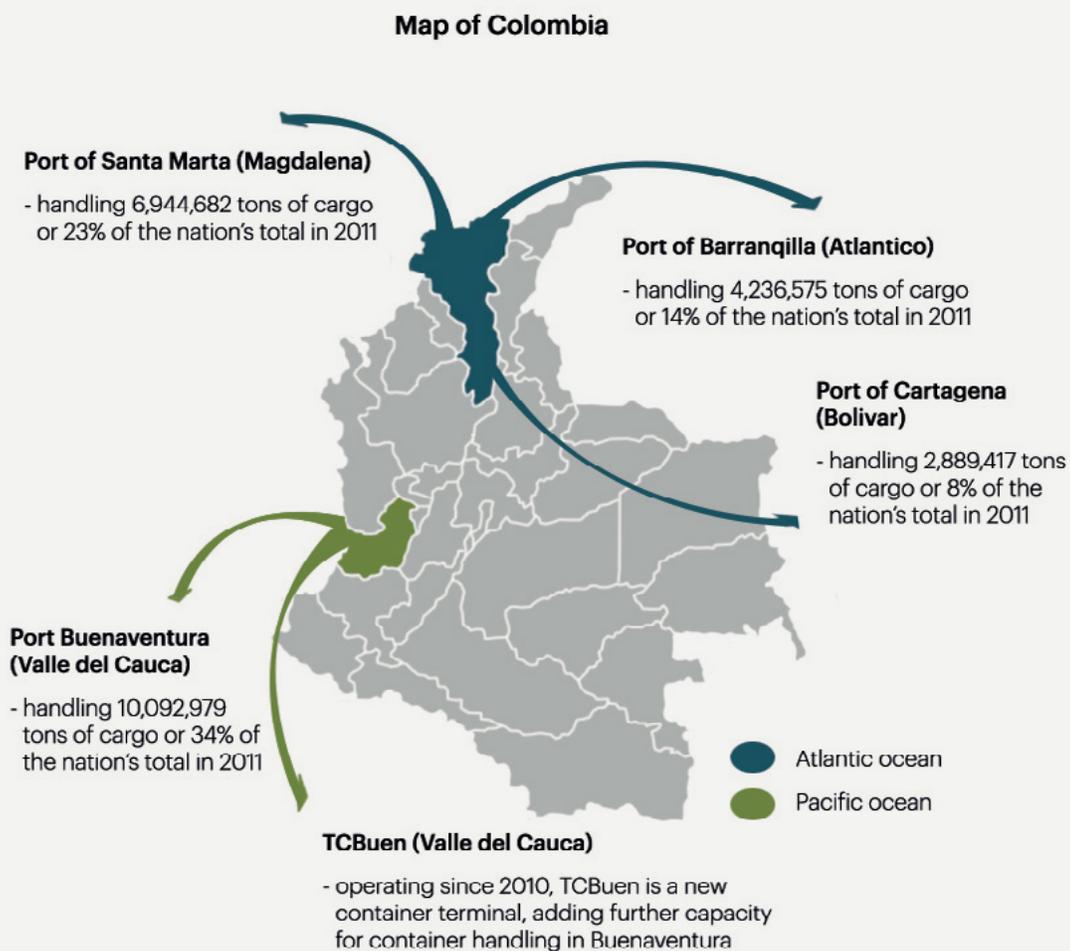


Figure 12: Concession route Corredor Atlantico



Appendix A5: Map of Colombia's seaports

Figure 13: Main ports in Colombia and characteristics



Source: PROEXPORT Colombia

Figure 14: Key Colombia ports



Appendix A6: Map of key Colombian cities

Figure 15: Important cities in Colombia



Appendix A7: Physical features of Colombia

Figure 16: Topographical map of Colombia

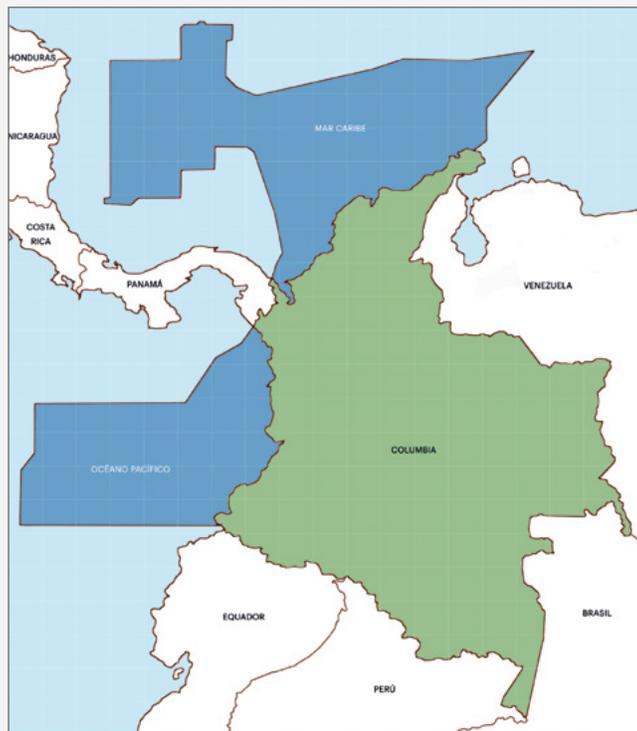
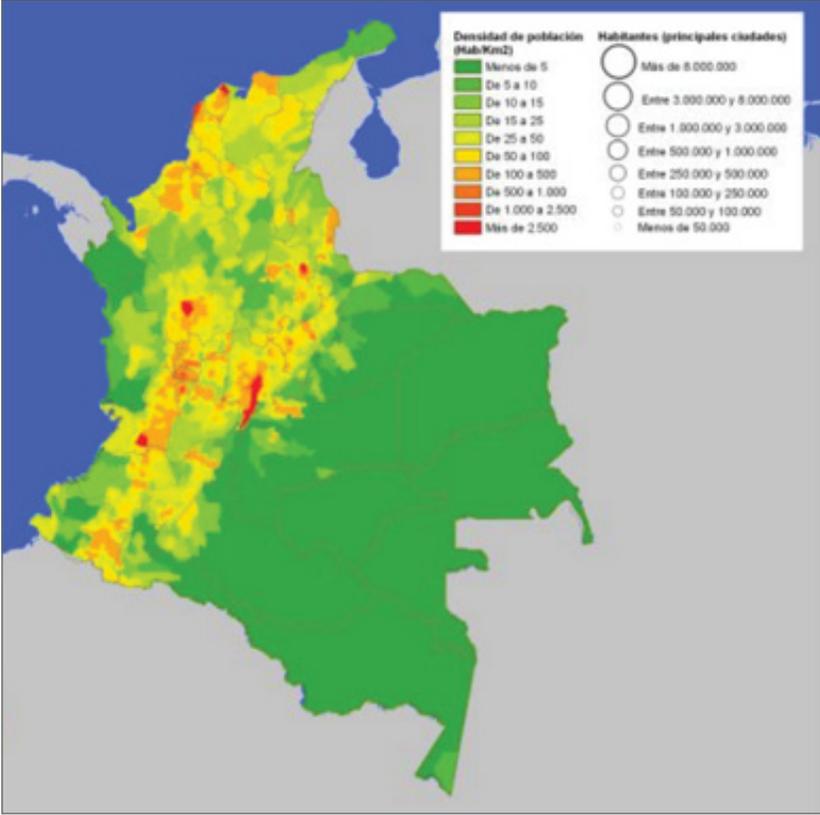


Figure 17: Active volcanoes of Colombia



Appendix A8: Population density

Figure 18: Population density of Colombia

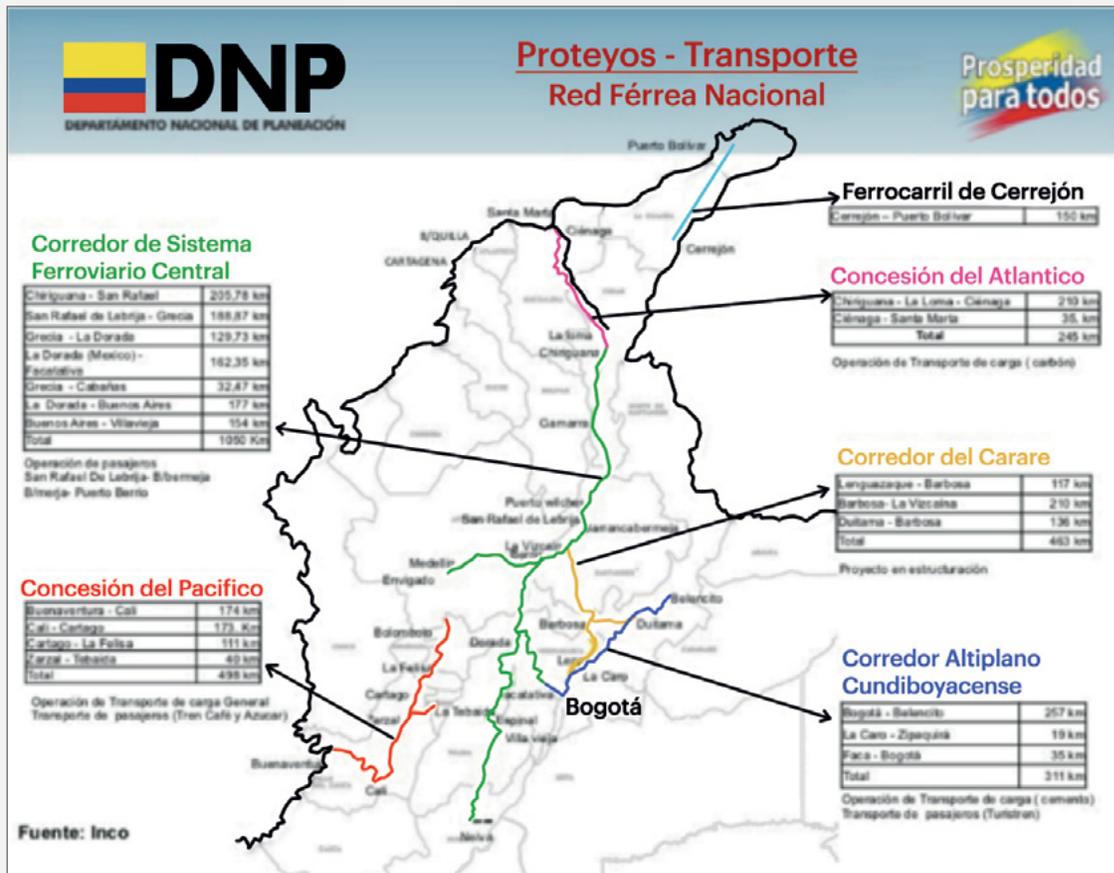


Appendix A9: Road and rail networks

Figure 19: Colombia road network



Figure 20: Colombia rail network



Appendix A10: Map of Magdalena River

Figure 21: Magdalena River



Egypt



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Introduction

Egypt is one of the oldest civilizations in the world, taking root in the tenth millennium BC. Since then the country has grown to be a regional power with the 15th largest population and the largest in North Africa and the Arab World.

The country has an area slightly greater than one million km² but a large portion of that is the uninhabitable Sahara desert, resulting in low population density and primary population centers located along the Nile River. Surprisingly, despite this geographic centralization, less than half of the population lives in urban areas.

The nation has one of the most diversified economies in the world. Only manufacturing (except petroleum), wholesale and retail trade, agriculture, forestry and fishing account for greater than 10% GDP. Even then, none of these sectors averaged greater than 13% over the last five years. The diversity enables the country to withstand fluctuation in oil and energy prices better than its African/Middle East counterparts. This is important because, as seen in Appendix A1, activities related to the extraction and refinement of petroleum and natural gas account for more than 18% of GDP.

Figure 1: GDP by sector at factor cost
Source: Ministry of Finance

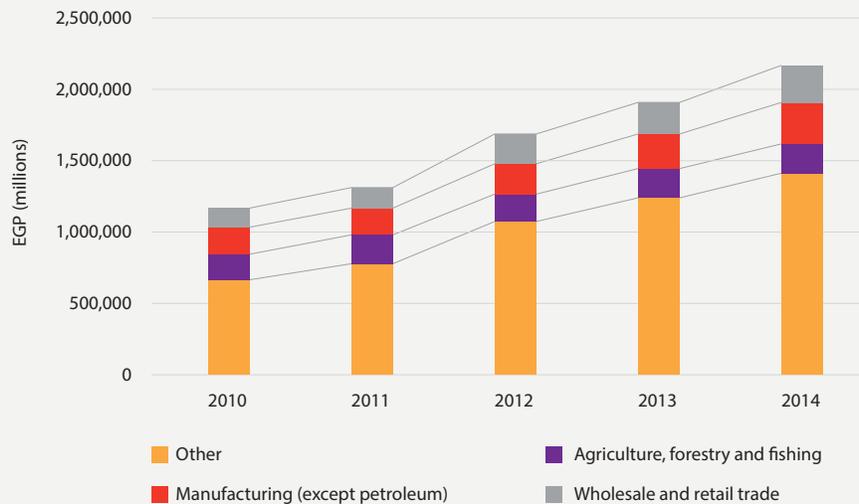


Table 1: Economic development indicators for Egypt
Source: World Bank

	2010	2011	2012	2013	2014
GDP at market prices (current US\$ millions)	218,888	236,002	262,824	271,973	286,538
GDP per capita (current US\$)	2,668	2,817	3,068	3,104	3,199
Inflation, GDP deflator (annual %)	10.12	11.60	12.44	8.99	11.48
Labor force, total	27,137,347	27,815,836	28,437,255	28,973,542	29,596,846
Population, total	82,040,994	83,787,634	85,660,902	87,613,909	89,579,670
Population density (people per sq. km of land area)	82.42	84.17	86.05	88.01	89.99
Population in urban agglomerations of more than 1 million	21,231,585	21,687,163	22,152,524	22,627,879	23,113,442
Unemployment, total (% of total labor force)	9.00	12.00	12.70	13.20	13.20
Urban population (% of total)	43.02	43.00	43.00	43.03	43.07

PEST analysis

Political

- After two uprisings in January 2011 and in June 2013, Abdel-Fattah el Sissi was sworn in as the president of Egypt in June 2014.
- In early 2014, a referendum was performed for a new constitution that was approved.
- In late 2015, parliamentary elections were held and the elected parliament started its duties in 2016.
- Since the government was sworn in, it has been evident that its main policies are in support of the civil society. One of the main concerns of the government is to improve the confidence of foreign investors in Egypt.

Social

- A higher concern is given to education; however, the education system in Egypt continues to be classified as poor.
- Most of the Egyptian population is living in the area around the Nile River, which is estimated to be nearly 3.5% of the total area of Egypt.
- One of the main social problems in Egypt is the unemployment rate, which is nearly 12.7%.
- The poverty levels in Egypt comprise nearly 22% of the population.
- Sixty-five percent of the population falls into the age group of 20 to 45 years.
- The health care sector needs some enhancement as it lacks quality and is insufficient for the growing population.

Economic

- The Egyptian economy is improving through corrective actions currently applied by the government.
- The Egyptian credit rating is improving: S&P B- with a positive outlook, Moody's B3 with a stable outlook, and Fitch B with a stable outlook.
- International financial institutions are actively re-engaging to support the economy.
- Rapid rise of inflation (6.91% in 2013 to 11% in 2015) proves to be problematic especially with the inadequate growth in GDP (3% in 2015).
- High involvement and support from government for infrastructure projects.

Technology

- New technological zones are being constructed by the government for IT-related companies.
- The government is moving into electronic services for people, which are available for them through the e-government port; however, there hasn't been much advancement in electronic services in transportation.
- There is a continuous increase in the rate of purchase of computer hardware in Egypt.
- While large-scale companies started implementing new technologies within their system, medium and small-size enterprises started realizing the benefits from such application and implementing them.

Status of transportation

Railways

Egypt's rail network follows the Mediterranean coastline and the Nile River, with some branches to the east and west of the country. The 9,570 km network^[1] uses standard gauge (1,435 mm). Two smaller routes use narrow gauge (610 mm) for sugarcane transport. It is run by the Egyptian National Railways (ENR), a state-owned enterprise. ENR is the largest transport service in Egypt and is considered integral to the country's economy.^[1]

Egypt's rail infrastructure is an underdeveloped, aging system in need of improvement and investment. Even though Egypt has achieved an infrastructure status that corresponds to what could be expected given the country's GDP,

the current network suffers from the decline of investment in the last 15 years.^[2]

Egypt has one metro system that serves Cairo and its metropolitan area. It is one of the busiest systems in the world, with 3.6 million passengers per day.^[3] It is a reliable, well-maintained and clean system with three current lines and three more to come. Construction of Phase 1 of Line 4 is scheduled to start in fiscal year 2016, while other improvements will begin for Line 3. These improvements are being financed by Japanese and European funds.^[4]

Challenges

- Bureaucracy is a major issue for foreign companies. Delays are frequent in legal and property transactions.^[5]

Figure 2: Egypt's rail network
Source: Sharemap



- Conflicts within the country and in the region might drive away investors.
 - There are other priorities in the country that might delay big projects, such as housing needs.
- Opportunities**
- The system needs to improve significantly in terms of safety. Egypt has an average of 12 rail crashes per month.
 - Up to 85% of the rolling stock has passed the replacement date.^[5]
 - The government is starting to hold conferences to discuss the future of rail and metro for Egypt.^[6]
 - Alexandria–Aswan High Speed Rail Project is under preparation and in the investment phase.^[6]
 - Future developments of Metro Cairo for Lines 5 and 6 are still in planning.
 - Projects for increasing the freight capacity within the country are being undertaken. The government wants to raise the share of rail freight operations from 1% to 10% to alleviate problems in the road network.^[6]
 - Egypt is looking for local and international investors either by direct contract tendering or by private-public partnerships.^[6]
 - The number of expected users for the Cairo Metro is projected to be five million in 2020; thus the need for expansion.^[7]



Roads and highways

The total length of the road network in Egypt, measured in 2010, was 137,430 km, of which 1,034 km were expressways. Two routes, under construction, from the Trans-African Highway network, a transcontinental highway development scheme to improve trade and alleviate poverty, pass through Egypt, and originate in Cairo. The geographical location of Egypt enables it to connect with Asia through multiple highway links. One of the main motorway links in the country is through the Cairo-Alexandria Desert Road (215 km in length).

Other important connections include the International Coastal Road from Alexandria to Port Said (280 km), Geish Road, Ring Road (inner Cairo) and Regional Ring Road (outer regions of Cairo connected).

The construction, operation and maintenance of the national road network is the responsibility of the General Authority for Roads, Bridges and Land Transport (GARBLT), affiliated with the Ministry of Transport. The road network is affected by interference from multiple local ministries responsible for secondary and other internal roads.^[42]

Figure 3: Egypt's rail network
Source: Sharemap



Opportunities

- Major widening operations are in place to reduce traffic congestion between Alexandria and Cairo. Other routes are also to be upgraded.
- Ninety-four percent of freight transport is by road, and therefore trade is highly dependent on road maintenance. Egypt supports freight transport with 92% of the roads being paved.
- Connections are only along the Nile and become sparse towards the south; thus, road facilities here need to be expanded
- High road fatalities are a concern (in 2012, 12000 people lost their lives to road accidents here), and the MOT is encouraging use of international standards for any future development.
- MOT has allocated EGP\$8 billion to develop 365 km of current road network and convert 450 km of one-way roads to two-way traffic.

Challenges

- The transfer to GARBLT of the higher share of responsibility to expand and maintain roads has put financial pressure on the authority. There are only a few small private road contractors, incapable of financially undertaking large contracts.
- Because of interference from multiple ministries in the sector, and with most of the contracts being awarded to state-owned companies, there has been less participation from private contractors.

Seaports

Egypt's geographic location influences its role in the maritime transport industry. Egypt is situated on both the Mediterranean and Red Seas, which are linked by the Suez Canal. The Suez Canal remains the main trade route between Asia and Europe, and accounts for 7.5% of the world's sea trade.^[27] Thus it appears to be a significant asset for Egypt as well as a huge liability. Since the canal is one of the most strategic points due to narrow sea passages where the world's oil flows, when a disruption occurs, several significant delays occur too. The Suez Canal faces a huge threat of maritime terrorism because of its strategic position.^{[27]–[29]}

The regional port and shipping market is involved in securing more regional and global trade. Egypt's government has demonstrated its impact on international trade by, for example, developing maritime industry infrastructure by building ports and providing them with state-of-the-art technologies and smart equipment to handle cargoes and passengers.

Egypt has 40 sea ports, including commercial ports, mining ports and fishing ports, as well as marinas and other oil shipping ports. The most significant ports are Alexandria Port, the biggest port in Egypt, and Dekheila Port, which is a natural extension of Alexandria Port.^[28] Damietta Port has the largest container terminal and the

most sophisticated equipment in the Middle East. The river’s transport network through the Nile Delta fosters the transport of goods, commodities and people.^[29]

Opportunities

- Egypt and Waterways Summit (two successful editions): New Suez Canal project as well as the Suez Canal area development plan called “SCZone.” Furthermore, the enhancement of ports in Egypt and transport infrastructure would help develop a world-class transshipment as well as a high-value services hub.^[29]
- MENA, infrastructure fund manager and equity investor in the Middle East, stated that it divested its 30% stake in Alexandria International Container Terminals to Hutchison Port Holdings in Hong Kong.

Challenges

- Few private investments triggered by an unstable political and economic situation (Arab Spring, oil crisis).

Airports

Egypt’s airport development plans are driven by long-term tourism opportunities. The international market is served by numerous European and Middle Eastern carriers. About a dozen local airlines compete in the domestic market. There are several improvements to the air infrastructure thanks to better handling capacity and new technologies. Large investments—billions of dollars—are forecasted for the development of the new Airport City.^[30]

Furthermore, EgyptAir is enhancing fleet and flight routes. Egypt is said to maintain its

Table 2: Statistics for main Egypt seaports

Port	Max. capacity	Achieved capacity during 2012	Total no of berths	Passengers traffic
Total (Km2)	Cargo (million tons)	Containers (million TEUs)	Containers (million TEUs)	Passengers (million)
Alexandria	1.6	36.8	20.9	0.6
El Dekheila	3.5	22.1	24.3	0.8
Damietta	8.5	19.75	23.9	0.7
Port Said	1.3	12.78	5.03	0.5
El Arish	0.05	1.2	0.9	0

position as the leading aviation hub in North Africa. Egypt has approximately 75 airports with paved runways. The main international airports are located in Alexandria, Cairo, Sharm El Sheikh, Hurghada and Luxor.^[31]

Cairo International: Egypt's largest airport and the second busiest airport in Africa, with more than 70 airlines using it annually. The airport has three terminals and a new cargo terminal.^[32]

Sharm el Sheikh International: The third-busiest airport in Egypt. In 2008, the Egyptian Airports Holding Company launched plans to build a third new terminal at the airport, which will double its capacity from 10 to 18 million passengers per year. Completion was first scheduled for 2015 but has been delayed by financing and political issues.^[33]

Hurghada International: This airport is located 5 km southwest of El Dahar. It is the second-busiest airport in Egypt after Cairo International, due to the numerous European flights. In 2014, the construction of the new terminal complex at a cost of US\$335 million had been mainly financed by the Arab Fund for Economic Development.^[34]

Opportunities

- A new rehabilitation and expansion project of Cairo International Airport is under construction in order to increase the capacity of number of passengers from 3.5 million per year to 7.5 million per year.^[41] ^[39]
- Order an IT modernization program at five of the largest airports across Egypt. EAC is using a combination of SITA airport technologies to improve the passenger experience and increase efficiency across all these airports.^[36] ^[35]
- Line 3 of the Metro in the Egyptian capital is designed to directly link Cairo International Airport to the city. The expected completion and operation is scheduled for 2019. Other projects are being constructed inside the airport, such as a five-star palace, a car park and Cairo Cargo City. In addition, a three square km family park, "Aerocity," is to be built inside the airport at approximately US\$185 million.^[36] ^[39] ^[41]

Challenges

- Few private investments triggered by an unstable political and economic situation (Arab Spring, oil crisis).
- Terrorism attacks.

SWOT analysis

Strengths

- Egypt's strategic location at the heart of the world's maritime trade routes enhances local and transit foreign trade.
- Egypt continues to have lower costs of construction compared to neighboring countries.
- Egypt holds control of the Suez Canal, which is considered to be the shortest link between the east and the west due to its unique geographic location.

Weaknesses

- Lack of development and advanced technology in Egyptian seaports and terminals
- Seaport congestion causes long wait times before entering port, especially during busy periods.
- Volatility in construction materials prices and decrease in the value of Egyptian pound.
- High numbers of accidents and fatalities due to transportation such as roads and rails.
- Current infrastructure insufficient for future development.

Opportunities

- Huge potential in infrastructure projects (Cairo Airport expansion – Cairo metro line expansion).
- Egypt is looking for local and international investors either by direct contract tendering or by private-public partnerships.
- Gulf countries are beginning to transform their support into direct investments in Egypt
- Increased confidence in the market supports the initiation of projects which were previously put on hold.

Threats

- Foreign embassies continue to warn their citizens against national security in Egypt.
- Bureaucracy is a major issue for foreign companies. Delays are frequent in legal and property transactions.
- The system needs to improve significantly in terms of safety. Egypt has an average of 12 rail crashes per month, and an average of 1,000 deaths due to road accidents per month.
- Decreased concern about technical education.
- Continued devaluation in the Egyptian pound rate affects the reliability on cost estimation for medium or short-term projects.

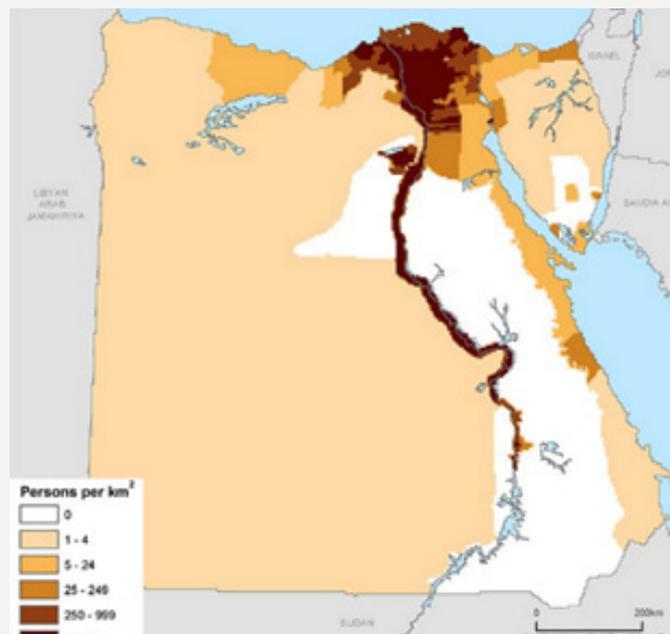
Geographical analysis

Egypt is located in the northeast of the African continent, with a small percentage of the country in Asia. Egypt shares borders with Libya to the west, Sudan to the south, Israel, the Gaza Strip, the Red Sea, Gulf of Aqaba and the Gulf of Suez to the east and the Mediterranean Sea to the north. Egypt has four natural regions: the Nile valley and delta; the western desert (part of the Sahara Desert west of the Nile River); the eastern desert (part of the Sahara Desert east of the Nile and bordered by the Red Sea) and the Sinai Peninsula, a mountainous region. The Suez Gulf and consequently the Suez Canal are economically important to the region and the world, allowing vessels to travel between South Asia and Europe without navigating around Africa. The canal also separates Africa from Asia.

Population density

Egypt has approximately 89.58 million people; the majority of the population resides near the Nile River, the Nile Delta or the Suez Canal. Other minor communities are spread in other parts of the country, mainly next to oases or transportation routes. Forty-three percent of the population is considered urban, with 2.3% growth in the last two years. Since 2007, the urban population growth has been increasing from 1.7%.^[8] Currently there are four metropolitan areas with more than one million people: Greater Cairo—by far the largest—with 19.4 million people,^[9] followed by Alexandria; Port Said and Suez.

Figure 8: Population density map 2010 census
Source: SEDAC



Infrastructure

Infrastructure in Egypt is influenced by the economic centers of the country and its people.

The road network is part of the Trans-African Highway Network and Arab Mashreq International Road Network. The latter includes countries in the Gulf Cooperation Council (GCC), Syria, Iraq, Jordan, Palestine, Lebanon, Yemen and Egypt (see Appendix A2). The Trans-African Highway links Egypt to Libya to the west and Sudan to the south (see Appendix A3). Major and local roads connect cities across Egypt.

The rail network follows the Nile River and the Mediterranean coastline. There are no connections to neighboring countries, even

though there are plans for a North African line that includes Tunisia, Libya and Egypt.

Egypt's largest ports are located in the Mediterranean Sea; Alexandria Port is the primary port. There are two ports in the Suez Canal, one at each end.

Airports are located near the Nile River and coastlines of the Mediterranean Sea and Red Sea. There are also two international airports in the Sinai Peninsula. Egypt has a strategic advantage due to its location in the world, and thus Cairo International Airport—the largest—is continuously under expansion.



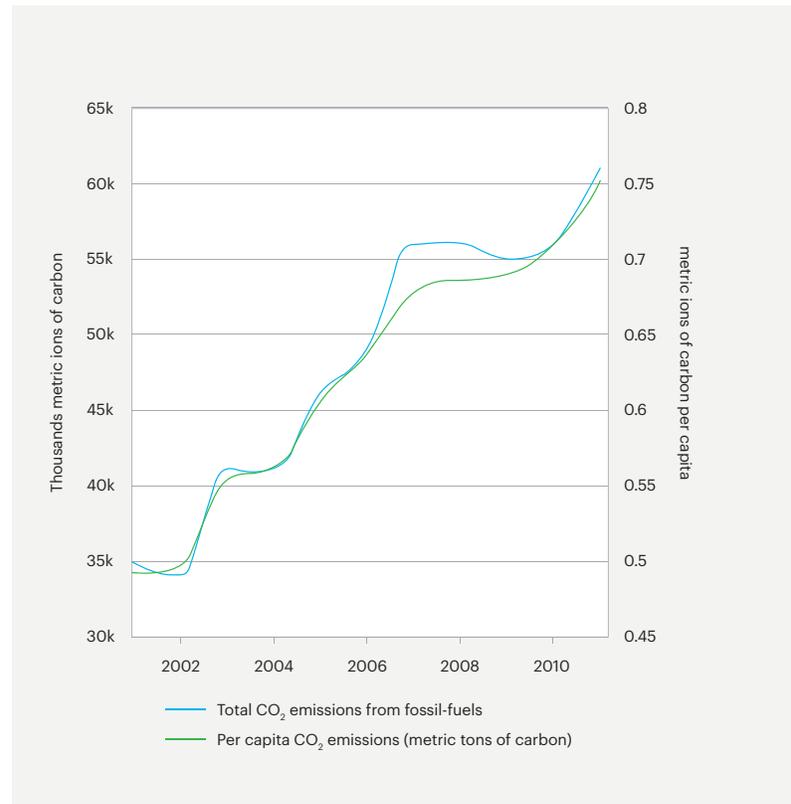
Sustainability

Egypt's population is not geographically dispersed. Much of its population is concentrated in cities near the Nile; there is a proportionate concentration of all services and facilities needing sustainable and innovative solutions.

Egypt's energy consumption has increased at a rate of 4.6%, primarily because of rapid urbanization and growth in demand for transport services.^[11] Fuel subsidies reached US\$20 billion in 2011, estimated at 20% of Egypt's state budget and 10% of its GDP, which aggravate problems in Egypt's energy sector. Reduction of such fuel subsidies in Egypt is a sensitive issue that has proven difficult to fully implement. Challenges must be addressed, such as increasing domestic energy demands, decreasing domestic production of fossil fuels, high prices of imported fuels, traffic congestion, and understanding of the relationship between fossil fuels and local or global environment. Thus, the government has been firm on its statement on withdrawing fuel subsidies, and has identified transport pilot plans as important alternatives to mitigate the impact of reduced fuel subsidies, as well as improving urban mobility and environmental quality.^[12] In 2010, the government of Egypt, in coordination with the UN, initiated and financed a project as an effort to reduce energy consumption increase, while ameliorating air quality and managing congestion. Public-private partnerships were promoted in an effort to encourage development of sustainable transport in greater Cairo. This sustainable transport project implements traffic congestion techniques to increase efficiency of transport.

Figure 9: Fuel CO₂ emissions by nation

Source: KNOEMA 2015



Project pipeline

Egypt plans to come up with large-scale, ambitious projects in the transportation infrastructure sector after decades of under-investment in infrastructure, and hopes to make the country a key logistics hub. The OBG's Egypt 2014 report called the scale and scope of transportation "breathtaking," and added that even though only half of the targets were met, the total achievements would be the largest in Egypt's history.^[13] Some of the projects are mentioned in detail below:

The New Cairo Monorail and Line 4: The Cairo Metro is the first rapid transit system in Cairo, Egypt. The project is to build six lines. Lines 1, 2 and 3 are already constructed and the construction of Line 4 is in progress.^[14] It is divided into four phases, as per the sections of area to be included in the line. Phase 1 bidding process was delayed until May 2015 to enable Japanese International Cooperation Agency (JICA) to complete the feasibility study. For Line 4, the total cost of the project is estimated to be US\$3.6 billion, with JICA lending US\$1.2 billion, while the Egyptian government contributes the remaining US\$2.4 billion. The status of all the phases can be seen in Appendix A4. There is a new Cairo monorail line proposed to connect Line 3 and Line 4, parallel to Ring Road's eastern arc, running through New Cairo from north to south. The project is estimated to cost US\$750 million and set to be completed in 2020.^[15]

Suez Canal: The project involves construction of a new canal from 60 km to 95 km and also deepening and widening of the Great Bitter Lakes and Ballah bypasses, with a total length of 37 km. The total length of the project is 72 km. The project aims to maximize benefit from the present canal and its bypasses. In addition, the Suez Canal Area Development is the second complementary phase of the new Suez Canal Project.^[16] The tunnels are to be used for public transport as well as rail transportation. The economic commission in charge of the Suez Canal Development project aims to finalize project plans by July 2016.^[17] The cost of the project is estimated to be US\$29 billion, with predicted completion in 2017.^[16]

New capital of Egypt: In the Egypt Economic Development Conference 2015, the development of a new city, predicted to be the new administrative and financial capital of Egypt, was announced. The goal of the project is to relieve congestion in Cairo, one of the world's most crowded cities.^[18] The city plans to have 21 residential and 25 "dedicated" districts, with a new international airport at the site of the existing Wadi al Jandali Airport^[19].

East Port: This project involves the construction of a 9.5 km channel with a depth of 18.5 m and width of 250 m, which will allow the operations of large vessels. The East Port is located at the northern entrance of the Suez Canal, an important trade route for Europe, Asia and

Africa. The country also is planning to expand the container terminal, making it an important hub for shipping operators. The cost of the channel project at the East Port is estimated to be around US\$60 million.^[20]



Delivery methods

Egypt was one of the pioneers and first-known users of what is now known as the design-build method. This method of procurement was enforced in Egypt through the master builder concept, to build the famous Pyramids. But gradually this method became less popular^[25]. Major projects in Egypt, although procured through competitive bidding, are awarded to state-owned construction companies, with minimal involvement from the local private sector. This has significantly impacted the know-how and experience that these private contractors would otherwise have. Because of this, the traditional design-build method has become more popular once again. Design-build procurement is generally used in Egypt for internationally bid projects with skilled foreign companies involved. There is little participation and financial involvement by the local private firms. Construction management at risk and multi-prime contract delivery is very rarely observed.^[21]

Public-private partnerships are gradually becoming more common, such as for projects with the Alexandria and Dekheila ports on the Nile Delta, Cairo Bus Rapid Transit, Nile River Transport, etc., procured only recently under this mechanism.^[26] The Line Ministries, in cooperation with PPP Central Unit, implements project tendering and procurement under this mechanism. There are 21 active PPP projects, with many in the transportation sector.^[22]

Public procurement in Egypt is in accordance with The Egyptian Act 89/1998 (see Appendix A5),^[24] which does not place a lot of importance on technical aspects of a big/complicated project. Bid price is the most important criteria in financial evaluation, with financial resources and experience of a company often overlooked during such evaluation.^[23]

Conclusion

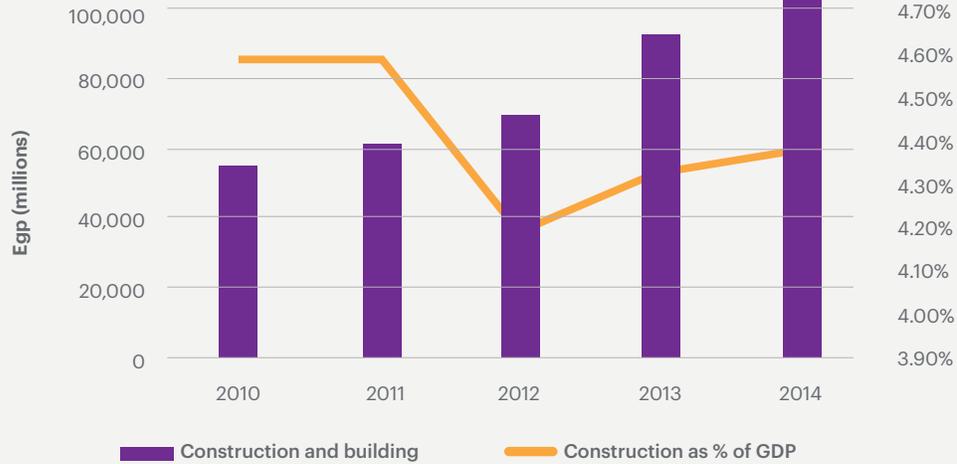
The horizon looks bright for Egypt's transportation infrastructure. Keynote projects such as the Cairo expansion project and Cairo Rapid Transit expansion will transform the transportation landscape of the nation's capital. Recent improvements in the country's credit ratings are attractive to foreign investors, and the government's strong support for privatization and PPP increases the attraction. Overly bureaucratic processes may invoke hesitancy from foreign investors, but this can be largely offset by inexpensive construction and labor costs. Of more concern to investors is the political instability the country has faced in recent years. After two uprisings in 2011 and 2013, the latest president has only been in place since June 2014.

Many of those factors should help Egypt make sweeping improvements in its transportation systems. The seaports face battles with congestion, and land-based travel is subject to elevated occurrences of accidents and fatalities. The biggest challenge the country may face is economic. GDP has consistently increased, but the GDP per capita is inadequate for a country of this size, and inflation is becoming increasingly worrisome. Adding to concern is falling global oil prices and the impact on the nation's economy. If the country can stabilize its currency, then it will be all the more attractive to foreign investment, despite how oil prices react in the future.

Appendix A1: GDP statistics

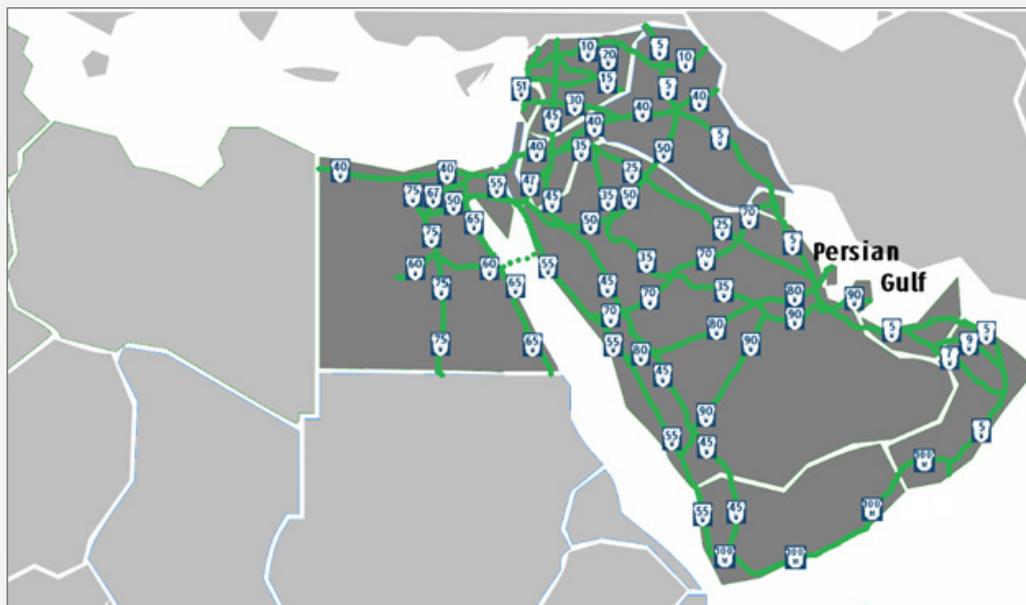
Table 3: Detailed GDP by sector in millions of EGP at factor cost.
Source: Ministry of Finance

	2010	2011	2012	2013	2014
Agriculture, forestry and fishing	160,970	190,159	188,785	209,748	241,493
Petroleum extraction	68,538	81,566	110,619	124,748	146,953
Natural gas extraction	92,538	108,206	145,040	159,339	175,371
Other extractive industry	4,671	5,364	22,575	24,987	28,336
Petroleum refinement	12,516	14,829	69,961	82,792	95,446
Manufacturing (except petroleum)	181,774	201,355	200,762	226,190	261,849
Electricity	14,897	16,832	27,109	30,173	33,974
Water	3,390	3,775	10,329	11,353	12,602
Construction and building	52,609	60,070	70,947	82,475	95,133
Transport and warehousing	47,400	53,351	69,629	78,358	91,130
Telecommunications	34,818	37,301	24,014	26,509	30,054
Suez Canal	25,803	29,311	31,203	32,396	37,236
Wholesale and retail trade	133,774	150,658	213,293	237,390	273,391
Financial intermediation	41,174	44,834	64,321	71,615	82,157
Insurance and social insurance	41,521	47,627	12,302	13,981	16,055
Tourism	40,028	41,755	45,675	53,827	35,165
Real estate	30,262	34,066	153,042	174,151	200,679
General government	114,944	133,688	150,924	174,234	213,144
Education	12,828	14,558	29,373	32,486	37,424
Health	14,797	16,595	36,842	40,875	46,451
Other services	21,339	24,005	18,352	20,687	23,777
Total	1,150,591	1,309,905	1,695,097	1,908,314	2,177,820



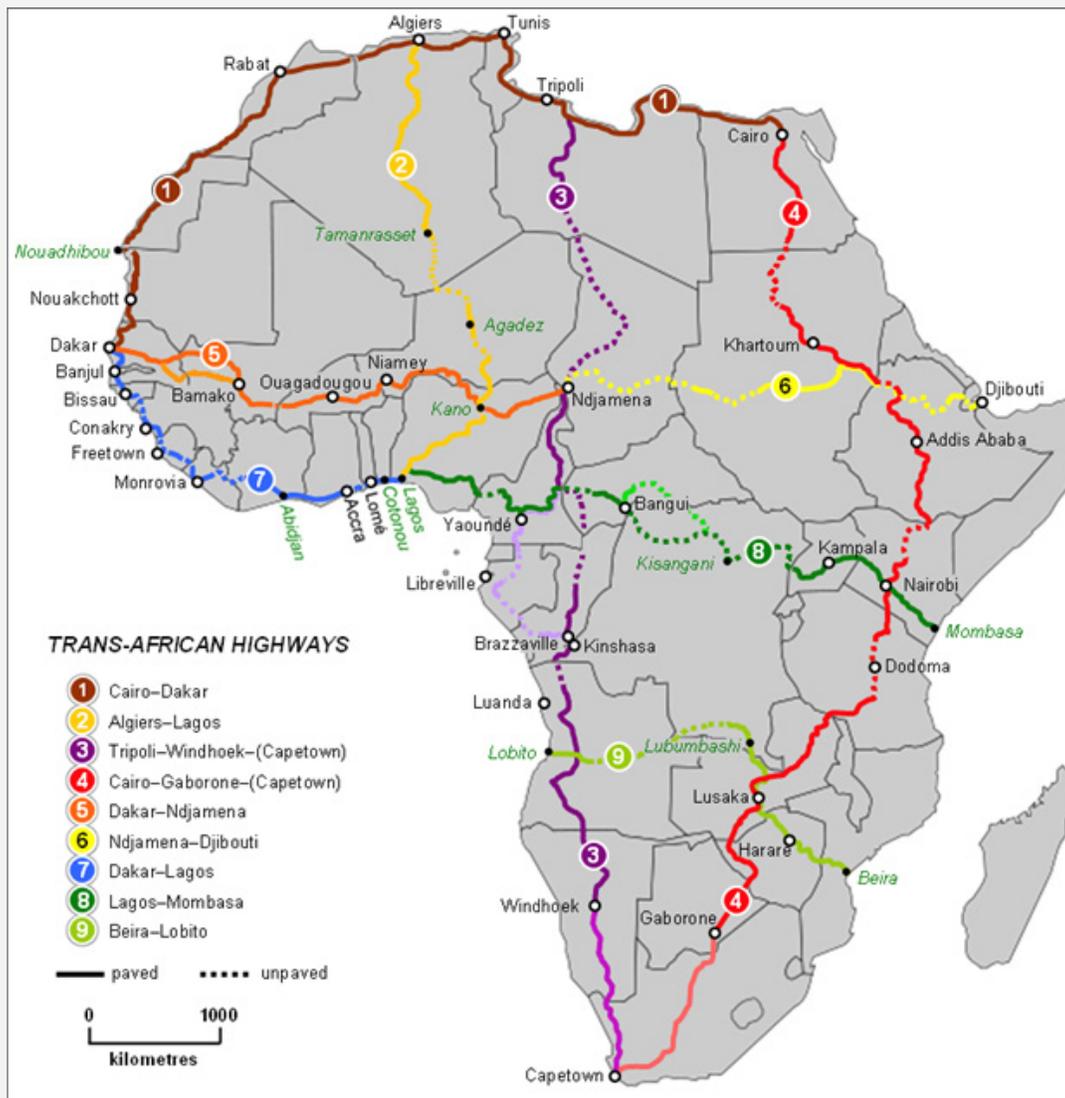
Appendix A2: Arab Mashreq International Road Network

Figure 7: Arab Mashreq International Road network
Source: Wikicommons



Appendix A3: Trans-African Highway Network

Figure 8: Trans-African Highway Network
Source: Wikicommons



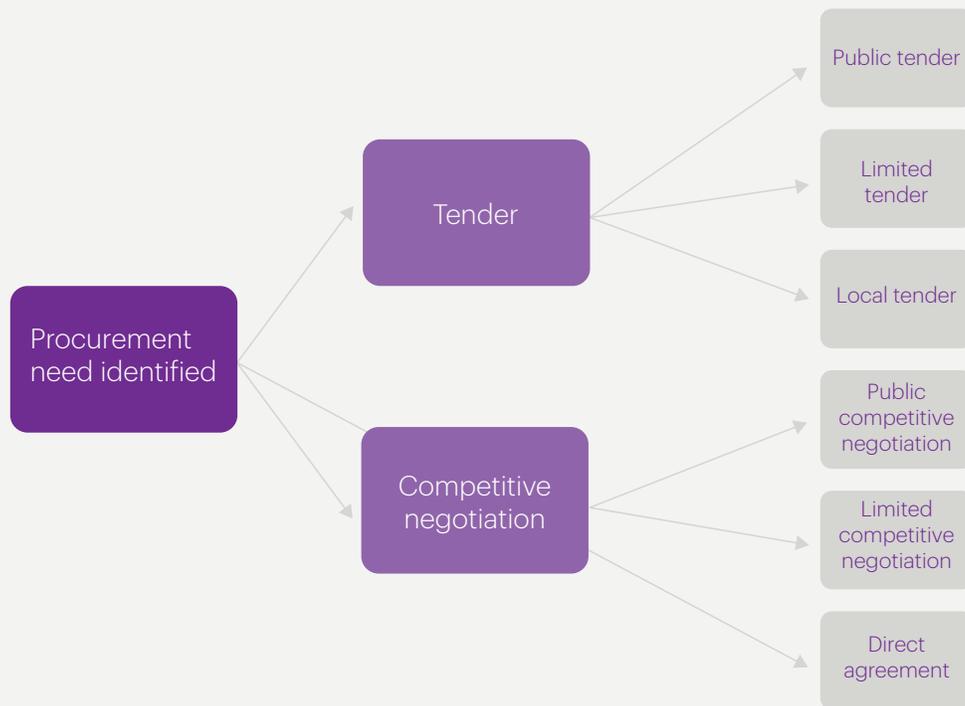
Appendix A4: Cairo Rapid Transit System Line 4 Phases

Table 4: Cairo Rapid Transit System Line 4 Phases
Source: WikiCommon

Phase	Start Date	Completion Date
Phase 1	2015-2016	-
Phase 2	2014	Oct 2018
Phase 3	2015	Oct 2019
Phase 4	2017	2020

Appendix A5: Procurement Law 89 of 1998

Figure 9: Procurement procedures authorized by Law 89 of 1998
Source: http://pdf.usaid.gov/pdf_docs/Pnacy313.pdf



India

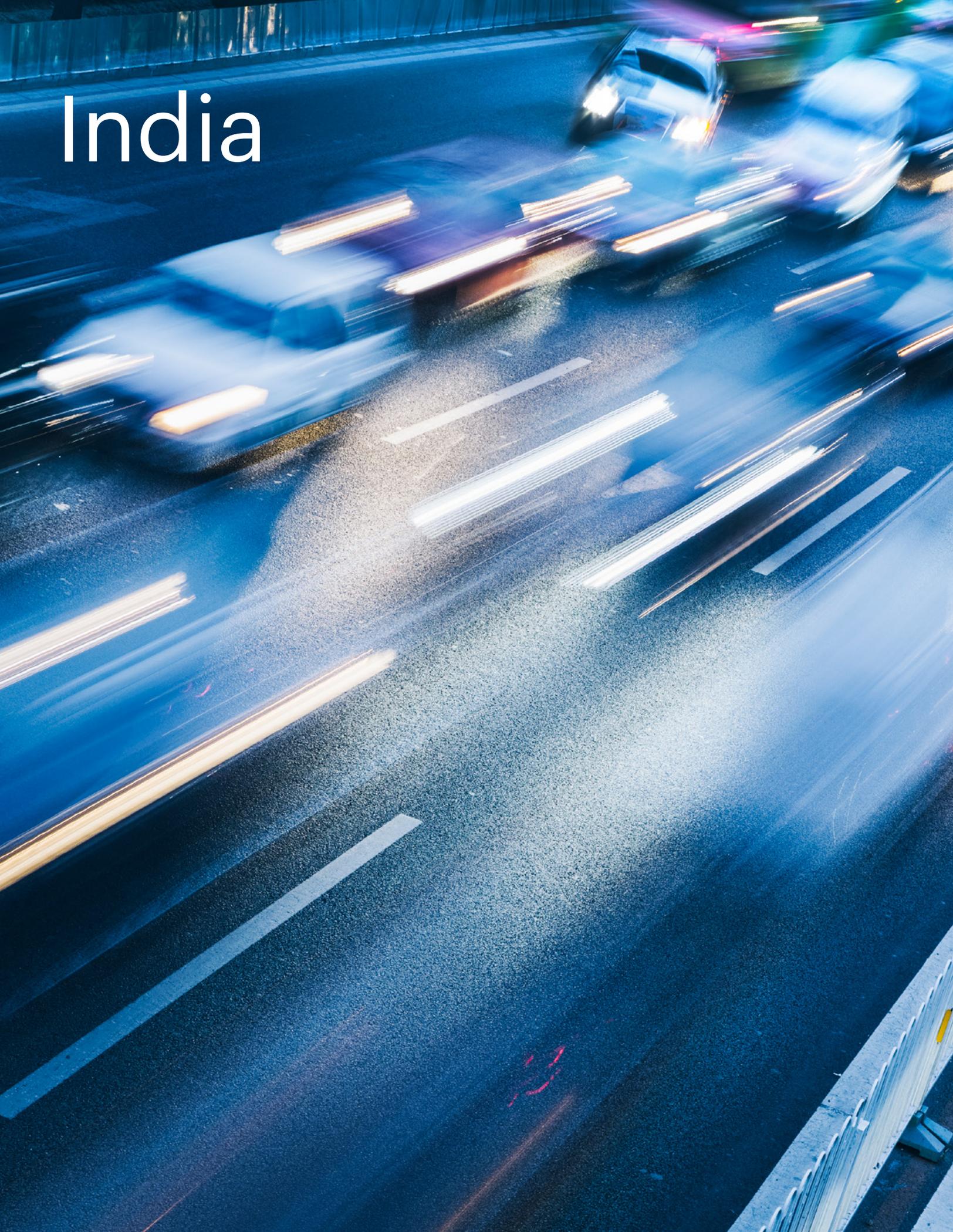


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Introduction

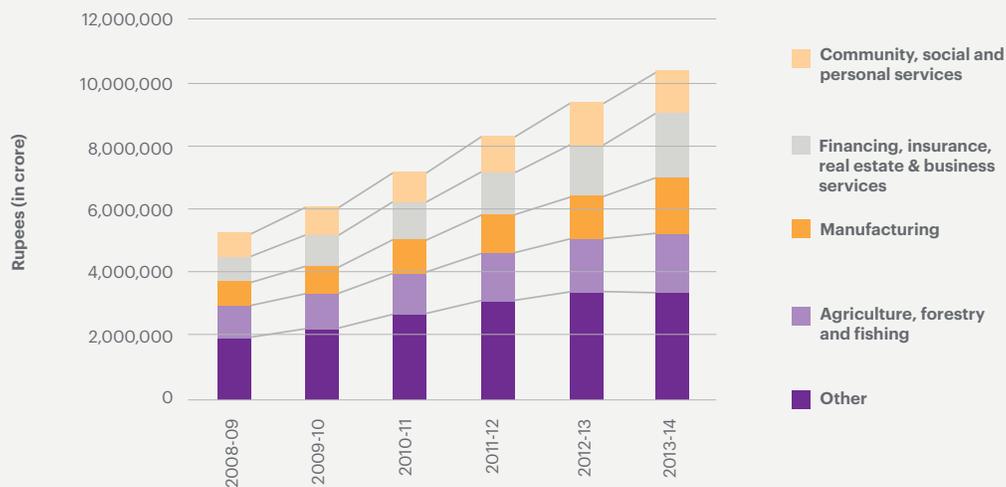
With over one billion residents, India is the second most populous country in the world and the seventh largest by land area. This results in a greater than average population density creating extreme roadway congestion, and a dire need for effective mass transit, especially considering four cities rank in the top 15 with respect to population density.

The country has the third-largest GDP in the world, behind only China and the United States. Services dominate the economy, accounting for roughly 30% over the last six years. Manufacturing, 17%, and agriculture, 19%, are also significant contributors to the GDP.

These transport-intensive industries demand an efficient and effective network for them to continue to prosper. Despite the country's rapidly growing economy, 10% in 2014, the GDP per capita is abysmally low for a country so developed, with nearly 180 million people living below the poverty line, indicating that the country is still developing.

As shown in Appendix A2, construction activity's contribution to GDP has fluctuated between 7.5% and 8.5% over the last five years, below its peak in the 2007-08 fiscal year. Inflation has exceeded 5% for four out of the last five years, which may temper private investment in

Figure 1: GDP by sector at factor cost. Source: Ministry of Finance



infrastructure, especially foreign. Making matters worse were the corruption and bureaucratic inefficiencies that plague development. India will need to invest in improving these processes in equal magnitude to their investment in infrastructure to realize true change.

Table 1: Economic development indicators for India
Source: World Bank

	2010	2011	2012	2013	2014
GDP at market prices (current US\$ millions)	1,708,459	1,835,814	1,831,782	1,861,802	2,048,517
GDP per capita (current US\$)	1,388	1,472	1,450	1,455	1,582
Inflation, GDP deflator (annual %)	8.98	6.40	7.63	6.25	3.04
Labor force, total	471,277,041	475,090,729	477,952,680	487,882,088	496,960,163
Population, total	1,230,984,504	1,247,446,011	1,263,589,639	1,279,498,874	1,295,291,543
Population density (people per sq. km of land area)	414.03	419.56	424.99	430.35	435.66
Population in urban agglomerations of more than 1 million	164,182,455	168,745,527	173,461,847	178,337,316	183,378,086
Unemployment, total (% of total labor force)	3.50	3.50	3.60	3.60	3.60
Urban population (% of total)	30.93	31.28	31.63	31.99	32.37

PEST analysis

Political

- India is one of the largest democracies in the world, and runs on a federal form of government.
- The taxation system is well-developed and several taxes, such as income tax, services tax and sales tax, are imposed by the Union Government.
- The government encourages free business through a variety of programs.
- Poor relations with its neighbors continues to be a dilemma, most notably with Pakistan. The unrest with Pakistan includes fighting over the rightful claim of Kashmir, which the US Central Intelligence Agency (CIA) recognizes as the world's largest and most militarized dispute over territory.

Social

- India has a population of more than 1.2 billion people (second-largest in the world) with about 70% between the ages of 15 and 65.
- In 2015, India ranked 130th out of 177 countries in human development. During the past decade, this ranking has declined while the economy has grown at record rates.
- India also ranks 142nd in the world for GDP expenditure on education by investing only 3.2% toward these programs (74% literacy rate).
- The difference in the wealth share held by India's poorest 10% and the richest 10% is enormous; India's richest 10% holds 370 times the share of wealth that its poorest holds.
- Due to unfavorable climatic conditions, it is common for work to be done in three shifts, which enhances the efficiency and output.

Economic

- Third-largest GDP in the world, after China and the US, with US \$2.049 trillion.
- The economy is dominated by services, which have accounted for roughly 30% over the last six years. Manufacturing, 17%, and agriculture, 19%, are also significant contributors to the GDP.
- Inflation has exceeded 5% four out of the last five years, which may temper private investment in infrastructure.
- Unemployment rate in India decreased to 4.90% in 2015 from 9.40% in 2010.
- India's export partners include UAE, US, and China. Their import partners include China, US, Saudi Arabia, UAE, Australia, Germany, and Singapore.

Technology

- Government IT spending in India reached \$6.488 billion in 2015, a 13% increase since 2012.
- The exploding mobile technology includes telecommuting, working from partner or client locations, from a plane or train through the use of wireless local-area network.
- Over three million technical and scientific professionals reside in India, with universities producing 50,000 computer science and 360,000 engineering graduates each year.
- Low but rapidly increasing Internet reach; 27% in 2015 compared to 7.5% in 2010.

Status of transportation

Railways

India's rail network is the fourth largest in the world, with 65,808 km total route length.^[1] Since India's independence from the United Kingdom in 1947, only 10,000 km of new routes have been added to the system up to 2009.^[2] The network covers every part of the country (as seen in Appendix A2) and is managed by the state-owned company, Indian Railways, under the Ministry of Railways. The railway provides passenger and freight services to the country and uses four different gauges: a 1,676 mm broad gauge for more than 90% of the route length; a 1,000 mm meter gauge; and two narrow gauges, 762 mm and 610 mm.

India's rail network plays a crucial role in the transportation of India's total freight and passenger traffic; it represents approximately 40% and 20%, respectively. Freight transport includes commodities such as coal, iron ore and other raw materials such as fertilizers, cement, steel products and food or grains.^[2] From 2004 to 2014, the number of passengers transported by rail more than doubled, to 1.16 million people carried.^[1]

India also holds an important metro-subway network in seven of their most important cities, and they are building or planning new metro systems in nine more cities, thus making urban rapid transit a priority to the country.

Challenges

- Excessive sanctioning of new projects annually beyond resources available to the country.
- Transport pricing policies are unsustainable for the maintenance of the network and need to be revised. The system is vastly subsidized.
- Modernizing the signaling, telecommunication and other rail infrastructure is important to improve safety and efficiency in the rail network.
- There are safety and security concerns for women in the rail system.
- The network has been affected by the lack of investment in the sector in proportion to its size.
- Major upgrades to the rail infrastructure need to be implemented before India could be eligible to handle high-speed trains,^[3] even though HSR is planned as dedicated corridors.
- There is an estimated need of US\$85 billion to complete ongoing projects.^[4]

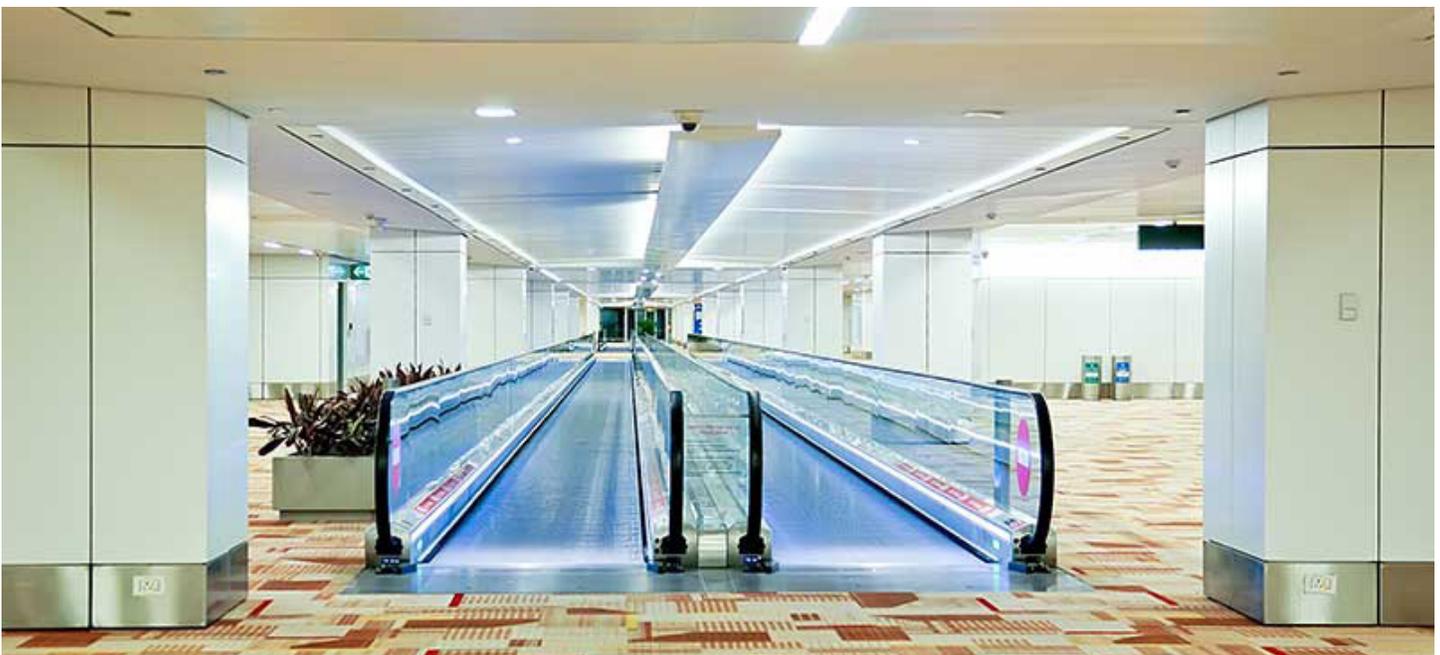
Opportunities

- India wants to standardize their track gauge with the Unigauge Project, which will convert almost the entire network to 1,676 mm broad gauge, with the exception of some narrow gauge routes.
- Both passenger and freight rail networks need to be expanded to keep pace with the economic growth.

- Little presence in the northeast states and the Himalayan region.
- The network needs extensive modernization, including speed and safety improvements, and modernization of rolling stocks, to meet the needs of the growing economy.
- Dedicated freight corridors are under construction, or in the planning stage, to increase freight capacity (US\$55 billion) (see Appendix A4 for DFC Map).
- Private investment is encouraged by the Twelfth Five-Year Plan.
- The World Bank is financing parts of the infrastructure improvements in India.^[5]
- The government is looking to create port connections to the rail freight system.
- Subway systems are being developed in major cities across India, representing an important boost for the trade.

Roads and highways

Roads are the dominant mode of transport in India currently, carrying 85% of passenger and 60% of freight traffic. The expansive road network (see Appendix A6)^[17] is the second-largest in the world, at 4.2 million km (as of 2010). The density of India’s highway network (0.66 km roads/km of land) is the same as that of the US (contributing 3.19% in India’s GDP, 2013-14). The number of vehicles using Indian roads is growing at a rate of 10.16% per year over the last five years.^[16]



The National Highways Authority of India (NHAI) was established under the National Highways Authority Act 1988 for development, maintenance and management of highways. Since then the government has been implementing the National Highways Development Program (NHDP), which consists of seven phases, prominent among them being the golden quadrilateral between Delhi, Mumbai, Chennai and Kolkata (the four major metro cities).^[10] This program entirely follows the PPP model with mainly BOT concessions and toll revenue surplus.^[36] Though the target for NHDP was 2012, 13,633 km of roads still needed to be awarded as of January 2016 (see Appendix A5).^[12]

Opportunities

- The freight sector dependence on roads is expected to increase until 2047, which will increase the demand for highway construction. Road connectivity from ports and rails to producers for transport of freight is expected to improve.^[15]
- NHAI/Government of India (GoI) provides capital grants of up to 40% of project cost to enhance viability (viability gap funding).^[8]
- The Bharat Nirman Program aims to provide every village with a population of more than 1,000 with all-weather road connectivity. Other similar programs are Prime Minister Gram Sadak Yojana's and Rural Road Scheme.^[7]

- One hundred percent foreign direct investment (FDI) is allowed under the automatic route in roads and highways sector, subject to applicable regulations. Moreover, the GoI will carry out all work to provide encumbrance-free right of way to concessionaires. A solid PPP model is beginning to be utilized in this sector with model concession agreements and BOT procurement in place.^{[6] [13]}
- The Roads Transport and Highways Minister has targeted a minimum 2% contribution to GDP by roads for 2017. This comes with widening and expansion plans for national highways to 150,000 km from 90,000 km.^[11]

Challenges

- With such a vast network, most of Indian roads are still unsurfaced (42.65%) and not suitable for use by vehicular traffic. As per one estimate, US\$30.2 million is lost in repairing vehicle damages from wear and tear due to poor road quality.^[14]
- Another major problem is mixing types of traffic: the same road, and sometimes even the same lane, can be used by high-speed cars, trucks, two-wheelers, cyclists and animals. This lack of discipline leads to congestion, and unsafe roads without speed limit regulations, cycle lanes or footpaths.^[14]

- The multiple check-posts and tollbooth collection points bring down the speed of traffic and cause irritation to travelers.^[14] ETC-based systems are absent in the majority of the highways; this technology was first implemented in 2013. There may be an opportunity here for foreign technology providers.^[9]
- India's rural areas, especially in the northern and northeastern states, have poor road access. Thirty-three percent of Indian villages have no access to all-weather roads and remain cut off during the monsoon season.^[11]
- Local contractors are accustomed to using bribery to influence official decisions, and cartel formation is common in competitive bidding. This approach may make it difficult for foreign companies to bid for mid-sized projects.

Seaports

According to the ministry of shipping, 95% of India's trade by volume and 70% by value takes place via maritime activities. The Indian ports and shipping industry play a crucial and fundamental role in maintaining and optimizing growth in India's trade and commerce.^[37]

Indian government has a federal structure; maritime transport must be managed by both the central and the state governments. While the central government's shipping handles the major ports, the minor and intermediate ports are managed by the relevant departments or ministries on the coastline. Both private and public operators share the control of the port

industry. Private port operators in India are currently enjoying larger market share over their competitors linked to the government.

There are currently 12 major and 187 non-major ports. The cargo traffic, equivalent to approximately 1,050 million metric tons (MMT) in 2015, is expected to reach 1,758 MMT by 2017.^[38] With 7,517 km of coastline, India is the sixteenth-largest maritime country in the world.^[39]

The handling capacity of major ports in India is sufficient to match trade demand. The capacity of all the major ports as of March 31, 2015, was 871.52 MMT, compared with 581.54 MMT in cargo traffic handled through 2014-15.^[40] Additionally, the government has taken several measures to improve operational efficiency through mechanization, deepening the draft and increasing the speed of evacuations.

According to the latest provisional data from Indian Ports Association, the publicly owned major ports in India reported healthier levels of growth in container throughput in 2014-15 than in the previous year. Container handling in 2015 expanded 6.7% year-over-year to eight million twenty-foot-equivalent units (TEUs) from 7.46 million TEUs through the same period in 2013-14. The data also showed that containerized cargo tonnage grew 4% to 119 million tons.^[41]

In 2014, cargo volumes at the major ports expanded 4.7% year-over-year to 581.3 MMT, while in 2015, coal cargo traffic grew 13.4% to 118.1 MMT from 104.2 MMT in 2014. Currently,

there are about 44 ongoing projects undertaken at major ports in India, with total investment of over Rs 25,870 crore (US\$3.88 billion).^[40]

Challenges

- Performance and productivity: Solutions exist to overcome the difficulties of productivity because regulations will create a positive competitive environment and will improve the Indian economy.
- Environmental policies: As an emerging country, environment regulations must be better implemented.

Opportunities

- The ministry of shipping has developed an action plan based on the Maritime Agenda 2011, which is aimed at developing the port and shipping traffic movement in India.^[42]
- The government has played a fundamental role by allowing foreign direct investment. The government has also initiated a 10-year tax holiday for companies that maintain and operate ports, inland waterways and inland ports.^[43]
- There is an ongoing large-scale civil engineering project to link the rivers in India by way of a developed network of reservoirs and canals, with a goal to reduce floods and water shortages as well as to improve the movement of merchandise within the country.^[44]

Airports

- Civil aviation is said to be the fastest growing sector of the transport infrastructure connectivity in India.^[45]
- Currently four PPP projects were achieved: Delhi, Mumbai, Bangalore and Hyderabad. Bangalore and Hyderabad were greenfield projects outside the city. Delhi and Mumbai airports both resulted from the development of existing airports.
- The main airports' players are AAI, GVK and GMR, which operate in the four main airports stated earlier. Additionally, some states initiated some small airports within the state.
- The growth of airlines is healthy because of a positive climate in India and is enhanced because of airport operators and allied service providers.^[45] New regulations allow them to expand their activities overseas if they operate nationally during five years and have sufficient airplane capacity.
- By 2020, Indian airports are estimated to handle 100 million passengers, 60% of whom would be national passengers.^[46]

Opportunities

- Modernization plan in order to modernize 35 non-metro airports.^[47]
- India faces issues common to developing countries, and needs funds for development of airport infrastructure. Conflicting budgetary priorities slow down the actual policies.^[45]

- Delhi and Mumbai airport development projects follow PPP ventures. Because of India's population growth, the operation and maintenance as well as the building and restructuring of new airports, are needed within the next 50 to 100 years, considering airport life span and durability.
- Air freight is currently increasing quickly; thus there is a need to build more cargo facilities in existing cities as well as improve and maintain the existing facilities.^[48]
- Some areas such as Northeastern India could represent a new potential market for the aviation industry.

Challenges

- There are no cities with two airports; the government has established a restriction.
- Regulation and user service charges: When these charges would be sufficient to finance the construction, operation and maintenance of the facilities at stake is an important question.
- For example, in 2004-2006, privatization triggered cost overruns.^[49]
- Traffic risk is more important for greenfield airports in cities with one or two maximum existing airports.
- Demand, supply and capacity data gathering remains a key challenge.^[50]

Table 3: Busiest airports in India, localization and passenger traffic

	Name	City	State	Passengers 2015
1	Indira Gandhi International Airport	Delhi	National Capital Region	35,294,957
2	Chhatrapati Shivaji International Airport	Mumbai	Maharashtra	30,765,406
3	Kempegowda International Airport	Bangalore	Karnataka	14,037,952
4	Chennai International Airport	Chennai	Tamil Nadu	11,127,458
5	Netaji Subhash Chandra Bose International Airport	Kolkata	West Bengal	9,208,884

SWOT analysis

Strengths

- India's government is keen to facilitate private sector participation in transportation infrastructure.
- Application of takeout financing increased in India, potentially unlocking around INR300 billion (US\$6.2 billion) in bank debts, which could be used to finance infrastructure developments.
- India's expansive road network is the second-largest in the world (4.2 million km).
- India has adopted e-tendering for all government contracts above INR 300,000, which has significantly improved transparency.

Opportunities

- India's strong population growth and a growing economy is fueling demand for infrastructure.
- Dedicated freight corridors are under construction to increase freight capacity and more are on the way (US\$55 billion).
- Twelfth Five-Year Investment plan targeting US\$1 trillion in investment, with 50% to come from the private sector.
- Roads Transport and Highways Minister has targeted a minimum 2% contribution to GDP by road improvement for 2017, including plans for widening and expansion of national highways to 150,000 km from 90,000 km.
- The government is looking to attract private companies to invest in infrastructure through PPPs.

Weaknesses

- Problems arising from PPP projects due to local level issues and site-specific issues
- Many of Indian roads are still unsurfaced (42.65%) and not suitable for use of vehicular traffic.
- The multiple check-posts and toll booth collection points bring down the speed of traffic and cause irritation to travelers.
- India's rural areas, especially in the northern and northeastern states, have poor road access. Thirty-three percent of Indian villages do not have access to all-weather roads and remain cut off during monsoon season.

Threats

- India may prove unable to cope with its burgeoning population, which has passed the one billion mark, posing a major threat to the economy and political situation.
- Destructive flooding affects productivity, especially in transportation projects.
- Obstacles such as red tape, lack of transparency and bureaucratic complexities will threaten implementation of the Twelfth Five-Year Plan.
- Land clearance issues cause major delays to infrastructure and construction projects.
- There are low levels of domestic expertise, stemming from a shortage of skilled project managers and engineers.

Geographical analysis

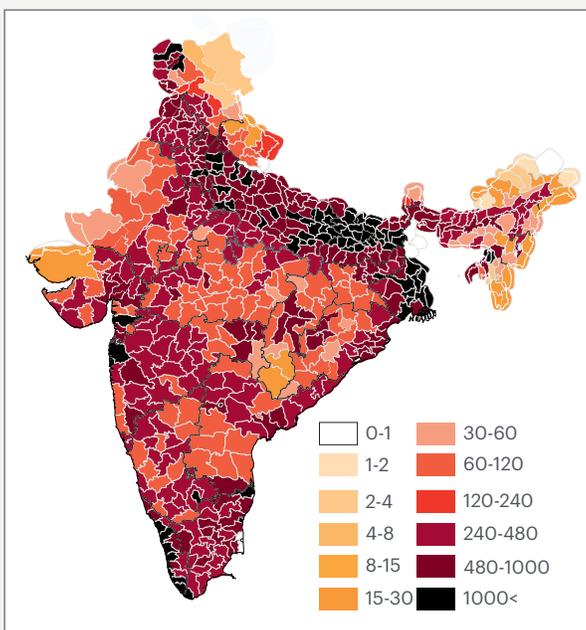
India is located in the south of Asia, which shares borders with Pakistan to the west; China, Nepal and Bhutan to the northeast; Bangladesh and Myanmar to the east; the Bay of Bengal to the southeast; the Indian Ocean to the south; and the Arabian Sea to the southwest. India can be divided into five geographical regions: the northern mountains, which include the Himalayas, the world's highest mountain range; the peninsular plateaus, raised flatlands located in west-central India; the Indo-Gangetic Plains, alluvial plains dominated by three rivers (the Ganges, the Indus and Brahmaputra); the Thar Desert, a large arid region in the northwest of

the country; and the coastal plains, located near the coast of the Arabian Sea or the Bay of Bengal. India also has important waterways, especially in the eastern area of the country (see Appendix A7). These rivers represent more than 14,500 km of inland navigable waterways that help to boost the economy.

Population density

India's population is approximately 1.3 billion, making it the second most populated country in the world. Approximately 32.4% of its population is considered urban, with 2.4% growth each year for the past five years. It is important to note that the urban population growth has been declining each year since 2002 from, 2.9% to 2.4%. The distribution of population in India is determined mainly by geography, climate conditions, and development of agriculture and industries.^[18] Coastal regions, with flat and fertile land, are heavily populated areas where industries have developed, which has increased population substantially. Mining centers and business centers also have high-density populations. Mountainous and desert regions are low density areas because of the difficulty of earning a living.

Figure 2: Population density in India. Source: Ucoz



Infrastructure

The road network is distinctive with north-south and east-west highways, and other important road connections that link important economic and business centers, as well as connections with neighboring countries.

The rail network is found throughout almost the entire country, connecting important cities and ports. It also includes connections to neighboring countries such as Pakistan, Nepal and Bangladesh, with other connections under construction or in the planning phase.

Ports are located all along the Indian coast. Kanda Port is the biggest and is within a special export processing zone. Other ports serve cities such as Mumbai and other economic centers of the coastline.

Airports are spread across the country; many of them are used to reach places where other methods of transportation would not reach. There are important regional and international airports; Delhi and Mumbai are by far the largest airports in the country.

Sustainability

As the country's population experiences rapid growth, India faces economic and environmental challenges in developing a sustainable infrastructure. While economic challenges are evident worldwide, India's steep environmental degradation has produced particularly strong impediments to the country's sustainable development strategies.

A diagnostic assessment of India's environmental challenges by the World Bank revealed that air pollution, water pollution, deforestation and natural disasters cost the economy US\$80 billion, almost 6% of the national economic activity. Of US\$80 billion, 52% is attributed solely to air pollution.

Table 4: Estimates of India's cost of environmental damage, 2009
Source: World Bank

	Low	Mid-point Estimate	High
Outdoor air pollution	170	1,100	2,080
Indoor air pollution	305	870	1,425
Crop land degradation	480	703	910
Water, supply, sanitation, and hygiene	475	540	610
Pasture degradation	210	405	600
Forest degradation	70	133	196
Total annual cost (Bn R / yr.)	1,710	3,751	5,821
Percent of Total GDP in 2009	2.60%	5.70%	8.80%

Several government initiatives such as the “Clean India” mission have been launched to conquer pollution. Generally, government initiatives are focusing on clean technology and energy efficiency while pursuing a low-carbon growth model:

From a federal budget allocation perspective, renewable energy is a high priority, with plans being developed to build mega solar power projects in each of Rajasthan, Gujarat, Tamil Nadu and Jammu and Kashmir with a fund of Rs. 500 crores.

India has been keen on addressing sustainable development, particularly for transport systems. For example, India adopted The National Urban Transport Policy (NUTP) in 2006 to introduce public transport using clean technology. Other sustainable development policies spanning different sectors are listed below:

- National Environmental Policy, 2006
- National Urban Housing and Habitat Policy, 2007
- National Action Plan on Climate Change, 2008
- National Disaster Management Policy, 2009
- National Rural Livelihood Mission, 2009



Project pipeline

The Indian government plans to invest US\$1 trillion in infrastructure between 2012 and 2017, due to the country's inadequate infrastructure and increasing demand for projects in the transportation sector.^[19]

The Delhi-Mumbai Industrial Corridor is a mega project worth US\$90 billion, covering 1,483 km between the political and financial capitals of India, Delhi and Mumbai. It is said to be the world's largest infrastructure project, with a high-tech industrial zone spread across six states—Delhi, Uttar Pradesh, Southern Haryana, Eastern Rajasthan, Eastern Gujarat, and Western Maharashtra (Appendix A8).^[20] It proposes 24 industrial regions, eight smart cities, two airports, five power projects, two mass rapid transit systems and two logistical hubs. India and Japan have together instituted a development fund for the project, initially US\$150 million. The project is underway and the corridor is expected to be completed in 2017.^[21]

The Sagar Island Deep Water Port Project involves development of a proposed new port at Sagar Island, which is an island in the Ganges Delta, lying in the Bay of Bengal about 100 km south of Kolkata.^[22] National Highway Infrastructure Development Corporation Limited is now in charge of preparing the Detailed Project Report (DPR) including identification

of the optimal way of crossing the river Muriganga, in the new Sagar Port. Included in the US\$1.9 billion project is the rail connectivity between Kashinagar station and Sagar Port. Eastern Railways will develop a feeder route to Eastern Dedicated Freight Corridor (DFC) from Kashinagar to Dankuni.^[23] The Sagar Port project, along with two other ports, VadHAVAN Port in Maharashtra and Colachel in Tamil Nadu, have been awarded to AECOM.^[24]

A much-needed project is the Mumbai Urban Transport Project, which aims to strengthen the physical infrastructure of rail and road transport in Mumbai, the financial capital of the country and also one of the most congested cities in the world. The total cost of the project is estimated to be US\$945 million, of which US\$542 million is being loaned by the World Bank. Development of Jogeshwari-Vikhroli Link Road and Santa Cruz-Chembur Link Road were completed under this project.^[25]

The major airport investment opportunities in India include two greenfield airports in Navi Mumbai and Goa Mopa and four brownfield projects—Chennai, Kolkata, Ahmedabad and Jaipur. The Navi Mumbai International Airport pre-development work started in March 2016 and flight operations are expected to begin in 2019. The projects comprise diverting Ulwe

River, flattening or cutting down hills and abandoned quarries, cleaning green patches, and ground leveling. A feasibility study for a metro network along the proposed coastal road is underway.^[26]

Mumbai Metro is a proposed rapid transit system to relieve congestion of the overly crowded Mumbai Suburban Railway network.

It will be executed in three phases across a 15-year period, with an overall completion date in 2021.^[27] There will be around seven lines; Line 1 is operational right now and Line 3 is under tender at the moment. The Colaba-Bandra-Seepz underground Metro line bids for civil works have been approved by Japanese International Cooperation Agency (JICA) to issue bids and commence the work.^[28]



Delivery methods

Although the traditional method of design bid build is most common in India, the GoI is constantly trying to utilize other means of delivery to close the financial gap between their targeted and their received investments from the private sector. Build-operate-transfer (BOT) became the new method of delivery to attract private investment. But the government realized that even this mode of delivery is not working well. Thus, just recently, there has been a shift towards two project delivery types—BOT annuity and EPC (engineering procurement construction).^[30] The BOT model is most common in road and railway projects.^[31] See Appendix A10 for an update on contracts awarded by NHAI under different procurement systems.^[35]

Under BOT annuity, the concessionaire is assured a minimum ROI in the form of annuity payments without any traffic risk. GoI bears the entire risk with respect to toll income. Under an EPC contract (generally lump sum turn-key contract) the engineering and construction contractor carries out detailed engineering

design, as well as procurement of materials and construction, to deliver a functioning facility to the owner.^[29] These are different from the once more commonly used item rate contracts by NHAI, where the government provided detailed designs and bill of quantities, which frequently lead to time and cost overruns.

To standardize the procurement system, the government uses a model concession agreement for PPP projects (most common for BOT projects in railways sector)^[33] and a model EPC agreement for EPC contracts. Here the contractor has freedom to plan the construction schedule and optimize the design, unlike the rigidity with which an item rate contract binds the contractor, with a single design to work with. The government is expected to rely heavily upon EPC contracts for future infrastructure project procurement (see Appendix A9).^[32] Refer to Appendix A11 for different types of PPP models in use by the Indian government.^[34]

Conclusion

India is one of the largest and most significant countries in the world. Its imposing population dictates the necessity for adequate infrastructure. Unfortunately, the country falls short in this regard. Although the road network is the second-longest in the world, nearly 50% remains unpaved, causing tens of millions of dollars in vehicular repairs. Large portions of the country lack access to all-weather roads and experience hardships when travelling during monsoon seasons. The rail network is desperate for expansion and modernization and lacks the proper investment for a system of its size. Adding to the infrastructure concerns, the ports have fallen behind in productivity compared to competitive nations.

The nation has begun to turn its attention to transportation systems, accepting the vital role they play in maintaining a country of this size. The Twelfth Five-Year Plan calls for US\$1 trillion in investment in infrastructure, in addition to the US\$85 billion estimated to be currently necessary to complete ongoing railway projects.

Electronic tolling was introduced in 2013 and presents a possible solution to achieving the 2% target of roads contribution to GDP set by the government. Dedicated freight rail corridors and the unigauge program will help the rail system meet current service-level demands. Massive projects such as the Mumbai Urban Transport Project, nearly US\$1 billion, will reshape metropolitan areas completely.

Despite the third-largest GDP, the country will still need to turn to private investment to achieve its ambitious plans. It expects the private sector to account for half of the total investments detailed in the Twelfth Five-Year Plan. To meet this goal, the country must enact legislation that clearly outlines and enables true participation between the private and public sectors.

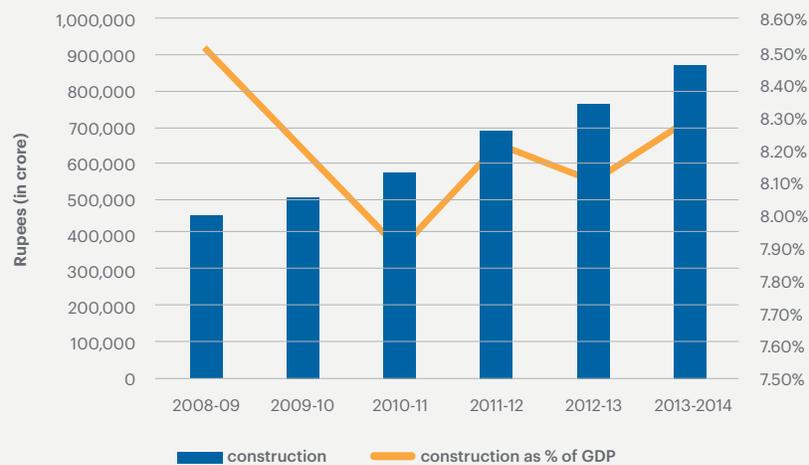
Appendix A1: GDP statistics

Table 5: Detailed GDP by sector in rupees in crore at current prices
Source: Central Statistic Office

		2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
1	Agriculture, forestry & fishing	943,204	1,083,514	1,319,686	1,499,098	1,644,926	1,881,152
1.1	Agriculture	806,646	928,586	1,143,517	1,300,569	1,417,468	1,639,630
1.2	Forestry & logging	92,485	104,558	118,898	131,667	149,405	144,698
1.3	Fishing	44,073	50,370	57,271	66,862	78,053	96,824
2	Mining & quarrying	139,828	159,304	204,866	222,716	222,416	298,544
3	Manufacturing	818,322	922,151	1,072,489	1,236,182	1,320,907	1,808,370
4	Electricity, gas & water supply	91,070	113,883	119,560	135,670	157,132	244,220
5	Construction	451,034	500,458	571,535	689,798	759,990	868,808
6	Trade, hotels & restaurants	895,397	1,010,232	1,250,472	1,457,565	1,615,865	1,257,324
6.1	Trade	813,503	923,004	1,143,104	1,330,489	1,479,787	1,147,274
6.2	Hotels & restaurants	81,894	87,228	107,368	127,076	136,078	110,050
7	Transport, storage & communication	415,448	471,391	529,158	614,707	708,830	688,736
7.1	Railways	47,478	55,571	56,877	62,710	70,616	79,759
7.2	Transport by other means	289,327	325,126	387,533	456,754	529,037	424,954
7.3	Storage	3,213	4,211	4,649	5,496	6,446	6,844
7.4	Communication	75,430	86,483	80,099	89,747	102,731	177,179
8	Financing, insurance, real estate & business services	845,369	964,937	1,165,243	1,381,524	1,617,076	2,074,623
8.1	Banking & insurance	298,931	331,793	410,407	481,495	549,500	609,464
8.2	Real estate, ownership of dwellings & business services	546,438	633,144	754,836	900,029	1,067,576	1,465,159
9	Community, social & personal services	703,894	883,033	1,015,850	1,154,431	1,341,734	1,355,362
9.1	Public administration & defense	306,652	403,641	442,120	498,346	567,193	630,500
9.2	Other services	397,242	479,392	573,730	656,085	774,541	724,862
10	Total gross domestic product at factor cost	5,303,566	6,108,903	7,248,860	8,391,691	9,388,876	10,477,140

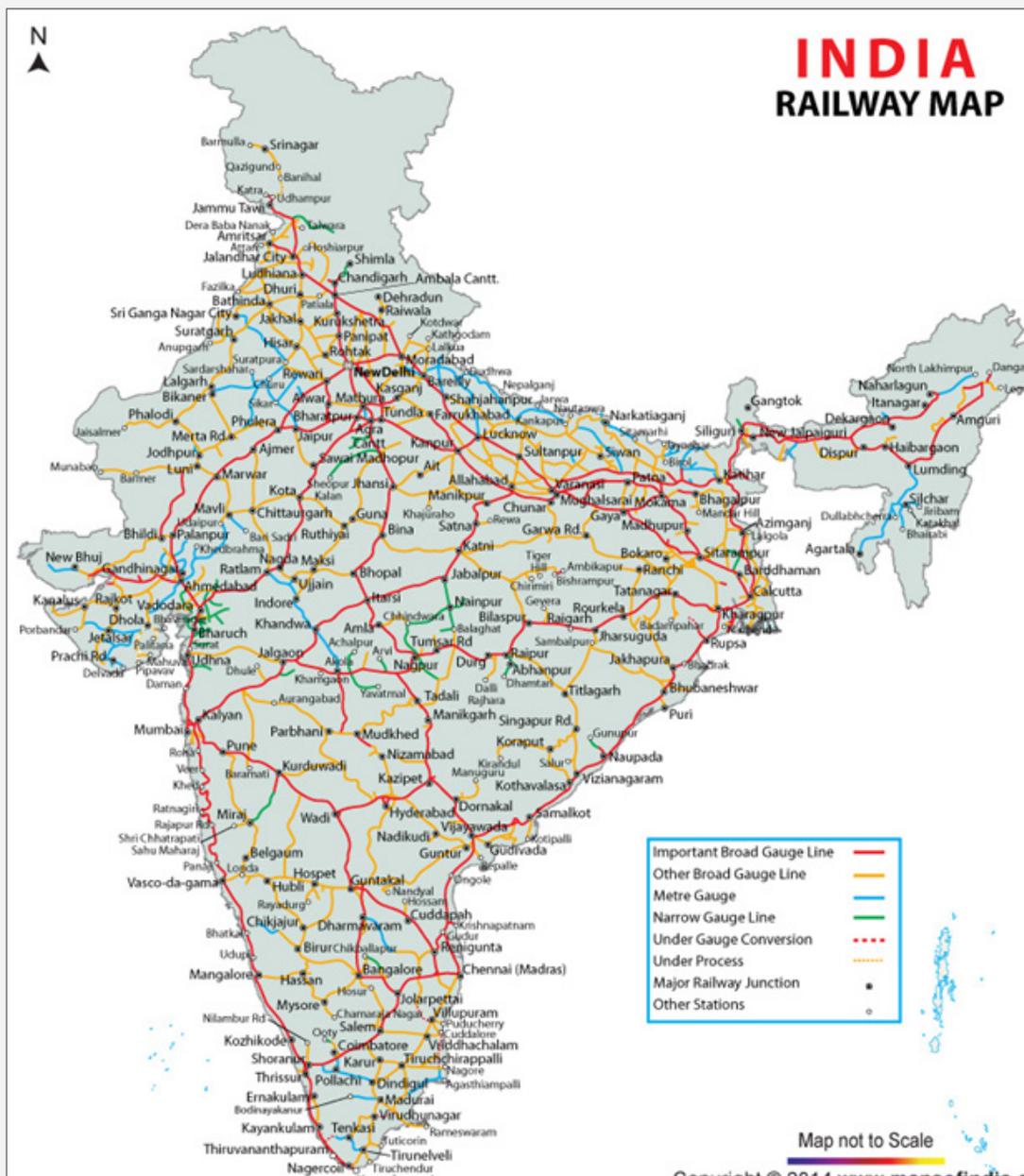
Appendix A2: Construction contribution to GDP

Figure 3: GDP by construction at current price
Source: Central Statistics Office



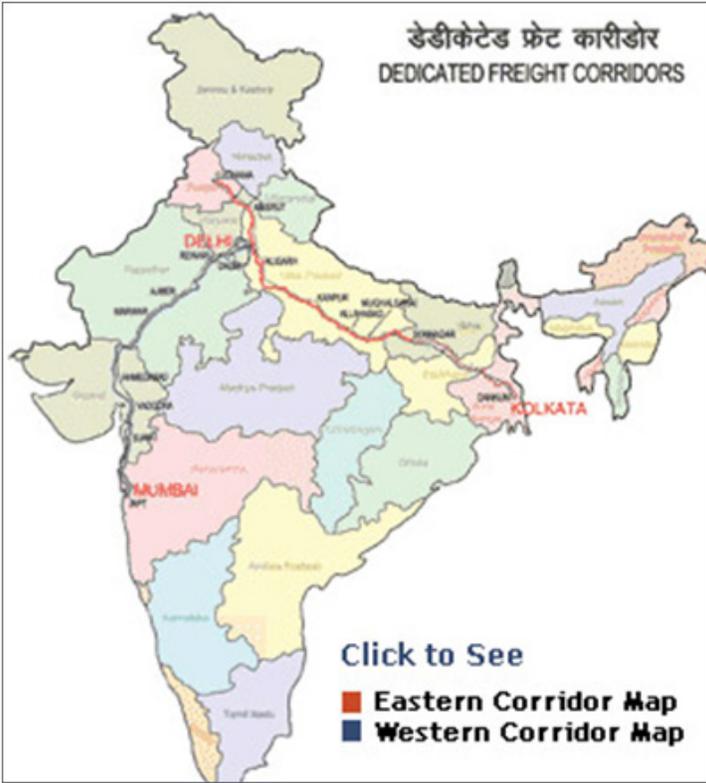
Appendix A3: Railway network

Figure 4: Map of rail network
Source: Mapsofindia.com



Appendix A4: Dedicated freight corridors

Figure 5: Dedicated freight corridors
Source: WorldBank - DFCCIL



Appendix A5: National Highways Development Program

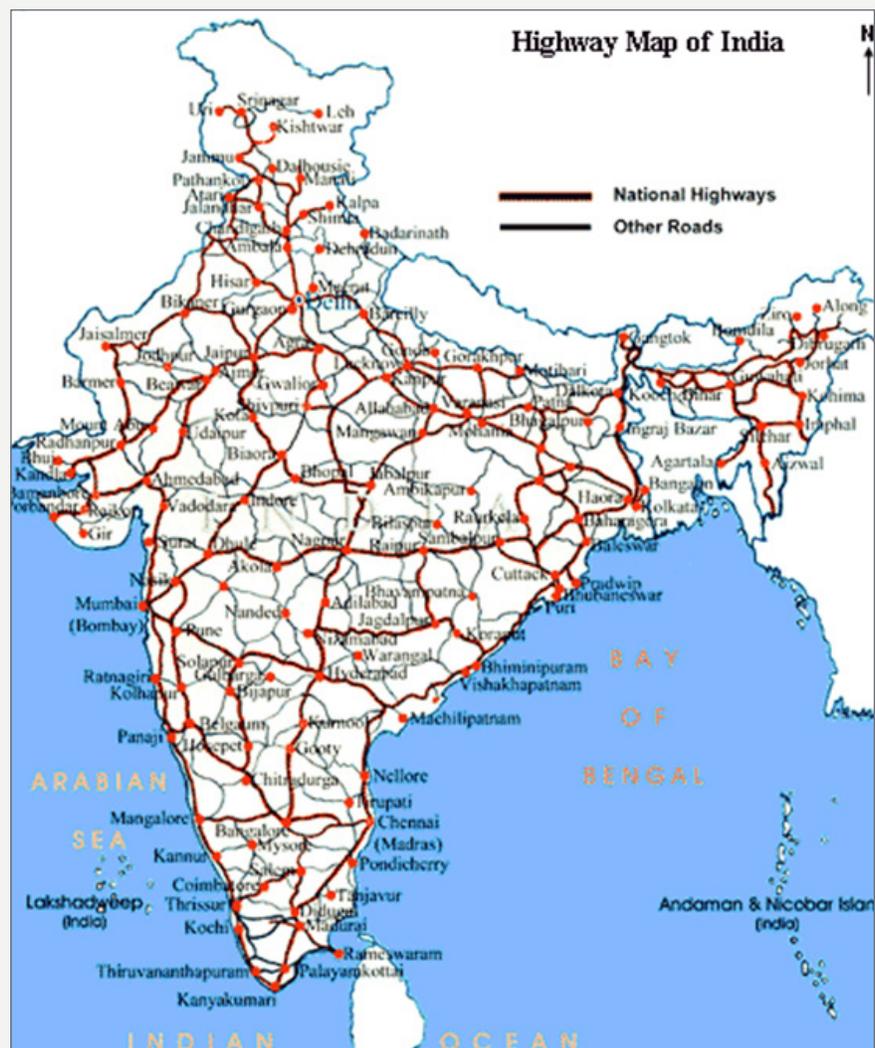
Figure 6: National Highways Development Program information
Source: NHA Website

NHDP and Other NHA projects						
January 2016						
		Total length (Km.)	Already 4/6 laned (Km.)	Under implementation (Km.)	Contracts under implementation (No.)	Balance length for award (Km.)
NHDP	GQ	5,846	5,846 (100.00%)	0	0	-
	NS - EW Ph. I & II	7,142	6,424	461	39	257
	Port connectivity	435	379	56	6	-
	NHDP phase III	11,809	6,791	3,129	78	1,889
	NHDP phase IV	13,203	1,905	4,685	62	6,613
	NHDP phase V	6,500	2,339	781	22	3,380
	NHDP phase VI	1,000	-	165	8	835
	NHDP phase VII	700	22	19	1	659
	NHDP Total	46,635	23,706	9,296	216	13,633
Others (Ph-I, Ph-II & misc.)		1844	1594	250	11	-
SARDP - NE		110	105	5	1	-
Total by NHA		48,589	25,405*	9,551	228	13,633

*Total 20,000 km. was approved under NHDP Phase IV out of which 14,799 km. as assigned to NHA remaining km. with MORTH.

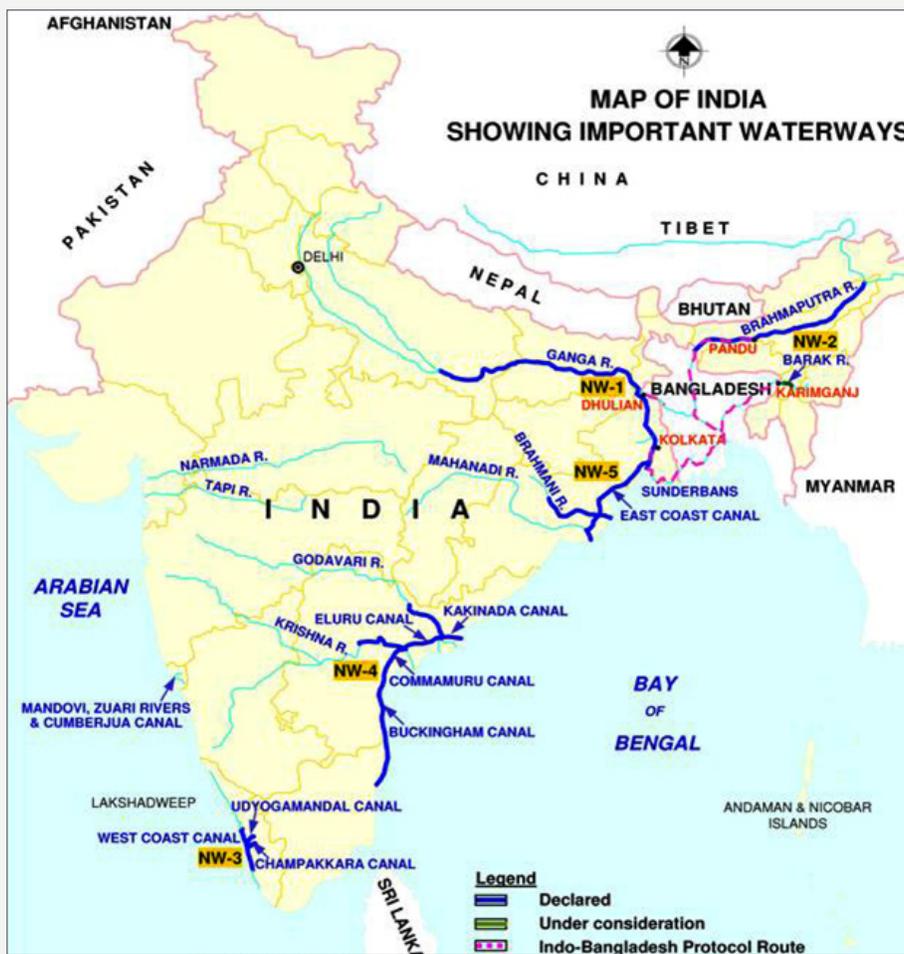
Appendix A6: Highway network

Figure 7: Highway network
Source: TravelIndia



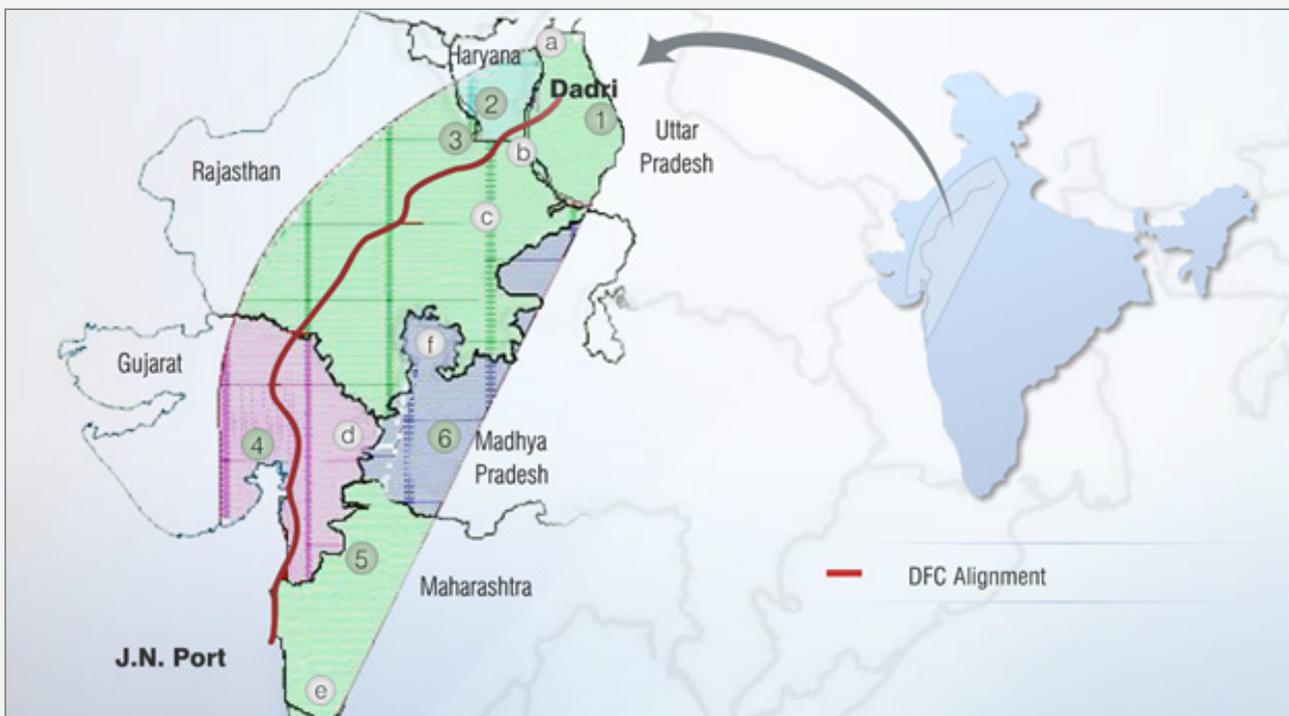
Appendix A7: Important waterways

Figure 8: Important waterways
Source: IWAI



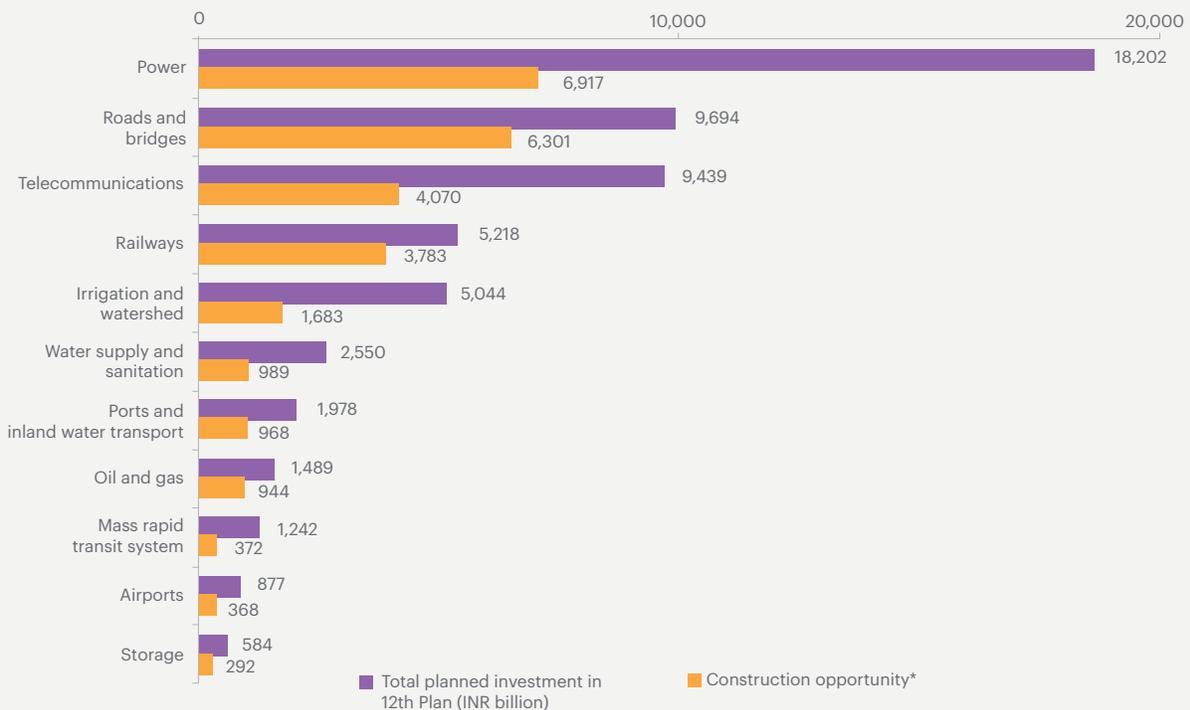
Appendix A8: Delhi-Mumbai Industrial Corridor

Figure 9: Delhi-Mumbai Industrial Corridor



Appendix A9: Twelfth Plan investment and construction opportunity

Figure 10: Opportunity for EPC contractors
Source: Ernst and Young [32]



*Construction opportunity comes from weighing total investment with construction intensity in each sector. For construction intensity in each sector, please see annexure
Source: Twelfth Five Year Plan document, Planning Commission; EY analysis

Appendix A10: Contract delivery methods by NHAI

Figure 11: Contract awarded by NHAI through various procurement methods
Source: World Bank [35]

NHDP phase	Total length	Awarded contracts under						Fully completed projects under					
		EPC		BOT (Toll)		BOT (Annuity)		EPC		BOT (Toll)		BOT (Annuity)	
		Length	No. of contracts	Length	No. of contracts	Length	No. of contracts	Length	No. of contracts	Length	No. of contracts	Length	No. of contracts
I	7498	6572	182	454	9	476	8	5436	152	454	9	476	8
II	6647	4190	118	843	17	864	16	713	14	210	5	85	1
III	12109	44	2	2665	36	36	1	30	1	157	4	-	-
V	6500	-	-	1035	8	-	-	-	-	-	-	-	-
Total	32754	10806	302	4997	70	1376	25	6179	167	821	18	561	9

Appendix A11: Indian public-private partnership methods

PPP Model	Description
Build, Operate and Transfer (BOT)	The private partner is responsible to design, build, operate (during the contracted period) and transfer back the facility to the public sector. The private sector partner is expected to bring the finance for the project and take the responsibility to construct and maintain it. The public sector will either pay a rent for using the facility or allow it to collect revenue from the users. The national highway projects contracted out by NHAI under PPP mode is an example.
Lease, Operate and Transfer (LOT)	Under this type of PPPs, a facility which already exists and is under operation, is entrusted to the private sector partner for efficient operation, subject to the terms and conditions decided by mutual agreement. The contract will be for a given but sufficiently long period and the asset will be transferred back to the government at the end of the contract. Leasing a school building or a hospital to the private sector along with the staff and all facilities by entrusting the management and control, subject to pre-determined conditions could come under this category.
Build, Own, Operate (BOO) or Build, Own, Operate and Transfer (BOOT)	This is a variation of the BOT model, except that the ownership of the newly built facility will rest with the private party during the period of contract. This will result in the transfer of most of the risks related to planning, design, construction and operation of the project to the private partner. The public sector partner will however contract to 'purchase' the goods and services produced by the project on mutually agreed terms and conditions. In the latter case (BOOT), however, the facility / project built under PPP will be transferred back to the government department or agency at the end of the contract period, generally at the residual value and after the private partner recovers its investment and reasonable return agreed to as per the contract.
Design, Build, Finance and Operate (DBFO) or Design, Build, Finance, Operate and Maintain (DBFOM)	The private party assumes the entire responsibility for the design, construct, finance, and operate or operate and maintain the project for the period of concession. These are also referred to as "Concessions". The private participant to the project will recover its investment and return on investments (ROI) through the concessions granted or through annuity payments etc. The public sector may provide guarantees to financing agencies, help with the acquisition of land and assist to obtain statutory and environmental clearances and approvals and also assure a reasonable return as per established norms or industry practice etc., throughout the period of concession.

Malaysia

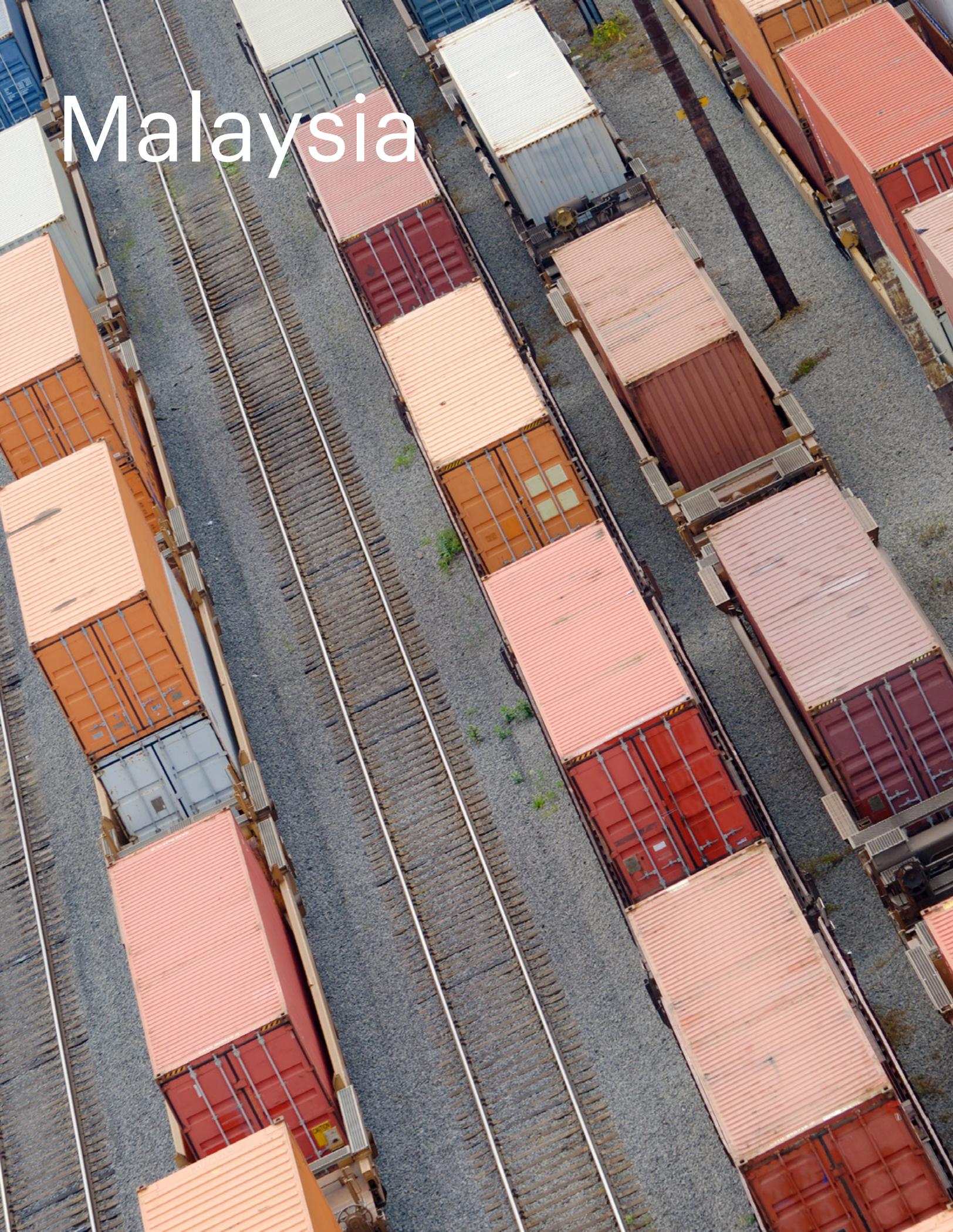


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Introduction

Although still not considered a developed country, Malaysia is currently undergoing rapid economic expansion. Annual GDP growth averaged 5.78% between 2010 and 2014. Approximately half of Malaysia’s GDP is derived from three sectors: manufacturing, wholesale and retail trade, including accommodations and food and beverage, and mining and quarrying. Of these, manufacturing accounts for the greatest contribution, consistently accounting for 22-25% of GDP.

Malaysia has long been dominated by private vehicles; however, Malaysia’s infrastructure profile is currently undergoing transformation. Public focus on sustainability in addition to steady population increase and rise in

urbanization has led to increased spending on mass transit projects.

In particular, the state of Selangor, which surrounds Kuala Lumpur, has been under heavy development, accounting for over half the construction sector’s contribution to national GDP in 2014—more than \$24 billion ringgit. The Klang Valley Mass Rapid Transit (KVMRT) program is the largest infrastructure investment in the country’s history, with the first phase alone valued at \$36 billion ringgit, and will serve to connect points within Kuala Lumpur, as well as nearby commuting neighborhoods. Heavy infrastructure investment and the nation’s central location give Malaysia the potential to achieve its primary objective of becoming a high-income country by 2020.

Figure 1: GDP by sector in current prices
Source: Malaysia Department of Statistics



Table 1: Key statistics for Malaysia
Source: World Bank

	2010	2011	2012	2013	2014
GDP at market prices (current US\$ millions)	255,016,919,685.80	297,951,960,784.30	314,442,825,692.80	323,342,854,422.50	338,103,822,298.30
GDP per capita (current US\$)	9,069.00	10,427.80	10,834.70	10,973.70	11,307.10
Inflation, GDP deflator (annual %)	7.3	5.4	1	0.2	2.5
Population, total	28,119,500.00	28,572,970.00	29,021,940.00	29,465,372.00	29,901,997.00
Population density (people per sq. km of land area)	85.6	87	88.3	89.7	91
Urban population (% of total)	70.9	71.7	72.5	73.3	74
Population in urban agglomerations of more than 1 million	5,809,953.00	6,004,742.00	6,206,062.00	6,414,131.00	6,629,176.00
Labor force, total	12,071,734.00	12,380,480.00	12,674,755.00	12,993,428.00	13,300,027.00
Unemployment, total (% of total labor force)	3.4	3.1	3	3.2	2

PEST analysis

Political

- Malaysia is a federal parliamentary democracy under an elective constitutional monarchy.
- The ruling Barisan National party has been in power for over 50 years; previously named Alliance.
- As of 2015, Transparency International ranks Malaysia at 54th of 168 countries in its Corruption Perceptions Index.
- The major proportion of government revenue comes from taxes, totaling 15.6% of GDP.
- There are 13 states and three federal territories: Kuala Lumpur, Labuan Island and the Putrajaya federal administrative territory.

Social

- The Malaysian population consists of the following ethnic groups: Malay (50.1%), Chinese (22.6%), Indigenous (11.8%), Indian (6.7%), other (0.7%), non-citizens 8.1%.
- The mixture of religions in the country gives rise to a large number of religious celebrations; Malaysia has more public holidays than any other country.
- Population distribution is uneven, with more than 65% of residents concentrated in the lowlands of Peninsular Malaysia.
- Population growth and aging population increase demand for transportation infrastructure.
- The Economist Intelligence Unit (EIU) ranked Malaysia among 31 countries with a low or very low risk of social unrest.

Economic

- Malaysia, a middle-income country, has transformed itself since the 1970s from a producer of raw materials into an emerging multi-sector economy.
- Economic expansion is incentivized by the government (11th MP Plan) and the Economic Transformation Program (ETP).
- Malaysia is ideally located to engage in international trade.
- Over the last 10 years, economic growth has averaged 7% per year.
- Exports account for 37% of Malaysia's GDP and the country achieves a healthy current account surplus.

Technology

- Technology needs huge development in order to compete in international markets.
- The high levels of investment in training and education, including the creation of "Smart Schools," and an excellent infrastructure, including a new town called Cyberjaya.
- Cyberjaya is a self-contained intelligent city with world-class IT infrastructure. It is considered one of the top three destinations for business support services and outsourcing in the world.
- Research and development expenditure (percent of GDP) in Malaysia was last measured at 1.07 in 2011, according to the World Bank.

Status of transportation

Railways

Malaysia rail network is well defined in Peninsular Malaysia, where it covers both the eastern and western regions of the peninsula. It is also present in East Malaysia but only in more populated areas, due to the remoteness of the area. The system consists of a total of 1,833 km and mainly uses 1,000 mm meter gauge tracks (approximately 94% of total system); the rest of the system uses the standard gauge, which is 1,435 mm. The airport rail link uses standard gauge and is one of the fastest ways to get from Kuala Lumpur International Airport—located in Sepang—to downtown Kuala Lumpur. The network is mainly owned by governmental agencies except for the airport rail link, which is owned by Malaysian private companies (YTL Corporation, Lembaga Tabung Haji, etc.).

One of the most important ongoing projects in Malaysia is the Klang Valley Mass Rapid Transit (MRT) (government funded). When finished, it will consist of a three-line mass rapid transit system that will serve Kuala Lumpur Metropolitan Area. The first line of the project is expected to be operational by July 2017. It will address Greater Kuala Lumpur environmental issues related to traffic. Another project is the Kuala Lumpur–Singapore High Speed Rail; which will connect the two cities by 2022 and will reduce the travel time to 90 minutes; less than conventional train, highway or total air travel time. The project will start in 2017 and consist of a 375 km track with multiple stations. The system will be paid for by both governments.

Challenges

- Low population density in Malaysian cities makes it difficult to encompass a wide range of people in one rail station, thus the service cannot fulfill its potential.
- Falling oil prices will cause commuters to return to vehicles instead of the rail system.
- Building new stations and lines in the middle of already urbanized areas will present a challenge to firms designing new projects.
- Rail industry involves cross-ministerial agencies; thus a mechanism is needed to effectively coordinate, facilitate and monitor the industry based on consensus at national level.
- Malaysia needs to prepare for the Trans-Asia Network; logistics and policies will be affected.

Opportunities

- Klang Valley is the cornerstone of Malaysia's pipeline projects, where rail is especially important.
- Construction of Lines 2 and 3 for the Klang Valley Mass Rapid Transit Project (MTR) has not started yet.
- New public-private-partnerships can generate new projects in other cities such as Johor Bahru.
- High road traffic congestion will make commuters turn to train and metro systems as an alternative.
- Advances in technology make the system antiquated in certain areas; thus the opportunity for improvement.

- Malaysia's legislation allows foreign companies to participate in the development of upcoming projects.

Roads and highways

The Malaysian road network covers about 89,728 miles, of which 80% is paved, and 1,132 miles are expressways. This is a smaller number compared to the neighboring Singapore (100% paved). The longest highway in the country is the North-South Expressway, which is 497 miles long. The Sabah and Sarawak roads are less developed than the roads in peninsular Malaysia and the Kuala Lumpur region. Every expressway has an open or closed toll collection system.^[3]

The Malaysian Highway Authority (MHA), or Lembaga Lebuhraya Malaysia (LLM), is a government agency established to build the North-South Expressway but is now involved in other highways as well. The recent trend involves privatization of transportation projects with highways being built under the BOT mechanism. The largest BOT concessionaire is the company, Projek Lebuhraya Utara Selatan Bhd (PLUS). SPAD, a government agency created in 2010, is responsible for drawing up policies, planning and regulating all land-based transport under a single roof.^[1]

Figure 2: Map of Malaysian highways



Challenges

- The formulation and implementation of decisions on urban transport in Klang Valley are highly centralized and are incorporated without much research.^[2]
- The falling oil prices may lead to more vehicles (>21.25 million units) on roads, which will eventually lead to congestion and increase in demand.^[6]
- Intelligent Transport System aided integrated road network operation needs institutional and operational level collaboration among stakeholders, which is currently lacking.^[1]
- Klang Valley, Penang and Johor Baru are experiencing problems in congestion and pollution in their highway network.^[7]

Opportunities

- There are financing opportunities for projects due to the initiation of PFI (or PPP). The sukuk bond market provides the opportunity for interest-free financing through a combination of leasing, repurchase agreements and equity. Please refer to the Project Delivery section for more insight.
- There are a number of projects in the pipeline under the Eleventh Malaysian Plan. The construction of the Pan-Borneo Highway was approved in 2015. Other projects in the pipeline are the Damansara-Shah Alam Elevated Expressway, East Klang Valley Expressway, Sungai Besi-Ulu Klang Expressway and West Coast Expressway.^[4]
- New technologies like electronic toll collection are encouraged, which is an

opportunity for foreign technology providers. Some contracts even specify the use of BIM, calling for technologically advanced companies to participate in such projects.^[5]

- Malaysia's ambition to achieve high-income status by 2020 points towards increased ease for private participation for projects having an economic impact on the nation.^[4]

Seaports

In Malaysia, 95% of the country's trade is done by sea.^[8] Port Klang and Port of Tanjung Pelepas both rank among Asia's top ten best seaports and best container terminal operators. One new measure that has been implemented and helped to optimize ports in Malaysia is the electronic data interchange (EDI). It has allowed speedy clearance of cargo with the electronic transfer of documentation. The growth of the economy and trade triggered a tremendous growth in ports' activities.^[8] The privatization of federal ports has been established, first with a focus on containerization, and second with the intensification of linkages with other transport modes.^[9] Furthermore, accommodation for larger vessels is needed. Currently, progressive use of IT in cargo handling, processing and tracking has also been implemented in order to enhance productivity and curb size-related issues.

Challenges

Ports are under pressure to accommodate growing vessel sizes. Also, there is dependence on foreign trade as well as competition from regional ports. Dependence on transshipment cargo and reliance on foreign vessels to carry certain types of cargo are other challenges.^[8]

Moreover, it can be difficult to obtain competitive financing and huge investment and capital expenditure to build, maintain, upgrade and expand ports, despite the five-year plans. Some facilities are also under-utilized. Low productivity and efficiency and poor integration with other transport modes are additional challenges.

Opportunities

Optimized integration of port facilities with other transport modes such as roads or railways must be achieved. Furthermore, ports must offer more incentives to attract operators and must follow the increasingly integrated and liberalized marketplace witnessed in Southeast Asia.^[10]

Port operations and productivity

Economies of scale—speed and size of ships—are essential for successful port operation. Ships' specialization must be determined on time. Time optimization must be achieved for processing, handling, storage and delivery of cargo. Because of space limitations, the box idling time must be optimized at the port. Greater volume must be delivered at a faster rate.^[11]

Several parameters could be improved, such as the use of handling equipment, which is mandatory when larger ships are used. Skilled laborers are needed and training must be provided.^[12]

Globalized markets as well as outsourcing enhance employment opportunities and

increase demand for maritime services. A growth in trade leads to additional investments in ports to widen the capacity and to expand the authorized trade volume. Greater port connectivity has been noticed due to flattening and liberalization of markets. China's influence on port throughput has been huge; Malaysia is China's twelfth-largest trade partner.^[13]

Airports

KLIA, located 50 kilometers south of Kuala Lumpur, is able to host 25 million passengers,^[14] and in 2014 was the twelfth-busiest airport in the world in terms of international passengers.^[15] Some 8,000,000 passengers were hosted in December 2015, and cargo movements reached 735,000 metric tons.^[16] KLIA was ranked number one for business passenger satisfaction in an International Air Transport Association (IATA) survey.^[17] A recent service-quality survey by Geneva-based Airports Council International has ranked Kuala Lumpur the second-best airport in Asia, after Seoul in South Korea.^[18]

Opportunities

- The boom in the aviation industry has been driven by economic growth as well as several market liberalizations of the Southeast Asia zone. It has led to the creation of low-cost companies which have flourished and highly increased Malaysian airports' activity, dynamism and know-how.
- In airports, implementation of the retail optimization program (ROP) has increased

the range of products for consumers and service programs for passengers.

- ASEAN Open Sky Policies have increased route development within the region.^[19]
- Favorable Malaysian demographics including a young and more active population fosters the development of Malaysian people' leisure time; travel is more common than 10 years before.

Challenges

- Global economic instability in the region caused by China: exports dropped.
- Newly imposed legislation and currency fluctuation.

- Safety is not always ensured because of quick growth and occasional intense weather conditions. For instance, after flooding in 2015, Kuala Lumpur International Airport's new passenger terminal budget was totally revised.
- Construction expenses for KLIA2's new terminal increased heavily from an initial estimate of about 1.7 billion ringgit (approximately US\$446 million) to 4 billion ringgit (approximately US\$990 million).^[20]
- There is higher competition because of the higher local growth: competition with Hong Kong and China, for instance, as well as with other actors such as Indonesia, Philippines, Vietnam and Thailand.

Table 2: Key statistics for Malaysian airports 2013
Source: Malaysia Airports Annual Report 2013

Airport Name	Cargo traffic in tons	Passenger traffic	Total aircraft movements
KLIA	750,655	47,498,157	325,537
Penang International	169,428	5,487,751	56,760
Kuching International	24,243	4,871,036	53,095
Subang International	29,148	1,859,020	41,707

SWOT analysis

Strengths

- Supportive government policies such as attractive tax incentives and openness to public-private partnerships on transportation projects.
- Strategic location within Southeast Asia. Important links with Singapore and Thailand.
- Malaysia's company tax rate is attractive at 29% and is applicable to both internal and external companies.

Weaknesses

- Lack of integrated planning and coordinated management.
- High reliance on private transportation.
- Unskilled labor force. Over half of the labor force is of foreign origin.
- Safety is not being prioritized during the rapid expansion of transportation infrastructure. There are an increasing number of accidents in various transportation modes.
- Malaysia ringgit has fluctuated wildly in recent months.

Opportunities

- Booming infrastructure spending (KVMRT – high speed rail).
- Improvement of standards and infrastructure requirements.
- Currency exchange rates for international business. An international company is usually paid in contracts using a fixed rate of USD to RM. Thus, if the RM FX rate falls, international companies will be able to get more profit.
- Malaysia's legislation allows foreign companies to participate in the development of upcoming projects.

Threats

- High reliance on O&G sector.
- Poor enforcement from statutory authorities on the construction of transportation projects such as road and rail.
- Low density of cities increases the challenges of delivering efficient, clean, and innovative urban transport.
- Currency exchange rates for local business. Local contractors usually import their materials. Thus, if the RMB FX rate falls, local contractors risk defaulting on the project or even bankruptcy.

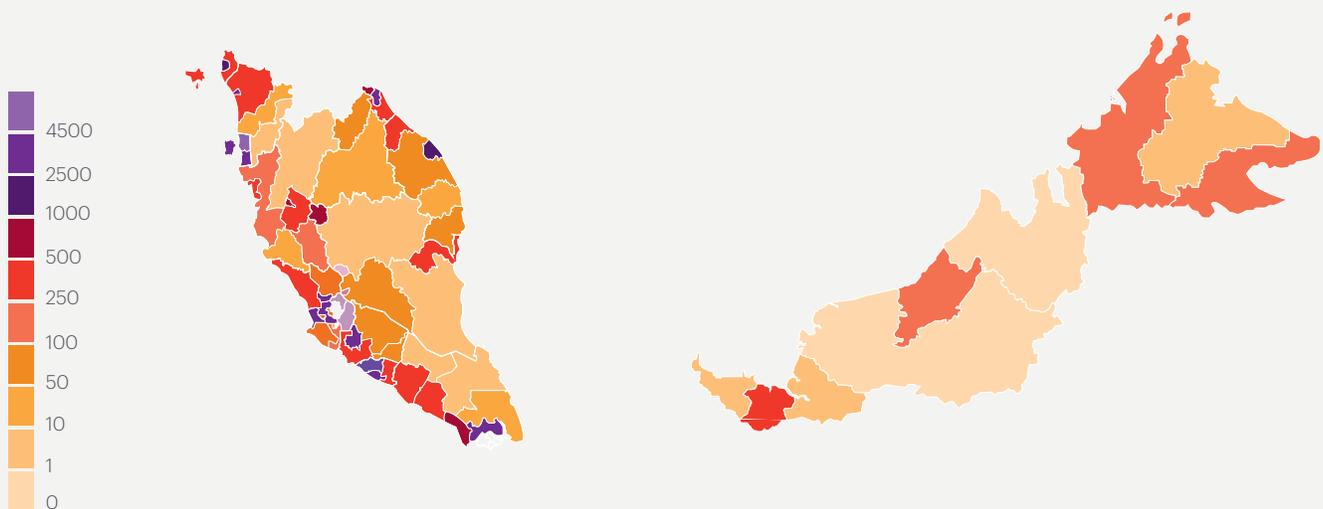
Geographical analysis

Malaysia is a federation of 13 states and three federal territories. Kuala Lumpur is the country's capital. Malaysia is divided in two regions: Peninsular Malaysia, which shares borders with Thailand; and Singapore and East Malaysia, located in the island of Borneo, which shares borders with Brunei and Indonesia. Both territories share a similar landscape featuring coastal plains, hills and mountains. Peninsular Malaysia is divided between its east and west coasts by the Titiwangsa Mountains. East Malaysia has its highest mountains in the border between Malaysia and Indonesia. East Malaysia is larger in territory and has more natural resources than Peninsular Malaysia.

Population density

Malaysia holds an approximate 31 million people in its territory; the majority of the population resides in Peninsular Malaysia (24 million) and seven million reside in East Malaysia (Figure 3). Seventy-four percent of the population is considered urban; this percentage increases an average of 2.5% each year. The population is mainly concentrated near the major economic and industrial cities of the country, especially in the Klang Valley, where Kuala Lumpur is located, and Iskandar, where Johor Buhru is located. Iskandar is the third-largest metropolitan area in Malaysia, and is located next to Singapore.

Figure 3: Population density of Malaysia (persons per sq km)



Infrastructure

Malaysia has a federal road system, a state road system and an expressway system that reaches every part of the country. It is part of the Asian Highway Network, where seven major routes pass through Peninsular Malaysia. Additionally, there are two fixed crossings between Malaysia and Singapore: the Johor-Singapore Causeway and the Malaysia-Singapore Second Link.

Rail transportation comprises heavy rail (intercity passenger and freight transport), light rapid transit (intra-city urban public transport), monorail, funicular railway and an airport rail link. The railway network covers almost the entire Peninsular Malaysia, connecting its east and west coasts in the city of Gemas, located approximately 165 km southeast of Kuala Lumpur. In East Malaysia, the rail network is present only in the state of Sabah, which is the most populated area of the island.

Ports are located where there are major trading sectors. Port Klang, which serves the Klang Valley and thus Kuala Lumpur, is the biggest port in the country. It is located 38 km southwest of Kuala Lumpur and is of great importance for the development of the area. Johor Buhru has two medium-size ports, which serve the area and the south of the country. East Malaysia has a series of ports, but the most important one is located in the city of Sandakan in Sabah.

There are 62 active airports in Malaysia; eight serve international destinations, with only three of those located in East Malaysia. The biggest is the Kuala Lumpur International Airport, located near the city of Sepang in the Klang Valley. East Malaysia has 38 airports, mainly because of the remoteness and lack of other means of connectivity.



Sustainability

Malaysia aspires to become the hub of green technology. However, Malaysia's natural resources have only been regarded as an advantage to the economy, with no consideration of the negative impact on society and the environment. Although the Southeast Asian countries met all eight millennium development goals prior to the end of 2015, the MDG performed inefficiently on sustainability. Thus, sustainable development goals (SDGs) were introduced by the UN to specifically address 17 goals pertaining to the triple bottom line. Malaysia has made many commitments to cut carbon emissions before 2020 and officially confirmed its pledge in Rio in 1992. The country has been known for exporting solar products to major countries around the world, and has led its nation in manufacturing electric vehicles, exhibiting its commitment towards sustainable transport. Nevertheless, they have been failing on most of those 17 goals when it comes to palm oil production, and have been criticized heavily because of many human rights and environmental regulation violations. Malaysia must work towards achieving each of the SDGs set forth in order to maintain a safe and healthy

environment. Sustainable development goals resulted in 17 goals and 169 targets for 2016 to 2030. These goals have been assigned an overall weighted score to rank them in the order of priority. "Resilient Infrastructure, sustainable industrialization and foster innovation" was assigned a weighted score of 26, which ranks thirteenth among all 17 goals. Malaysia is currently focused on the primitive goals, which are an absolute right in other parts of the world. Sustainability goals are met when all aspects are achieved while not compromising one aspect. Although the palm oil industry contributes considerably to the economy, it fails on the social and environmental aspects of the triple bottom line. The palm oil industry is infamous for treating laborers unfairly while increasing inequality and limiting prosperity for those individuals. Ending poverty, promoting good health and well-being, and reducing inequality are all sustainable development goals that the Malaysian government needs to address, given the poor planning and corrupt system set in the palm oil industry.

Figure 4: Malaysia ranks infrastructure as their ninth priority

Rating Sustainable Development Goals (SDGs) for Malaysia

No.	Sustainable development goal (SDG)	Overall weighted score	Overall priority
1	End poverty	49	6
2	End hunger, achieve food security, improved nutrition and sustainable agriculture	96	1
3	Good health and promote wellbeing	75	2
4	Quality education and learning opportunities for all	69	3
5	Gender equality and empowering women	22	14
6	Clean water and sanitation	68	4
7	Access to affordable and sustainable energy	20	15
8	Economic growth and employment for all	46	7
9	Resilient infrastructure, sustainable industrialisation and foster innovation	26	13
10	Reduce inequality and increase global prosperity	39	10
11	Sustainable cities and safe, inclusive, resilient and sustainable human settlements	38	12
12	Sustainable consumption and production pattern	45	8
13	Action to combat climate change and its impacts	39	11
14	Conserve oceans, sea and marine resources	16	16
15	Protect the terrestrial ecosystem, manage forests and halt biodiversity loss	41	9
16	Promote peace and justice and build effective, accountable and inclusive institutions at all levels	67	5
17	Strengthen the means of implementation and revitalise global partnership	10	17

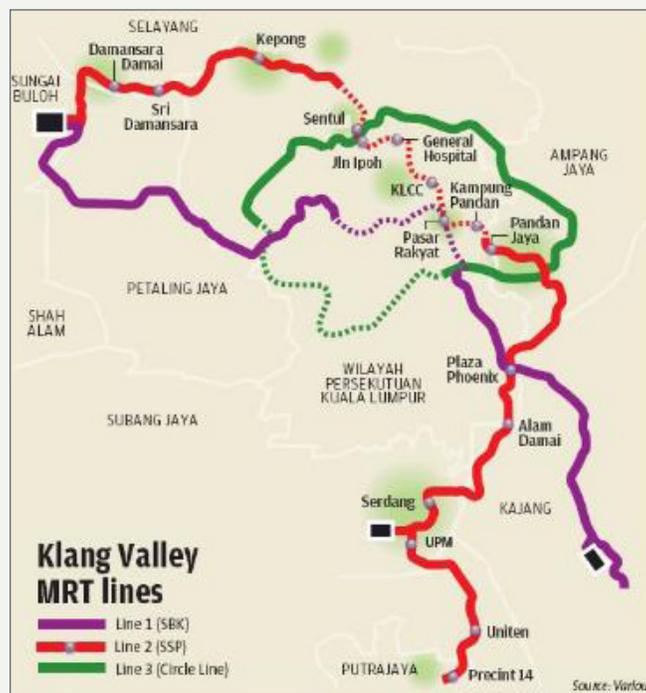
Project pipeline

Malaysia has been experiencing a boom in the development of infrastructure, making it stand out among the various other newly industrializing countries of Asia. Several projects are planned in the coming five to seven years under the Economic Transformation Program by the Malaysian government, possibly making Malaysia a developed nation soon.^[21] Three of the ongoing mega-projects in Malaysia are described below.

1. Klang Valley Mass Rapid Transit Project (MRT): The MRT project is a planned three-line railway system used for public transport and is expected to alleviate the increasing

traffic congestion in the Greater Kuala Lumpur region. The Mass Rapid Transit Corporation Sdn Bhd (MRT Corp) has been declared by the government as the official asset owner of the project. MMC Gamuda KVMRT Sdn Bhd is the project delivery partner (PDP). The first line is 51 km with 31 stations plus three reserved stations planned; the estimated contract value is MYR\$36 billion. Construction began in July 2011 and is expected to be operational by July 2017. The second line will be a 52.2 km line with 36 stations, with 11 of them built underground. The construction is expected to start in 2016

Figure 5: Map of proposed KVMRT



and the full service should commence in 2021 for phase 1 and 2022 for phase 2.^[22]

2. Penang Undersea Road Tunnel: The Penang tunnel is a 6.5 km road tunnel project connecting Butterworth in the east to George Town, Penang Island in the west. The project was scheduled to begin construction in 2016. However, it has been delayed due to a delay with the feasibility and detailed design studies for the project.^[23] The owner of the project is the state government of Penang, and the main contractor is Consortium Zenith BUCG Sdn Bhd. The project is expected to cost US\$1.42 billion. In the first phase, three highways with a combined length of 21.2 km will be constructed.
3. Kuala Lumpur-Singapore High Speed Rail: The 375 km HRS is aimed to connect Kuala Lumpur and Johor Bahru with Singapore, at a cost of MYR\$43 billion. YTL Corporation and Malaysian Land Public Transport Commission (SPAD) will coordinate the construction in the Malaysian corridor, whereas LTA will do the same for the Singapore corridor. The RFI exercise took place in November 2015 and 14 companies have been asked to present

their ideas on the project.^[24] The commercial model and the procurement method are targeted to start by the end of 2017.

In order to further spearhead private sector participation in the national development agenda, the public-private partnership unit was established in the prime minister's department in April 2009.^[26] As per the prime minister's guideline, the usual framework consists of a contract between the public entity and the private party for financing the assets that will deliver the services based on agreed performances.^[27] In return, the public sector compensates the private sector in the form of benefits like tax breaks, etc. Ownership of the project is generally transferred to the public sector at the end of the concession period. This delivery method usually is the solution for the projects with technological obsolescence and funding limitations, also creating a potential "win-win" situation for the benefit of all.

Delivery methods

Among the many delivery systems used for procurement in the construction industry, the most common ones in Malaysia include the traditional system, design and build,^[28] management contracting and construction management. The traditional procurement system was predominant in the country until 1992.^[29] However, this system has become less popular due to its inability to cope with the complexity and dynamic nature of the current industry. Innovative models and privatization are becoming increasingly popular.^[30]

The MRT line under construction in the Klang Valley is the largest infrastructure project ever undertaken in Malaysia and an example of innovative delivery. Here MMC-Gamuda was appointed as the project delivery partner (PDP). The PDP assumes complete risk ownership and project delivery accountability, from conceptualization to completion, while keeping a focus on project time, cost and quality, and integrating all contractors involved. Such PDP partners can be used as an addition to any type of delivery (PPP/BOT in this case) to ensure smooth procurement.^[31]

Although there have been no specific laws governing PPP and BOT models, Malaysia is one of the few Asian countries where there are guidelines and a master plan for privatization. The PPP structure is based on the UK model where the key players form an SPV (Special Purpose Vehicle). Most PPP projects, especially the road and railway projects, follow the BOT mechanism for procurement.^[32]

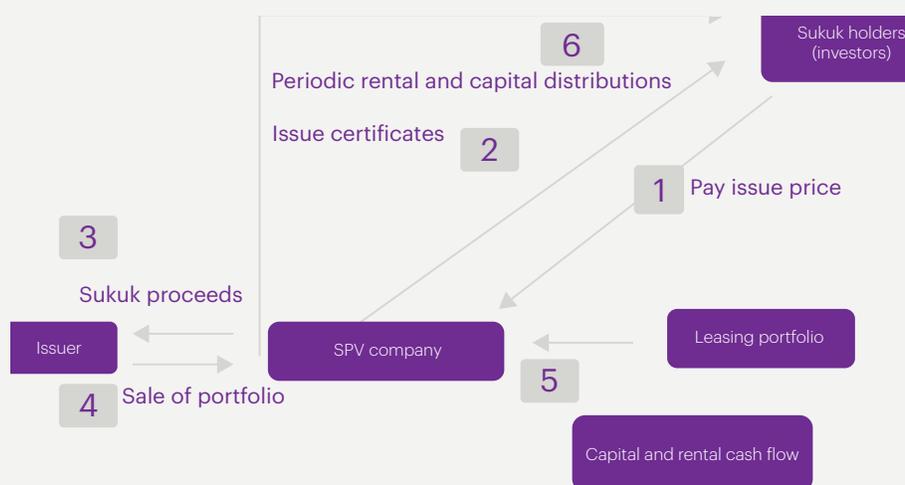
The majority of the private finance initiative projects are financed by two financial institutions—Bank Negara Malaysia and finance companies—which provide a long-term loan of more than 15 years and 80% leverage. Another alternative is to finance a project using Islamic financing or sukuk. Malaysia is one of the largest markets for these bonds, which promote risk-sharing between stakeholders and interest-free financing through a combination of leasing, repurchase agreements and equity.^[33]

Distinguishing characteristics

Malaysia has two unique characteristics that help distinguish the local market from surrounding countries. First is the institution of two specialist construction courts. The courts, instituted in 2013 and located in Kuala Lumpur and Shah Alam, handle disputes related to the construction industry only. The result is a quicker and more effective resolution process for all parties. The court is one of the few across the globe which specifically cater to the construction industry and is generally seen as favorable amongst the industry. As judges hear more cases, and become more knowledgeable of the particulars of the industry, the court will continue to warrant positive opinions. The CIDB has established a unit to work in conjunction with the courts that will track and analyze cases brought before judges. The effort will be utilized to identify common causes of disputes and issues specific to Malaysia.

The other notable attribute of the country is the presence of Islamic financing. The nation has consistently accounted for 60% to 70% of total sukuk bonds issued in past years. The financing system is unconventional, banning the collection of interest and speculation. Instead, the structure replaces coupons with pay-outs derived from tangible assets. This is one of the reasons it has been limited in application in certain geographical areas; however, there is regulatory framework in Malaysia which allows the Islamic bond system to be widely implemented, creating a major advantage for the construction industry. Although the bond market has slowed due to political and financial turmoil, the bond market as a whole remains strong and Malaysia continues to be a positive environment for sukuk financing.

Figure 6: Diagram of typical sukuk bond financing



Conclusion

Malaysia has set aggressive goals as part of their 2020 vision. They benefit from a strategic location in the center of Southeast Asia, experiencing a steady increase of the number of ships and aircraft that annually pass through the country. The government dedicates significant spending towards enhancing the country's infrastructure and has promoted participation of the private sector through the use of special purpose vehicles. Key frameworks such as the Construction Industry Transformation Plan target objectives of increased productivity and sustainable policy. Sustainable development goals show a commitment to the environment and act as an example of the country's forward thinking.

For all the positive attributes Malaysia possesses, certain struggles lie ahead for the Southeast Asia nation. Questionable transparency of procurement practices has

overshadowed certain agencies. Safety remains a key concern of the industry. Over half of the labor force is of foreign origin. These workers are often unskilled and perpetuate a general lack of safety. The nation's reliance on oil and gas is of consideration given the recent drop in oil prices and re-emergence of Iran into the oil market. Furthermore, the exchange rate of the Malaysian ringgit has fluctuated wildly in the past, leading to uncertainty of foreign investments.

If the government can successfully address these challenges, Malaysia may realize their ambitious 2020 vision. If not, then Malaysia will continue to show signs of promise, as it has for the last decade, but ultimately miss out on its full potential.

Appendix A1: Malaysia GDP statistics

Table 3: Detailed breakdown of GDP by sector at current prices in millions of MYR

Source: Malaysian Department of Statistics

	2010	2011	2012	2013	2014
Agriculture	82,882	104,424	95,122	92,754	98,150
Construction Spending (% of GDP)	28,213	30,892	37,909	42,764	48,741
Finance, Insurance, Real Estate and Business Services	93,939	99,118	108,044	113,993	120,907
Government Services	64,359	72,390	85,560	89,960	95,438
Import Duties	7,672	8,711	10,186	10,763	11,947
Manufacturing	192,493	212,618	224,730	232,720	253,392
Mining and Quarrying	89,793	95,905	101,474	103,484	109,123
Other Services	36,766	39,297	41,514	44,216	46,873
Transport, Storage, Information and Communication	68,511	73,701	79,620	85,973	93,509
Utilities	22,173	23,676	25,699	27,428	30,923
Wholesale and Retail Trade, Accommodation, Food and Beverage	134,634	151,000	161,393	174,764	197,576
Total	596,117	347,820	367,718	380,420	409,388

Table 4: GDP by state at constant 2010 prices in millions of MYR

Source: Malaysian Department of Statistics

	2010	2011	2012	2013	2014
Johor	74,102	78,946	84,050	88,013	93,737
Kedah	27,356	29,585	31,241	32,755	34,139
Kelantan	15,591	16,691	17,558	18,140	19,055
Melaka	24,187	25,487	27,276	27,947	30,078
Negeri Sembilan	30,229	32,007	33,924	34,858	35,943
Pahang	35,871	38,148	40,047	42,158	43,810
Pulau Pinang	52,946	55,827	58,353	61,288	66,187
Perak	43,313	46,346	49,756	52,381	54,789
Perlis	4,105	4,214	4,426	4,576	4,809
Selangor	177,718	187,434	200,906	212,760	227,085
Terengganu	22,769	23,509	24,292	25,359	26,890
Sabah	58,127	59,339	61,223	63,150	66,283
Sarawak	87,131	92,700	94,013	98,132	102,385
WP Kuala Lumpur	113,095	122,890	131,514	140,625	152,439
WP Labuan	3,389	3,852	4,167	4,550	4,791
Supra	51,505	47,946	49,515	48,570	50,086
Total	821,434	864,921	912,261	955,262	1,012,506

Appendix A2: GDP by construction statistics

Figure 7: GDP by construction per state at constant 2010 prices
Source: Malaysian Department of Statistics

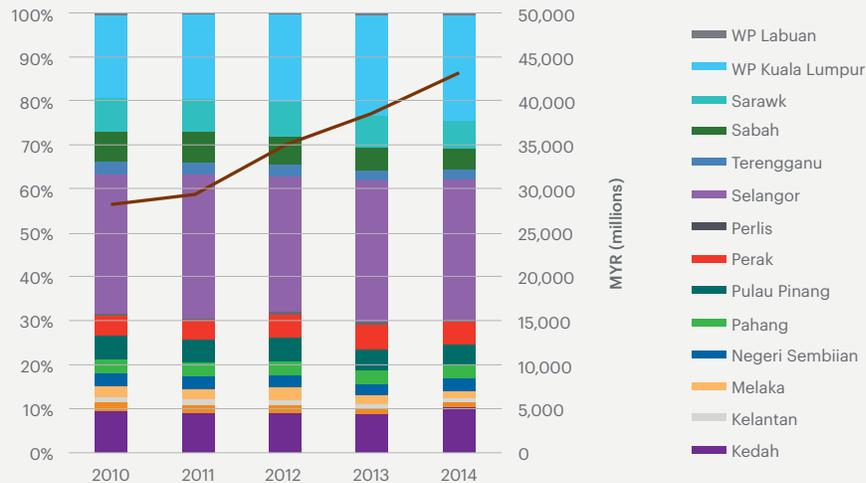
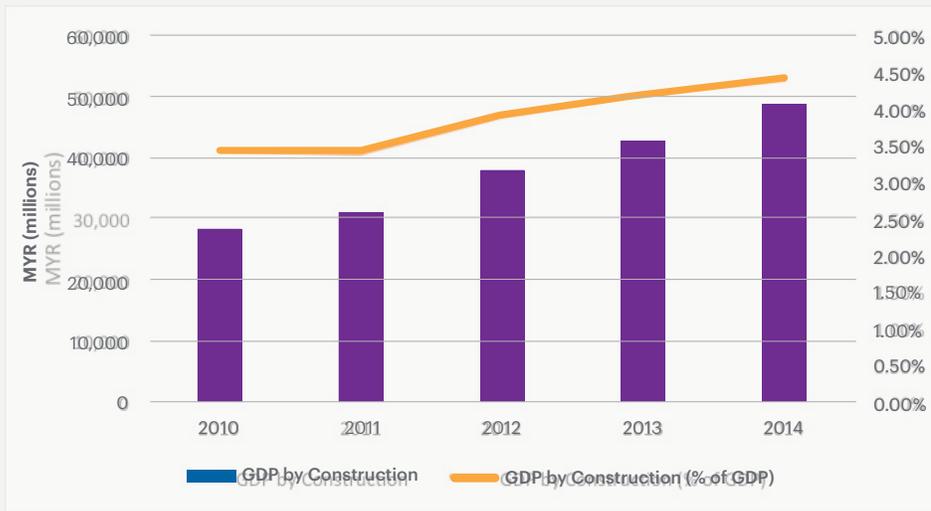


Figure 8: GDP by construction at current prices
Source: Malaysian Department of Statistics



Appendix A3: Congestion costs in Malaysia

Table 5: Congestion costs Malaysia 1.1 to 2.2 percent of GDP a year

Type of cost	Cost per year (time/liters)	Annual monetary cost (RM billion)	Cost as a % of 2014 GDP
Delays	269.9—487.8 million hours/year	10.8—19.6	1.0—1.8
Fuel	449.9 million liters—1.2 billion liters	0.9—2.4	0.1—0.2
CO ₂ and other emissions	N/A	0.9—2.7	0.1—0.2
Total	N/A	12.7—24.7	1.1—2.2

Appendix A4:

Table 5: Future projects as result of integrated planning

Project	Estimated budget	Estimated completion
LRT1 & LRT2 extensions	RM11 billion	Oct-16
MRT Line 1	RM23 billion	Jul-17
LRT 3	RM9 billion	2020
MRT Line 2 & MRT Line 3	RM50 billion	2021 and 2022

Appendix A5: Rail and highway networks

Figure 9: Malaysia rail network



Figure 10: Peninsular Malaysia highway network



Appendix A6: Map of Malaysian seaports

Figure 11: Map of all Malaysian ports

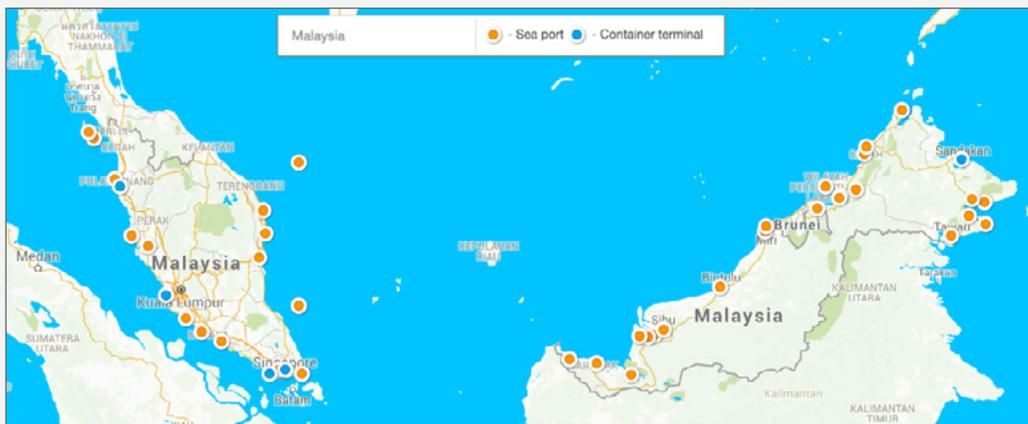
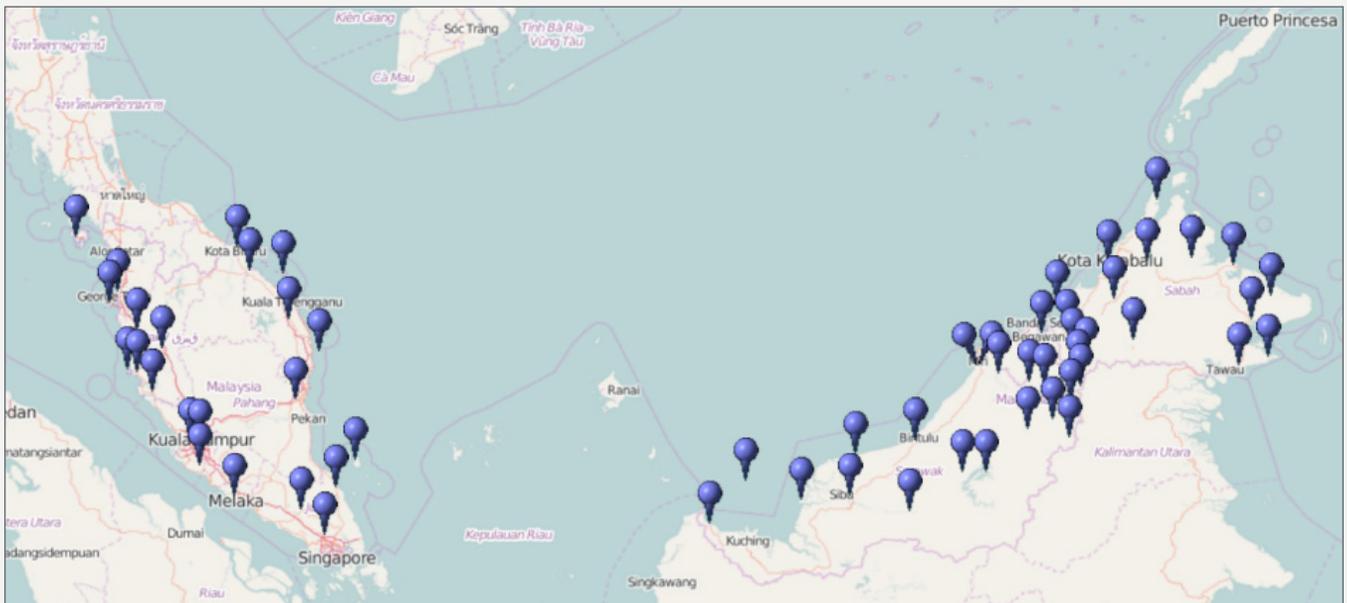


Figure 12: Enlargement of seaports in Peninsular Malaysia



Appendix A7: Map of Malaysian airports

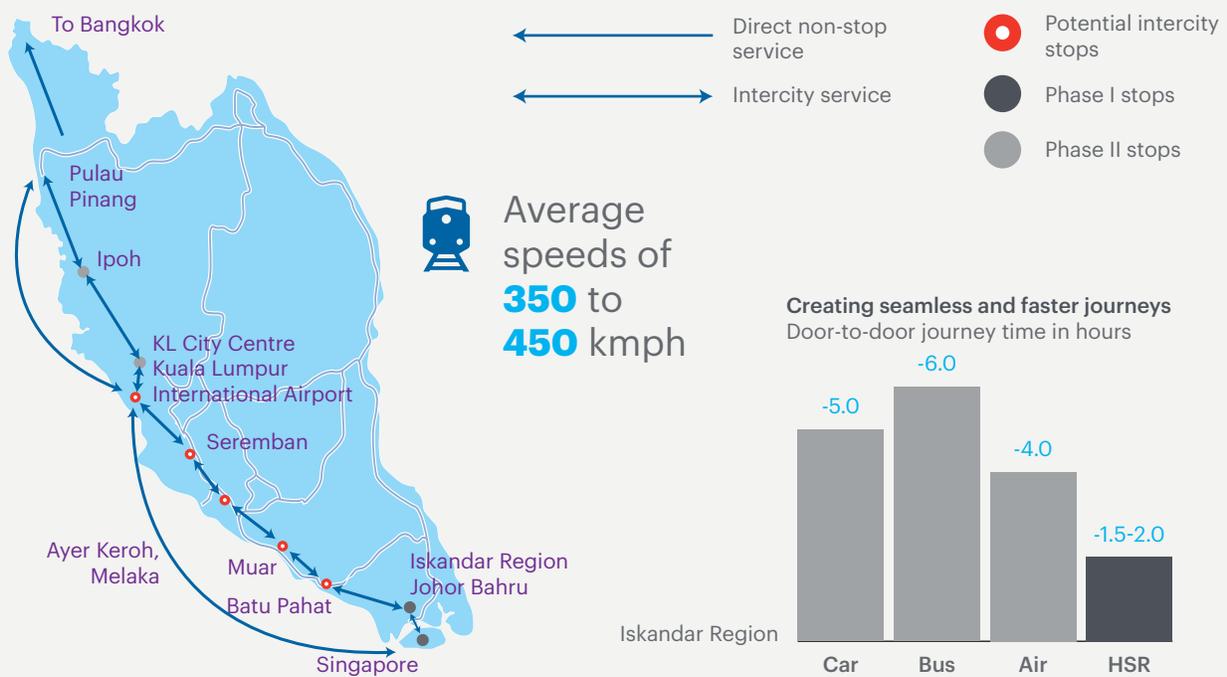
Figure 13: Locations of Malaysian airports



Appendix A8: Kuala Lumpur – Singapore high-speed rail

Figure 14: KL-Singapore high-speed rail infographic

High speed rail will provide non-stop services to major regional centers and intercity services



Mexico



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Introduction

Mexico is classified as an upper-middle income country by the World Bank and a regional power. It boasts the fifteenth-largest GDP in the world, driven by its manufacturing sector and accounting for an average of 17% over the last five years. Its economy is strongly connected with NAFTA members, particularly the United States. It was the first country to join the OECD in 1994 and shows potential to become the fifth-largest economy in the world by 2050.

At eleventh in the world, Mexico's population has grown consistently, although moderately, never growing more than 1.5% since 2010. Urban population has risen even less; however,

more than 40 million people reside in urban agglomerations of more than one million people. It is the fourteenth-largest country with respect to land area, and a below-average population density of 64.5 in 2014.

In short, Mexico is a large, fiscally strong country with extreme concentrations of residents at the major economic centers, which require a strong national network of multimodal systems, enhanced in populous districts by sustainable mass transit methods. To continue driving Mexico's growth as a global power, the nation must prioritize infrastructure.

Figure 1: GDP by sector at current prices
Source: Instituto Nacional de Estadística y Geografía

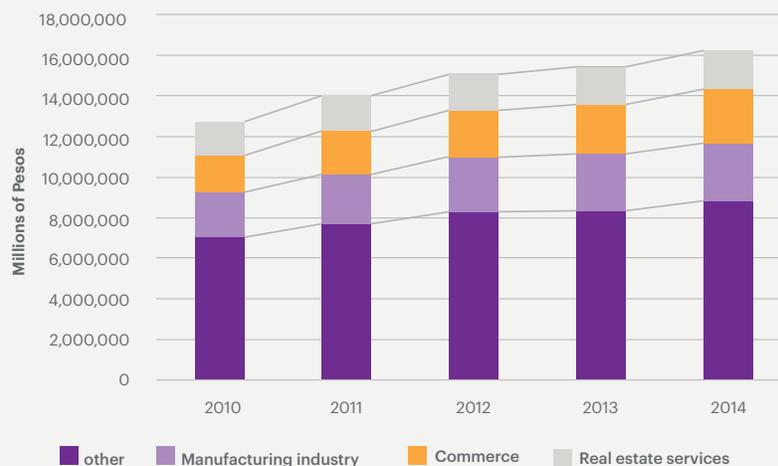
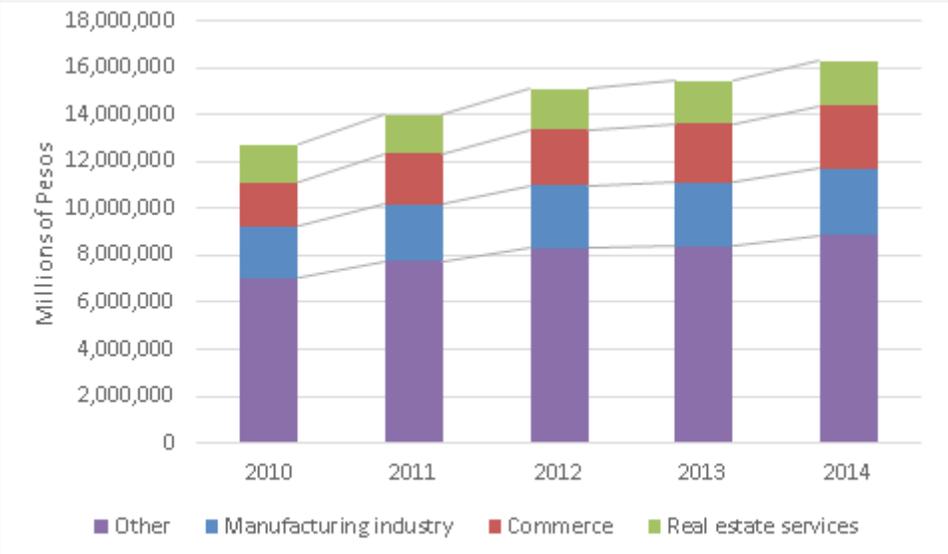


Table 1: Economic development indicators for Mexico
Source: World Bank



PEST analysis

Political

- Federal Constitutional Republic: Mexico is a federation comprising 31 states and a federal district, the capital city.
- Since Mexico joined the North American Free Trade Agreement, it has witnessed a reduction of trade barriers.
- Local governments have the potential to affect business practices significantly. Some local governments may be willing to provide incentives to attract business to the area, such as providing low-interest bonds to encourage a desirable business to move into the community.
- Three years after being elected president, Enrique Peña Nieto's ratings have been falling dramatically (down to 44% in 2015 from 51% in 2014). This is mainly due to concerns over rising prices and crime, and lack of employment opportunities.

Social

- Mexico is a country that is rich in cultural diversity, as evidenced by the more than 62 indigenous languages spoken in Mexico today.
- Mexico still struggles with formal-sector unemployment and poverty. Drug trafficking remains a serious problem.
- Mexico's growing population offers the opportunity to invest in many sectors for children and adults. There will be as many children under 20 as adults over 65.
- The population of the area around Mexico City is nearly 22 million, which makes it the largest concentration of population in the Western Hemisphere.
- According to the World Bank, 53.2% of the Mexican population live in poverty (2014).

Economic

- The country is one of the most industrialized countries in Latin America; the transportation sector accounts for one-fourth of the gross domestic product.
- Tourism is a key industry and Mexico's second-largest economic asset after petroleum.
- Private investment, particularly in the energy sector, may enhance economic growth. For the first time in more than 75 years, foreign and private oil companies will be allowed to produce oil and gas in Mexico.

Technology

- According to the National Council of Science and Technology, in 2006 the report of the World Economic Forum, which includes 125 countries, the indicator of Higher Education and Training places Mexico in the 71st place, in the availability of technology in place 56, and innovation in position 58.
- Mexican government is putting great emphasis on nanotechnology and biotechnology.
- The Internet contributes only 1% of GDP in Mexico; lack of quality in infrastructure.
- E-commerce grew 58% from 2005 to 2014.

Status of transportation

Railways

Mexico's rail network consists of 26,727 km of operational railways^[1] that use standard 1,435 mm gauge. The system is owned by the Mexican government but operated by private parties under concessions awarded since the privatization of the network in 1998.^[2] The two biggest operators are Ferromex, which operates more than 30% of the network, and Kansas City Southern de Mexico (KCSM), which operates 16% of the network.^[3] Other smaller companies operate the remaining tracks. According to the Organization for Economic Co-operation and Development (OECD), rail service performance in Mexico has improved since its privatization, with better management, rolling stock, productivity, increased traffic levels, and market shares.^[3]

The network is mainly used for freight transportation between ports and cities. It is also used for international commerce between Mexico and the United States with seven border crossings (see Appendix G3). The most important ones are: Mexicali; Nogales; Ciudad Juarez and Piedras Negras.^[4]

A high-speed rail project was announced in 2012 between Mexico City and Queretaro, with a length of approximately 210 km. The project was suspended in late 2014 because of economic concerns, as well as risk due to the existence of a freeway between Mexico City and Queretaro. Studies show that in the next five to 10 years the project should be feasible to build, thus generating new opportunities in the rail sector.^[5]

Mexico has important subway and light rail systems in Mexico City, Monterrey and Guadalajara. Mexico City Metro has one of the highest number of riders in the world.^[6] Mexico City also has a suburban rail system which provides service to the Valley of Mexico and metropolitan areas.

Challenges

- Speed levels in certain zones are restricted because the network is too close to urban zones.^[3]
- Double-stack freight trains are not supported in important sectors of the system.^[3]
- There are monopoly concerns because of the control of Ferromex and KCSM, which operate more than 70% of the network, mainly within some strategic ports.^[2]

Opportunities

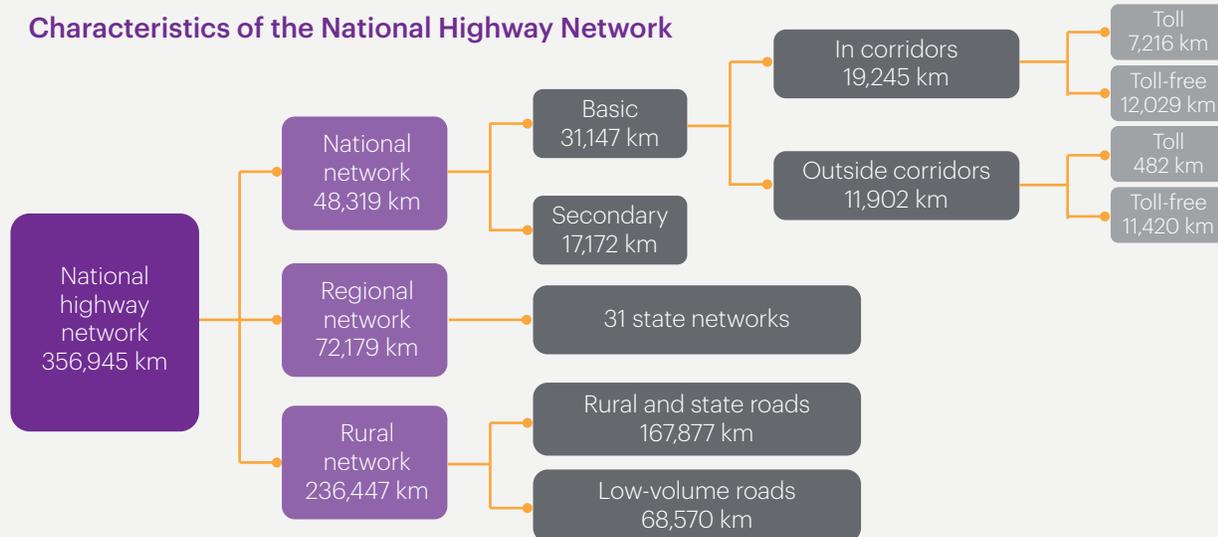
- The systems need new tracks to interconnect port areas to the system.^[3]
- New signals need to be installed in almost the entire network. Due to old signaling, accidents rose 83% since 2007.^[3]
- Natural phenomena such as hurricanes have affected the system, necessitating repair and maintenance of the system in the southern parts of the country.^[3]
- The demand for use of the system, especially for freight, is expected to increase in the future.^[3]
- Currently there are 2,923 km of routes out of service, representing 10.9% of the entire network.^[3]

- Changes to the rail legislation are being discussed, which will allow new operators to come into play.^[7]
- The government sees rail freight transportation as a more effective and less expensive mode of transport than road freight.^[3]
- New routes for passenger commuting between cities are being developed.^[3]
- Government is encouraging private-public partnerships for the development of new routes or operation of existing ones.

Roads and highways

Mexico, considering its size, boasts a massive 0.38 million km of road network length (see Appendix G5). Like most other countries, Mexico has a network of rural roads and state and federal highways (Figure 2). Federal highways are those which connect roads from foreign countries and are built and maintained using federal funding. The Federal Constitution mandates that the states may not “levy duties on persons or goods transiting their territory.” In compliance with this mandate, Mexico has networks of federal and state highways that have free access. However, Mexico also has

Figure 2: Categories of different roadways



highway networks, both state and federal, that charge tolls. But out of 50,000 km of federal roads, only 9,000 km are tolled. Major toll roads stretch from Guadalajara to Zaplotanejo, Maravatio to Zapotlanejo, and Leon to Lagos de Moreno and Aguascalientes.^[11]

Mexico does not charge a vehicle miles travelled tax (VMT tax). At one time gas was heavily taxed; however, beginning in 2006 it was subsidized, although this subsidized charge was eventually phased out. In 2013, Mexico's gas prices were comparable with average international prices.^[10]

Opportunities

- Mexico's government is trending towards brownfield and greenfield projects, with four of its toll roads approved for a DBFO-type procurement by Caisse de dépôt et placement de Québec and Empresas ICA, Mexico's largest construction firm, in a joint venture worth US\$267 million.^[9]
- Logistics managers rate roads and highways eight out of 10 (higher than seaports and airports). This is only getting better, with 90% of the roads already comparable to international standards.^[11]
- Seventy-four percent of federal funding between 2011 and 2013 was used for road expansion. Since then many cities have begun investing in bicycle routes, bus rapid transit and pedestrian routes for safe multi-modal transportation.^[14]

Challenges

- Mexico's toll-free highways are of poor quality; only 25% of its roads are paved. This negatively impacts freight movement, since 70% of the international freight movement is dependent on highways.^[11]
- Problems arise on toll roads like Autopista del Sol, which was constructed with poor material and awarded for a 10-year concession period. The government has bailed out companies and re-privatized in such instances.^[11]
- Road safety in Mexico has been a problem. According to the World Bank, Mexico, along with Peru and Latin America, has the most dangerous roads.^[13]
- Mexico has had to heavily invest in efforts to reduce violence and drug cartels—money which could have otherwise been allotted to infrastructure.^[12]

Seaports

The improvement in Mexico's economy enabled the development of major transportation infrastructure projects, which increased cargo activity.^[36] Mexico has 11,500 km of coastline with a wide variety of port facilities, including harbors, commercial, industrial, oil, fisheries, tourism, and military and national security. (See Appendix G6.) The busiest commercial ports (measured in annual volume of goods as well as number of foreign shipping companies that operate them and their frequencies of service) are Manzanillo and Lázaro Cárdenas ports on the Pacific coast, and the Veracruz and Altamira ports on the Gulf coast.^[45]

Through its ports, Mexico's international maritime trade relations have increased, and are responsible for more than 95% of the tonnage of containerized cargo moving in Mexican ports.^[36]

Opportunities

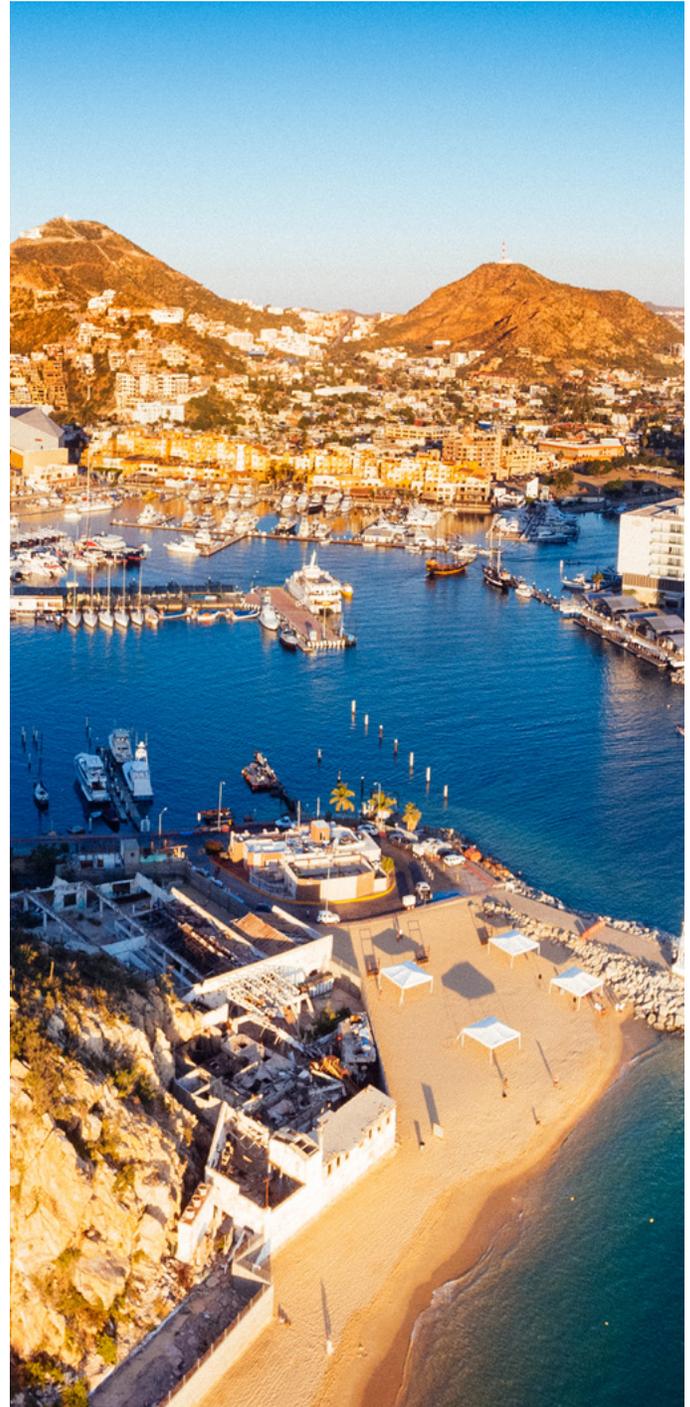
- Most of Mexican infrastructure investment has previously come from public funds, but private investment initiatives have increased. Pension funds are also expected to become investors in infrastructure projects, which would create a shift and boost within the sector.^[46]
- Mexico's logistics and infrastructure sectors provide many opportunities for both local and foreign companies, due to development of investment projects in every sector. The Port of Veracruz project is one of the most

important; it is expected to at least double the port's capacity, and constitutes a major portion of the US\$5 billion investment for port infrastructures. Volumes forecasted were close to 550,000 TEUs in 2001, and in 2015 they increased to just under 900,000 TEUs.^[37]

- According to Mexico's Department of Transport and Communications, the Mexican government has allocated approximately US\$4.5 billion to numerous projects in the country's port sector. Projects include the construction of new ports, specialized terminals and a cruise ship terminal. They also take into consideration the expansion of six ports equipped by infrastructure for new short-sea shipping services.^[44]
- By the end of 2018, an 80% increase of cargo volumes is expected. The Journal of Commerce stated that the volume would reach a little less than 510 million tons annually by the end of the current administration.^[44] Today, approximately 300 million tons pass through the country's ports every year.^[44]
- Macroeconomic policies are said to help Mexico's economic activity and growth as well as consumer power and export activities, which will boost throughput. The US recovery allowed Mexico's container trade sector to achieve great performance with a significant country-wide growth in box throughput for the second consecutive record year.^{[42] [43]}

Challenges

- “Nearshoring” could be perceived as a risk for operators in the freight transport industry, as it implies centralized production close to consumer markets, reliable security and proper skills.^[38] It could also be considered an opportunity, as several parameters such as oil prices and wages, as well as climate change, help to enhance Mexico’s position. Indeed, when companies consider their next production centers, Mexico ranks well. The advantages of “nearshoring” in Mexico are low freight costs, optimized time-to-market rates, and low inventory costs. More production centers in Mexico foster more capacity to enter the US market.^[39] ^[40]
- The US economy impacts Mexico’s economy. For instance, the significant correlation between increased importation of intermediate goods and the economic activity index has shown the strong dependence of Mexico’s economy on the re-export goods sector called maquila.^[44]
- The North American Free Trade Agreement between Mexico and the US has increased trade between the countries; however, only a few Mexican trucking companies have agreed to cross-border transportation trade.^[41]



Airports

The airport system is composed of almost 90 airports and 1,400 airfields.^[47] Until 1998, almost 60 airports were operated by the Airports and Auxiliary Services (ASA, in Spanish). Nevertheless, from 1998, around 40 concessions of major Mexican airports went private. A new system was created composed of 85 airport facilities: around ten were assigned to GAP; the Pacific Airport Group and ten others at OMA, Central-North Airport Group ; ten to ASUR, the Southeast Airport Group , around 30 were managed by ASA and 30 others by the secretaries of National Defense and the Navy as well as various state and municipal governments.^[47] Private-sector concession holders such as ASUR, GAP, and OMA, as well as agencies working with the state ASA, created and initiated technology-driven programs to upgrade ground support systems.^[47]

Opportunities

- In order to finance the plan to convert Mexico into a hub for a state-of-the-art logistics and transportation network, President Enrique Peña Nieto launched the Transport and Communications Investment Program in 2013. This program is said to be achieved by 2018. The program is composed of more than 200 projects and cost just under 1.5 billion Mexican pesos (US\$70 million).^[48]
- The Mexican tourist industry is said to be competitive and is currently contributing almost 3.5% to Mexico's GDP and security.^[49] The US and Mexican governments agreed on

the "open skies" initiative, enabling low-cost carriers to operate direct routes between American and Mexican cities that have no connective transit. The aim of this agreement is to foster decentralization of air traffic in North America, with the priority of connecting smaller cities over utilizing major hubs.^[50]

- The 2014 Mexico City International Airport plan, initiated by President Enrique Peña Nieto, has stated that the Mexico City Airport would be built near the Mexico City Juarez International Airport. Construction costs reach approximately US\$12 billion, and the airport will have a capacity of just under 130 passengers, with six runways, quadrupling Juarez Airport's capacity. Operations are expected to start by October 2020.^[51]

Challenges

- Improvements should follow safety regulations.
- Operations challenges for some airports are extreme: some airports' infrastructure cannot handle the requirements of special aircraft. For instance, the Air France A380 faced challenges with landing in Mexico City Airport. Air France executives stated that it took almost one year for the Mexico City airport authorities to commit to improving the airport facilities. One upper deck boarding bridge was added in 2015 to accommodate the A380.^[52]

SWOT Analysis

Strengths

- Large domestic industry means there is a high level of expertise available to undertake major projects.
- Rise in trade volumes and port throughput, expansion plan at major ports, growth in transpacific routes.
- New public-private partnership (PPP) law will offer investors greater security and should unlock private investment potential in Mexico.
- Fiscal reform opens the potential for greater public sector infrastructure investment.
- Infrastructure investment has been around US\$50 billion a year, equal to 5% of GDP, according to the government.

Weaknesses

- Potential escalation of drug-related violence.
- Weak infrastructure and intermodal links.
- Several large-scale tenders have been postponed numerous times, eroding confidence in the private sector.
- Slow progress and uncertainty regarding the National Infrastructure Program.
- Strong ties to the US economy means that Mexico must take measures to distance itself from volatility in the US market.

Opportunities

- New National Infrastructure Program includes US\$315 billion for infrastructure investment, including transport, energy, water and power. The plan hopes to use private investments for infrastructure investment.
- The current president elected since 2012, Enrique Nieto, has a strong history of infrastructure investment, especially private investment into transport infrastructure.
- President Enrique Peña Nieto launched the Transport and Communications Investment Program 2013-2018, which aims to secure and finance his ambitious master plan to transform Mexico into a hub for value-added logistics and transportation. The program involves more than 200 projects that will cost around 1.28 billion pesos, 45% of which will be allocated for transport infrastructure.

Threats

- US fiscal tightening; dependence to the US economy; rise in Asia-US trade can affect Mexico.
- Mexico has had to spend extreme amounts to reduce violence and drug cartels—money which could have otherwise been allotted to infrastructure.
- Institutional delays could continue to impact construction project implementation.
- Road safety in Mexico has been a problem. According to the World Bank, Mexico, along with Peru and Latin America, has the most dangerous roads.

Geographical analysis

Mexico is a country located in the south of the North American continent. Mexico shares borders with the United States of America to the north; Belize and Guatemala to the south; the Caribbean Sea and the Gulf of Mexico to the east; and the Pacific Ocean and the Gulf of California to the west. Mexico has a 11,122 km coastline, 7,828 km to the Pacific Ocean and 3,294 km to the Gulf of Mexico and Caribbean Sea. In the north and center of the country there are high plateaus, which are surrounded by two major mountain ranges. The Yucatan Peninsula, located in the southeast of the country, is a lowland region. Mexico is located in an area of great tectonic activity, with many faults, volcanos and earthquake zones.

Population density

Mexico's population is approximately 125 million people;^[1] a high percentage of the population resides near the Mexico Valley in the Mexico City metropolitan area (Figure 3). It's the third most populous country in the American continent after the United States and Brazil. Seventy-nine percent of the population is considered urban, with an urban population growth of 1.7% each year.^[1] Eleven metropolitan areas in Mexico have more than one million people residing in them: Mexico City, the highest, with more than 20 million people; Guadalajara, second, with more than 4.4 million people; down to San Luis Potosi, eleventh, with 1.04 million people.

Figure 3: Population density for 2005 by federal entity
Source: INEGI



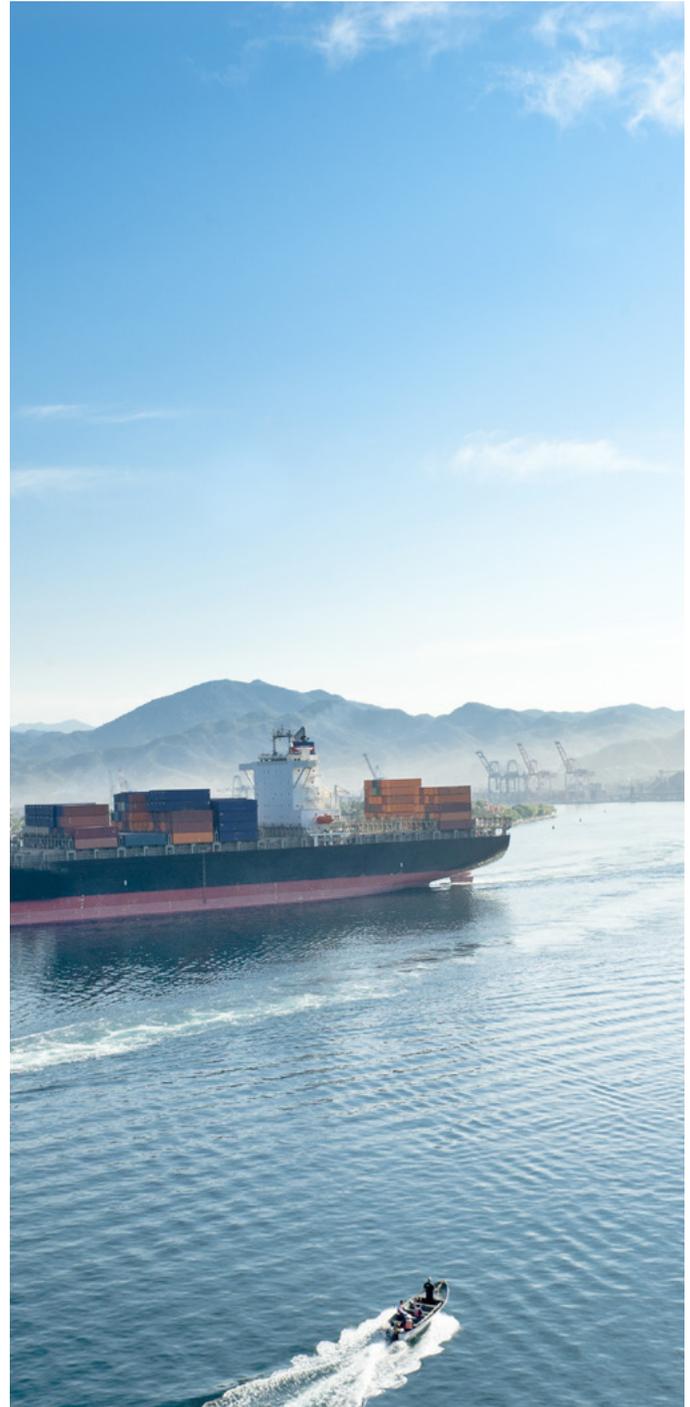
Infrastructure

The road network is present in every part of the country, with a higher concentration in the central Mexico Valley. All of the important cities and economic centers are within the network. There are connections to the neighboring countries such as the United States, Guatemala and Belize.

The rail network is concentrated in the central and northern areas, with the exception of Baja California Peninsula, because of that area's proximity to the United States and the increased opportunity for international commerce. There are tracks that connect the Yucatan Peninsula as well as all major ports. There is an old, out-of-service connection to Guatemala, where a break in gauge occurs (see Appendix G4).

Ports are located all along the coastlines in Mexico. The most important ones are located in the Gulf of Mexico, followed by the Pacific Ocean ports, and less important ports in the Caribbean Sea.

There are 76 airports in Mexico, 58 of them with international qualification. They serve metropolitan areas such as Mexico City and Guadalajara, as well as tourist destinations across the country. It is important to note the position of Mexico as a midpoint between the United States and South America.^[16]



Sustainability

The ITDP awarded Mexico the 2013 Sustainable Transport Award for the BRT system now serving Mexico's population. In addition to that system, Mexico instituted bicycling routes, as well as pedestrian walkways, establishing a resilient and safe environment for multi-modal public access. Mexico has become the ideal example of a Latin American country achieving successful sustainable transport. The city expanded its BRT system, Metrobus, introducing a new line connecting the heart of the city to the airport. It also "piloted a comprehensive on-street parking reform program (ecoParq), expanded its successful public bike system (Ecobici) and revitalized public spaces such as Alameda Central and Plaza Tlaxcoaque."^[17] Mexico City also connected the bus system to local narrow streets, thus serving the majority of the public. These achievements came as a response to the social impacts, such as stress level from longer commutes.^[18] Nearly 90 stations and 1,200 new bicycles were introduced to the Ecobici bike-sharing program, and pedestrian walkways were provided. Cars were prohibited from parking on streets to make space for public transport (e.g., buses and pedestrians).

Leaders from both private and public entities have collected US\$150 million to invest in sustainable infrastructure. The city has attained this investment in order to restructure the current infrastructure system, improve air quality and reverse the progressive deterioration of the current microbus system. EMBARQ will advise

on the proper allocation of the investment fund for different modes of transport, and has stressed that a good starting point is to invest in the management of the current microbus system. These minibuses have attained a bad reputation among the public due to poor management and regulations under which they operate. Restructuring and providing a robust management for the current microbus system will help improve air quality. Also, some of the funds will be allocated to expand the Metrobus system and add two more lines. Therefore, a well thought-out approach in improving sustainability is to rectify the current microbus system, expand the current Metrobus system, and build other systems based on the success of the Metrobus system. The success of the Metrobus (world's sixth BRT system) substantiated the feasibility of responding to climate change with an efficient and economical solution proposed by EMBARQ. Mexico can now position itself on a sustainable path given the financial support, along with strategies complementing their current transport system.

Project pipeline

As per the National Infrastructure Plan 2014-2018 (NIP) proposed by the Mexican government, the federal government plans to invest around US\$300 billion across six sectors—communications and transport, energy, health, urban development and housing and tourism. Of all these sectors, communications and transport accounts for 17% of the investment (US\$101 billion).^[24]

Some of the major projects about to boost competitiveness for exporters and power growth of the country are as follows:

1. Mexico City new international airport: The new airport aims to relieve some of the congestion and traffic in the existing international airport. The project is a collaboration between London-based Foster + Partners and Mexican-based Fernando Romero Enterprise (FR-EE). It would have a single, six-million square foot, X-shaped terminal.^[25] The cost of the project is estimated to be US\$9.16 billion, of which US\$288 million was used in 2016. The Mexico City Airport Group (GACM) is building the facility and will take on operations on completion. It plans to work on the main terminal building, the fuel terminal, boarding platforms, the central service tunnels and support buildings, to name a few. A total of six runways are to be built, three of them to be fully operational by 2020 with 56 million passenger capacity.^[26] The airport, with six runways and 120 million passenger capacity, is expected to be completed by 2050.^[27]
2. The Mexico-Toluca Interurban Train Project: The project involves construction of 57.7 km of new railroads (Appendix G9) to connect the country's capital with Toluca and is estimated to cost US\$2.9 billion. Once completed as scheduled at the end of 2017, the train will have a passenger capacity of about 300,000 passengers a day. SENER is the company chosen to execute the final preliminary design of the line, and is now also responsible for drafting of the corresponding construction project.^[28] As of August 2015, civil works were 11% complete, with three stations under construction. A train fleet of 30 EMUs would operate with a maximum speed of about 160 km/h, giving a journey time of about 39 minutes.^[29]
3. Port of Veracruz Expansion: The Port of Veracruz plans on expanding the northern area by 500 hectares into the Vergara Bay. They plan on building 32 additional docks with specialized terminals for cargo containers. Phase 1 is to be completed in 2015, and involved construction of the 4.3 km breakwater and dredging. Phase 2, to be completed in 2018, involves construction of three terminals. After completion, the port will have 48 berths, with increased capacity.^[20]

4. The Mexico City-Queretaro high-speed rail project: This project calls for a 210 km rail line between Mexico City northwest to Queretaro City, 16 km on viaducts and 12 km in tunnels. Expected completion date was by 2017.^[31] The contract for building the rail link was originally awarded to China Railway Construction Corp (CRCC). However, the contract was scrapped after the government

was accused of randomly favoring CRCC to be the general contractor for the project. The tender is to be re-opened now. Other rivals such as Siemens, Bombardier and Alstom are being considered. CRCC might be eligible for compensation, given the termination of the BOT contract.^[32]



Delivery methods

Procurement agencies in Mexico are bound by many regulations under the Mexican Constitution, codes, decrees and treaties. Article 134 establishes that procurement of all goods and services by the federal public administration, states, municipalities and federal district is carried out through public tenders (except in special justifiable circumstances). The framework for procurement of projects depends on the choice of delivery type and nature of the project. For instance, in a PPP-type airport project like Nuevo Aeropuerto Internacional de la Ciudad de Mexico (NAICM), the applicable statutes would be the Procurement Act, Public Works Act (for commissioning) and the Public-Private Partnerships Act. There are also specific sections within the constitution (like Article 1, Section V) which govern procurement by private companies with the state owning the majority of its shares.^[33]

One of the international treaties that is relevant here is the North American Free Trade Agreement (NAFTA), which sets the rules for investment and trade in Mexico, the US and Canada. Provisions include foreign investment, labor cooperation, environmental protection and access to government procurement. General guidelines on government procurement have been gradually adopted into the legislation. This includes the “national treatment”

for all NAFTA members, where foreign companies are accepted into the government public procurement system and are treated the same way as any other national participant. However, when a contract is incorporated, it is generally requested that the international company choose a national company to be the vehicle with which the government enters a corresponding contract. When an international company is a participant in a project which requires it to spend considerable time in Mexico, it is recommended that a Mexican entity be formed for contract management purposes.^[34]

A consortium of Chinese and Mexican firms (including the China Railway Construction Company (CRCC)) was the only bidder and was awarded the flagship Mexico City-Queretaro high-speed rail project on a turnkey DBOM basis. The Ministry of Transport and Communications annulled the award with a view to re-tender, but in January 2015, “indefinite suspension” of the work was announced in response to cuts in the budget due to the steep drop in crude oil prices. CRCC, the Chinese company, was compensated when it threatened to sue.^[35]

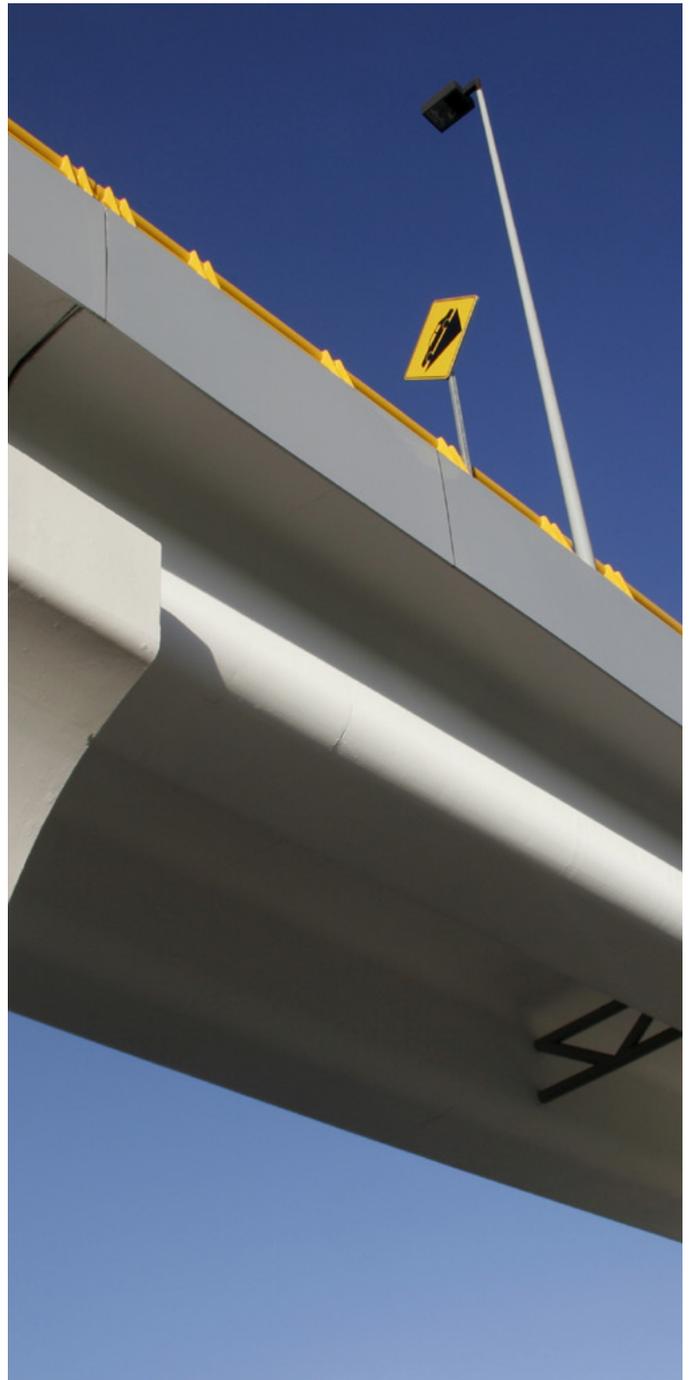
Conclusion

The country's port system continues to thrive and grow, but the road and rail networks are not doing as well. About 75% of the roads remain unpaved and fatalities are among the highest in Latin America. The rail system cannot accommodate proper train heights in vital economic centers. Additionally, the TPP could cause a shift in US transactions towards the Asian market at Mexico's expense.

Although these concerns are valid, there is a positive outlook for Mexico. It is investing heavily in infrastructure at about 5% of annual GDP, and infrastructure has been a means to an independent economy and achieving economic equality in other places such as Medellin, Colombia.

A new airport in Mexico City will help reduce congestion and better accommodate the nearly 30 million annual international arrivals fueling the tourism industry. A high-speed rail will link two of the most important economic centers in the country.

The projects can shape a brighter future for Mexico, but only if they can be fully realized. The government expects to elicit private investment to fund these and many other projects as part of its National Infrastructure Plan and has recently passed legislation enabling PPP delivery. Time will tell if this focus on private investment will be the solution to finally enacting large-scale transportation and economic reform.



Appendix G1: GDP statistics

Table 2: Detailed GDP by sector in millions of pesos at current prices
Source: Instituto Nacional de Estadística y Geografía

	2010	2011	2012	2013	2014
Agriculture, animal breeding and exploitation, forestry, fishing and hunting	425,590	448,103	505,675	506,394	538,018
Mining	966,823	1,298,146	1,315,847	1,176,101	1,168,070
Generation, transmission and distribution of energy electricity, water and gas pipeline	262,368	256,570	248,709	268,925	327,792
Construction	1,040,901	1,152,544	1,236,785	1,166,705	1,229,139
Manufacturing industry	2,199,445	2,393,798	2,703,787	2,713,468	2,881,449
Commerce	1,894,386	2,172,857	2,354,947	2,483,002	2,673,378
Transportation and storage	796,765	860,889	945,708	1,001,762	1,062,472
Mass media information	353,873	347,783	349,354	357,185	363,572
Financial services and insurance	439,976	452,489	472,716	535,440	569,440
Real estate services	1,592,103	1,686,555	1,768,489	1,839,112	1,907,465
Professional, scientific and technical services	290,670	314,793	331,432	345,630	362,171
Corporate	75,756	81,100	92,102	92,078	103,110
Support services to business	406,127	443,877	488,555	516,744	535,713
Education services	529,239	567,719	623,822	662,898	704,399
Health and social services	286,604	310,997	334,330	364,491	382,018
Cultural, sport, recreation and entertainment services	63,423	65,318	69,045	73,519	74,178
Accommodation and food and beverage services	279,801	297,886	323,537	340,863	365,464
Other services except government activities	278,669	291,558	311,645	329,156	344,831
Legislative, government and law enforcement services	540,958	578,274	640,513	669,403	713,927
Total	12,723,477	14,021,256	15,116,998	15,442,876	16,306,606

Appendix G2: Construction contribution to GDP

Figure 4: GDP by construction at current prices
Source: Instituto Nacional de Estadística y Geografía



Appendix G3: Critical railway border crossings

Figure 5: Map of critical railway border crossings
Source: Ferromex



Appendix G4: Railway network

Figure 6: Map of railway network
Source: Ferromex



Appendix G5: Mexico roadway network

Figure 7: Map of Mexico's road network
Source: Economist



Appendix G6: Characteristics of main ports in Mexico

Table 3: Characteristics of the 10 busiest ports in Mexico
Source: SCT, Coordinacion General de Puertos y Mercante, Estadisticas Mensuales

Port	Total Cargo (Metric Tons) - 2013
Lazaro Cardenas	30,781,903
Manzanillo	25,923,821
Veracruz	20,530,234
Altamira	15,333,440
Isla de Cedros	15,234,436
Punta Venado	9,064,845
Guerrero Negro	7,573,513
Coatzacoalcos	7,052,059
Guaymas	5,832,015

Appendix G7: Important airports in Mexico

Table 4: Busiest airports by passenger traffic 2014-15

	Airport	State of Location	City served	2015	2014
1	Benito Juárez International Airport	Distrito Federal	Mexico City	38,430,494	34,252,381
2	Cancún International Airport	Quintana Roo	Cancún	19,596,485	17,455,353
3	Miguel Hidalgo y Costilla International Airport	Jalisco	Guadalajara	9,758,516	8,695,183
4	General Mariano Escobedo International Airport	Nuevo León	Monterrey	8,461,917	7,128,531
5	Tijuana International Airport	Baja California	Tijuana	4,853,797	4,372,865

Table 5: Busiest airports by aircraft operation 2015

Rank	Airport	City/State	2015
1	Mexico City International Airport	Distrito Federal	426,761
2	Miguel Hidalgo y Costilla International Airport	Guadalajara, Jalisco	145,102
3	Cancún International Airport	Cancún, Quintana Roo	
4	General Mariano Escobedo International Airport	Monterrey, Nuevo León	114,428
5	Lic. Adolfo López Mateos International Airport	Toluca, Mexico State	95,063

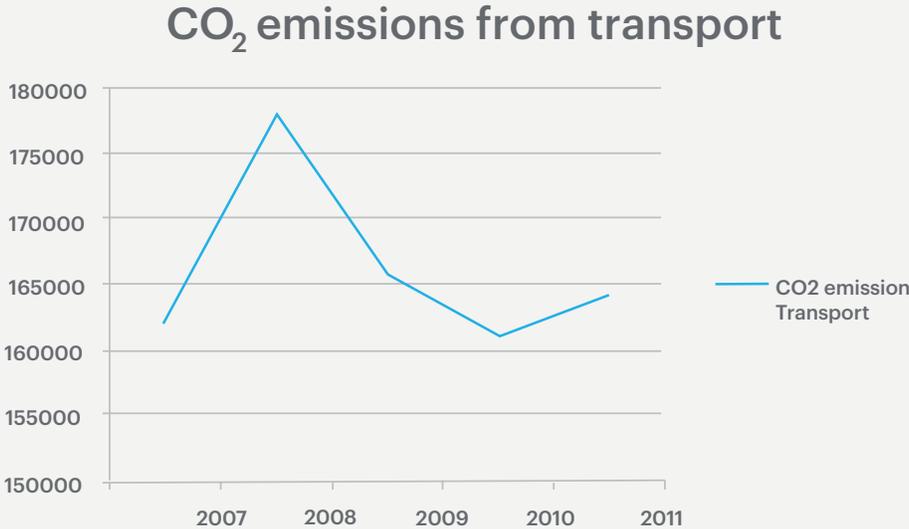
Table 6: Busiest airports by cargo traffic 2014

Rank	Airport	City/State	Total Cargo
1	Mexico City International Airport	Distrito Federal	396,732
2	Miguel Hidalgo y Costilla International Airport	Guadalajara, Jalisco	142,580
3	General Mariano Escobedo International Airport	Monterrey, Nuevo León	43,545
4	Ponciano Arriaga International Airport	San Luis Potosí, San Luis Potosí	28,531
5	Lic. Adolfo López Mateos International Airport	Toluca, Mexico State	26,696



Appendix G8: CO₂ emissions from transport

Figure 8: Mexico's CO₂ emissions (kt) from transport
Source: World Bank



Appendix G9: Mexico-Toluca interurban train route

Figure 10: Route of the Mexico-Toluca interurban train



Poland



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Introduction

Poland is located in Central Europe and is bordered by Germany, Czech Republic, Slovakia, Ukraine and others. It is the sixth-largest member of the European Union (EU) with respect to population.

Despite suffering significant destruction in World War II, Poland has maintained its status as a rich and developed country. The majority of the country's GDP consists of trade and manufacturing. The GDP growth of the country has varied widely in the last five years. It grew more than 10% from 2010 to 2011 and then dropped roughly 5% from 2011 to 2012. Over last three years, the GDP has grown steadily between 3% and 5%.

Much of Poland's infrastructure was constructed after World War II and as a result is now feeling the fatigue of age and lack of maintenance. Fortunately for the system, overall population and urban population have remained steady over the last few years, not bombarding the system with sudden spikes in traffic.

In general the country prefers the personal vehicle to the train or plane. Airports are struggling in Poland and railways have experienced decline in traffic over the years. This looks to remain the same as much of future investment is targeted towards expressways rather than mass transit.

Figure 1: GDP by sector at current prices
Source: Central Statistical Office of Poland

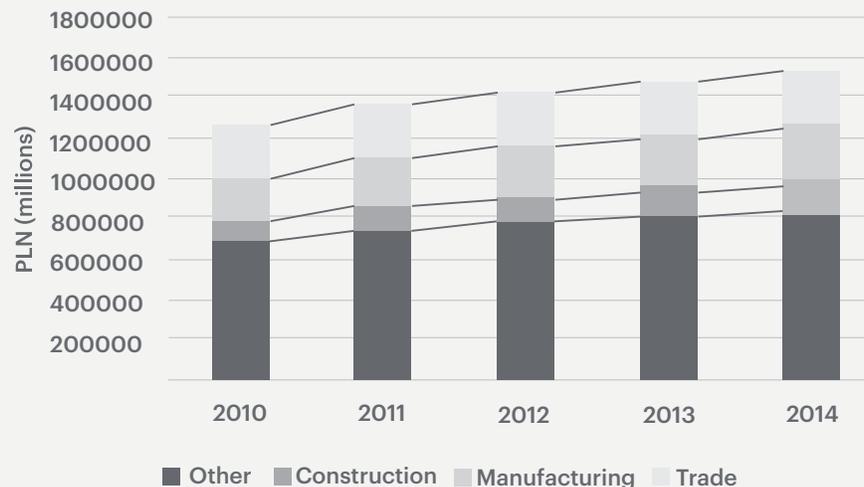


Table 1: Key statistics for Poland
Source: World Bank

	2010	2011	2012	2013	2014
GDP at market prices (current US\$ in millions)	479,243	528,742	500,228	524,059	544,967
GDP per capita (current US\$)	12,597	13,891	13,142	13,776	14,343
Inflation, GDP deflator (annual %)	2.33	3.24	2.39	0.41	0.44
Labor force, total	18,084,506	18,158,612	18,296,625	18,294,714	18,272,368
Population, total	38,042,794	38,063,255	38,063,164	38,040,196	37,995,529
Population density (people per sq. km of land area)	124.21	124.30	124.30	124.23	124.08
Population in urban agglomerations of more than 1 million	1,702,689	1,706,551	1,710,428	1,714,314	1,718,208
Unemployment, total (% of total labor force)	9.60	9.60	10.10	10.40	9.20
Urban population (% of total)	60.89	60.78	60.69	60.62	60.57

PEST analysis

Political

- Poland is a parliamentary republic consisting of two houses, the Sejm, or lower house, containing 460 members, and the Senate, or upper house, containing 100 members.
- To encourage foreign investment, it offers benefits such as low corporate tax rates as low as 19% and, in certain Special Economic Zones, income tax exemption and real estate tax exemption.
- Poland ranks 41st out of 183 countries in Transparency International's Corruption Perceptions Index.
- Stressed relations with Russia following the 2010 and 2014 plane crashes.

Social

- Good performance on social indicators (39/187 on the Human Development Index).
- Poland's population is among the most highly educated in the world (literacy rate of 99.8%).
- Low spending on health care (7% of GDP spending compared to the EU average of 9.5%).
- Social reforms such as government planning to increase the labor participation of the 50+ age group and the under-30 age group.
- May witness demographic challenges owing to a declining birth rate and an aging society.

Economic

- Poland's economy has been consistently growing since its induction into the EU, and it is considered one of the strongest economies in Eastern Europe.
- Although Poland is a member state of the EU, it still uses its own currency, the zloty.
- Problem of high unemployment rates being addressed adequately (down to 7.9% from 10.2% in 2012).
- Poland was ranked 14th in transnational corporations' top prospective host economies.
- Despite being the eight biggest economy in the European Union, GDP per capita remains significantly below the EU average (13,500 compared to EU's 34,300).

Technology

- The country ranks 49th among 142 countries on the Networked Readiness Index according to the World Economic Forum's Global Information Technology Report.
- Poland's innovation performance is well below the EU average. According to the Innovation Union Scoreboard 2011, Poland ranks among the moderate innovators due to a below-average performance in innovation.
- Poland spends a relatively low amount on R&D. According to Innovation Union, the country's total R&D expenditure was around 0.68% of GDP in 2009, almost one-third of the EU average of 2.01%.
- The country has been emerging as a business process outsourcing (BPO) hub. The city of Krakow has been ranked among the top 20 outsourcing destinations.

Status of transportation

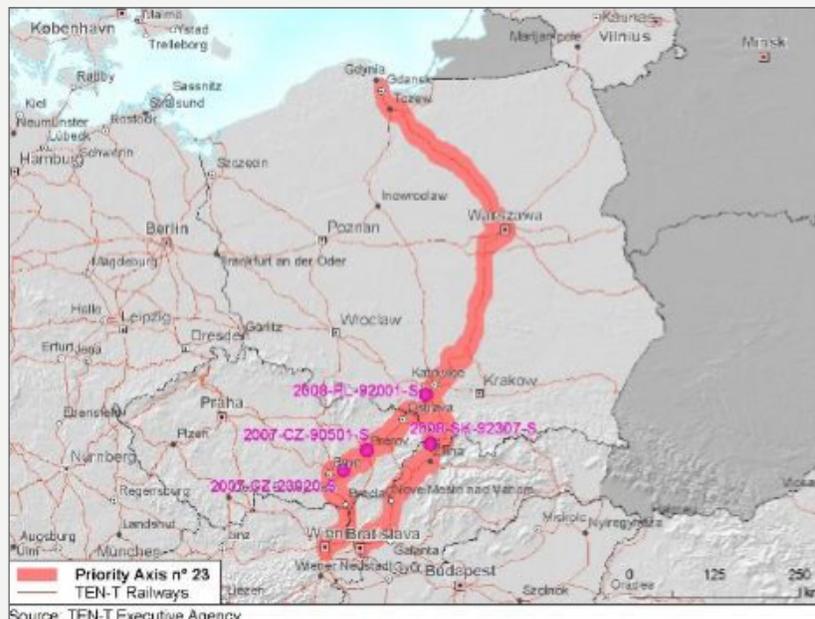
Railways

Poland's rail network is an extensive 23,429 km network run by Polish State Railways (PKP), a state-owned company. Most of the network uses standard gauge and is electrified; however, 394 km (used for cargo operations) are broad gauge (1520 mm) and not electrified.^[1]

PKP has two important subdivisions: PKP Intercity and PKP Cargo. PKP Intercity is responsible for short and long-distance passenger transport; this includes local, regional and international transportation. PKP Cargo is the second-largest European railway freight carrier; it transports coal, aggregates,

construction materials and steel. It operates nationally and internationally with eight other countries. Germany and the Czech Republic are the principal countries with which KP Cargo operates apart from Poland.^[2]

PKP Intercity has introduced the Pendolino recently — a high-speed rail system that connects most of the important cities in Poland. It links Warsaw with Krakow, Katowice, Wroclaw, Gdansk and Gdynia. The trains feature seat reservation, air conditioning, and complimentary WiFi, among other amenities.^[3] These trains are upscale compared with other trains in service. This service is attracting customers for the first



time in 15 years, and data showed an increase in ridership during the last quarters of 2015.

The high-speed lines were built with proceeds from a grant awarded by the European Union that determines a priority axis for construction of new tracks across Europe. The Gdansk–Warsaw–Bratislava–Vienna axis was priority number 23 in the Trans-European Transport Network (TEN-T).^[4] The upgrade was finished in late 2014, and substantially increased track safety, allowing increased speeds in the network.

Challenges

- Even though the number of passengers increased in the fourth quarter of 2015, for the last 15 years the system's total number of passengers has decreased.
- Pendolino trains can only operate inside Polish borders, due to the financing agreement from the European Union, until late 2024.^[5]
- Safety standards for high-speed rail exist only in limited routes. Thus, there are fewer high-speed links between cities.

Opportunities

- Much of the rail infrastructure still needs improvement.
- Most of the network is limited to speeds below 160 km/h because of the aged infrastructure.
- Part of the network can be upgraded to high-speed tracks using funds from European Union or other entities.
- New high-speed rail services, Pendolino, are attracting more public use.

Roads and highways

The Polish motorways and roads authority, GDDKiA, will be tendering 1,800 km of new roads by 2020. They have already tendered 700 km roads. There is current development, but most of the road improvement was carried out between 2007 and 2013, with more than PLN\$74 billion spent—more than half of this came from EU. At the end of 2013, the overall length of motorways in the country had more than doubled since 2007 to almost 1,500 km, and dual roadways now measure 1,248 km.^[6] Now the government's priority is to reduce congestion on existing roads. A big advantage in the procurement process for this sector is that Polish authorities try to tender a project in sections and encourage smaller local contractors to bid, thereby encouraging the local industry.

Only certain sections of all motorways in Poland are toll roads.

Opportunities

- There is an increase in foreign investment due to better accessibility with improved roads.
- Within the frame of the TEN-T budget, large projects may be financed to develop the common EU market.
- More than half the total length of highways between Poland, Czech Republic, Hungary and Slovakia will be located in Poland. Thus many projects will be available in the future.
- The cost of building roads in Poland, when compared to other EU countries, is less expensive.

Table 2: Price paid for journeys in Poland
 Source: Highway Toll Poland

stretch/weight	to 3.5 t	over 3.5 tons
Highway A1	3,50 - 29,90 PLN	8,30 - 71,00 PLN
Highway A2	15 PLN/section	27 PLN/section
Highway A4	4,5 PLN/section	9 PLN/section

Figure 3: Map of roadways
 Source: DocelowyUkladDrog.svg



- Optimize and build, a hybrid of design build and traditional procurement, is becoming popular. This is explained further in the delivery methods section.
- The GDDKiA is working on a National Traffic Management system able to integrate new road infrastructure with intelligent solutions.

Challenges

- Six European governments have complained about the way their companies have been treated in Poland, after participating in the road-building wave between 2007 and 2012.^[7]
- Project details are not clarified immediately, leading to a risk of bidding with incomplete information.^[7]

- Twenty percent of pedestrian fatalities in EU occur in Poland.^[8]
- The complete construction of A1 motorway has been a highly politicized issue, leading to Austria’s biggest corporate collapse since World War II.^[7]

Seaports

On the northwest side of Poland, the ports of Szczecin and Swinoujscie focus on dry bulk cargo, including coal, iron ore or raw materials.^[20] Smaller ports such as Kolobrzeg and Ustka focus on fishing activities and coastal shipping with other Baltic Sea ports. On the east coast, several ports are dedicated to fishermen and recreational sailors.^[21] The two biggest ports in Poland are in Gdansk and Gdynia.

Table 4: Statistics of ports of Gdansk and Gdynia
Source: port.gdynia.pl and portgdansk.pl

Ports	Container handling (tons)	Annual cargo tonnage (tons)	Passengers
Port of Gdansk	10,700,000	35,900,000	118,000
Port of Gdynia	695,000,000	18,200,000	365,000

- The Port of Gdańsk is the largest Polish port. It ranks third in oil imports and second in container ranking on the Baltic Sea.^{[22] [23]}
- The Port of Gdynia is both accessible from the sea as well as highly connected to the city, thanks to important transport infrastructure facilities. Imports focus on iron ore and food, whereas exports focus on sugar, lumber and coal.^[24]

Polish seaports are growing: By 2020, Poland aims at investing more than US\$3 billion (about 10 billion PLN) in seaport facilities, according to the Transport Ministry. The majority of the amount will help financing projects which would rehabilitate and improve port infrastructure. Since 2008, sea ports investment expenditures include projects co-financed by EU funds.^[25]

All the investments improve the position of Polish ports in the region:

- In 2014, the four biggest Polish seaports handled cargo at a total value of PLN\$50 billion. This constitutes a huge increase compared to 2007 (PLN\$30 billion) and 2011 (PLN\$42 billion), according to the OECD.^[26]
- In 2015, an increase of two million tons of cargo was handled in Gdańsk compared to 2014, according to the OECD.^[26]
- In January 2016, the second maritime container terminal in Gdańsk was finished, and cost PLN\$1 billion, according to the OECD, thus epitomizing the great role of ports in the Polish economy.^[26] The budget

of cargo declared by the ports reached approximately PLN\$10 billion every year.^[26]

Challenges

- Environment and economy: Application of ecological initiatives in Polish ports is expensive, and no ecological development can be undertaken without solid financial support contributed by the European Union.^[27]
- Environment and legislation: There is some confusion between EU and Polish regulation and legislation concerning environmental issues; introducing new environmental policy is a complex process. Still, the European Commission is implementing European environmental requirements such as intermodal transportation management, dialogue between port stakeholders, and the respect of sustainability and competition community rules.
- Competition: There is fierce competition in the Baltic Sea. The biggest rivals are Kaliningra and Lubeck.

Opportunities

- The European Union is willing to grant port investment in Poland, although the European Commission maritime regulations can be different from Polish ones, and port authorities are trying to initiate new directives.^[28]
- Expansion of Polish seaports: By 2020 approximately PLN\$1 billion for Gdańsk port investments.

Airports

The Polish airline market was closed until 2004, when bilateral agreements between countries ensured service from Warsaw, the national hub, to regional airports, which used to be controlled by PPL, the state-owned airport authority.^[29] In the 1990s, the airport market was deregulated and PPL-dominant positions were demolished. Almost all local airports became separate companies managed by government, contributing to partial decentralization. Opening the Polish air transport industry to competition decreased the use of the national hub in Warsaw.^[30] Warsaw Chopin Airport handles between 35% and 40% of the passenger traffic activity in Poland. The two airports in the capital handled about 14 million passengers by the end of 2015. Warsaw is the major aviation market in East Europe.^[30]

There are 13 airports operating in Poland; 10 of these are members of the Trans-European Transport Networks (TEN-T). Until the end of 2015, the total value of investments in Polish TEN-T airports was PLN\$4.5 billion (US\$1.5 billion) according to an OECD economic survey in 2016. Airports are taking advantage of this positive trend. They have experienced record increases, with the results of Lublin (+95% year-on-year), Modlin (+40%) and Katowice (+14%) standing out, according to the OECD economic survey of 2016.^[31]

According to Michal Marzec, the director general of the Polish airports, the country has ambitious initiatives planned for airports in order to establish Poland as a new European hub.^[32]

Challenges

Economy: Nationally, the mobility of the population is increasing. Nevertheless, air travel is still moderately low per capita in the country: 0.7 trips per year in Poland compared to 2.5 flights per year for France and Germany.^[33] The European Union provided more than €100 million (US\$125 million) to build at least three so-called “ghost” airports in places where there are not enough passengers to keep them in business.^[34]

Legislation: Respect and establishment of the European requirements. EU and Polish laws are competitive, contradictory and thus sometimes hard to apply. Such laws include: “prohibitions on restrictive practices, supervision of the activities of providers of services of general economic interest, control of concentrations between undertakings and regulations for state aids.”^[35]

Establishment of airport security controls according to the European Parliament.

Technology: Advanced technologies in Poland are needed in the following areas landing systems (ILS/DME), terminal security systems and diverse equipment for airport traffic control towers.^[29]

Opportunities

Traffic: The Civil Aviation Authority forecasts an increase to one flight per year, which means that the number of flights would increase to about 40 million by the end of 2016. Furthermore, an increase of 70%, which represents approximately 65 million flights, is forecasted by 2020.^[36]

Social: As the prosperity of the population increases, air travel is expected to grow at an annual 5-8% over the next 20 years.^[36]



SWOT analysis

Strengths

- Relatively high density of the railway network.
- Good modal balance between rail and road.
- Central location between Germany, Scandinavia/Baltic States, and Central Europe.
- Extensive and affordable accessibility from both Warsaw and numerous regional cities to Western Europe through an extensive flight route network operated mainly by low-cost carriers.
- The concept of sustainable development is recognized as a constitutional rule.
- Comparatively good urban mass transit infrastructure in major cities.

Weaknesses

- Poorly maintained condition of old road networks.
- High level of accidents on roads and highways.
- Inadequate speeds of railway lines (both passenger and freight).
- Inadequate airport infrastructure (particularly in Warsaw) to cope with projected growth in passenger numbers.
- Unfavorable and unstable legislative and regulatory framework for the transportation sector.

Opportunities

- Availability of new and significant EU funding from the Structural Funds and Cohesion Fund, which aims at reinforcing competitiveness, employment and attractiveness of the infrastructure sector.
- Greater utilization of PPP and other innovative financing solutions.
- Further development of international freight transport, building upon the country's central location and wage competitiveness.
- Further development of a robust air transport sector, facilitating increased international accessibility, particularly through "low-cost" carriers.
- Reducing differences in economic development between regions—including increased levels of EU funding for Poland's poor eastern regions where accessibility is at its worst.

Threats

- Political instability resulting in constantly changing transport policies.
- Administrative capacity is insufficient to administer current and future EU funding.
- Environmental and legal conflicts slowing down investment program.
- A significant shift in the modal split towards road transport.
- Highly bureaucratic policies imposed by the government and its agency which discourage international companies.

Geographical analysis

Poland is considered a large country by European standards. It is located in the center of Europe and shares borders with Germany to the west; Czech Republic and Slovakia to the south; Ukraine and Belarus to the east; and the Baltic Sea, Lithuania and Russian exclave Kaliningrad Oblast to the north. The Baltic Sea gives Poland access to the world's oceans. Poland is mainly a plain that extends across the country with an average elevation of 173 meters. In the south are the Carpathian Mountains—where the average elevation is higher than 500 meters—and the borders of Slovakia and the Czech Republic are to the northwest.

Population density

Poland's population is approximately 38 million people, with an urban population of around 60.5%. Since the year 2000, the urban population has declined, on average, 0.2%.^[9] This could be the result of the population moving away from urban centers, or the stagnation in the population growth as in other European countries.^[10] Two of the largest metropolitan areas are located to the south; Katowice, the largest, is a conurbation of approximately 3.24 million people. Krakow, the third-largest metropolitan area of the country, has a population of approximately 1.23 million. In the Central Lowlands of Poland is Warsaw, the capital and second-largest metropolitan area of the country, with 2.68 million people, and Lodz, an important industrial center of the country, with 1.06 million people. The Tricity metropolitan area, located to the north, consists of Gdansk, home of the largest port, and Gdynia and Sopot, together containing 1.2 million people.^[11]

Infrastructure

Most of the infrastructure in Poland was built after World War II, during the Communist regime. After joining the European Union, Poland started to improve all infrastructure systems, including but not limited to the road and rail networks, its ports and airports.

The road network comprises national, provincial, county and municipal roads that reach every part of the country. Main highways connect to international locations, with the exception of Russian exclave Kaliningrad Oblast, where only a single-lane route connects both regions.

The rail network has more tracks in the north and west parts of the country, while the southeast is less developed than the rest of the country. The rail network connects every major city of the country and operates local and international routes. Due to the mostly flat topography, development of the rail network is not a challenge. Warsaw is the only location with subway lines.

Poland has three main ports. The Port of Szczecin has access to the Oder River, which has a canal system, and accesses the southwest industrial regions of the country. The Port of Gdynia and the Port of Gdansk (the largest in Poland) are both located in the Gdansk Gulf, which is connected to the Vistula River, the largest river in Poland. Currently the river can only accommodate vessels in one-third of its length.

Poland has 15 operational airports around the country; they are primarily used for regional and international travel.

Sustainability

The National Sustainable Developmental Strategies (NSDS), also known as the “Sustainable Development Strategy for Poland up to 2025” (Polska 2025), is the long-term framework for multiple other plans and programs, and provides for continuous harmony among societal factors of growth, social unity and environmental protection.

Poland has signed three declarations—Agenda 21, the environmental and developmental declaration of Rio, and the declaration of principles for the forests conservation and management—as well as two global agreements covering sustainable development principles.

In 1991, the Sejm of the Republic of Poland accepted the Ecologic Policy of the state, the first program of its kind, which determined Poland’s goals and strategy for improving the environment. In 1997, the concept of sustainable development was recognized as a constitutional rule; this was a crucial moment in implementation of sustainable development in national legislation. In 2003, the government of Poland started following the “Obligations of Poland” document, which includes the provisions mentioned in the “Action Plan” of the Earth Conference in Johannesburg.

Sustainable development in Poland has been considered a “constitutional principle,” as mentioned in Article 74, in the context of ecologic security and environment protection. Many plans, sector programs and strategic documents have been instituted in support of

sustainable development. Examples of such plans are presented below:

- National Development Strategy 2007-2015
- National Strategic Reference Framework 2007-2013
- Poland 2030. Development Challenges
- National Environmental Policy for 2009-2012 and its 2016 Outlook
- Poland’s Climate Policy
- Energy Policy of Poland until 2030
- National Transport Policy for 2006-2025
- Long-term National Development Strategy (LNDS)
- Medium-term National Development Strategy

Five major projects, at a cost of €293 million paid from the Cohesion Fund, have been supported by the European Commission in order to provide for better sustainable transport services in the most important Polish metropolises. Public transport systems have been modernized to be eco-friendly and sustainable. Travel conditions are more comfortable and more efficient. These investments were all financed by the Polish operational program, “Infrastructure and Environment,” under the same priority, “Environment-friendly transport,” and were finalized by the end of 2015.

Project pipeline

Poland plans to continue its development of transportation infrastructure over the next decade, in order to increase opportunities for international trading. A wide range of projects intended to improve Poland's transport and utilities infrastructure would be dependent on European Union funding.

In 2015, €609 million had been invested by the European Commission from the EU Cohesion Fund to modernize Poland's road and urban transport. There were five projects distributed under three major priority axes: namely, "Transport safety and national transport networks," "Environment-friendly transport," and "TEN-T road and air transport network."^[12]

The Polish General Directorate of National Roads and Motorways (GDDKiA) signed contracts worth US\$843 million to build two S7 dual carriageway sections. The construction works are performed by several independent construction companies from different countries, which are dedicated to certain road sections.^[13]

A new 10-km S8 expressway is also being planned in the country, both S7 and S8 aimed at improving traffic flows on part of a Trans-European Network in a convergence region.^[14] Austrian contractor STRABAG is responsible for designing and building the €57 million project. The work also includes construction of a bridge

Figure 4: Major airports of Poland



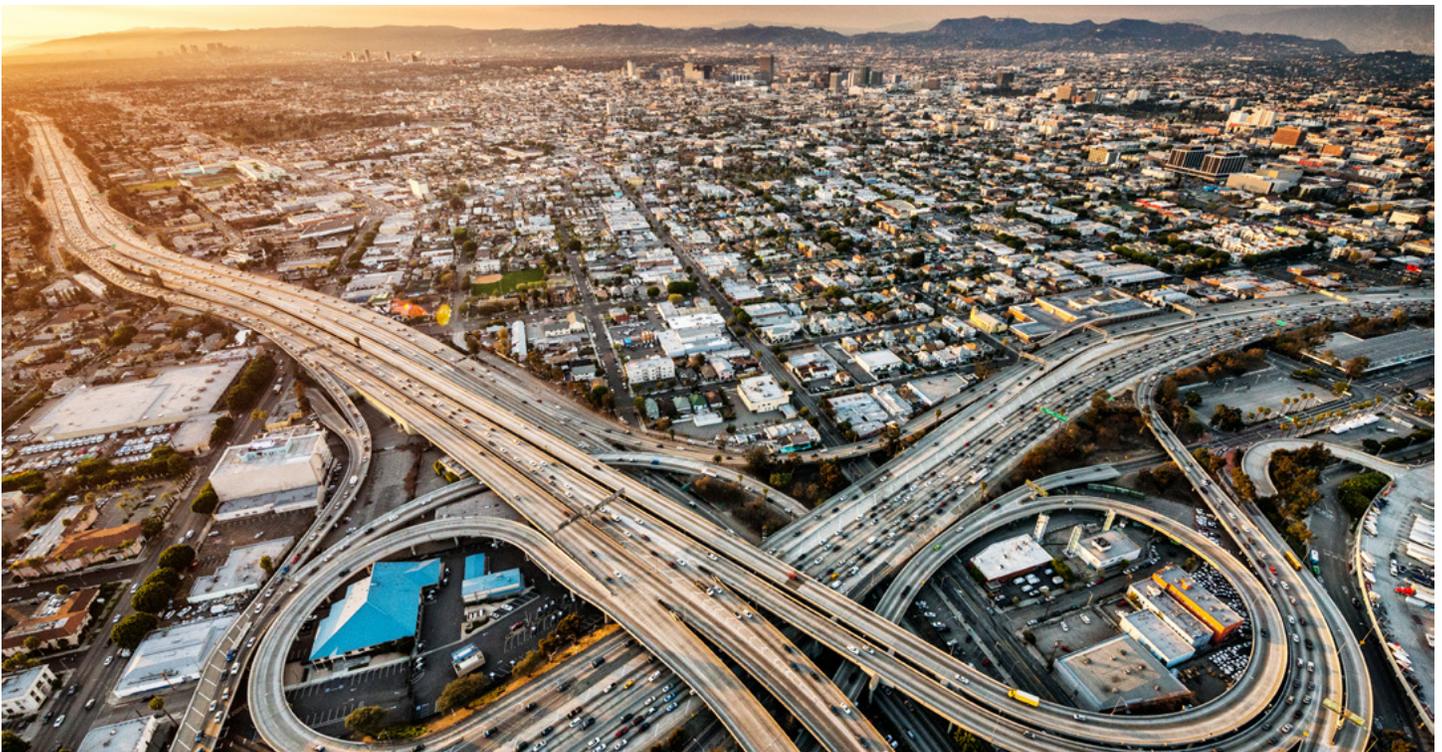
over Pisia Tuczna and the Zabia Wola junction and several other structures.^[15]

Poland has received €17.8 billion in the EU financial period 2014-2020 for transport infrastructure projects. Rebuilding of the existing passenger terminal of Krakow-Balice Airport, worth PLN\$426 million, is being planned. Development of the existing infrastructure of both Krakow Airport and Szczecin-Goleniów Airport is also planned, with values of PLN\$178 million and PLN\$118 million, respectively.^[16]

In January 2015, the European Commission approved €293 million for five public transport projects in four Polish cities: Warszawa (€141

million), Łódź (€111 million), Szczecin (€52.2 million), and Poznań. The projects are financed under the Polish Infrastructure and Environment operational program and their scope includes modernization of the trams, construction and upgrade of tram lines and stops, and much more.^[17]

Moreover, the Seaport of Gdańsk completed the expansion of its intermodal container terminal at the Szczecińskie Quay in January 2016. The construction of a second berth at the Port of Gdansk's Deepwater Container Terminal (DCT) was started in May 2015 and was completed in October 2016.



Delivery methods

In Poland, as is common in most global regions, construction projects can be implemented under various contractual and organizational structures. A broad classification would be: structures without a managing company (done by client) and systems where management is entrusted to an external company. A project manager can assign operations to another party, the project supervisor, for a fee. This is sometimes even required by a project under FIDIC conditions. The conditions underlying a project supervisor role can be found in the Polish Standard of April 25, 2000. The supervisor is not obliged to proceed with a project, but is required to take specific actions in organization and coordination to facilitate project completion. Public contracts involving project management were generally conducted through an open tendering process with price as the only criteria, one of the major ways of public procurement in this region. On July 25, 2014, the Polish Parliament passed an amendment to the public procurement law to address competition based solely on price, rules for retaining deposits and simplified tendering procedures for non-priority services.^[18]

The “design and build” and “optimize and build” systems are a new trend. In optimize and build, the contractor receives a design, which can be optimized or changed as long as the end product retains the same level of performance. This is also consistent with clause 13.2 of the international FIDIC guidelines, which allows contractors to suggest solutions to accelerate project completion.^[19]

Under the programs for building national roads for the years 2008-2012 and 2011-2015, more than 17 contracts have been executed using the design and build approach.^[19] Although not as favored as design and build, the optimize and build approach is also gaining popularity. Another innovative approach, integrated project delivery, is developing a niche in public procurement, as its fundamental focus is to ensure successful project delivery with maximum efficiency for all parties involved, incorporating BIM technology and lean building techniques, with all parties working together in a spirit of trust and collaboration from the beginning of a project.

Quick Fact: The Opacz-Paszkow part of the S8 highway was tendered under the optimize and build system, which led to the bid price being just 65% of the cost estimate. Value engineering played an important role here, which was possible due to this innovative new system.

Conclusion

Poland has one of the most extensive and well-connected railway networks in all of Europe. The nation's roadway system can be considered of similar pedigree. The issue is that the majority of the country's infrastructure, particularly rail, has become obsolete due to its age. The rail system is slower than that of other European nations and the primary airport in Warsaw is not capable of meeting future demand.

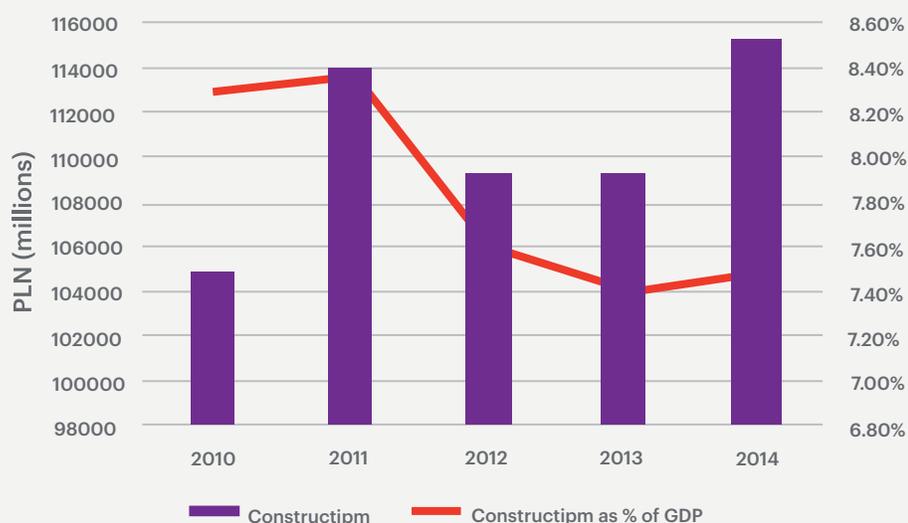
This is changing, however, as the infrastructure systems in Poland undergo a massive refreshment. The European Union granted the country over €600 million in 2015 for road and rail investment. There is potential for similar investments in airports and seaports, on the horizon. Recent advancements in train modernization have caused an increase in ridership for the first time in 15 years. Moreover, a strong national economy and the utilization of the "optimize and build" delivery system enables Poland to consider sizeable projects and efficiently deliver those works. Poland has plans to become a hub and gateway to Europe and the realization of that vision will depend on the development of its infrastructure in the next few years.

Appendix A1: GDP statistics

Figure 5: GDP by construction at current prices
Source: Central Bank of Colombia

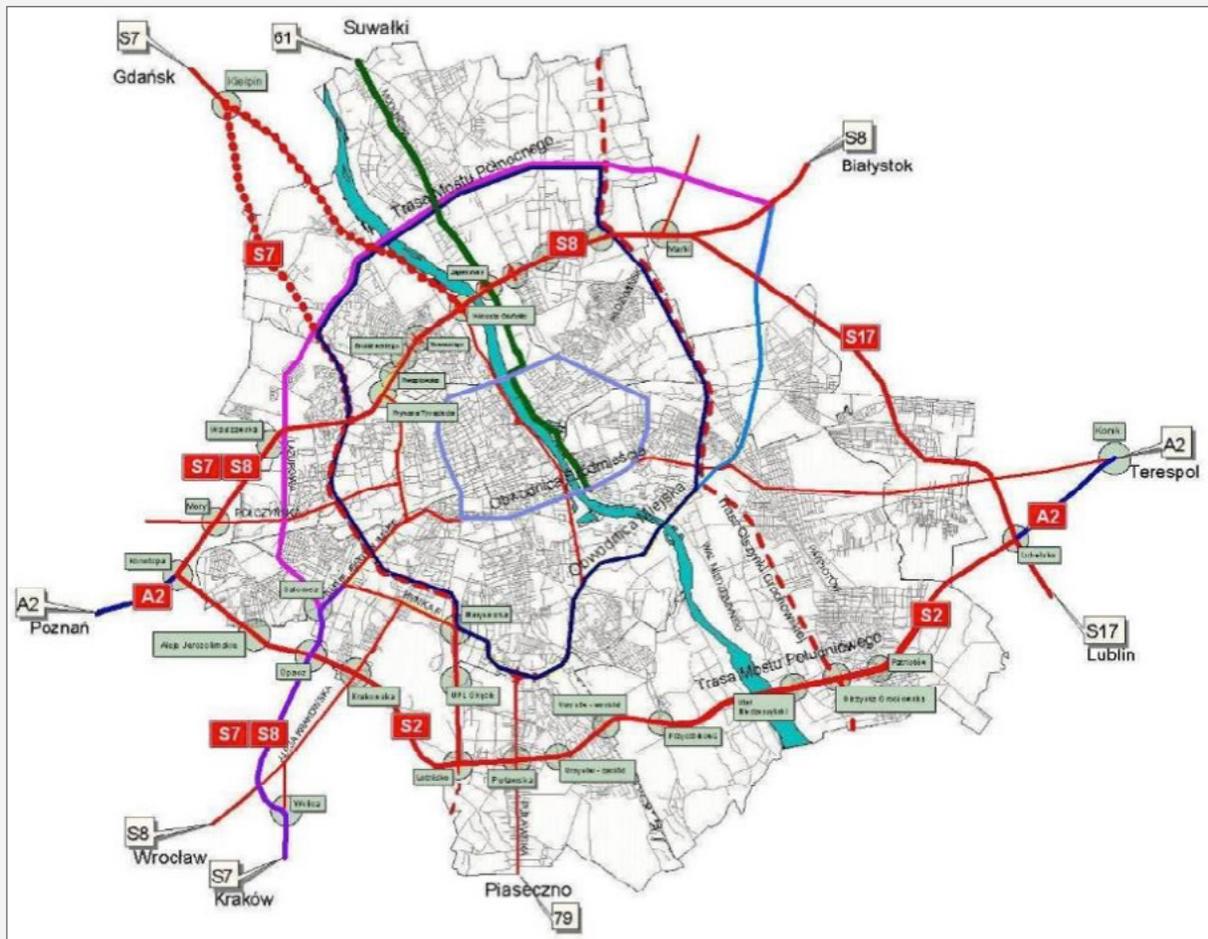
	2010	2011	2012	2013	2014
Agriculture, forestry and fishing	37,520	44,576	46,018	49,191	51,993
Mining and quarrying	30,892	37,309	35,934	31,908	28,299
Manufacturing	221,357	246,873	257,084	266,030	28,2174
Electricity, gas, steam and air conditioning supply	44,184	45,894	50,819	52,170	55,117
Water supply	15,841	16,666	17,459	18,084	19,537
Construction	104,807	113,895	109,112	109,256	115,106
Trade	245,343	252,996	275,104	281,771	294,363
Other	565,960	607,413	640,342	668,751	688,129
Total	1,265,904	1,365,622	1,431,872	1,477,161	1,534,718

Table 5: Detailed GDP by sector in billions of zloty at current prices
Source: Central Bank of Colombia



Appendix A2: Poland roadway network

Figure 6: Roadway map of Poland
Source: European Investment Bank



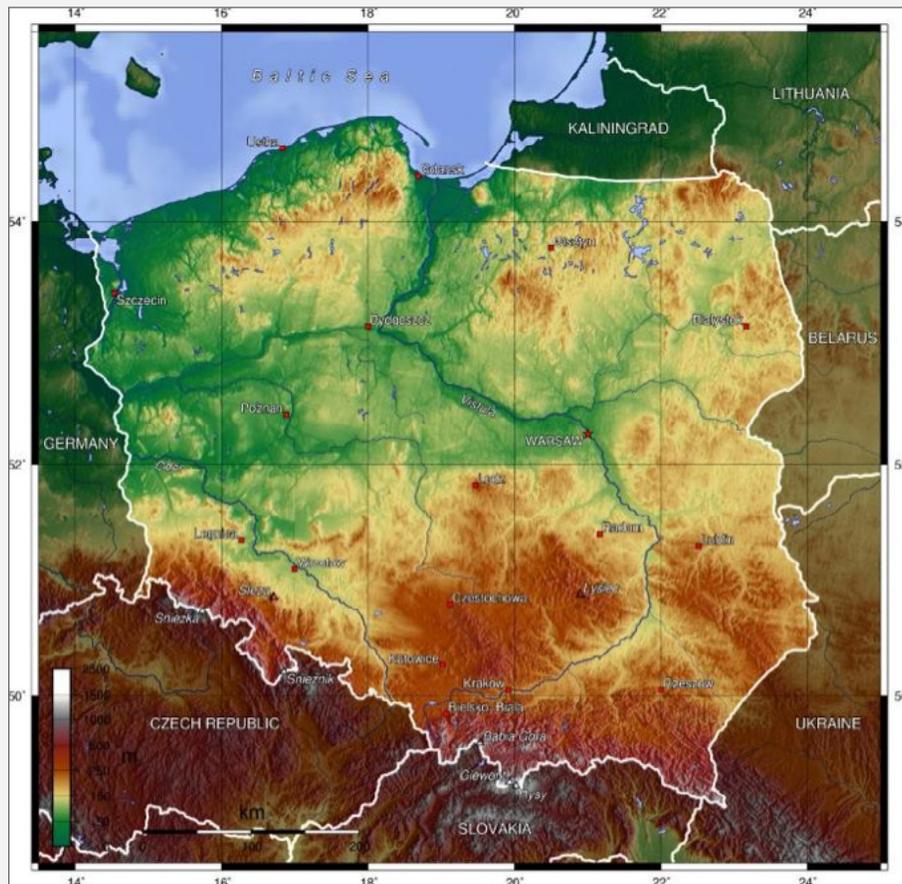
Appendix A3: Map of Poland airports

Figure 7: Airports in Poland



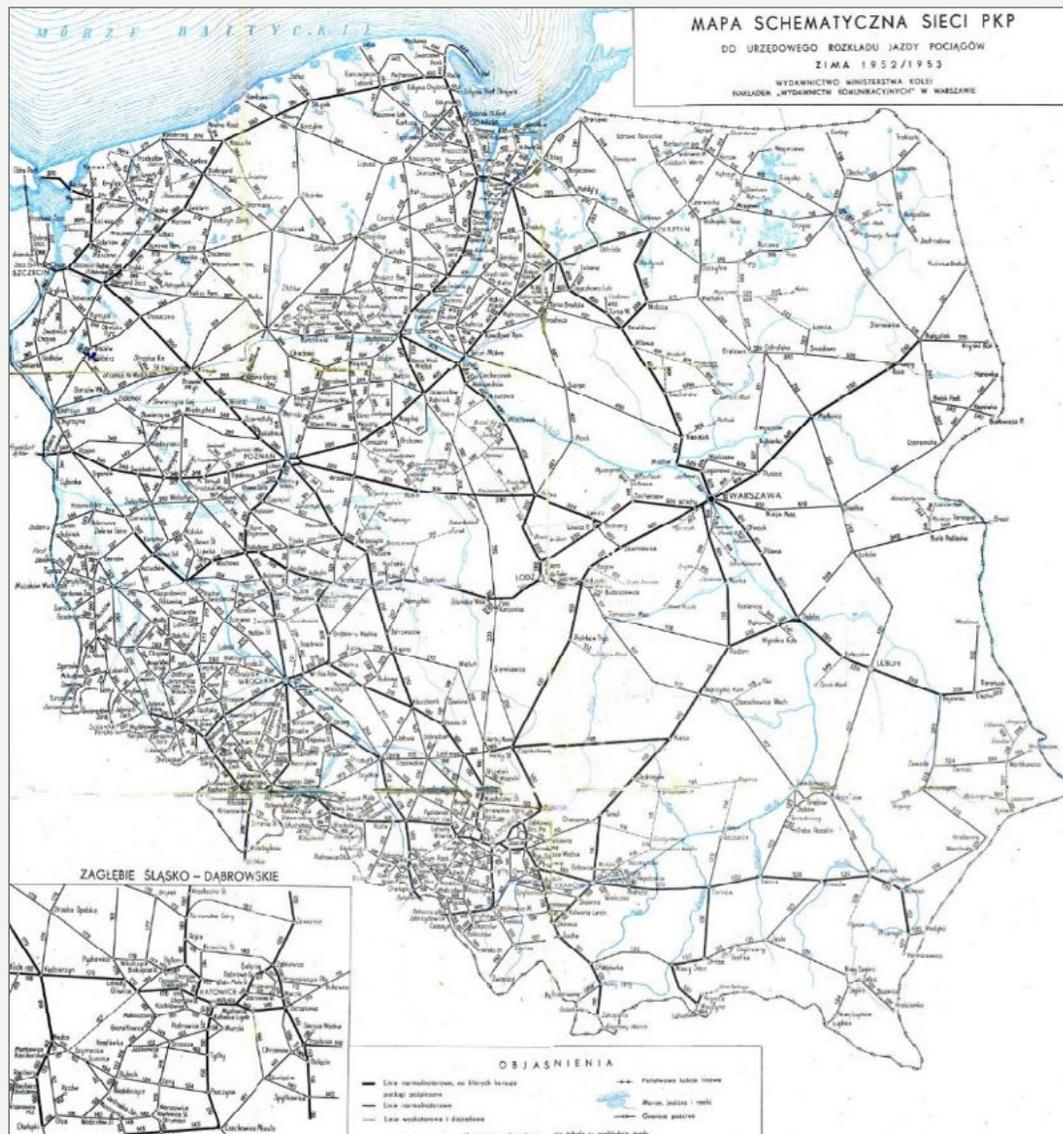
Appendix A4: Topographic map of Poland

Figure 8. Poland topographic map with elevations



Appendix A5: Map of Poland rail network

Figure 9. Poland's rail network



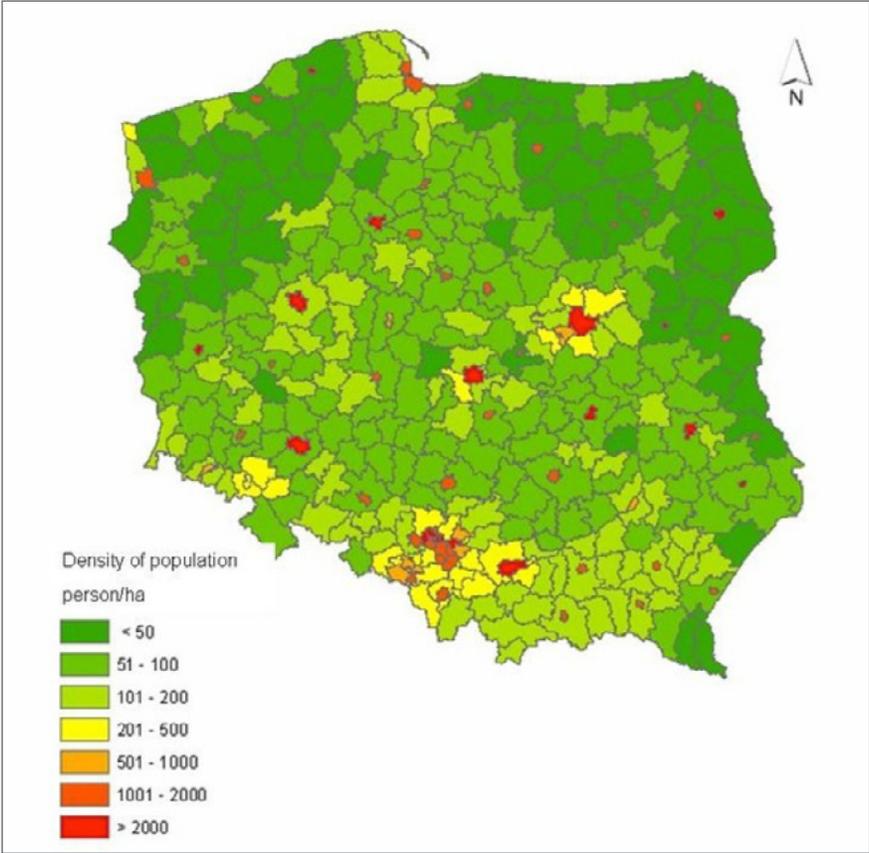
Appendix A6: Map of Poland road network

Figure 10. Poland's road network

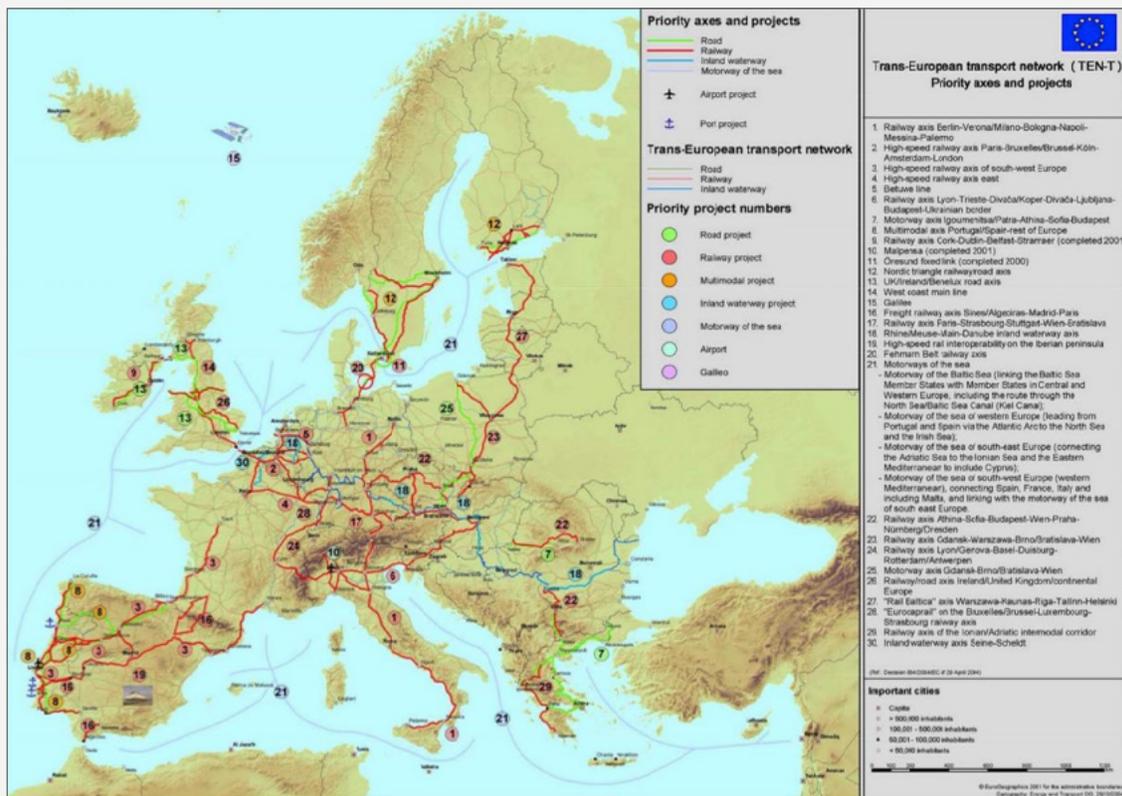


Appendix A7: Poland's population density

Figure 11. Population density in ppl/ha



Appendix A8: TEN-T integration network



South Africa



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Introduction

South Africa is the southernmost country in the continent of Africa. The majority of its border falls along the South Atlantic Ocean and Indian Ocean. The country's land borders include Namibia, Botswana, Zimbabwe, Mozambique and Swaziland. Interestingly, the nation completely surrounds the kingdom of Lesotho. Lesotho is primarily a services nation, with more than 40% of the nation's GDP deriving from government, personal and finance, real estate and business services.

Despite being one of the richest countries in the continent, South Africa has struggled with unemployment, with a quarter of the work force

remaining jobless. Inflation has also been of concern, averaging just over 6% in the last five years. These factors have been reflected in the nation's GDP, which has been steadily declining since 2011.

The nation is the 24th most populous in the world, and the population of the country has remained stable, increasing less than 2% over the last five years. Similarly, it is the 25th largest country by land size, resulting in a relatively low population density. Another result of the expansive land size is a stagnant urban population with less than 3% movement towards urban areas between 2010 and 2014.

Figure 1: GDP by sector at current prices
Source: Statistics South Africa

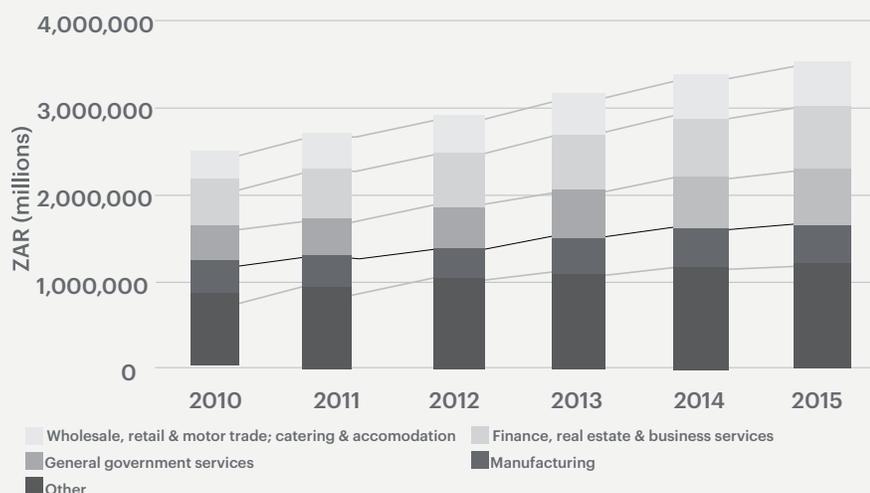


Table 1: Key statistics for South Africa
Source: World Bank

	2010	2011	2012	2013	2014
GDP at market prices (current US\$)	375,349	416,597	397,386	366,244	350,085
GDP per capita (current US\$)	7,390	8,081	7,592	6,890	6,483
Inflation, GDP deflator (annual %)	6.35	6.65	5.51	5.99	5.80
Labor force, total	17,994,649	18,316,871	18,878,104	19,407,803	19,980,062
Population, total	50,791,808	51,553,479	52,341,695	53,157,490	54,001,953
Population density (people per sq. km of land area)	41.87	42.50	43.15	43.82	44.52
Population in urban agglomerations of more than 1 million	17,919,502	18,414,831	18,926,571	19,454,600	19,999,485
Unemployment, total (% of total labor force)	24.70	24.70	25.00	24.60	25.10
Urban population (% of total)	62.22	62.75	63.27	63.79	64.30

urban population with less than 3% movement towards urban areas between 2010 and 2014.

PEST analysis

Political

- South Africa is a parliamentary representative democratic republic, which has the president as the head of government.
- Since the 1990s, the African National Congress (ANC) has dominated South Africa's politics, providing stability in the country and enabling the country to host the 2010 South Africa World Cup.
- Government offers lucrative tax incentives for investments such as the Strategic Investment Project Program which offers a tax allowance of up to 100% on the cost of buildings and machinery.
- High rate of criminal violence, and poor regulations in some of the key sectors like telecommunications, contribute negatively to foreign investment.

Social

- With a growing population of more than 50 million and 11 official languages, South Africa is a highly diverse nation.
- The population of South Africa includes the indigenous people, European, Chinese, Indian, and many more from rest of the world that have migrated to South Africa.
- More than half of the people living in rural areas are Afrikaner farmers who are descendants of the Dutch Calvinists; conversely, urban people are becoming more and more influenced by the urban environment and international and modern life style that surrounds them.
- The poverty rate has decreased in the last 10 years, reaching a record low of 39%, but is still seen as one of the country's biggest threats.

Economic

- South Africa is one of the world's leading mining and mineral processing countries (diamonds, gold, platinum and coal).
- Agriculture contributes only 2.6% of the nation's GDP.
- GDP growth rate is slowing down (0.6% in 2016) while per capita Income is rapidly growing (\$6,068).
- One of the biggest challenges to the economy is the high unemployment rate (24.5%).
- The banking sector is stable and has survived the financial crisis relatively safely compared to other developing countries.

Technology

- South Africa is not a leader in ICT technologies but rather an adaptor, integrator, assembler, and follower.
- Skills gaps: broad IT skills, but shortage of degreed professionals and learners in math and science entering IT-related disciplines.
- South Africa National Roads Agency, with local authorities, will implement intelligent transport systems (ITS) to manage traffic and provide real-time traffic conditions.
- Approximately 7.9 million net new devices and connections were added to South Africa's mobile network in 2014. This will grow to 112 million mobile-connected devices by 2019, fueling a 63% compound annual growth rate in the amount of mobile data traffic generated between 2014 and 2019.

Status of transportation

Railways

South Africa's rail network is the fourteenth-longest in the world.^[20] The network represents approximately 80% of Africa's total network.^[20] ^[22] Transnet (freight) and Prasa (passenger), both state-owned companies and part of the Department of Public Enterprises and the Department of Transport, respectively, manage the system. According to the 2014 update of the National Transport Master Plan (NAPMAP), the condition of the entire network is classified as fair on average, with the freight lines averaging a good status and the lines used by both passenger and freight as fair.^[21] The government, using the NATMAP 2050 as a guideline, has given priority to improvement of the country's rail network, with projects aiming to increase freight rail capacity and increase passenger commute.^[21]

The network is unique because CAPE gauge (1,067 mm) is used in 92.7% of the system. Some isolated branch lines use a narrow gauge of 610 mm (7%), and standard gauge of 1,435 mm is used for 0.3% of the lines (for a private mass rapid transit link between Johannesburg, Pretoria and the OR Tambo Int. Airport). CAPE gauge was used by the government to facilitate building through mountainous regions, and now it is not financially feasible to change the entire system to standard gauge, even though standard gauge would allow faster speeds and greater tonnage capacity. Other factors that are considered are: regional and cross-

border network connectivity with neighboring countries; procurement (it is more cost efficient to select CAPE gauge because of the extensive network); installed legacy systems; stand-alone lines and application. The NAPMAP 2050 says that for new or greenfield lines, feasibility studies should be done in a case-by-case basis following the factors described above.

According to a 2012 report, approximately 2.2 million people commute by train every day in South Africa. Cape Town, The Eastern Cape Province, Johannesburg, Pretoria and Durban have commuter services.

Challenges

- The African Union resolved that standard gauge should be adopted for all new railways lines.
- The conversion to standard gauge on a large scale is not economically viable.
- Transnet estimated the cost of the conversion to standard gauge to be approximately US\$30 billion in 2006, excluding the costs of terminals, handling facilities and operational constraints.^[23]
- Transnet has placed orders for new CAPE gauge locomotives, further committing the system to using CAPE gauge.
- The need for balance between the needs of rail freight and passenger demand, to prioritize future network developments.

Opportunities

- The government has formulated a road-to-rail strategy to rebalance the road freight to the rail network, thus reducing the heavy truck overload on the road network.
- The government is willing to accept new private operators other than Transnet and Prasa, especially for the branch line concessions.
- The system needs constant investment and maintenance because it is mainly used for freight transport.
- Network operators should look for opportunities to migrate portions to standard gauge.
- Transnet and Prasa have expansion plans to increase the rail infrastructure.
- South Africa – Swaziland Rail Link. A new CAPE gauge line for the flow of goods in the region.

Roads and highways

South Africa has the longest network of roads of any African country—760,000 km and expanding, with 10,000 km fully surfaced highways. The Department of Transportation is responsible for overall policy maintenance, while the South African National Roads Agency SOC (Sanral), with the local governments and provinces, are responsible for road building and maintenance.^[3]

According to the SA Institute of Civil Engineering, Sanral is responsible for 16,200 km of national roads. Provincial and municipal roads cover 25,000 km of the road network. Approximately 19% of the roads are tolled and maintained by Sanral. Others, like the N4 road maintained by Bakwena and TRAC, are procured under a BOT mechanism. National highways

Figure 2: National highway network
Source: South Africa National Roads



start with “N,” metropolitan freeways with “M,” provincial main roads with “R” and secondary roads are classified by a number.^[3]

The S’hamba Sonke program was dedicated to rural and provincial road maintenance.

Challenges

- Opposition to Urban Tolling Alliance (*Outa*) was launched to frustrate e-tolling implementation. This is now settled, but similar opposition to new technology may arise.
- Gauteng, the economic heart of South Africa (38% economic value contribution), is not keeping up with its current road requirements, which creates problems in freight movement.^[6]
- Road safety is a significant issue, with 40 fatalities recorded per day.^[5]
- Work on national roads is keeping up with demands, but provincial roads are in a state of disrepair.

Opportunities

- A new scheme has been developed for e-toll users in Gauteng, which cuts rates to 50% to enable Sanral meet its capital and debt obligations by attracting more vehicles. Other private operators, to meet their traffic demands and pay off loans, can use similar schemes.
- R\$870 billion is to be invested in infrastructure (2016 SA budget). R\$3.7 billion is to upgrade the Moloto road, R\$30 billion for provincial road maintenance and R\$18 billion for BRT projects.^[2]

- Bus rapid transit projects are becoming popular, with phases 1A and 1B already operational in Johannesburg, carrying 40,000 passengers a day.^[4] BRT has been successfully implemented in Cape Town and Port Elizabeth as well.
- Sanral, with local authorities, will implement intelligent transport systems (ITS) to manage traffic and provide real-time traffic conditions.^[7] This shows that the government is committed to using modern technology, which creates an opportunity for foreign technology providers under BOT mechanism.

Seaports

The ports of South Africa play an important role in the economies of countries of the Southern African Development Community (SADC). South African ports are the entrance to South Africa, with approximately 96% of the country’s exports conveyed by sea.^[30]

South Africa has eight main commercial ports that focus on supplies or service industry, such as Mossel Bay, which focuses on the offshore oil industry. Richards Bay has the world’s main bulk coal terminal. Durban was previously the largest container-handling facility in the southern hemisphere (overtaken in recent years by Jakarta, Indonesia). Ngqura Port is the deepest container terminal in Africa.^[30]

All of South Africa’s airports were owned and operated by the state until the 1990s, when nine airports were reallocated to the Airport Company South Africa. The state was the only

shareholder until the late 1990s, when 15-20% of the shares were bought by Europeans.^[30]

Privatization measures have been banished from South Africa's ports and replaced with large-scale government investments, which has resulted in improved cargo-handling processes and upgraded facilities.

Eastern region (Durban and Richards Bay)^[4]

Durban focuses mainly on break-bulk cargoes and containers. Richards Bay is largely focused on bulk cargoes and primarily coal export. Combined, the two ports represent nearly 70% of the cargo market in the country.^[31]

Durban is Africa's busiest port. Three out of every five containers entering or leaving the country go through this port. Durban's position in relation to the N3 highway and its high throughput volumes position it as a future hub for world trade.

Central region (Port Elizabeth, Ngqura and East London)^[4]

- Port Elizabeth has dry bulk and container terminals.^[31]
- East London has the largest export grain elevator in South Africa.
- Ngqura is a deepwater port on the east coast on the Indian Ocean.^[32]

Western region (Saldanha, Cape Town and Mossel Bay)^{[2] [4]}

- Cape Town has a container terminal and is famous for its exports volume achieved.

- The Port of Saldanha is the deepest and largest natural port in South Africa, the largest iron ore exporting facility in Africa, the only iron-ore handling port in South Africa and the third-largest port in the country in terms of tonnage handled.
- The Port of Mossel Bay is the smallest of the commercial ports. It is the only South African port that operates two off-shore mooring points within port limits, and it serves as an oil rig supply boat base.^[33]

Opportunities

- The Blue Economy, Ocean Economy, Operation Phakisa ("Hurry Up"). South Africa's ocean economy is said to trigger \$130 — \$180 billion by 2033 and create over one million jobs. This operation is a result-driven initiative. The method relies on eight steps, bringing together important stakeholders from the public and private sectors, professionals and civil society organizations. Key subjects to be studied are offshore oil and gas exploration, aquaculture work stream and marine protection services and ocean governance.^[34]
- Transnet – South Africa's state-owned transport company and main operator of ports, railway and pipelines works on expanding handling capacity of the container ports of Durban, Cape Town and Ngqura. A container strategy has been set to improve both port capacity and inland terminals.
- Expansion of the Port of Durban: Conversion of an 800-hectare zone, including the Durban International Airport, into a dig-out port with a

handling capacity of approximately 9.5 million TEU. The first phase would open by 2019 and its completion is expected for 2050.^[35]

Challenges

- Productivity and performance are the biggest challenges of South African ports.
- Operational efficiencies, fees, taxes and linkages with the land affect port performance.
- Port of Durban's weak productivity cause importers and exporters to bypass Durban in favor of other ports such as Port Elizabeth, Walvis Bay in Namibia and Maputo in Mozambique. While there has been significant investment in cranes and other equipment at Durban, South Africa still remains behind its global competitors regarding port productivity.^[36]
- High prices paid by vessels coming to South African ports have reduced volumes and port stay times.
- Public accountability is a critical issue and must be addressed properly for good governance. An effective regulation against corruption must be undertaken. For instance, Botswana is the top-ranked African state at 37, followed by Cape Verde at 39, Mauritius at 42, and Rwanda at 53. Denmark, Sweden and New Zealand tied at the top with scores of 90. Fragile, unstable states linger at the bottom of the rankings: Afghanistan, North Korea and Somalia all scored eight, according to *Transparency International*.^[37]

Airports

South Africa has an excellent airport infrastructure, which was significantly improved for the FIFA World Cup in 2010.

- OR Tambo in Johannesburg has a capacity of almost 19 million passengers a year.^[38]
- Lanseria International Airport is the second-busiest airport in South Africa in terms of aircraft movements.^[39]
- Cape Town International Airport handles almost nine million passengers a year and is one of the busiest airports in South Africa in terms of passenger movements and one of the busiest in the country in terms of aircraft movements.^[40]
- King Shaka International Airport hosts five million passengers a year; it satisfies the demand for scheduled flights within the 2050 NATMAP planning for the province.^[41]
- Grand Central is less important in size but plays a very important role in the corporate aviation field in South Africa.^[42]

Opportunities

- NATMAP National Transportation Master Plan will ensure strategic transportation development and planning by 2050.
- Capacity is not a major issue and the facilities and associated services meet expectations; however, over-capacity issues have caused higher airport charges.
- South African Airways (SAA) is the national carrier holding a significant aviation market share.

- Innovation (Feb. 2016): Africa’s first solar-powered airport (solar energy supplies 750 kW of its electricity needs) was launched in the city of George. The project was commanded by the Agency of the Department of Transport, Airports Company South Africa ACSA and the Minister for Transport.^[43]
- Maintenance, repair and operation opportunities exist to support requirements of other national and regional airline operators flying into the South African hub.

Challenges

- Local: The political situation surrounding South Africa is not stable.
- Economy: Operation and maintenance costs for innovative initiatives are sometimes too high.

Table 2: Main airports in South Africa, location and total passenger
Source: Minister of Transport

Airport	Location	Total Passenger
OR Tambo I. Airport	Johannesburg	18,621,259
Cape Town I. Airport	Cape Town	8,434,799
King Shaka I. Airport	Durban	4,668,467
Port Elizabeth Airport	Port Elizabeth	1,311,553

SWOT analysis

Strengths

- South Africa has the most effective public-private partnerships environment in Africa (68 active PPPs).
- Recent investment in international airports (R12 billion at CTIA), plus ongoing expansions and operational excellence resulted in the CTIA being named Africa's top airport.
- Cape Town rail, road, bus and NMT planning and investment is ongoing and a strong priority. This is good for the economy, locals, and visitors alike.
- Fourteenth-longest rail network in the world (represents about 80% of Africa's total network).

Opportunities

- An estimated expenditure of about US\$80 billion has been allotted to develop both existing and new infrastructure projects over the next three years.
- The government has formulated a road-to-rail strategy to rebalance the road freight to the rail network, thus reducing the heavy trucks overload on the road network.
- Transnet—South Africa's state-owned transport company and main operator of ports, railway and pipelines—is focused on expanding handling capacity at the main container ports of Durban, Cape Town and Ngqura..
- There are large expansion plans from Transnet and Prasa to increase the rail infrastructure.

Weaknesses

- Unorganized structure for promoting foreign investments.
- Problems with maintenance, rehabilitation, upgrading, and provision of new roads are due to inadequate funding.
- Port roles are shifting; with limited space and capacity, industrial and consumer demands for cargo uses are squeezing out leisure users.
- Distance to Cape Town from major tourism markets and land borders into South Africa makes it much more expensive and, as a long-haul destination, less attractive to the international market for tourism.

Threats

- Several small affordable airline companies such as Velvet Sky closing down as a result of financial mis-management.
- High number of road fatalities (40 fatalities per day).
- Job creation targets not met as a result of poor coordination and planning together at three tiers of government.
- Legislation acts as an inhibitor; i.e., many procedures are governed by legislation, which does not allow flexibility and innovation.

Geographical analysis

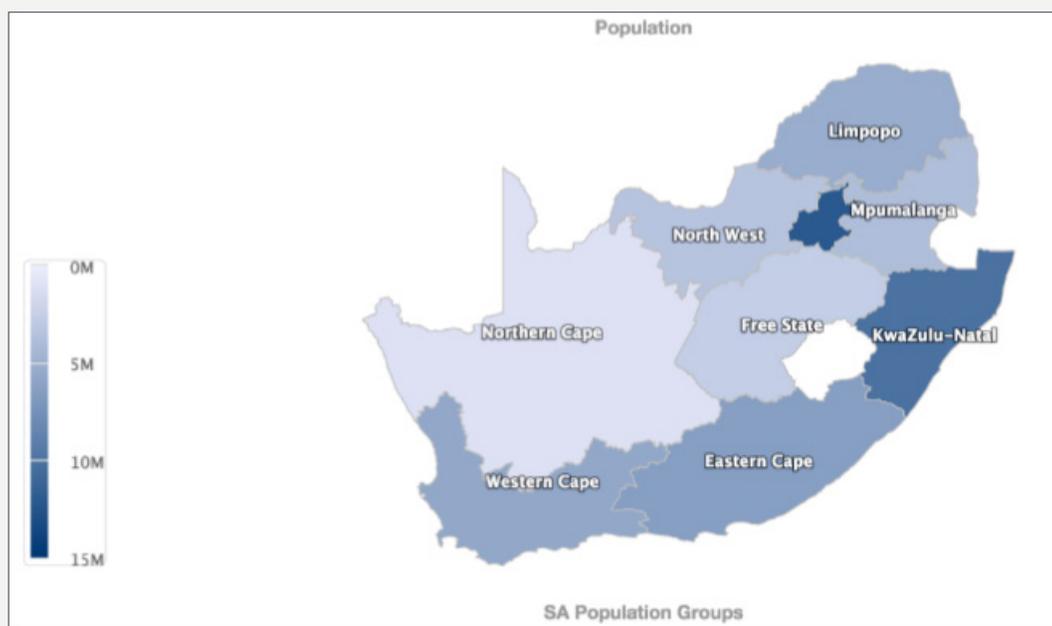
South Africa is a country divided into nine provinces with three different capitals: Pretoria, to the north, is the administrative and executive capital; Bloemfontein, central, is the judicial capital; and Cape Town, to the southwest, is the legislative capital. South Africa shares borders with Namibia, Botswana and Zimbabwe to the north, Mozambique and Swaziland to the east, the Atlantic and Indian Oceans to the south, and it surrounds the entire kingdom of Lesotho. South Africa's coastline is one of the country's more distinctive characteristics, stretching approximately 2,798 km. A mountainous region separates the coastal zone from a high central plateau, which accounts for the majority

of the country. South Africa does not have any navigable rivers, but the Orange River is important to its economy by providing water for irrigation and hydroelectric power.

Population density

South Africa holds approximately 55 million people; the majority of the population resides in the northeast and in the coastal zones. Sixty-five percent of the population is considered urban, with an average urban growth of 2.4% each year since 2006.^[8] Currently six cities account for more than one million people. Johannesburg, the largest, had 4,434,827 people, according to the

Figure 3: Population by region
Source: 2011 census data.



2011 census, followed by Cape Town, Durban, Germiston, Pretoria and Port Elizabeth.^[9]

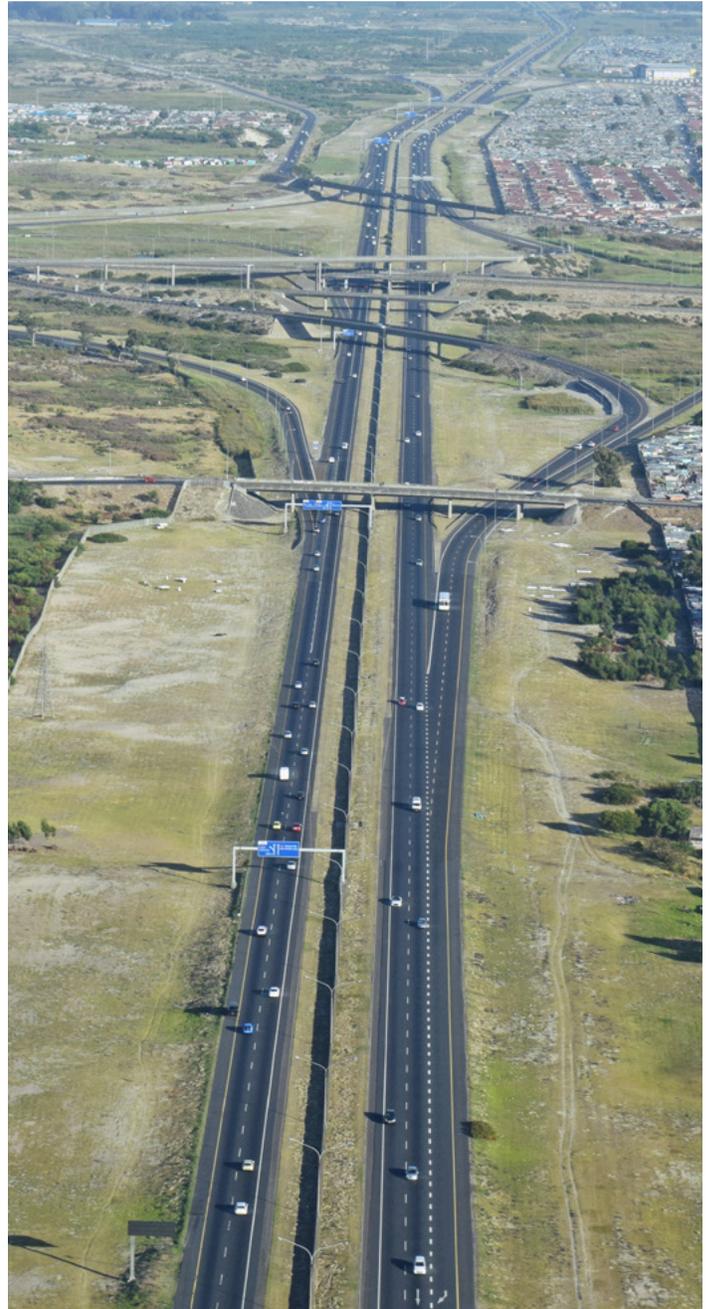
Infrastructure

South Africa has the most advanced transport infrastructure in the continent. The road network has major highways that connect the most important cities and regions of the country. There are two active links with Namibia, two with Botswana, one with Mozambique, one with Swaziland and one with Lesotho.

The rail network is the largest of the continent. It connects all important cities and economic centers. The system uses narrow CAPE gauge for most of the main rail infrastructure because of the topography of the country and for connectivity with neighboring countries.

Ports in South Africa are an important connection to the rest of the world. The largest ports are located where the economic centers are, and are used to export commodities such as iron, steel or other minerals.

Airports are located all across the country; international airports connect South Africa to the rest of the world, with direct flights to the US, Europe, South America and Asia. Johannesburg has the biggest and most active airport in the country, with a capacity to handle 28 million passengers.



Sustainability

Framework

South Africa leads in executing bus rapid transit systems that guarantee travelers quick, dependable and economical transport. Cape Town and Johannesburg were among the first to implement the transit systems in South Africa, and will soon launch a project for a new transit system in Tshwane. South Africa's dependency on non-renewable fuel resources in the transport sector must be addressed; it must diversify oil resources in order to diminish greenhouse gas outflows. South Africa's import of nearly US\$1.19 billion of different petroleum derivatives will have a negative impact on the country's economy in terms of government expenditures and environment. A main contributor of air pollution in Johannesburg is traffic congestion; the adaptation of new sustainable projects will help mitigate the effects of pollution and climate change. The chief director stated that the government is implementing new legislation in order to encourage people to develop more energy-efficient public transport, by increasing the taxes on carbon emissions from vehicles and supporting the use of fuel substitutions and the implementation of green technological resources. The bus rapid transit system was the main and only initiative that was adopted by the government of South Africa to mitigate transport gas emissions. The carbon dioxide gas emissions will significantly decrease from 382,900 million tons in 2013 to 1.6 million tons through 2030, which is a major step towards greener technologies and reducing the reliability on oil resources. The Vaya transit includes 120 bus vehicles and 25 km of coverage and is capable of carrying up to 29,000 individuals per day. New

policies were created to encourage consistency and sustainability development, listed below.

Legislation

- Environment Conservation Act No 73 of 1989: Presents the useful protection and controlled function for the environment and matters related thereto.
- Constitution of the Republic of South Africa (Act 108 of 1996): The highest law of South Africa that provides the legal foundation for the existence of the Republic of South Africa, sets out the rights and duties of the citizens and defines the structure of the government of South Africa.
- Development Facilitation Act No. 67 of 1995: Supports and encourages integrated and efficient land development, discourages urban expansion.
- National Environmental Management Act (NEMA) No. 107 of 1998: Promotes supportive governance and procedures for coordinating environmental functions.

Policies

- Urban Development Framework: Guidelines and programs for sustainable urban settlements.
- Green Paper on Development: Social right protection through spatial development.
- Land Use Management Bill: Principles for spatial planning, land development and land use.
- National Spatial Development Perspective (NSDP): Growth plans and support for government's national spatial development vision.

Project pipeline

The infrastructure in South Africa is very modern and among the most developed in Africa. Projects related to the 2010 FIFA World Cup helped improve the physical infrastructure. In the recently adopted 2013-2014 National Infrastructure Plan, an estimated US\$80 billion has been allotted to develop both existing and new infrastructure projects over a period of three years.^[10] Some of those projects are discussed below.

In the past, S'hamba Sonke Programme (SSP) was a labor-intensive secondary and rural road maintenance program with a focus on repairing potholes. It was an initiative by the National Department of Transportation (DOT), implemented through the Provincial Road Maintenance Grant (PRMG) in 2011. To date, the total funds allocated are R\$23 billion, which has been invested on the Medium Term Expenditure Framework (MTEF). It aimed to reduce the percentage of poor roads from the current 30% to 10%.^[11]

There are 18 strategic integrated projects (SIPs) included as a part of the National Infrastructure Plan, which are a set of catalytic projects aiming to stimulate development and growth of social and economic infrastructure. The Durban–Free State–Gauteng logistics and industrial corridor (SIP2) mainly focuses on strengthening the logistics and transport between SA's main industrial hubs by improving access to Durban's import/export facilities.^[12] It also involves upgrading Pier 2 at the Port of Durban. The port is also being expanded by converting an 800-hectare site (old Durban International Airport) into a dig-out port, with an estimated handling capacity of approximately

9.5 million TEU. The first phase is predicted to be in operation by 2019, with the whole project scheduled to be completed by 2050.^[11]

Additionally, there is a unique A Re Yeng–Tshwane Rapid Transit (TRT) system being implemented in Gauteng, SA. It is a part of the city of Tshwane's 2055 Growth and Development Strategy, which aims to develop a high-quality yet affordable public transport system. The 56 BRT buses in dedicated lanes stop at pre-determined stations. Construction has begun in TRT Phase I, and will be completed in five construction phases, with two different station designs being chosen by the city of Tshwane. The phases in TRT Phase I is scheduled to be complete by June 2017. Some of the contractors appointed for different sections of the project are Lonerock Construction, Mivami Construction, and Superway Construction.^[13]

At the OR Tambo International Airport, the platforms at the Gautrain station near Johannesburg, South Africa are being expanded to accommodate four-carriage trains, double the passenger capacity, and attract more passengers to the integrated rapid rail network linking the cities of Johannesburg and Pretoria with the airport. The year-long project comprises extension of the roof canopy and expansion of the platform by 55 meters, with the use of pre-cast concrete slabs. The concrete parapet will be extended and two fire towers will also be constructed. The Bombela Concession Company, which is responsible for execution of the turnkey project, has appointed Turner & Townsend as the project manager.^[14]

Delivery methods

The traditional procurement system, where the client is under contractual obligation with a design professional and a general contractor, has been in existence for many years now. This type of procurement tendering is open, selective or negotiated. Various other systems are continually gaining popularity, such as the integrated procurement system (DB), management-oriented procurement and collaborative procurement.^[15] South Africa had adopted a ready-made construction framework for project delivery from the British, but post-1994, the government established a Construction Industry Development Board for national reconstruction, growth and development.^[18] The SANS 294, a set of procurement guidelines, are used to make all procurement in the country equitable, transparent and uniform.^[17] A survey conducted by Glober and Pretorius (2002) revealed that

29% of the civil engineering projects were delivered using the integrated approach (DB). Construction management was found to be least popular here.^[19]

South Africa's PPP environment is strong, ranked highest in Africa by the 2015 Economist Intelligence Unit Africa Infrascopes. The framework dates back to 1997. Later a Government Technical Advisory Center and PPP unit were formed to support this type of partnership. There are 68 active PPP projects under construction or operation and US\$17.512 billion in committed investment.^[16] Some successful alternate procurement systems implemented are the Gautrain by the Gauteng Provincial Government using DBP-FO (design build part-finance and operate) and the N3 toll road by the South African National Road Agency Limited using DCOMF (design construct operate maintain and finance).^[15]



Conclusion

South Africa is one of the most well-developed countries in Africa. It has the fourth-longest network of railway tracks and the longest network of roadway on the continent. The ports along the southern coast are key to trading with Europe and Asia and the airport system is widespread, with routes to many of the top-tier international destinations. The country will require major infrastructure investment, however, if it plans to be one of the most developed globally.

Due to antiquated materials in the railway lines, the network cannot accommodate the weight or speed of modern counterparts, and widespread upgrades are economically unfeasible. Roadways are overburdened with freight trucks and smaller roads tend to lack proper maintenance; a lack of efficiency has hurt the port system worse than capacity constraints.

Although these challenges are certainly significant, they are not insurmountable. South Africa benefits from the most advanced PPP status of the continent and can leverage that reputation to attract private investments in all sectors of infrastructure. Compounded with US\$80 billion planned for investment in the next three years, the country's infrastructure system can be significantly enhanced.

The country must upgrade or expand its rail network to provide an acceptable level of service and reduce roadway freight congestion. This will improve the connectivity of the coastal ports with inland population centers, benefitting productivity and local economies. New projects such as the expansion of the Port of Durban can incorporate technological innovations to boost productivity further.

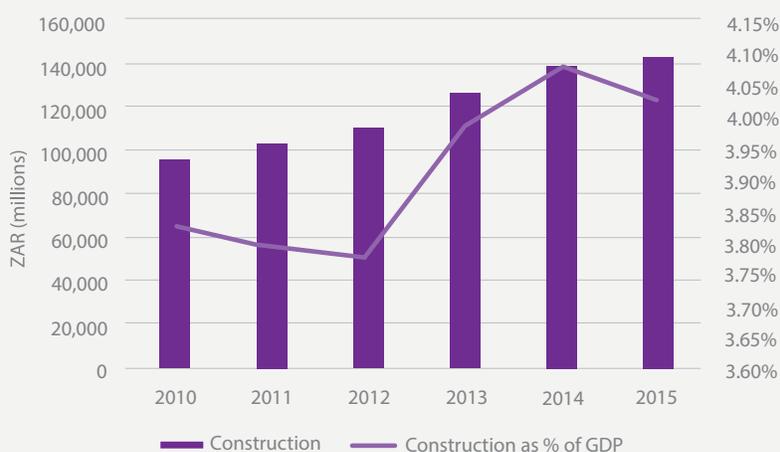
South Africa's infrastructure has a strong foundation to build upon; however, the interdependency between multimodal systems will require a holistic and cohesive development of the country's systems. If these systems are successfully developed, positive trends in GDP and unemployment could certainly be close behind.

Appendix A1: GDP statistics

Table 3: Detailed GDP by sector in millions of ZAR at current prices
Source: Statistics South Africa

	2010	2011	2012	2013	2014	2015
Agriculture, forestry and fishing	65,605	68,591	70,245	73,458	84,662	83,497
Mining and quarrying	230,350	262,392	271,410	284,802	286,606	286,522
Manufacturing	358,699	363,174	385,654	419,930	452,326	462,956
Electricity, gas and water	67,941	86,905	105,773	117,465	125,377	129,794
Construction	95,453	103,302	111,039	126,435	138,917	143,301
Wholesale, retail and motor trade; catering and accommodation	370,581	405,859	441,038	471,008	505,460	535,472
Transport, storage and communication	229,499	258,731	292,841	317,974	339,930	354,296
Finance, real estate and business services	523,526	565,056	606,031	643,166	699,531	743,524
General government services	404,647	449,360	482,144	532,122	578,030	618,167
Personal services	148,561	161,653	173,465	186,599	194,261	203,029
Total	2,494,862	2,725,023	2,939,640	3,172,959	3,405,100	3,560,558

Figure 4: GDP by construction at current prices
Source: Statistics South Africa



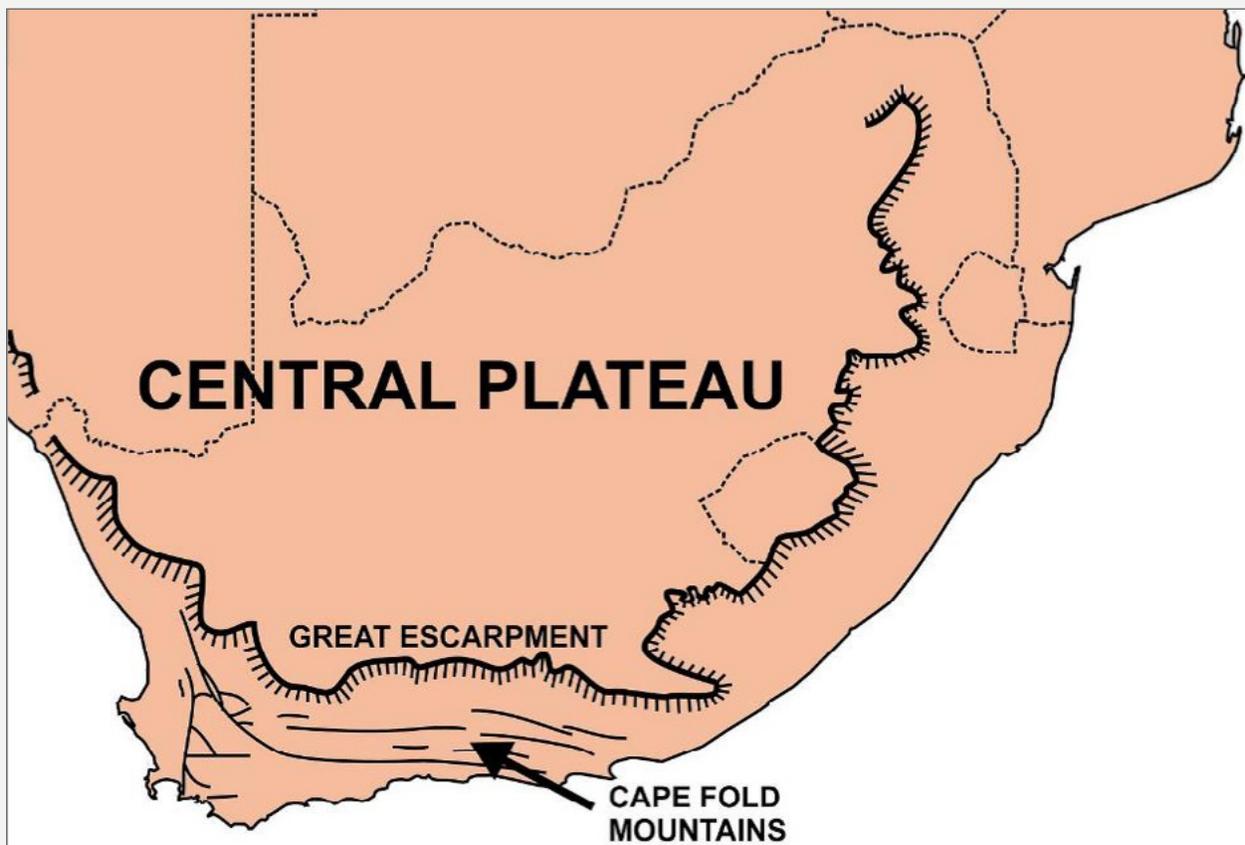
Appendix A2: Map of South Africa

Figure 5: Map of South Africa
Source: United Nations



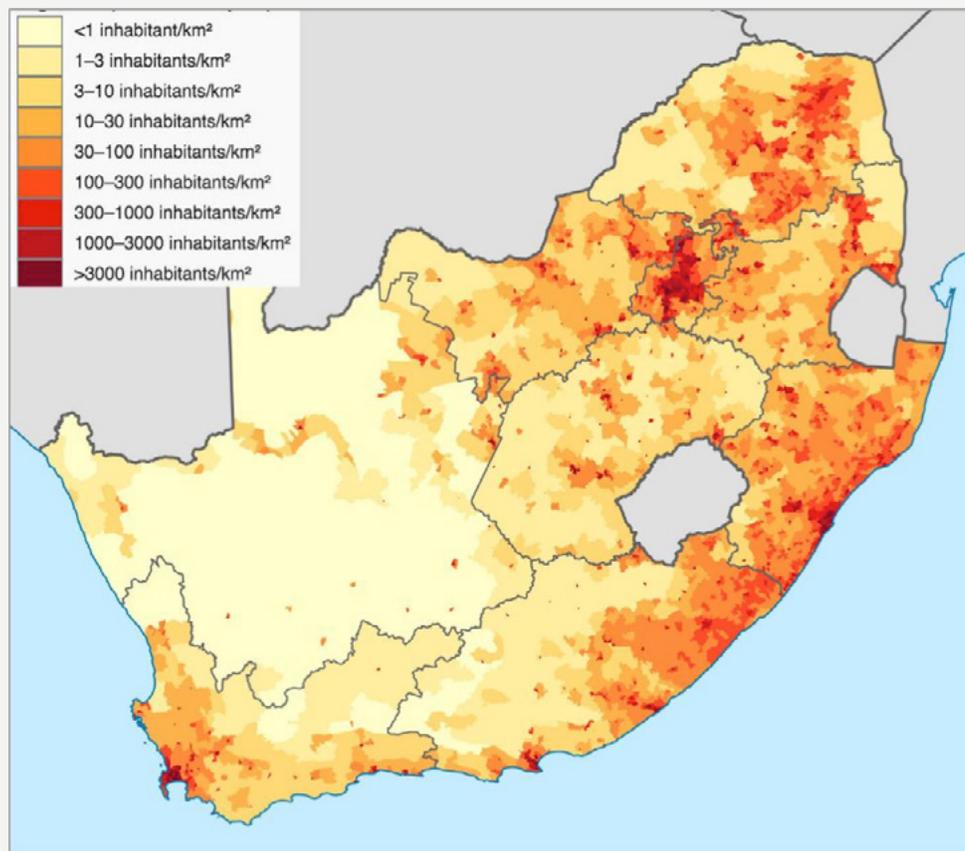
Appendix A3: Map of South Africa Central Plateau

Figure 6: Great Central Plateau of South Africa



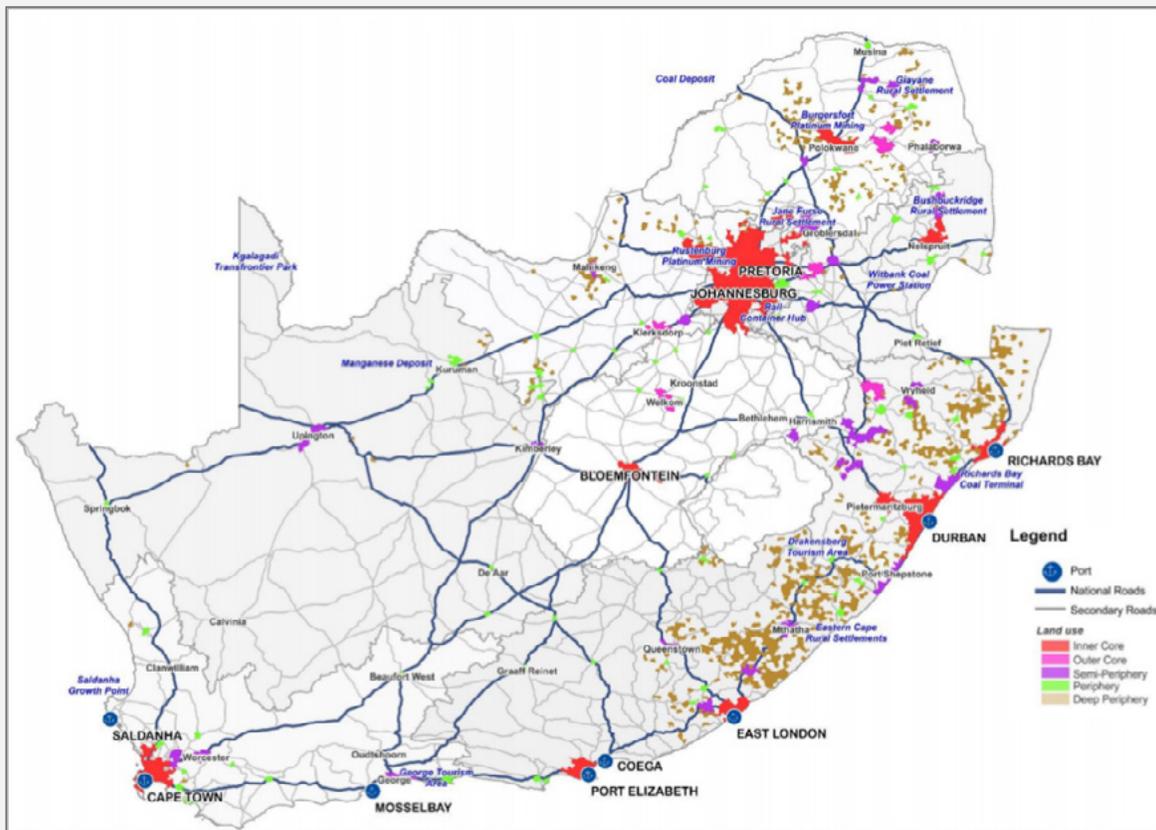
Appendix A4: Population density map

Figure 7: Population density of South Africa
Source: Wikicommons 2011 Census Data



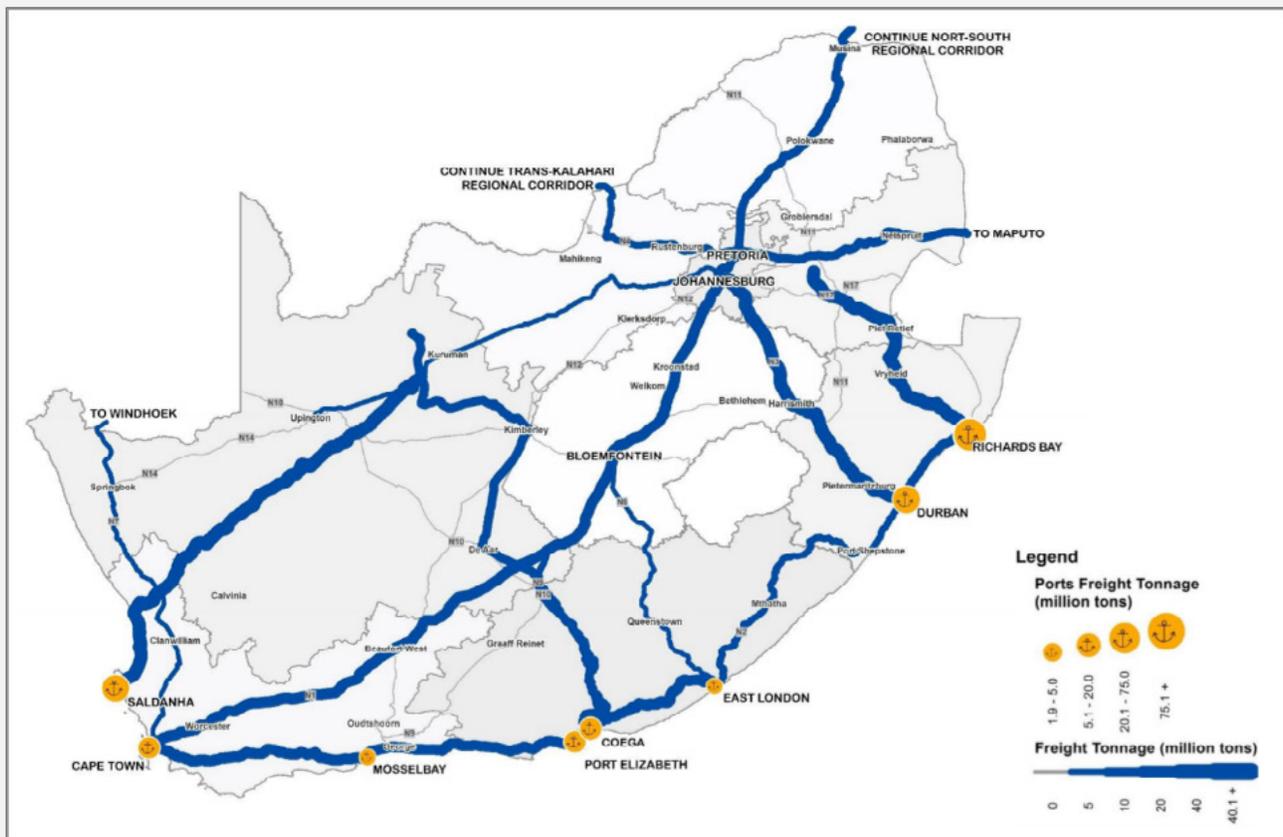
Appendix A5: Notable cities in South Africa

Figure 8: Notable cities of South Africa
Source: Department of Transport



Appendix A6: Map of links between freight tonnage and ports

Figure 9: Link between freight tonnage and ports
Source: Department of Transport



Appendix A7: Breakdown of railway usages

Figure 10: Rail percentage split
Source: Department of Transport

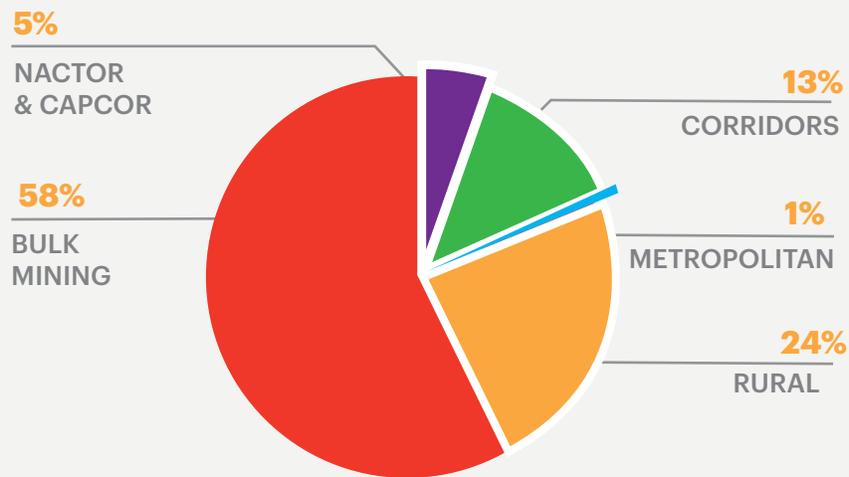
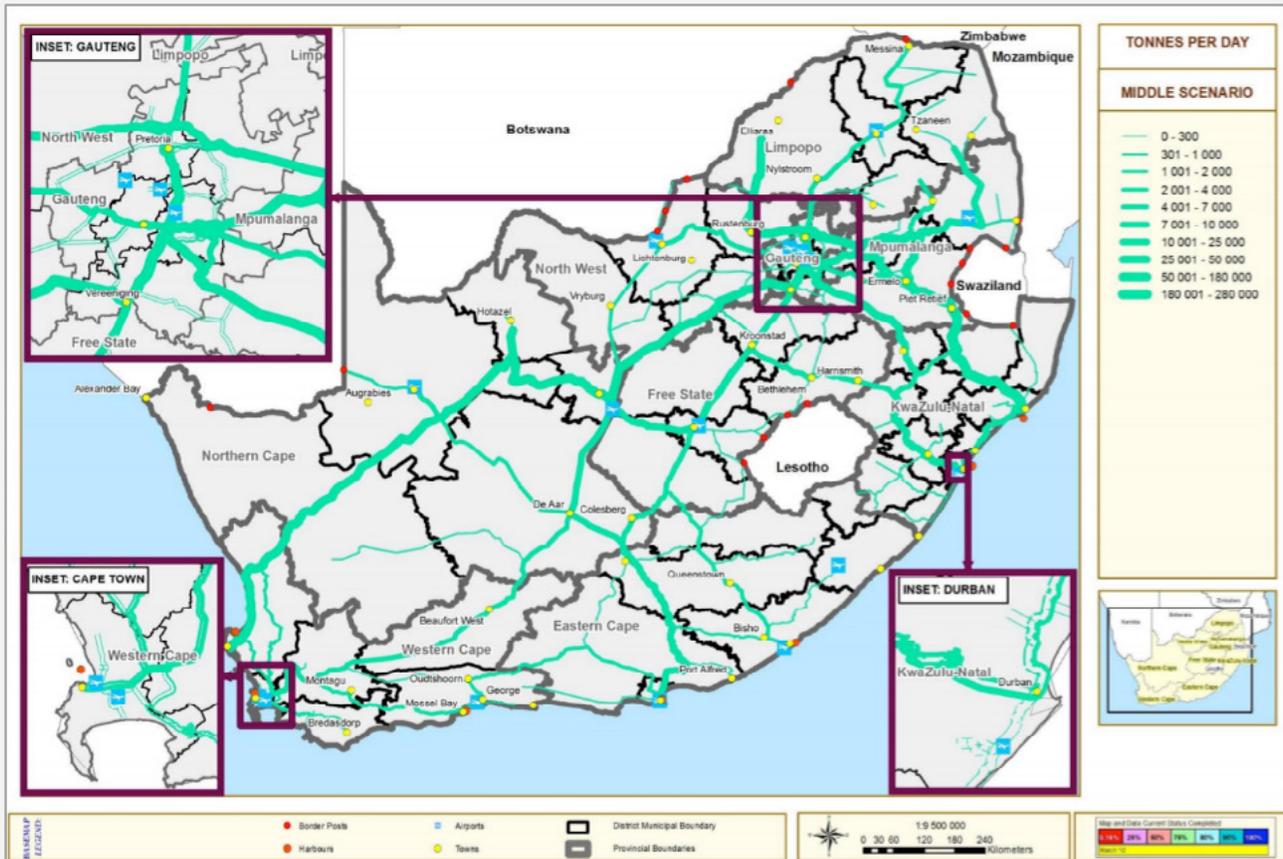


FIGURE 7-4: RAIL PERCENTAGE SPLIT
(Source: State of Logistics Survey, 2013)

Appendix A8: Estimated 2050 rail freight volumes

Figure 11: Estimated rail freight volumes for 2050
Source: Department of Transport



Appendix A9: Rail operators

Figure 12: Rail operators in South Africa

Source: NAPMAP 2050

IMPORTANT RAIL NETWORKS	DESCRIPTION
Suburban Network (PRASA)	The suburban rail networks in the metropolitan areas of the Western Cape, Gauteng, and KwaZulu-Natal are well developed and are maintained by the regional Metrorail offices. Of the 468 passenger rail service stations (across 3 180 kilometres of rail lines), 374 are on property owned by PRASA. The suburban rail infrastructure belonging to PRASA includes 175 route kilometres in the Western Cape, 385 route kilometres in Gauteng, and 138 route kilometres in KwaZulu-Natal. Metrorail also uses Transnet lines for the suburban rail services. The route kilometres span 235 in the Western Cape; 119 in Gauteng; 136 in Kwazulu-Natal; 43 between the Port Elizabeth Station and Uitenhage in Nelson Mandela Bay; and 41 between East London Station and Berlin Buffalo City. The Metrorail operations between Kraaifontein and Malmesbury in the Western Cape, and the services in the Eastern Cape include train authorisation by Centralised Traffic Control (CTC) and colour light signalling. PRASA is currently planning a four kilometre line to Cape Town International Airport. A new line from Duffs Road has been completed and is already operational.
Gautrain	The Gautrain infrastructure belongs to the Gauteng Provincial Administration. The rail connection comprises two links, a link between Tshwane and Johannesburg and a link between OR Tambo International Airport and Sandton. Apart from the three terminal stations on these two links, seven other stations are linked by approximately 80 kilometres of rail along the route. The standard gauge lines allow for a maximum speed of 160 kilometres per hour. The following extensions are currently being considered under the Gautrain Phase 2 development: Extension 1: New line from Mamelodi in Tshwane to Naledi in the south of Johannesburg; Extension 2: Extensions from ORTIA to Boksburg; Extension 3: New connection between Randburg and Sandton.
Kei Rail	The Eastern Cape Provincial Administration leases the 281 kilometre Kei Rail Line between Amabele and Mthatha from Transnet. The Province upgraded the line and introduced a limited passenger service - strategic planning includes the offering of freight services that will support development in the northern areas of the Province.
Transnet Freight Network (TFR)	Transnet's TFR is well-developed and connects to the strategic rail lines of landlocked neighbouring countries. The rail gauge (Cape) allows inter-connectivity and mutual usage of rolling stock and traction between neighbouring countries without any infrastructure complications. A record high of 857 000 TEUs for freight transported on rail was achieved in 2013. For 2013/2014, this network transported 83.1 mt coal, 18.5 mt mining minerals and chrome, 62.9 mt iron ore and manganese, 21.4 mt cement and steel, 11.1 mt agricultural products and bulk liquids, along with 13.4 mt for the automotive and container industries. The Transnet freight network consists of 31 000 track kilometres and 22 500 route kilometres. The main objectives are to: (1) Provide capacity ahead of demand, (2) Ensure sustainability of development plans, (3) Integrate port, rail and pipeline planning (4) Align the network with National road and electricity supply planning (5) Provide capacity through operational efficiencies before infrastructure provision and (6) Ensure proper environmental and social integration.

Turkey



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Introduction

The nation of Turkey has played a significant role in world history. Inhabited since the Paleolithic age, the importance of its location at the intersection of Europe and Asia cannot be overstated.

Turkey's economy is led by the manufacturing sector, which accounted for an average of 17.6% contribution to the GDP over the last five years. The economy is fairly diversified, with the only activities contributing greater than 10% being wholesale/retail trade, transport/storage, real estate activity and agriculture. The country does struggle with inflation, exceeding 5% every year since 2010, and twice exceeding 8%.

The country is home to the 18th-largest population, and Istanbul is the largest city in Europe. As seen in Figure 5, the majority of the country's population is located on the coastlines of the Black, Mediterranean and Aegean Seas. Moreover, the attractiveness of the European economies has skewed the population towards the west. This distribution of population requires well-connected networks of transit systems that can also sustain the heavy congestion of large population centers such as Istanbul and Ankara.

Figure 1: GDP by sector at current prices. Source: Turkish Statistical Institute

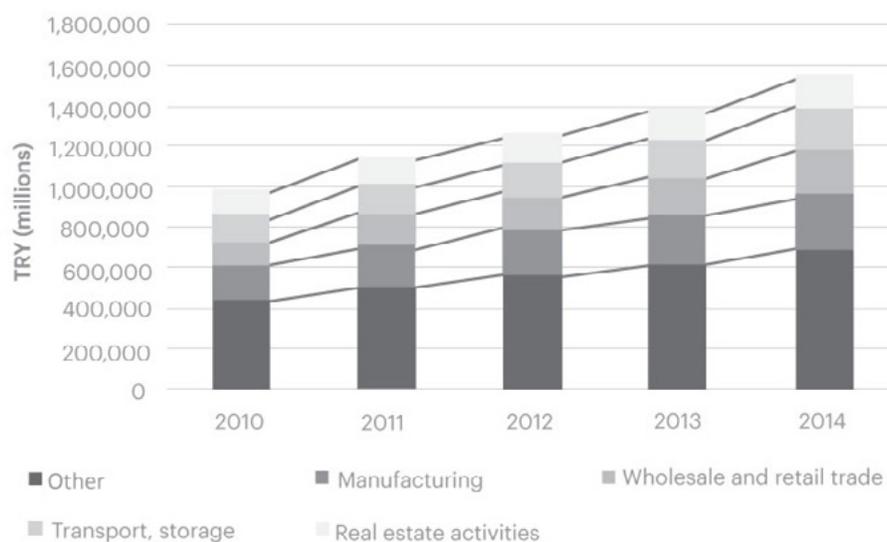


Table 1: Economic development indicators for Turkey
Source: World Bank

	2010	2011	2012	2013	2014
GDP at market prices (current US\$ millions)	731,168	774,754	788,863	823,243	798,429
GDP per capita (current US\$)	10,112	10,584	10,646	10,975	10,515
Inflation, GDP deflator (annual %)	5.68	8.58	6.90	6.17	8.33
Labor force, total	25,644,596	26,585,102	26,941,990	27,354,730	27,778,482
Population, total	72,310,416	73,199,372	74,099,255	75,010,202	75,932,348
Population density (people per sq. km of land area)	93.95	95.11	96.28	97.46	98.66
Population in urban agglomerations of more than 1 million	26,036,680	26,861,638	27,574,632	28,242,488	28,927,418
Unemployment, total (% of total labor force)	11.90	9.80	9.20	8.70	9.20
Urban population (% of total)	70.72	71.28	71.83	72.37	72.89

PEST Analysis

Political

- The Justice and Development Party (AKP) has been the ruling party since 2002, but lost majority in June 2015 and reclaimed it back in November 2015, bringing stability back to the market.
- The ruling party has associated economic growth primarily with a thriving construction industry that supports around 200 other sub-sectors. A major support in growing the industry is tax discounts for urban regeneration projects.
- Minimum labor wage increased approximately 30% in 2016, significantly increasing the labor costs for the industry.

Social

- Being the third-largest in Europe, Turkey's population reached 80 million with an annual growth rate of 1.33%.
- Domestic migration into larger cities and migration from Syria are important dynamics.
- GDP per capita increased by 80%, from US\$5,770 in 2004 to US\$10,390 in 2014.
- Fifty percent of the population is below the median age of 30.
- Twenty cities have a population of more than one million.
- Urbanization rate increased to 91.3% in 2013 from 77.3% in 2012. A main reason behind the significant increase is due to administrative status changes of certain villages and counties.

Economic

- Nominal GDP of Turkey was US\$798.3 billion in 2014 and the economic growth has increased from 2.9% in 2014 to 4.0% in 2015.
- The unemployment rate in Turkey was 10.4% in October 2014 and 10.5% in October 2015, similar to the European average.
- Total export was US\$157.6 billion and import was \$242.2 billion with US\$84.5 billion negative trade balance in 2014.
- Annual minimum wage for an employee is US\$9,031 for 45 working hours per week, 20th highest in the world.
- External debt of Turkey was US\$405.2 billion, which corresponds to 52.5% of GDP, 25th highest in the world.

Technology

- Turkey's gross domestic expenditure on R&D is US\$15.3 billion (0.95% of its GDP), 18th-highest in the world. In 2015, total patent applications obtained by local companies were 5,302, an increase of 13.4%.
- The construction industry in Turkey is reluctant to embrace new technologies, mainly due to the high investments required.
- The use of building information modeling is not very common in the industry due to hesitancy in embracing new technology.
- Green building rating systems (mostly LEED) have become popular in the Turkish construction industry. Having 2.95 million gross square meters of LEED-certified space, Turkey was rated ninth country by USGBC in using green technology.

Status of transportation

Railways

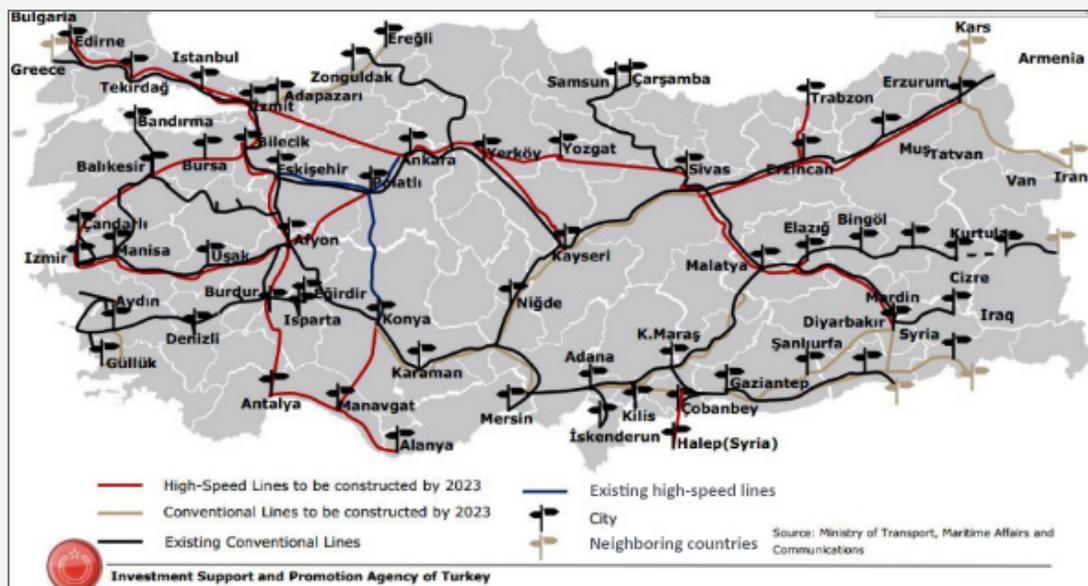
Turkey's rail network is extensive and covers important regions of the country. It is run by the State Railways of the Turkish Republic (TCDD), a government-owned entity. Other privately owned companies operate suburban passenger trains. The network has a total length of 10,087 km including conventional and high-speed routes.^[1] The network uses standard gauge (1,435 mm) in the entire system.

The network is continuously improving due to the country's plans for expanding. Some routes might be closed for work due to construction

zones in the region, thus hindering commerce between local and international regions.^[2]

Turkey, with its 2023 Vision, is looking to increase the capacity of the system, especially the high-speed network across the country. Turkey is comparing the density of its system to other European countries to determine how much their system needs to grow.^[3] Approximately US\$45 billion are expected to be invested into high-speed rail by 2023.^[3] It is not clear how much investment will be made in freight rail improvements. China is a major contributor for the development of the network; they are building the Edirne–Kars railway line,

Figure 2: Rail network plan for 2023
Source: MTMAC



which will reduce the travel time between the two cities, one located in Europe and the other in Asia, from 36 hours to 12 hours.^{[3][4]}

Turkey plans to expand its network by adding 10,000 km of new high-speed rail lines and 5,000 km of conventional rail lines, which will integrate with the Trans-Asia Railroad Network and the Trans-European Transport Network.

Challenges

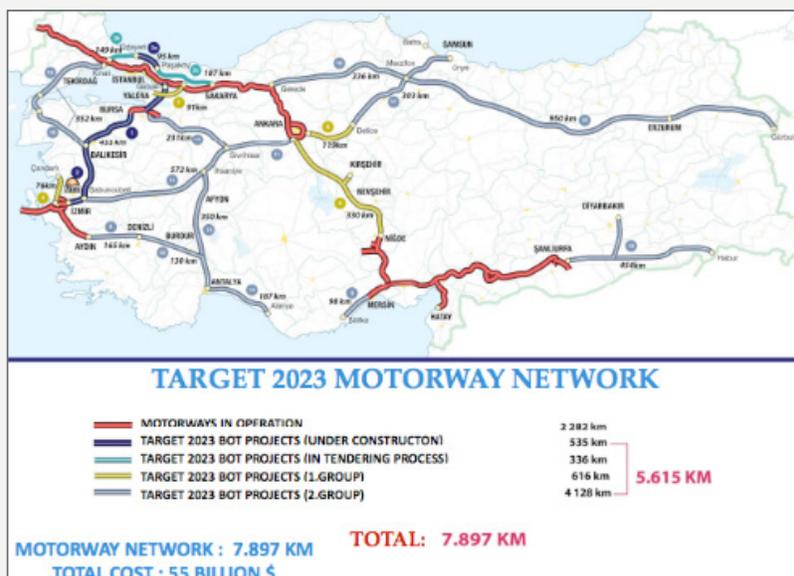
- Ongoing conflicts in the region might drive away investment from foreign and local companies.

- Turkey's policies that continuously attract private investment might represent a challenge for competing firms to get certain projects.^[35]
- Commerce is declining in some areas because of construction of new high-speed or conventional lines.

Opportunities

- The use of standard gauge in the entire system allows higher speeds for passenger commute and more capacity for freight travel, as well as interconnectivity in the entire system.

Figure 3: Target 2023 motorway network^[6]



- Turkey wants, under their centennial vision for 2023, to increase the railway transportation for passengers to 10% and 15% for freight transportation.
- The government is expected to open large projects to private investment via the private-public partnership method.^[35]

all under General Directorate of Highway's (GDH) control. Village, tourist, forest and urban roads are controlled by separate institutions. The GDH is a public entity under the ministry of transport and communication and is responsible for planning, design, construction, maintenance and operation of highways in compliance with law 6001.^[5]

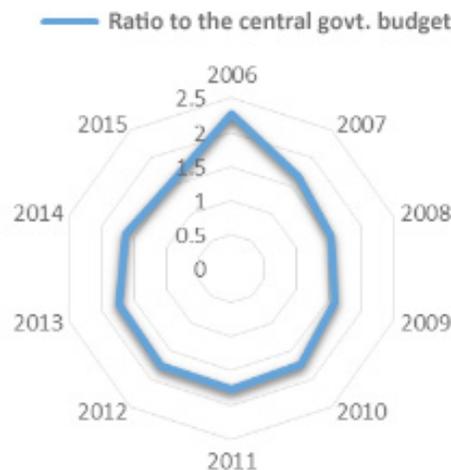
Roads and highways

Turkey has a strong geographical position between Europe, Asia and Africa, and focuses efforts on development of transportation connections. The total length of highways is 65,909 km, which is divided further into motorways, state highways and provincial roads,

Major projects include Istanbul-Izmir Motorway, Northern Marmara Motorway and Sabuncubeli Tunnel Project, all under BOT procurement structure.

Figure 4: Investments in road development. Source: GDH

Ratio to the central govt. budget



Strengths and opportunities

- Car ownership is 127 cars per 1,000 people. There is high potential for this to increase, which will increase demand for roads.^[9]
- The government plans to reduce the road fatality rate by 40% by upgrading single carriageway to dual carriageway, with plans to upgrade approximately 15,000 km by 2023.^[6]
- Twelve BOT motorway projects are planned, at a cost of US\$47 billion. The PPP type procurement is becoming popular, which is opening doors for foreign companies in this sector. The Turkish government is also planning to privatize 2,000 km of toll road network. It is one of the few countries to have its own PPP regulation.^[10]
- Road freight volumes are forecasted to rise by 5.4% in 2016, to reach 2.2 million tons, thus increasing demand for road transportation. Currently, highways support 95% of the passenger and 92% of the freight traffic.^[8]

Challenges and threats

- The ratio of investment for road infrastructure to the total budget is constant and on the verge of decreasing, as seen from GDH-provided data.^[5]
- Enlargement of Turkish cities without use of urban transportation plans leads to local authorities and GDH having no control over the repurposed roads.^[7]

Seaports

Turkey has 8,400 km of coastline.^[39] International maritime trade is fundamental to the economy of the country. About 90% of overseas trade has been supported via maritime transport.^[40] The government's goal is to double the freight rate by sea within the country by 2023.^[41] Turkey has 450 sea ports; 220 of them are open to commercial traffic (Appendix A2).^[45] Finally, the Turkish port capacity is also expected to increase by 100% by 2023.^[42]

Port facilities are owned and operated by three organizations: state-owned companies, municipalities and private companies. About 30 to 40% of the total cargo handled at ports is managed by the Turkish State Railways: TCDD Ports.^[43] Currently, TCDD operates six ports, including the top container ports of Izmir and Haydarpasa.

The busiest ports are owned and operated by State Economic Enterprises, the Turkish State Railways or the Turkish Maritime Organization. The port industry faces a privatization trend; some ports are either already privatized or going to be privatized. Privately owned ports are mostly constructed for industrial plant purposes and less often by third parties.^[44] Small ports are usually municipality-owned ports and serve local needs of provincial areas. Not all ports are directly connected to the railway network.

In order to enhance the efficiency and capacity of ports, the government has fostered the process of privatization.^[46] For instance, the Samsun Port has been privatized, and in 2011 the Iskenderun Port began development and operation under a 36-year concession. By 2023, the Turkish government aims to have at least one Turkish port among the ten largest ports in terms of handling capacity in the world.^[47]

The maritime transport of passengers is negligible. Nevertheless, the cruise passenger traffic has increased 180 by? to 185% between 2005 and 2012.^[48]

Turkey's largest container-only port, Asyaport, opened in June 2015 and has a capacity of approximately 2.5 to 3 million TEU. It is one of the main 100 container ports in the world. It shares activity loads with the Istanbul Ambarh Port (European side).^[49]

Challenges

- Not all ports are connected to the railway network.
- Political and economic instability of neighboring countries (Iran, Syria, Iraq, Greece).
- The number of ports must increase according to the tourism industry in order to reduce the independence on neighboring and riskier countries.

Opportunities

- Attractiveness of Turkey's geographical position between Europe, Asia and the Middle East.
- Turkish ports can enhance the supply chain and can be drivers of increased economic performance of the country.
- Tremendous government initiative: Istanbul Kanal project initiated in order to minimize the shipping traffic by building an artificial sea-level waterway linking the Asian and European Turkish ports.^[50]

Airports

Airports are managed by the General Directorate of State Airports Authority (see Appendix A3). In order to access capital and attract foreign investments, the government has greatly increased and encouraged the use of PPP in the sector. TAV Airports Holding is the foremost airport operator in Turkey (operates Ataturk and Esenboga International Airports). Furthermore, TAV Construction ranked as the world's largest airport construction company on Engineering News-Record's 2015 list.^[51]

There are currently 55 airports in Turkey, representing slightly less than 170 million passengers and almost three million tons of cargo in 2014.^[52] Furthermore, five airports are under construction and the Ministry of Transport aims at building an airport every

100 km in Turkey. Between 2003 and 2015, the total budget for airport investments was approximately US\$6.0 billion.

Seven Turkish airports are listed among the 100 busiest airports in Europe, with Istanbul Atatürk Airport ranked third on the list.^[53]

Turkish Airlines is one of the fastest-growing airlines and the most profitable European carrier worldwide. Furthermore, Turkey is the sixth most populated country in the world, with 41 million tourists in 2014.^[54] Istanbul-Atatürk Airport is the fourth-largest European airport in passenger

traffic. Moreover, in 2014, Istanbul's Sabiha Airport ranked 18th in Europe, with 23.5 million passengers.^[55]

This has led to the construction of the third Istanbul international airport in Arnavutköy, located 35 km northwest of the city center. It is planned to become one of the biggest in the world by 2018-2020, with six runways, four terminals and handling almost 150 million passengers a year. The first phase (90 million passenger capacity) should be completed by 2017. Current construction costs are estimated at US\$10.2 billion.^[56]

Table 2: Main airports and passenger traffic in 2015

Rank	Airport	Location	Passenger traffic 2015
1	Araturk I.A	Istanbul	61,323,000
2	Sabiha Gokcen I.A	Istanbul	28,000,000
3	Antalya Airport	Antalya	27,700,000

Challenges

- The newest and third Istanbul airport project raises several environmental concerns. It will destroy a forest, according to the Ministry of Forest and Water Management (657,950 trees could be cut and 1,835,400 moved).^[57]
- Major safety issue: the Nicosia, Flight Information Region (FIR) polemic absence of direct contact between the (Nicosia FIR and the “Ercan Advisory Area” or any air traffic control center in Turkey) is in breach of all International Civil Aviation Organization — ICAO requirements.^[57]

Opportunities

- Government aims at attracting private capital through PPP structures in the port sector. It also implements greenfield projects.
- The prosperous financial status of Turkish aviation fostered the government plans and initiated several projects for increasing airport capacity.
- Government aims at expanding the civil aviation fleet to more than 750 aircraft, from about 340 in 2010,^[58] an increase of more than 50%.



SWOT analysis

Strengths

- Turkey's strategic position regarding transport between Europe and Asia, as well as Europe and Middle East.
- The existence of well-organized firms with high-capacity fleet in international road transport.
- Existence of firms with international experience in the construction of transportation infrastructure and skilled human resources in these firms.
- Successful implementation of build-operate-transfer model especially in airport and terminal construction.

Weaknesses

- Weak equity capital structure of Turkish construction companies, limited loaning capacity of Turkish banks and lack of various financial instruments.
- Inadequate connection between national networks and regional growth poles; most transportation infrastructure spending is centered around the capital Istanbul.
- Lack of corporate transparency in the construction companies regarding the existence of a shadow economy in the industry.
- Low road and railway density (51/125 in road and 63/125 in rail).

Opportunities

- Enactment of the Urban Regeneration Law to rebuild 7.5 million houses.
- Huge investments into the mega-infrastructure projects regarding the government's 2023 targets.
- Attracting foreign investors due to strong demographics and domestic consumption-driven demand as well as the enactment of the Reciprocity Law in May 2015, to let foreigners buy homes in Turkey.
- Positive impact of the falling global oil prices on the construction industry due to the loss of construction projects in oil-rich countries.

Threats

- Regional conflicts which may interrupt transport services with neighboring countries.
- Global economic developments causing instability, mainly currency fluctuations.
- The lowest price tendering regardless of the qualification and financial capability of bidders in public bids.
- The future implementation of north-south transport corridor by Russia-Iran-India, which may threaten the role of Turkey between Europe and Asia.

Geographical analysis

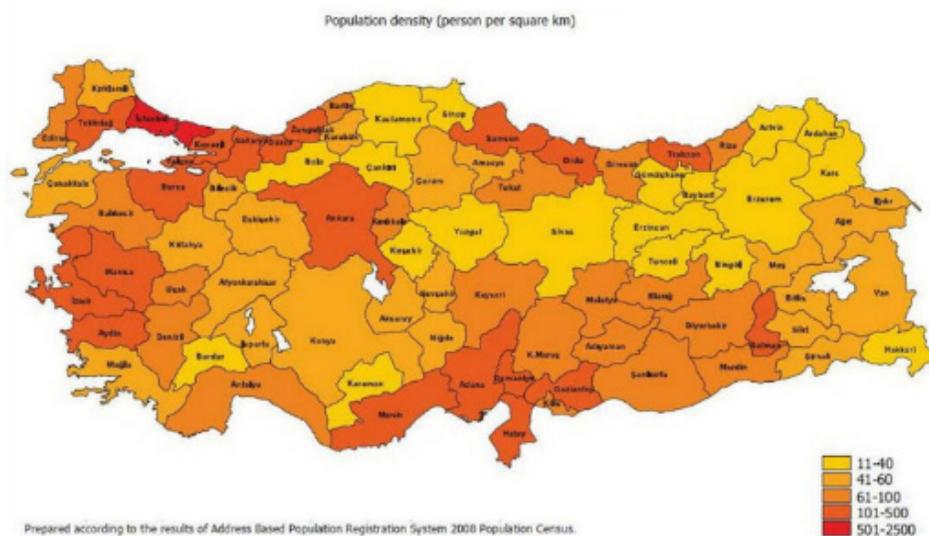
Turkey is located between Europe and Asia, and shares borders with Syria and Iraq to the south, Iran, Armenia and Nakhchivan (an Azerbaijani exclave) to the east, Bulgaria to the northwest, and Greece to the west. It also has access to the Black Sea to the north, the Mediterranean Sea to the south, and the Sea of Marmara is between the borders. The majority of the area is in the Asia region, and is considered a hub for international trade.^[1] Turkey is a crossroads of Europe and Asia, with Istanbul in the middle, thus giving significance to the city and the country. Turkey is mainly a massif with a plateau appearance with rough terrain, with lowlands in the coastal zones and flat surfaces near the

deltas of the Kizil River. The eastern region of the country contains mountain ranges that reach up to 5,137 meters.

Population density

Turkey's population is approximately 76 million, with an urban population of around 72%. Over the last 10 years, there has been an average growth of 2.0% in urban population.^[1] The largest metropolitan area is Istanbul, with an estimated population of 14.2 million, making Istanbul the largest city in Europe.^[12] The second-largest city of the country is Ankara, the country's capital, with an estimated population of 4.6 million.^[13] The majority of the population

Figure 5: Turkey's population density as of 2008 Census
Source: E.E.A.



is located in the coastal regions of the country, especially to the west; however, in the central part of the country, where Ankara is located, the population density is high (Figure 5). The west of the country is more populated because of its proximity to economic centers and natural resources. See Appendix A4. Even though only 3% of the country is in Europe, it holds approximately 10% of the population.

Infrastructure

All sectors of infrastructure in Turkey are undergoing a series of improvements.

The road network is connected to the Pan-European Corridor and the Trans-European Transport Network, giving road access to the entire European Union. Within the country there are important highways connecting the most important cities and economic centers, while local and regional roads serve the rest of the

country. International links to Asian countries are also established.

The rail network is located near the economic centers of the country, including the mountainous region. There are also links to other countries in the region, but some connections are closed due to ongoing conflicts in the neighboring countries.

Given Turkey's extended coastline, there are an important number of ports located in the Mediterranean Sea, Marmara Sea, Aegean Sea and the Baltic Sea.

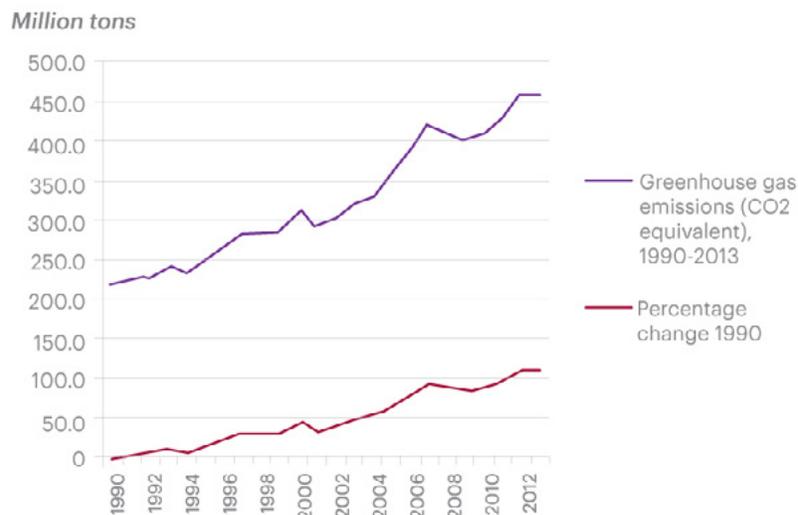
Turkey has an advantageous position because of its location for international travel. Europe, Asia and Africa are within reach. With new long-distance airplanes, the Americas and Australia are also within reach. Turkey is used as an international hub for transfer traffic.^[14]

Sustainability

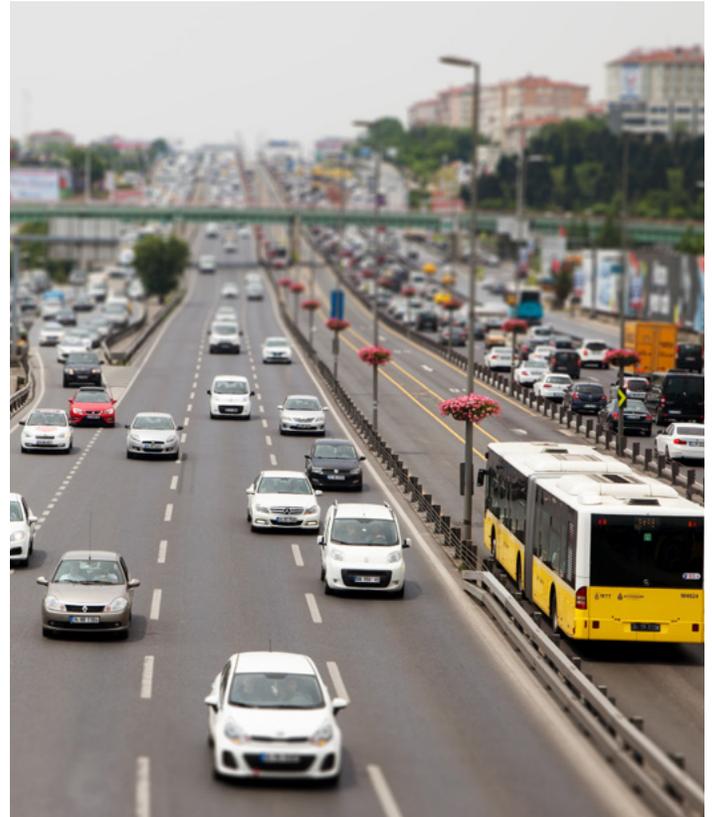
The ancient city of Istanbul faces environmental problems such as congestion, air pollution, and newly constructed overpasses and car infrastructures that are favored over the cultural heritage. EMBARQ, The World Resources Institute Center for Sustainable Transport, introduced Istanbul transportation officials to sustainable transport with the bus rapid transit system. In 2007, the city opened its first line, which now is one of the most utilized BRT lines in the world.^[15] The world's first inter-continental BRT corridor was introduced in March 2009 across the Bosphorus Bridge, a bridge that is well known for its traffic congestion between Europe and Asia. While coordinating with Istanbul officials, EMBARQ conducted commuting studies and proposed practical solutions for some routing and station locations that are now built. The Istanbul

Metro is operated by Istanbul Ulaşım (Istanbul Transport), a public enterprise governed by the Istanbul Metropolitan Municipality. This metro connects the city of Istanbul by a fast railway network. The M1 line, opened in 1989, is the oldest section of the metro and comprises 70 stations in service,^[1] with 30 additional stations under construction. In recent years, Istanbul has introduced several sustainable transport systems, such as its world-class BRT, and pedestrianization of public spaces. Istanbul continuously aims to enhance sustainable transport access, health, road safety, and CO₂ emissions. In 2007, Istanbul's BRT system, Metrobüs, was launched; about 600,000 travelers use it each day, according to EMBARQ's 2013 Social, Environmental, and Economic Impacts of BRT Systems study.^[16] The Metrobüs aims to tackle the transport situation of the

Figure 6: Greenhouse gas emissions
Source: TSI 2016



lower and middle income groups in Istanbul, which constitute the largest proportion of users. A recent study indicated TL\$11.4 billion (US\$6.4 billion) of total net present benefits. These benefits exceeded the costs by a 2.8 to 1 ratio and directly contribute to travel time savings, safer roads, and reduction of air pollutants.^[17] By using Istanbul's Metrobüs, travelers can save 28 days of travel time per year. The Metrobüs system is expected to save 167 tons per day of CO₂ emissions and more than 240 ton of liters in total. Moreover, a reduction of about 50,000 vehicles per day resulted because of this system, which was crucial since Istanbul is considered to be one of the most congested cities worldwide. EMBARQ Turkey completed a survey in which 83% of those surveyed requested that safe bike lanes be introduced. As a result, Istanbul plans to install 1,000 km (650 miles) of bikeways by 2023. It is vital for planners to optimally integrate the biking system with the other available modes of transport.



Project pipeline

Turkey is a leading economy that is developing at a comparable rate to other countries. As listed in Appendix A5, the country plans to be one of the world's top 10 economies as expressed in the 2023 Vision in the 100th anniversary of the foundation of the Turkish Republic. In order to accomplish this goal, there are plans to build 11,000 km of new railway, expand the high-speed train network, build 15,000 km of divided highway, and improve the airports and the seaports.^[19] Some of the major projects are as follows:

- 1. New airport in Istanbul:** The international airport is under construction and is supposed to be the largest airport in the world on completion, with an annual passenger capacity of 200 million. The airport will have six runways constructed on 77 million square meters of land. Construction is divided into four phases. Phase I is estimated to be completed in 2019, after which the airport will become operational with a temporary capacity of 90 million passengers, while all the phases will be completed in 2028.^[20] Construction began on May 1, 2015, the tender of which was given to a joint venture of Turkish companies, Cengiz-Kolin-Limak-Mapa-Kalyon Consortium in May 2013.^[21] Designs for the air traffic control tower, from AECOM and the Italian automotive design company Pininfarina, were recently released.^[22]
- 2. Marmaray Project:** This project is of prime importance since the new tunnel connects Europe and Asia (Appendix A6) and will thus create opportunities for economic development. The four main components are: i) the underwater railway tunnel under the Bosphorus Strait, ii) improvement of the existing lines, iii) electrical and mechanical works, iv) procurement of the rolling stock. As per the funding agreement between the Republic of Turkey and the Japanese Bank for International Co-operation in 1999, initially, the total project cost was estimated to be US\$4.5 billion. The construction work was supposed to start in 2009, and was later revised to 2010.^[23] In July 2004, a Japanese-Turkish consortium led by Taisei Corporation was awarded the construction contract for the project. The second phase of the project was started in 2015 and the completion date has not yet been announced.^[24]
- 3. North Marmara Motorway:** This is a planned motorway project with an initial scope of about 260 km motorway, 115 km connecting roads (Appendix A7) and the 2,164-meter third Bosphorus Bridge, which, on completion, will unite Europe and Asia. The total cost of the project was estimated to be US\$6.2 billion with the bridge alone accounting for US\$4.5 billion.^[25] The bridge has four motorway lanes and one railway line on one direction. On completion, it will be the longest combined motorway/railway bridge

in the world. The tender of the bridge was awarded to the Ictas-Astaldi Consortium on May 29, 2012.^[26] The bridge became operational in August 2016.

4. Privatization of Istanbul Salıpazarı Port

Area: The redevelopment of Istanbul's largest waterfront site on the Bosphorus is due in Q4 2018. Dogus Holding had been awarded the

tender for operation of the port for 30 years, with a bid of US\$702 million^[28]. The port is predicted to have a shopping district, office space, hotel space and other attractions. Recently, BLG Capital Fund has raised US\$166 million of equity for the proposed Galataport development.^[29]



Delivery methods

In Turkey, the traditional procurement method (design-bid-build) often jeopardizes rapid development due to cost and time overruns. Alternative project procurement methods, from the West, are being utilized to solve these problems. The build-operate-transfer model has enhanced construction industry activities.^[34]

The common procurement methods used by public sector clients, other than the above-mentioned traditional and BOT models, are package deals (also known as design-build) and management contracting. The Turkish government observed that foreign investors would not participate in projects because of inflation in oil and raw material prices. Hence, to reduce the effect inflation has on construction projects, design-build projects, which shorten the delivery time, started becoming popular. Contracts under the FIDIC template are generally procured with a construction manager involved.^[34]

The most popular procurement type for highways in Turkey is BOT, which was introduced in 1980 and has had strong government support. Law 3465 came into place in 1988, for procurement of highway projects through BOT, although BOT can be found in many official documents before this date. It has its own competitive bidding procedures and a maximum 49-year contract term (article 5).^[32]

Small projects like Kinali-Sakara highway (US\$1.6 million)^[3] and bigger projects like the Eurasia Tunnel (US\$1.25 billion) all utilize this procurement type. New rail, road and airport projects are procured through private financing and operation, with the third airport for Istanbul to be built and financed by a consortium of Turkish companies under the BOOT mechanism^[33] for a contract period of 25 years. The Marmaray tunnel project (US\$4.5 billion) also has partial financing by Japan Bank for International Cooperation (JBIC). Thus, with the advent of many mega highway and tunnel projects, project financing schemes under the BOT, BOOT and PPP approaches are gaining immense popularity,^[30] with 131 active PPP contracts in the country.^[31]

Conclusion

Turkey is a regional power in the geostrategic location linking Europe, Asia and the Middle East. With an advanced economy and an ambitious set of goals as part of their national 2023 Vision, the country looks to make strides with its transportation infrastructure systems.

Rapid development in Turkey has been led by an experienced construction sector and boosted with an affinity for private investment. It has more than US\$47 billion in projects slated for delivery via the build operate transfer method through the year 2023. Nearly 2,000 km of roadways are planned to be privatized and utilize some form of toll operations.

On the forefront of this development should be improved connectivity between the country's ports and the main population centers, especially since 90% of the nation's trade is conducted through maritime means.

Additionally, integration between national highway networks and regional roadways needs to be vastly improved to alleviate congestion in denser areas.

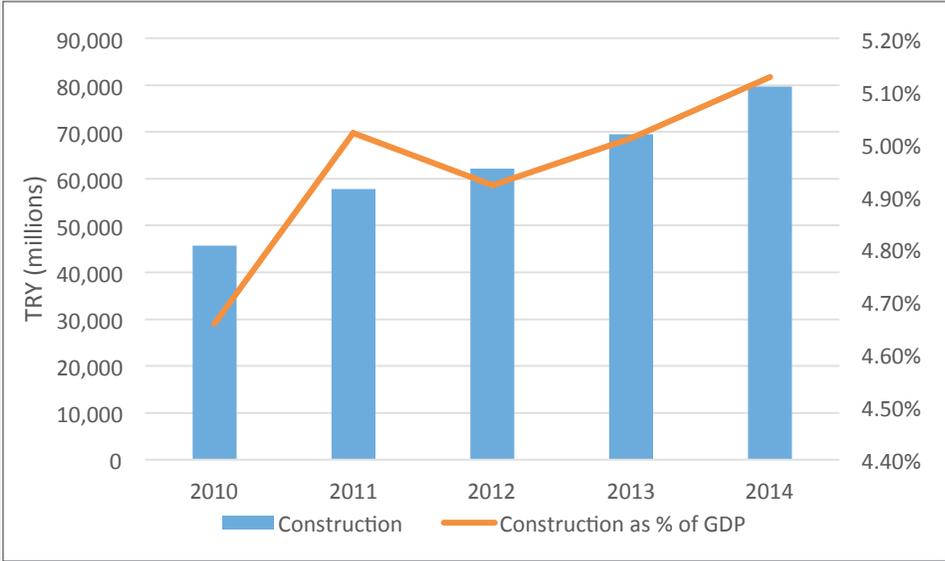
As mentioned earlier, privatization is at the center of this infrastructure renaissance. Unfortunately, Turkey has lost attractiveness given recent events. The large number of refugees relocating to, or travelling through, the country is creating instability in certain areas. This has the added effect of unexpectedly taxing an already deficient infrastructure system with a sudden surge in population. Given the uncertainty of the refugee crisis currently facing Europe, the country may be better to address its infrastructure needs through domestic funds, or through European Union payments.

Appendix A1: GDP statistics

Table 3: Detailed GDP by sector in millions of TRY at current prices
Source: Turkish Statistical Institute

	2010	2011	2012	2013	2014
Agriculture, forestry and fishing	92,733	103,628	111,682	115,658	124,586
Mining and quarrying	15,785	19,133	21,200	21,916	25,453
Manufacturing	170,755	209,165	219,641	240,200	276,549
Electricity, gas, steam and air conditioning supply manufacturing	19,719	21,868	24,808	27,422	27,754
Water supply, sewerage, waste management and remediation activities electricity, gas and water supply	6,861	8,133	9,001	10,261	12,026
Construction	45,670	57,751	62,157	69,557	79,701
Wholesale and retail trade	119,893	154,648	168,296	188,390	209,271
Transport, storage	121,985	151,009	170,629	186,958	208,687
Accommodation and food service activities	25,590	30,028	33,367	39,412	44,879
Information and communication	24,179	25,555	28,668	31,105	32,987
Financial and insurance activities	40,502	40,576	46,538	52,483	52,989
Real estate activities	126,370	133,125	142,799	155,839	171,433
Professional, scientific and technical activities	31,879	36,822	42,703	48,915	58,972
Administrative and support service activities	20,807	24,604	28,347	31,925	36,815
Public administration and defense; compulsory social security	46,090	52,249	60,931	66,337	74,083
Education	36,815	42,731	49,432	55,580	64,936
Human health and social work activities	17,807	19,244	21,719	23,312	26,980
Arts, entertainment and recreation	2,346	2,594	2,929	3,260	3,749
Other service activities	12,666	15,211	15,408	16,486	19,395
Activities of household as employers	2,097	2,380	2,718	3,088	3,450
Total	980,547	1,150,453	1,262,973	1,388,105	1,554,693

Figure 7: GDP by construction at current prices
Source: Turkish Statistical Institute



Appendix A2: Modal share of maritime transport

Table 4: Modal share of maritime transport within Turkey for 2013

Modal share of maritime transport	2013	Objective 2023
Freight	7%	10%
Passengers (excluding cruise passengers)	0.60%	N/A

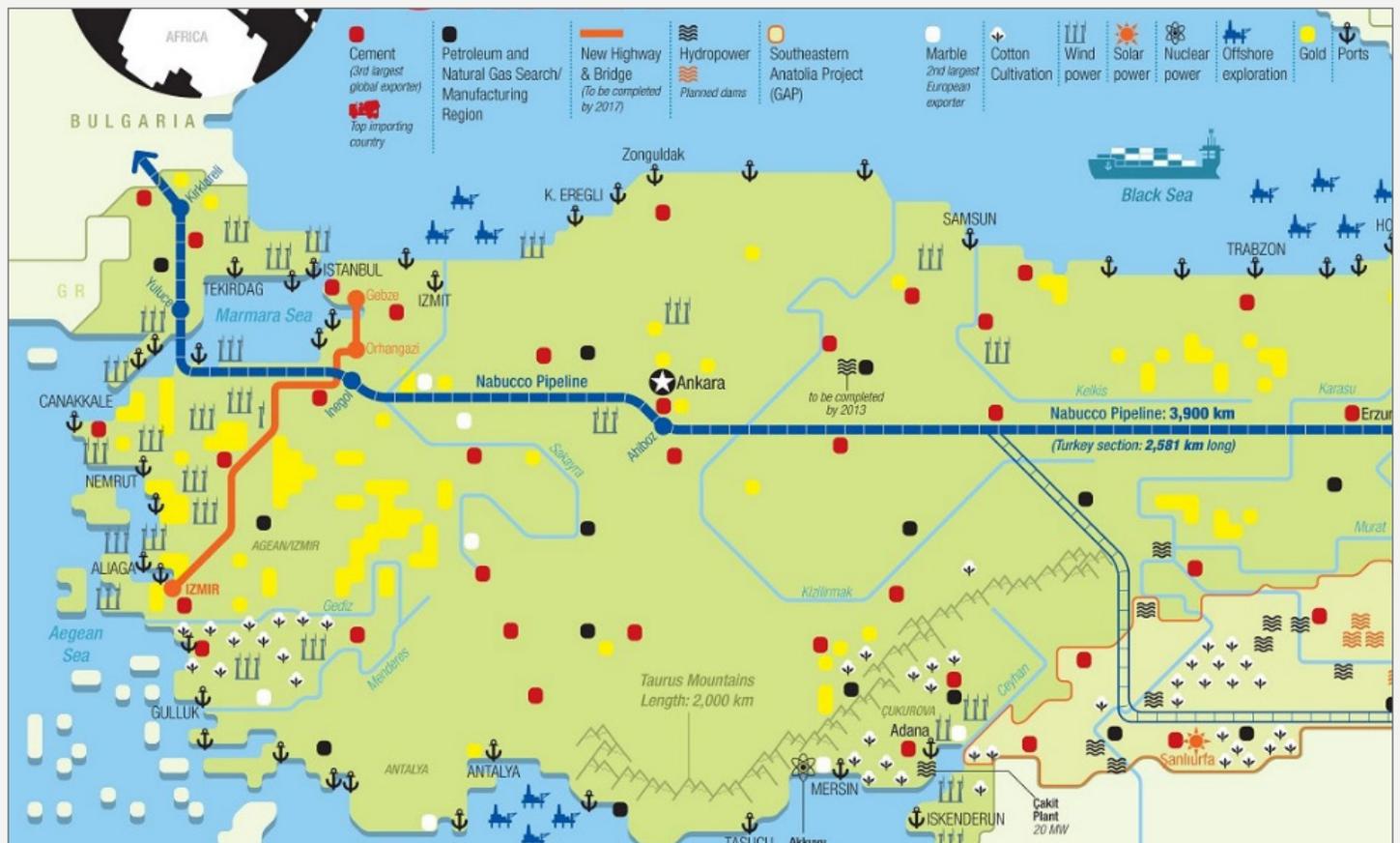
Appendix A3: Airport traffic statistics 2002 vs. 2013

Table 5: Evolution of passenger traffic, cargo and commercial aircraft between 2002 and 2013

Passenger, in million	2002	2013	Change between 2002/2013
Domestic	8.7	76	774%
International	25	73	193%
Cargo, in tonne			
Domestic	181000	744027	311%
International	700000	1851289	165%
Registered commercial aircraft	138	385	180%

Appendix A4: Map of Turkey's natural resources

Figure 8: Turkey's natural resources and projects
Source: Revolve Media



Appendix A5: Turkish 2023 plan

Figure 9: Details of the 2023 Vision of Turkey

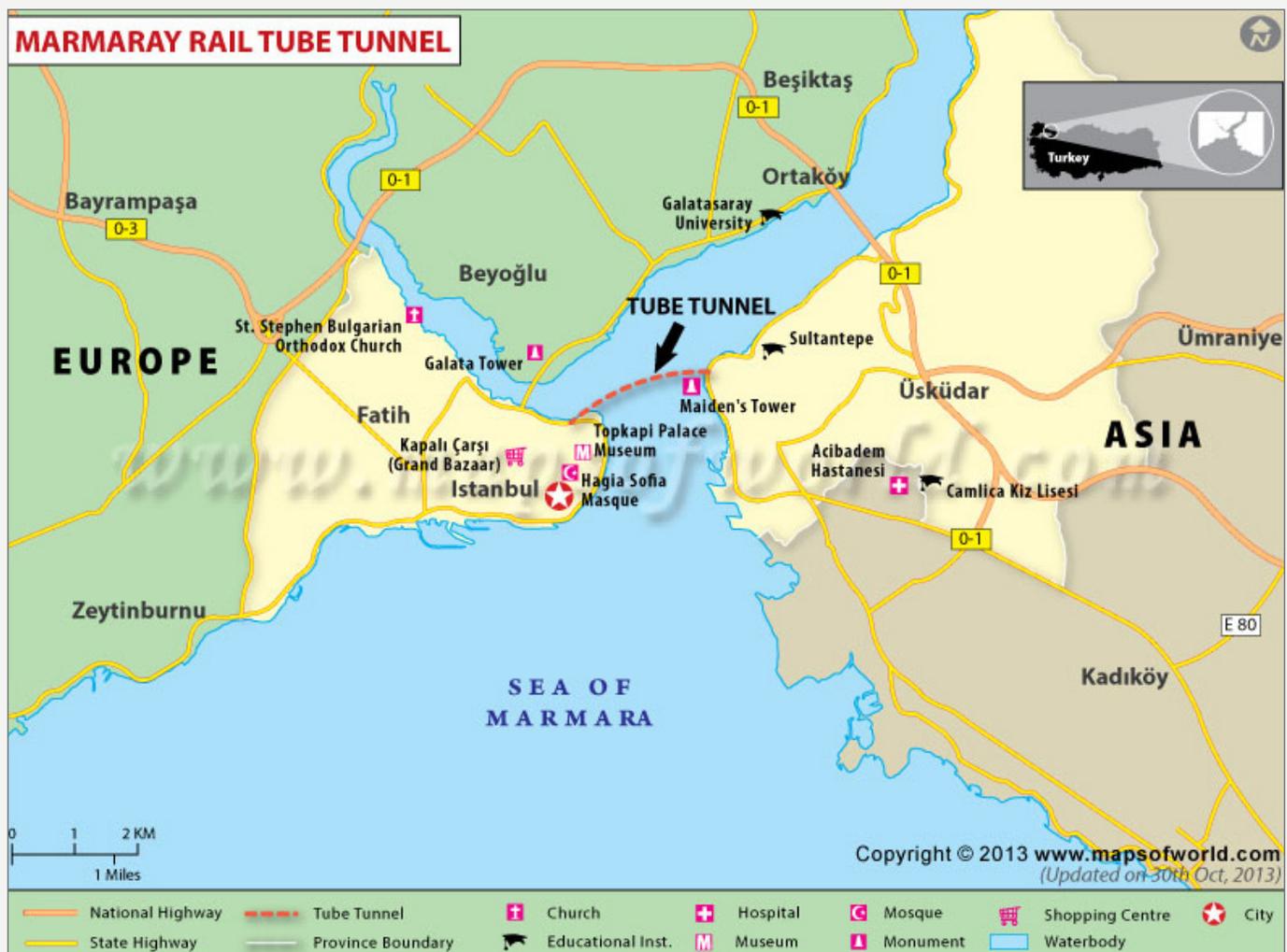
Source: <https://turkishpassport.wordpress.com/vision-2023/>

Economy	2001	2011	2023
The World's Biggest Economy	26	16	in 10
Central Bank Reserve	22 Billion \$	82 Billion \$	N/A
IMF Loan	25,6 Billion \$	5,5 Billion \$	0 \$ at 2013
Education Budget	6,5 Billion TL	34 Billion TL	80 Billion TL
Per Capita Income	3.000 \$	10.000 \$	25.000 \$
Health Care Budget	2.9 Billion TL	14 Billion TL	N/A
Overnight Interest Rate	7500%	%6.25	N/A
Export	25 Billion \$	114 Billion \$	500 Billion \$
Economic size of Agricultural at World	11	8	5
Inflation	68%	%3.9	Less Than %1
Unemployment	10,30%	11,20%	5%
Research and Development	2,9 Billion TL	10 Billion TL	%3 of GDP
Overseas Contracting Business Volume	10 Billion \$	25 Billion \$	100 Billion \$
Transportation	2001	2011	2023
High-Speed Train (km)	0	972	10
Divided Highways (km)	6000	20	36,5
Fiber Internet Subscriber	0	2.000.000	30.000.000
Logistics Center	0	2	16
The Average Growth in Aviation sector	5%	%53.5	N/A
Total Tunnel	52	209	N/A
Traffic Accident Due To Road Errors	409	130	N/A

Appendix A6: Marmaray rail tube tunnel

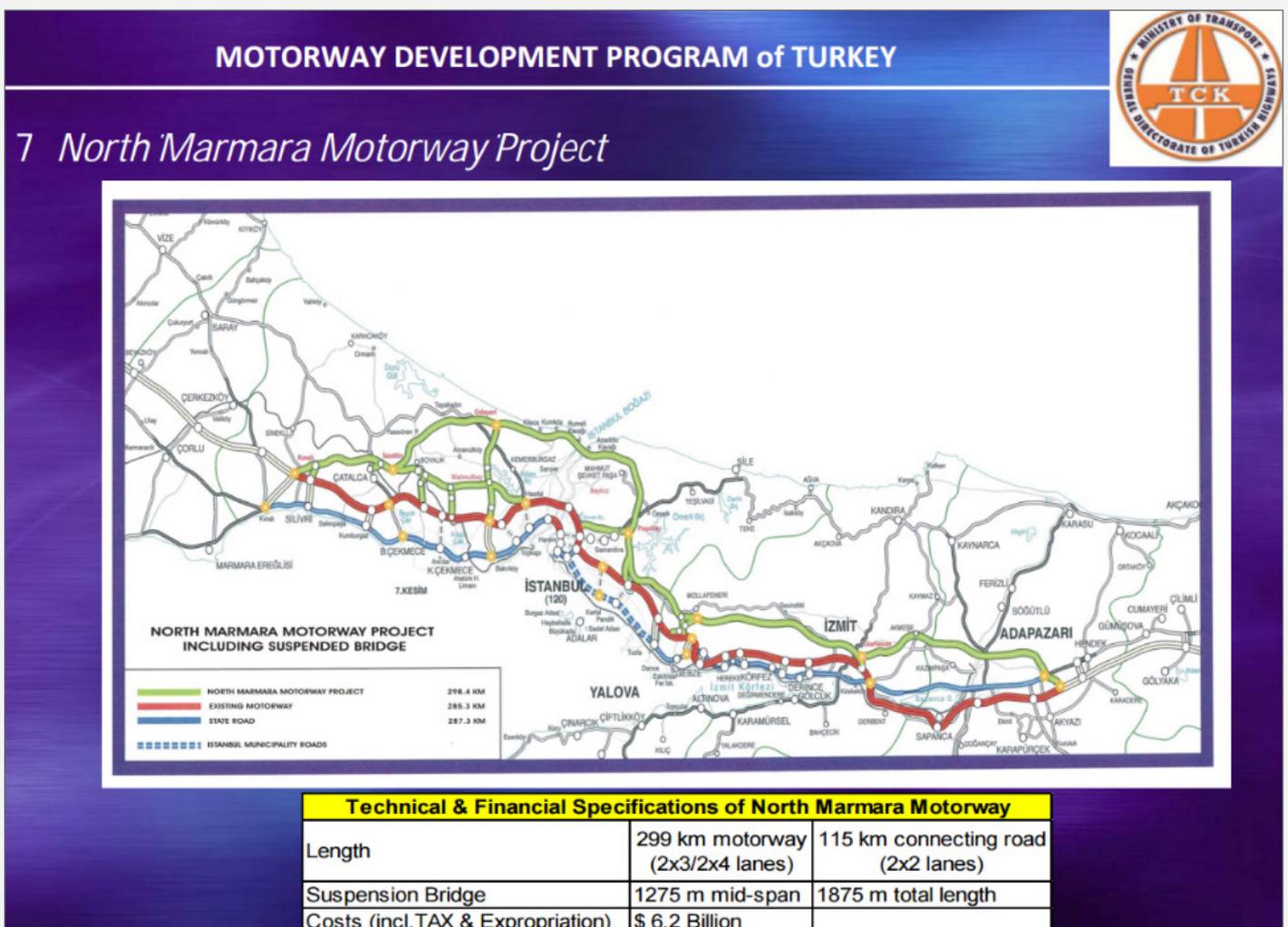
Figure 10: Map of Marmaray rail tube tunnel.

Source: <http://www.mapsofworld.com/turkey/marmaray-tube-tunnel-map.html>



Appendix A7: Northern Marmaray Motorway Project

Figure 11: Planned alignment of the Northern Marmaray Motorway Project
Source: Republic of Turkey



United Arab Emirates

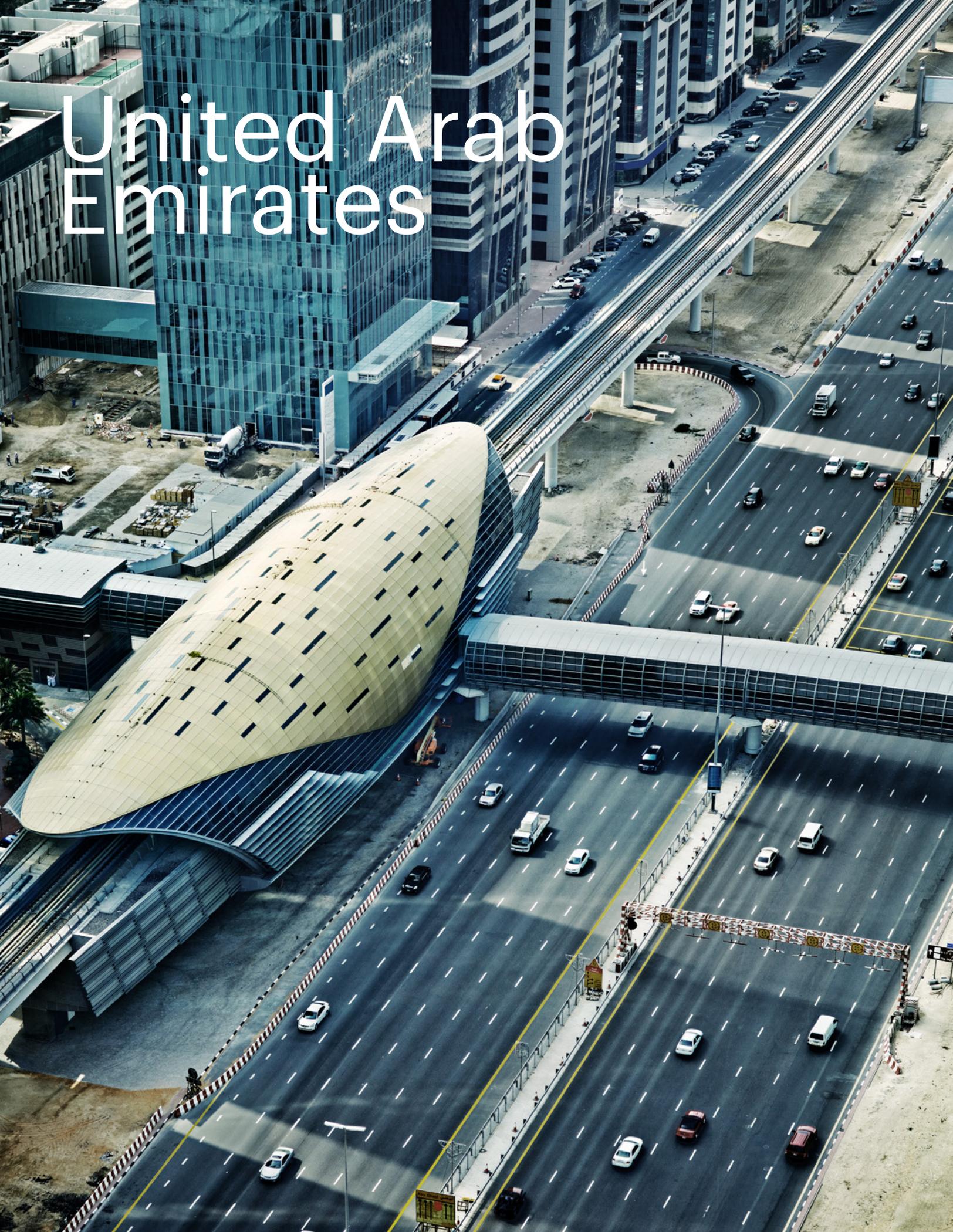


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Introduction

The United Arab Emirates is one of the six membership states that comprise the Gulf Cooperation Council (GCC). Within its borders it is divided among seven constituent emirates, the most popular being Abu Dhabi and Dubai. It is one of the wealthiest countries in the Middle East region and has experienced tremendous growth in recent years.

Its economy is dominated by the oil and gas sector, which accounted for 32% of GDP in 2014 and averaged more than 35% since 2010. An OPEC member, the UAE had benefited tremendously when oil prices skyrocketed, stimulating heavy investment in public infrastructure. Recently prices have dropped to record lows, prompting experts to question the

UAE's economic future. It should be noted that the reliance on oil is high, but the UAE economy is still the most diversified in the GCC. The UAE has the eight largest proven oil reserves in the world, sixth among OPEC nations and third in the GCC region. Of those reserves, roughly 94% is located within the emirate of Abu Dhabi.

Population has grown almost 10% between 2010 and 2014, but urbanization has been disproportionately affected, increasing less than 1.5% in that same time frame. These populations flocking towards suburban and rural areas will require effective commuting infrastructure to travel into major metropolitan areas.

Figure 1: GDP by sector at current prices
Source: UAE Bureau of Statistics

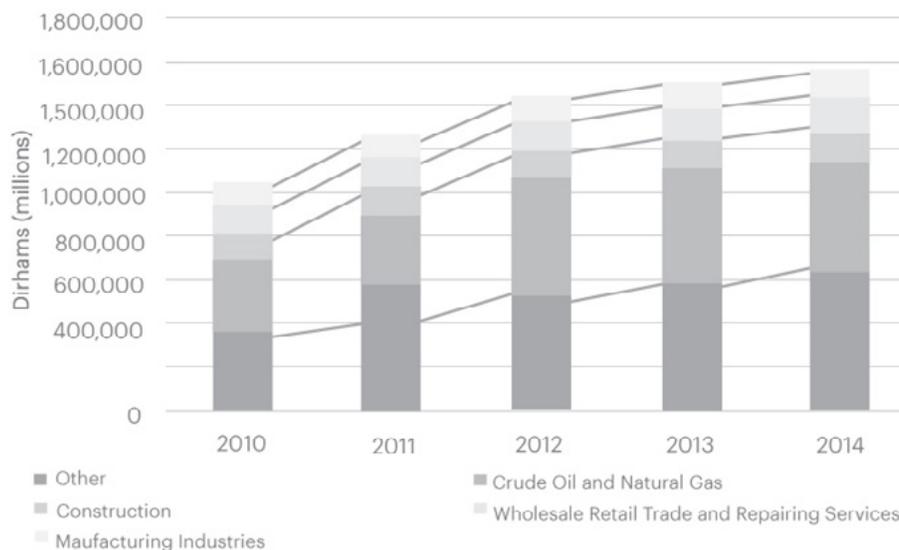


Table 1: Economic development indicators for UAE
 Source: World Bank

	2010	2011	2012	2013	2014
GDP at market prices (current US\$ millions)	286,049	348,526	373,430	387,192	399,451
GDP per capita (current US\$)	34,342	39,901	41,712	42,831	43,963
Inflation, GDP deflator (annual %)	11.00	15.81	0.24	-0.61	-1.34
Labor force, total	5,644,707	5,947,418	6,133,667	6,232,093	6,302,492
Population, total	8,329,453	8,734,722	8,952,542	9,039,978	9,086,139
Population density (people per sq. km of land area)	99.63	104.48	107.09	108.13	108.69
Population in urban agglomerations of more than 1 million	3,575,848	3,823,292	4,088,329	4,371,031	4,673,386
Unemployment, total (% of total labor force)	4.20	4.10	4.00	3.80	3.60
Urban population (% of total)	84.06	84.38	84.68	84.98	85.27

PEST analysis

Political

- Federal government composed of seven emirates; each emirate has its own governmental institution. The head of each emirate's ruling family serves as a member of the Supreme Council, which is responsible for policy-making and electing the president.
- Consistent policy implementations and stable political situation to attract almost any major financial institution that needs to invest.
- Slight implementation of democracy in the country despite several changes in the international sphere.
- Foreign policy is based on maintaining close strategic relations with the West, particularly the US.

Social

- Liberalized labor immigration to allow foreign workers to work in the UAE. Due to liberalized labor policies, the country has a skilled workforce from all parts of the globe.
- Increase of unemployment rate from 3.3% in 2006 to 4.2% in 2010; however, it has decreased since then and reached 3.8% in 2015.
- Dubai and Abu Dhabi ranked as first and second highest cities in terms of quality of life in the MENA region.

Economic

- Per capita income is US\$44,000, ranks the 21st highest in the world. High per capita income shows a strong market for goods and services across all sectors.
- Increase in trade surplus from US\$31 billion in 2009 to US\$130 billion in 2014. The largest contribution of the balance of trade comes from oil exports, with the UAE being the fifth largest exporter.
- Vulnerability of government to oil price fluctuations due to the high degree of dependence on oil exports for revenues.
- Restricted complete foreign ownership under the country's law. At least 51% of a business must be owned by a UAE national.

Technology

- World's first zero-carbon city is located in UAE-Masdar City.
- Very low expenditure on R&D (US\$2.5 billion which accounts for 0.49% of GDP) causes lack of localized innovation.
- UAE won the right to hold the Expo2020, selecting as the theme "Connecting Minds, Creating the Future," with sub-themes being Sustainability, Mobility, and Opportunity.
- Leading regional technology hub given its position as a platform for top tier international tech companies and a stage for global technology-oriented events.

Status of transportation

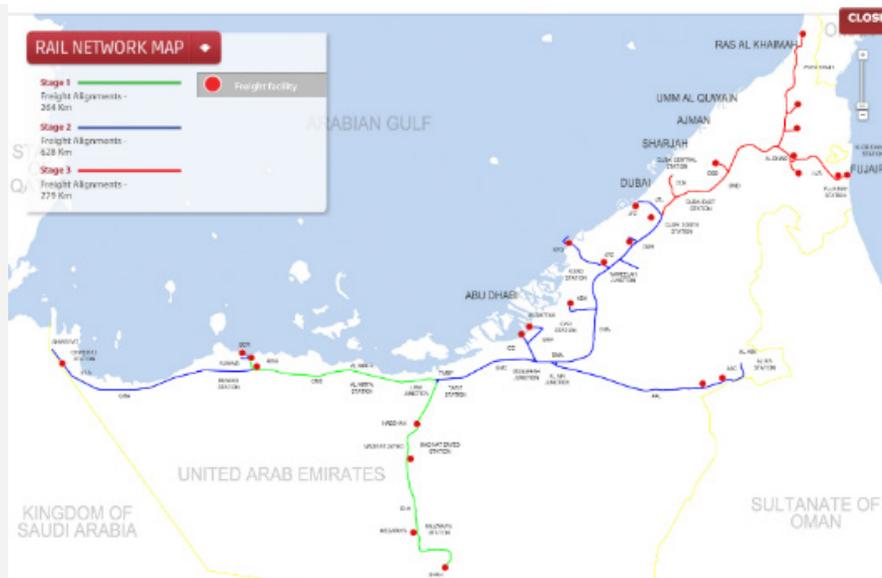
Railways

United Arab Emirates' rail network is fairly new. It connects the south of the country, where granulated sulfur is processed, to the northwest port of Ruwais for export. It is a 267 km network that uses standard gauge (1,435 mm). It is run by Etihad Rail, a state-owned company. It provides freight services in Stage 1 of the project from industrial locations within the country. Two more stages are planned to increase the network size by 628 km and 279 km, respectively. Stage 2 will connect Abu Dhabi with Dubai, and it will add international connections with the Kingdom of Saudi Arabia and the Sultanate of Oman under the GCC rail network (see Appendix K3).

Stage 3 will connect the northern part of the country to the network.^[1] The system will have speeds of 120 km/h for freight trains and 200 km/h for passenger trains.

Dubai, the biggest city in the Emirates, has a metro, monorail and tram within the city. Dubai Metro is a driverless metro rail network with two operational lines totaling almost 75 km. It is an underground system in the city center and elevated system in other parts of the city. The system has a daily ridership of almost 500,000 people.^[2] The system will undergo future extensions of Lines 1 and 2; also there will be four new lines by 2030, adding a total of 421 km and 197 stations.^[3] The Dubai tram is a 14.5 km

Figure 2: Etihad rail network map
Source: Etihad Rail



tramway that connects the metro system and the monorail. It has 11 stations, with eight more planned. The Dubai monorail connects the Palm Jumeirah to the mainland.

Abu Dhabi, the Emirates capital, has plans for creating a 131 km metro network within the city, connecting the island to the mainland and its suburbs.^[4] Existing bus routes and a new tramway will complement this.

Challenges

- Falling oil prices have halted plans for expansion of the Etihad Rail and other networks.^[5]
- The climate and harsh terrain in the area present significant challenges for the construction and operational phases.
- Railway is a public benefit and thus is considered a need that should be subsidized. A cost-reflective tariff needs to be implemented.^[5]

Opportunities

- By 2025 the urban population is expected rise to 88% within the UAE cities,^[6] thus creating a market to expand the rail systems within the cities.
- The underdevelopment of the system in the area offers a chance to test new systems and methods.

- A large number of projects are expected to be built within the next years following the Abu Dhabi 2030 Plan, Dubai 2020 Urban Master Plan and GCC regional plans.
- High-speed rail is included in Stage 2 of the Etihad Rail system, with speeds of 200 km/hr. The project is halted at the moment.

Roads and highways

UAE has a road network length of 4,080 km. However, UAE is one of only 17 countries in the world with 100% paved roads. The UAE's road network provides connections to each of the seven emirates and links major city centers.^[12] Neighboring Oman and Saudi Arabia are also connected with UAE via roads, to facilitate trade. UAE ranks first globally in the quality of roads indicator by the World Economic Forum Global Competitiveness Report 2015-16. This recognition is in line with the country's 2021 vision launched by His Highness Sheikh Mohammed bin Rashid Al Maktoum.^[11]

There are various departments responsible for overall transportation in UAE, with authority for land and maritime transport at the federal level. Individual emirates have their own authorities like the Road and Transport Authority (RTA) for Dubai and the Department of Transport for Abu Dhabi.^{[8] [9]}

Opportunities

- With the road network already extensive and paved, major opportunities exist for the government to focus more on technology implementation in road infrastructure. The Abu Dhabi City Municipality has launched an online system for road infrastructure designs, called IDAS. This provides an online procedure to apply for projects, obtain approvals and communicate, with the system maintaining an online database for all design phases.^[11]
- There have been massive improvements and new projects in road infrastructure by the RAK emirate through the Department of Public Works. The RAK ring road, for instance, provides a critical link for heavy vehicles carrying cement and aggregate from RAK quarries to cement works north of the city. Thus, constant building of ring roads and highways is being encouraged in this emirate, which is now becoming a major contributor to the national GDP.^[9]
- The Dubai RTA launched Salik (electronic toll system) in 2007. Currently there are six Salik toll gates which are linked to motorists' mobile smartphones through apps. Salik has been recognized as the biggest tolling system in the world, providing free traffic gates 44 miles

in one direction and covering 12 lanes of the Sheikh Zayed road in both directions.^[10]

- Dubai is constantly upgrading its metro and air infrastructure, and supporting road infrastructure projects are continually needed to connect commuters with such facilities, especially for the Expo 2020.^[7]

Challenges

- The biggest challenge for road construction and improvement in UAE, especially for Dubai, is to keep pace with increasing tourism and population. Congestion in Dubai has become a growing problem as local agencies like RTA struggle to meet transportation needs.^[7]
- The UAE government is trying to increase the utilization of public transport. In 2014, there were 313 motor vehicles per 1,000 people, which posed a great problem with just 4,080 km of roads. Attractive alternatives to private vehicles are being developed, such as the bus service started by RTA Dubai. If such alternatives do not show a positive result, Abu Dhabi alone faces a 500% increase in traffic demand by 2030.^[8]

Seaports

By building state-of-the-art port infrastructures and introducing tax and tariff incentives to encourage development of special free zones near the ports, the UAE government has been considered a port-friendly government. UAE has a strategic geographical position and time zone advantage, which reinforces the impacts of ports on the economic growth and diversification of the country.^[13] Mr. Al Nuaimi, the Minister of Infrastructure Development and Chairman of the Federal Transport Authority Land and Maritime, stated in March 2016 that UAE ranks first regionally and third globally in terms of quality of seaports infrastructure.^[14] Moreover, globally it ranks sixth in terms of seaports structure, according to the Global Competitiveness Index 2014-2015. Also, according to the World Shipping Council, two of the world's top 50 container ports are in the UAE, with Dubai ports in the top ten. Furthermore, 60% of cargo destined for GCC countries reach their destination through UAE seaports.^[15]

For 40 years, the Mina Zayed port in Abu Dhabi was the main general cargo port for crude oil and gas export. Currently it caters to the growing leisure and cruise ship market, and has been replaced by the 420 sq. km Khalifa Port (UE\$26 billion, US\$7.2 billion).^[16] Khalifa Port has enhanced the industrial development of the Al Taweelah east region. By 2030, the Khalifa Port will have the capacity to handle 15 million TEUs

and 35 million tons of general cargo, with the result that the surrounding industrial Kizad area contributes 15% of the capital's non-oil GDP.^[17] In Dubai, Port Rashid and Jebel Ali to the south of the city play a vital role in UAE's trade. DP World is a state-owned company which operates these ports and is a major regional and international terminal and ports operator in the region.

Another important port is Jebel Ali Port in Dubai, with 90 weekly services that connect it to over 100 other ports around the world and 150 shipping lines. It has the capacity to simultaneously handle 10 massive next-generation vessels, and has increased its capacity from 14 to 19 million TEUs this year.^[18] Sharjah is the only emirate with a port on both east and west coasts. On the east coast, Khor Fakkan Container Terminal, with the only natural deepwater port in the area, has a strategic geographic position in the deep sea container trade. Furthermore, it is located close to the main east-west shipping lanes outside the sensitive Strait of Hormuz. Another operator, the Gulftainer, is the largest private operator, which also runs Sharjah Container Terminal on behalf of the Sharjah Port Authority. Fujairah Port, strategically located outside the Strait of Hormuz, offers multi-purpose activities and recently increased its onshore bunkering facilities to a capacity of more than six million cubic meters.^[19]

Challenges:

UAE ports face high-speed evolution,^[20] which is a phenomenon relevant to the Middle East and is related to rising oil prices, investments by the government, and an increasing population. (Appendix K7.) UAE ports witnessed great growth over the past three decades, thanks to the port of Jebel Ali, which handled 45% of GCC throughput in 2010. Nevertheless, today the industry is facing its “moment-of-truth phase”^[20] and is confronting new challenges. The main issue is the quick development of local markets, which could trigger oversupply and increase competition. (Appendix K8.) Rail and road networks will create strong linkages. In addition, the European economic crisis, security, and pressures surrounding Iran and Israel affect shipping costs and harm the trade sustainability in this zone.

Opportunities:

The Statistics Center of Abu Dhabi says that Abu Dhabi ports continue to grow despite a volatile market. They have contributed US\$14 billion of GDP and in 2014 generated around 40,000 new direct and indirect opportunities.^[21] Also, 2.9% of Abu Dhabi non-oil GDP comes from Abu Dhabi ports. In September 2015, the Khalifa semi-automated container port was ranked third in the world, and the Khalifa industrial zone and optimized operations have also contributed to the success of the Abu Dhabi ports.^[22]

The UAE plans to develop cruise ports due to its facilities which allow larger cruise ships.^[23]

Airports

UAE’s aviation sector has great impacts on trade, tourism, and finance as well as on economic diversification. UAE enjoys a strategic geographical position and a time zone advantage which strengthens the country’s connectivity.^[24] Aviation’s infrastructures are highly effective and an international success. The competitive and flourishing airlines such as the Emirates and Etihad triggered a significant increase in passenger and cargo throughput in airports (Appendix K9). In 2014, the capacity was approximately 100 million passengers and could more than double (to 250 million) by 2020.^[25] Heavy investments in airport development—up to US\$50 billion—are to be effected by 2020, and will focus first on improving efficiency of operations.

Dubai and Abu Dhabi airports are quickly expanding and taking market share from European strategic hubs (Appendix K10). Below is a description of the major airports’ status and trends.^[26]

Dubai International Airport (DXB) is the third-largest airport in international passenger traffic, with almost 80 million passengers in 2015. DXB has overtaken Heathrow Airport in London. It is the sixth-busiest cargo hub and the busiest for the A380^[27] in the world. By 2018, the capacity is expected to increase to 90 million passengers per year, thanks to the US\$8 billion development project. By 2020, the aviation industry in UAE is expected to represent 32% of Dubai’s GDP.

Al Maktoum International Airport, the essential part of the Dubai South City project, started its cargo operations in 2010 and its passenger services in 2013. It helped transfer general aviation traffic from DXB to Al Maktoum International airport: its five runways and four terminals would host 220 million passengers per year as well as 16 million tons of cargo.^[28] Five airports are operating in Abu Dhabi; the main one is Abu Dhabi International Airport, which hosted 20 million passengers in 2014 and had an increase of 15% in aircraft movements. It is located around 30 km from Abu Dhabi City. Al Ain Airport is the second-busiest airport of the region.^[29]

Sharjah International Airport reported a 12% increase in passenger traffic in 2014, based on a throughput of almost 10 million passengers, as a result of the aggressive expansion by Air Arabia, the main low-cost airline. However, cargo handling decreased, from around 300,000 tons in 2013 to 240,000 tons in 2014.^[30]

Challenges

The tremendous growth in the international passenger throughput and aircraft movements have triggered several logistics and security challenges for UAE's airports. The Expo 2020 would considerably increase this challenge. Furthermore, airspace is complex: national restrictions and military "no-fly zones" are increasing.^[31]

Opportunity

Services at the airport, particularly for the handling of A380s, have been improved.

Low oil prices have impacted different domains; low prices will slow down the oil-related field but will boost not only the transport sector but also the tourism and retail sectors.^[32]

Dubai Airport: The creation of Concourse A, the first custom-built A380 in the world, would maintain the strong growth at the Dubai Airport. Emirates heavily increases its network for cargo and passenger services.^[33]

SWOT analysis

Strengths

- Ranked sixth in the world for the quality of infrastructure according to WEF.
- Strategic location, within an eight-hour flight to two-thirds of the world's population.
- Free Trade Zones, relative ease of business to start up.
- Large sums already invested and yet to be invested in infrastructure over the next 10 years.
- Leading sea-air multimodal transport hub in the world—a cost-effective transport mode that provides considerable savings in transit time and freight cost.

Weaknesses

- Regulations can vary considerably across the emirates, owing to the state's federal nature.
- Oil-dependent regional economy. This has historically been very cyclical, which increases risks for long-term projects.
- The imbalance between imports and exports by maritime cargo causes inefficiency due to lots of containers being sent empty on the export side.
- Stringent screening on cargo, making it hard to strike a balance between addressing the need for cargo security while permitting international trade and commerce to thrive.

Opportunities

- Major expansion projects in hotels and airports to boost the tourism industry.
- Chance to test new systems and methods in the rail system due to its underdevelopment.
- Upcoming projects like world's biggest arc bridge, Dubai moving skyscrapers, towers and various other projects.
- Huge opportunities in infrastructure such as roads, rail, airports, and seaports to accommodate the influx of people in the upcoming Expo 2020.
- No negative impact on the infrastructure will take place in the next four to five years despite the fluctuations in oil prices due to the diversification of the UAE economy. (oil revenues account for only 30% of the country's GDP, while it was 90% in 1970).

Threats

- Delays in projects due to climate conditions (extreme hot weather, sandstorms and dust storms).
- Risk profile could be affected by issues concerning regional and international relations as the country is situated in a volatile region.
- Government always threatened by hacking attempts and cybercrimes of all types, despite the centers of e-security.
- Dependence on revenue from the oil industry in some projects; e.g., falling oil prices have halted plans for expansions of the Etihad Rail.

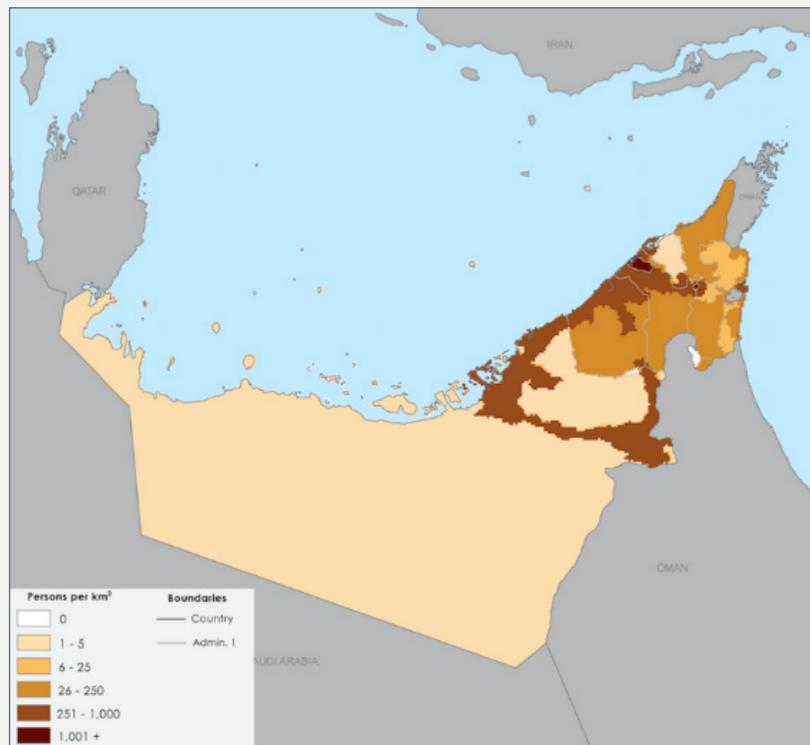
Geographical analysis

United Arab Emirates is a country located in the southeast of the Arabian Peninsula. UAE shares borders with the Kingdom of Saudi Arabia to the south and west, the Persian Gulf to the north, and the Sultanate of Oman and the Gulf of Oman to the east. The coast consists of salt pans that extend to the inner parts of the country; to the northeast, the Al Hajar Mountains elevate the terrain between Oman and the Strait of Hormuz. Sand dunes are located to the south and west of Abu Dhabi. There are two major oases in the country, the Al Buraymi Oasis, near Oman, and the Liwa Oasis in the southern part of the country.

Population density

United Arab Emirates holds approximately 9.1 million people; the majority of the population resides near the coastal or oasis areas. The population is considered 85.3% urban, with an urban population growth of 0.8% for 2014.^[34] Dubai is the largest city in UAE, with approximately 2.1 million people; Abu Dhabi is next with approximately 1.5 million people. More than 50% of the population is in a city of more than one million people.^[34]

Figure 3: UAE population density 2000
Source: CIESIN



Infrastructure

Infrastructure in the UAE is fairly new and is well maintained.

Within the country's road network, major roads connect to neighboring countries and connect important cities within the country, such as Abu Dhabi and Dubai. Other major and local roads connect important economic centers of the country.

The rail network connects important industrial sectors of the country with ports for exporting goods. The network will expand to connect UAE to the GCC rail network.

Ports are located in the Persian Gulf and the Gulf of Oman. Given the importance of UAE for the international trade of oil and oil derivatives, ports are an important part of its economy.

UAE has one of the world's busiest airports, the Dubai International Airport. It is used by airlines as a middle point in travel between the Americas or Europe to Asia and for incoming tourism or business to the region.

Sustainability

The UAE has extensive highway construction and infrastructure. Nevertheless, developed cities require innovative public transport to catalyze their accelerated growth, decrease traffic congestion, and revitalize communities.. Dubai has initiated its movement with the opening of the 52 km Metro red line in 2009, and subsequently a 23 km green line.^[36] The Metro was a tremendous achievement executed along three parking stations, a bus route network, and a toll road system. Another 15 km road, Al Sufouh, was substantially operational in 2014 after its testing was successfully completed. In Abu Dhabi, the metro line is integrated as part of the city's transit system.^[37] The transit system will be 131 km, including an 18 km underground line, two rails, and BRT. The first phase of the network is expected to be substantially completed in 2017, with an extension of 70 km in subsequent phases. The transport authority established "pedways," which connected stations to neighboring facilities and added great value to the entire network.^[38] Various efforts have been invested in sustainable transport to further enable the country to have an efficient, safe and environmentally sound transportation system. Some of the key players deploying those efforts:

- **Abu Dhabi's Department of Transport (DOT):** Abu Dhabi's DOT issues reports that focus on overcoming congestion issues by designing public infrastructure (roads and highways),

and integrating multimodal networks with smart transportation networks.

- **The Road and Transport Authority (RTA):** The RTA has set forth plans and regulations to overcome obstacles in an effort to transform Dubai into an eco-friendly city.
- **The Dubai Award for Sustainable Transport (DAST):** This award is issued by a governmental agency that nominates private or public entities excelling in sustainable transport contributing to reduced greenhouse emissions.
- **The Dubai Electricity and Water Authority (DEWA):** DEWA initiated transporting employees on mass transit buses, which contributed to less dependence on private vehicles.
- **Al Otaiba General Transport:** Initiated road hazard control through a bus and driver program.
- **The Emirates Transport:** Initiated Students Safety in School Buses program, which implements innovative solutions in technological and smart procedures. The program constitutes regulations, policies, legislation, and equipped human resources.

Project pipeline

UAE has witnessed a fall in oil prices and every region has reacted differently towards this. Dubai plans to have a 12% increase in spending, while at an emirate level, the spending plans are expected to be revised.^[39] Some of the projects planned in the region are as follows:

1. **New Abu Dhabi – Dubai Main Road:** The Department of Transport (DOT) aims to reduce congestion and improve the traffic flow on the current road between Abu Dhabi and Dubai. It also would create new entrances to the city of Abu Dhabi and Abu Dhabi International Airport. It will consist of 62 km of an eight-lane dual carriageway. The project is to be executed through two tenders. The first tender will cover construction of 34 kilometers with three interchanges, and the second tender will focus on the construction
- of 28 kilometers, with three new interchanges and modification of an existing one.^[40] Sixty percent of the work is already completed; the whole project will cost up to US\$571 million. The road is predicted to be fully operational by the end of 2017.^[41]
2. **Ras al-Khaimah Airport Expansion:** Ras al-Khaimah is planning to expand its existing international airport.^[43] The project was announced in 2012, put on hold in 2014, and was again revived in mid-2015. Construction started in May 2016. The work involves expanding the existing terminal's capacity to 3.5 million passengers annually. It also involves installing baggage and cargo-handling facilities.^[42]
3. **Dubai New Metro (Route 2020):** The project involves the 14.5 kilometer extension of Dubai Metro by the Roads and Transport Authority



(RTA) (Appendix K12). The new metro link will have wider platforms, easily accessible escalators and lifts to avoid crowding among people. The extended line will have seven stations—five elevated and two underground. The route 2020 will connect the Nakheel Harbor and Tower Stations on the red line with the Expo 2020 site. The line will also connect to Al-Maktoum International airport.^[44] Five contractors submitted technical bids for the design-build contract in January 2016 and the commercial offers were opened by RTA in March 2016.^[45] The RTA has recently discussed the project with all five bidders and will finalize the award decision soon. The lowest bid submitted is that of a consortium, with a quoted price of about US\$1.9 billion for the whole project.^[46]

4. **Etihad Rail Project:** This project involves a 1,200 km network, extending across UAE, from the border of Saudi Arabia to the border of Oman. The project is divided into three stages—stage 1 plans to construct 264 km of the road length, stage 2 with 628 km and stage 3 with 279 km.^[47] Of these stages, stage 2, involving construction of the rail network in the Abu Dhabi Emirate by connecting to the Saudi border and the Omani border, has been halted. Abu Dhabi has suspended the tendering process for stage 2, with stage 1 completed in 2015, winning the Project of the Year award. The commercial operations of stage 1 have already begun.^[48] Atkins is the preliminary engineering consultant for the early stages of the project.^[49]

Delivery methods

In construction works in UAE, especially in the big transportation-related projects, joint ventures are quite common. Special Purpose Vehicles are formed for mega-projects, between local, international and management contractors, to ensure effective risk management. Through this mechanism LLCs are generally created between contracting entities. Financing structures range from debt/equity finance to government funding. With the recent financial turmoil, government-funded projects are preferred by local contractors.^[50]

Construction contracts are typically based in International Federation of Consulting Engineers (FIDIC). The most common types of procurement are the traditional owner-design or design-bid-build using the FIDIC red book, design-build projects using the FIDIC yellow book, and EPC projects using the FIDIC silver book. The Abu Dhabi government uses the 1999 edition of the FIDIC red book, after some amendments to it that shift additional risk related to unforeseen site conditions, restrictive suspension and termination rights, etc. Force majeure contractual provisions are quite common. However, for major projects (including PPPs), it is common for owners to use bespoke contracts with specific terms.^[52]

The UAE Federal Government Contracts Regulations set contractual requirements for federal projects. Procurement laws of other emirates are also very similar to the federal law. Local procurement laws apply depending on the emirate that a firm is under contractual obligation with. Determining whether an entity is subject to these local laws is an important step. Also, it is important for foreign firms to partner with a UAE national company, otherwise it is not uncommon for rules to prohibit award of a contract. Exceptions apply to this rule when the government is in dire need of certain services that no other alternative may provide. The most important thing for foreign firms to be cautious of is whether their contracts are being considered with the local procurement laws in mind.^[51]

Conclusion

According to World Economic Forum's 2015-2016 Global Competitiveness Report, the UAE ranks in the top three for quality of overall infrastructure, quality of roads, quality of port infrastructure and quality of air transport infrastructure. The only transportation category in which the country is not ranked in the top three is the quality of railroad infrastructure; it is not ranked at all, due to the limited implementation of railways. These rankings provide a solid foundation for the UAE to expand its infrastructure and continue its strong growth.

UAE has recently invested heavily in infrastructure and the upcoming Expo 2020 has prompted further investment, such as with the Dubai Metro Line extension. This summit of international leaders will test the capability of the national infrastructure at an unprecedented level.

The infancy of the country's rail system may be one of its biggest opportunities. Many countries

are plagued by outdated and underperforming rail infrastructure. The UAE has a clean slate to implement a railway system that integrates recent technological advancements as well as plan for future improvements.

With all of these positive attributes, UAE is not without its own challenges. Its governmental composition of seven individual emirates means regulations can vary widely between regions. The country relies on imports much more than its exports, causing issues with the operation of the seaport system.

As with any OPEC country, the UAE is vulnerable to cyclical fluctuation of oil prices. More than a third of GDP is contributed by the oil and gas sector, and prices were at record lows in 2016. Even with the most diversified GCC economy, this trend jeopardizes sizeable and long-term infrastructure investment.

Appendix K1: GDP statistics

Table 2: Detailed GDP by sector in millions of Dirhams at current prices
Source: UAE National Bureau of Statistics

Appendix K1: GDP statistics

	2010	2011	2012	2013	2014		
Total Non-financial sectors	964,886	1,191,868	1,271,409	1,303,651	1,330,634		
Agriculture, livestock and fishing	8,992	9,354	9,483	9,708	9,949		
Crude oil and natural gas	331,584	503,232	539,174	531,013	503,841		
Quarrying	2,463	2,821	2,986	3,326	3,479		
Manufacturing industries	94,546	111,772	121,816	125,631	132,321		
Electricity, gas and water	25,706	29,734	33,688	34,403	36,056		
Construction	122,352	122,204	120,445	124,569	132,109		
Wholesale retail trade and repairing services	131,954	135,984	143,719	153,464	165,753		
Restaurants and hotels	21,566	25,047	27,316	30,349	32,441		
Transport, storage & other communication	63,212	73,856	79,315	85,564	94,091		
Telecommunication	26,305	26,908	27,807	29,698	32,905		
Real estate and business services	112,621	121,123	132,791	140,870	151,582		
Social and personal services	23,586	29,833	32,868	35,056	36,107		
Total financial sectors	74,017	78,862	87,353	106,065	122,055		
Financial service activities and activities auxiliary	n/a	n/a	66,468	82,639	96,521		
Insurance, reinsurance and activities auxiliary	n/a	n/a	20,885	23,426	25,534		
Domestic services of households	4,651	5,104	5,451	6,660	7,477		
Total	1,043,554	1,275,834	1,451,566	1,522,441	1,582,221		
Total of non-oil sectors			711,970	772,602	912,392	991,428	1,078,380

Appendix K2: Construction contribution to GDP

Figure 4: GDP by construction at current prices
Source: UAE Bureau of Statistics



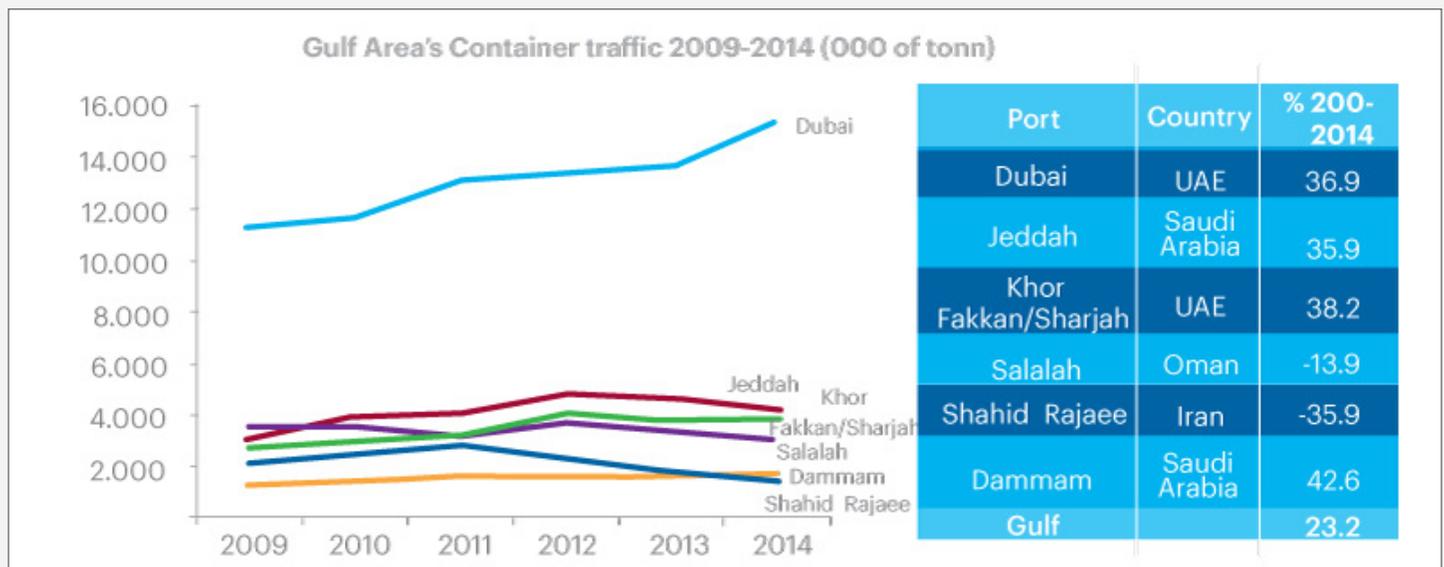
Appendix K3: GCC rail network

Figure 5: Map of GCC rail network
Source: Etihad Rail



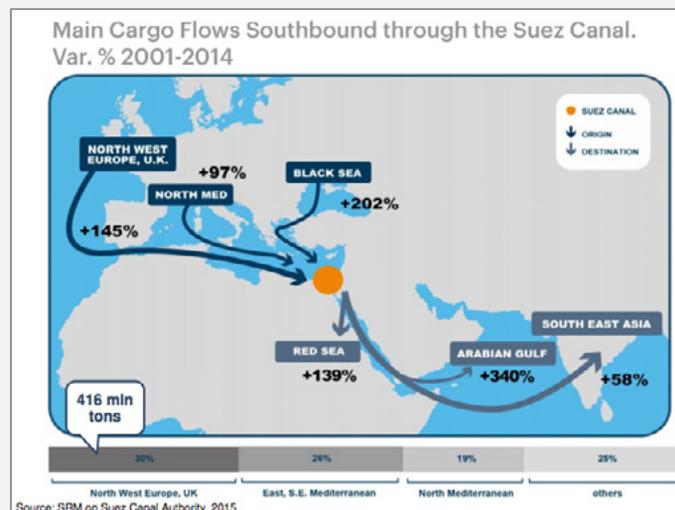
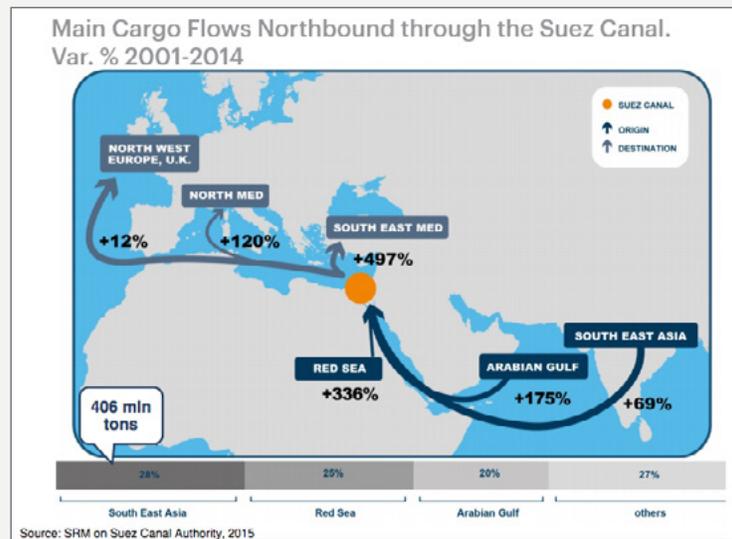
Appendix K5: Gulf Area's container traffic

Figure 7: Gulf Area's container traffic 2009-14 (000s of tons)
Source: SRM on Port Authorities 2015



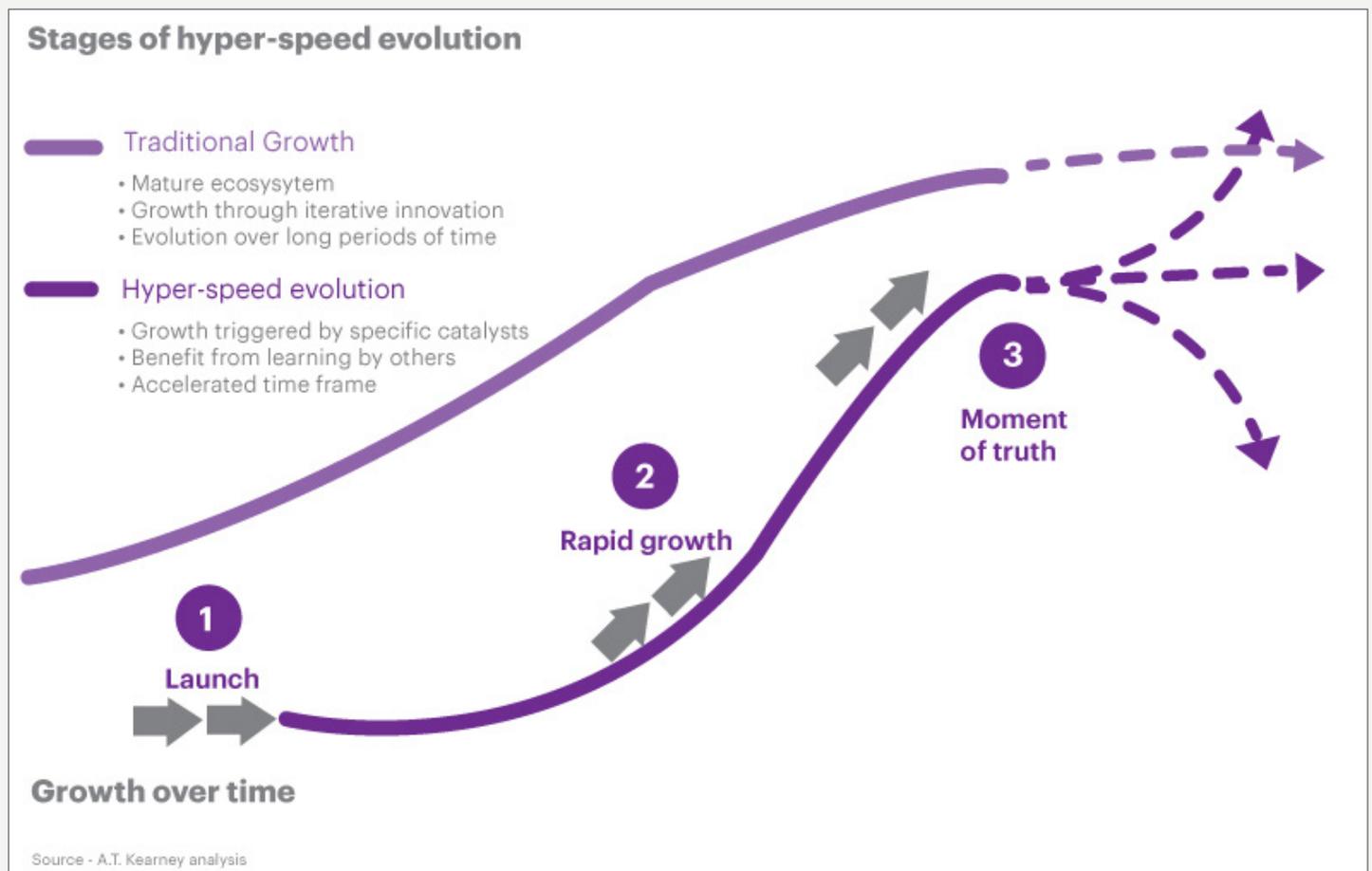
Appendix K6: North and south flows through Suez Canal

Figure 8: Main cargo flow through the Suez Canal
 Source: SRM on Suez Canal Authority



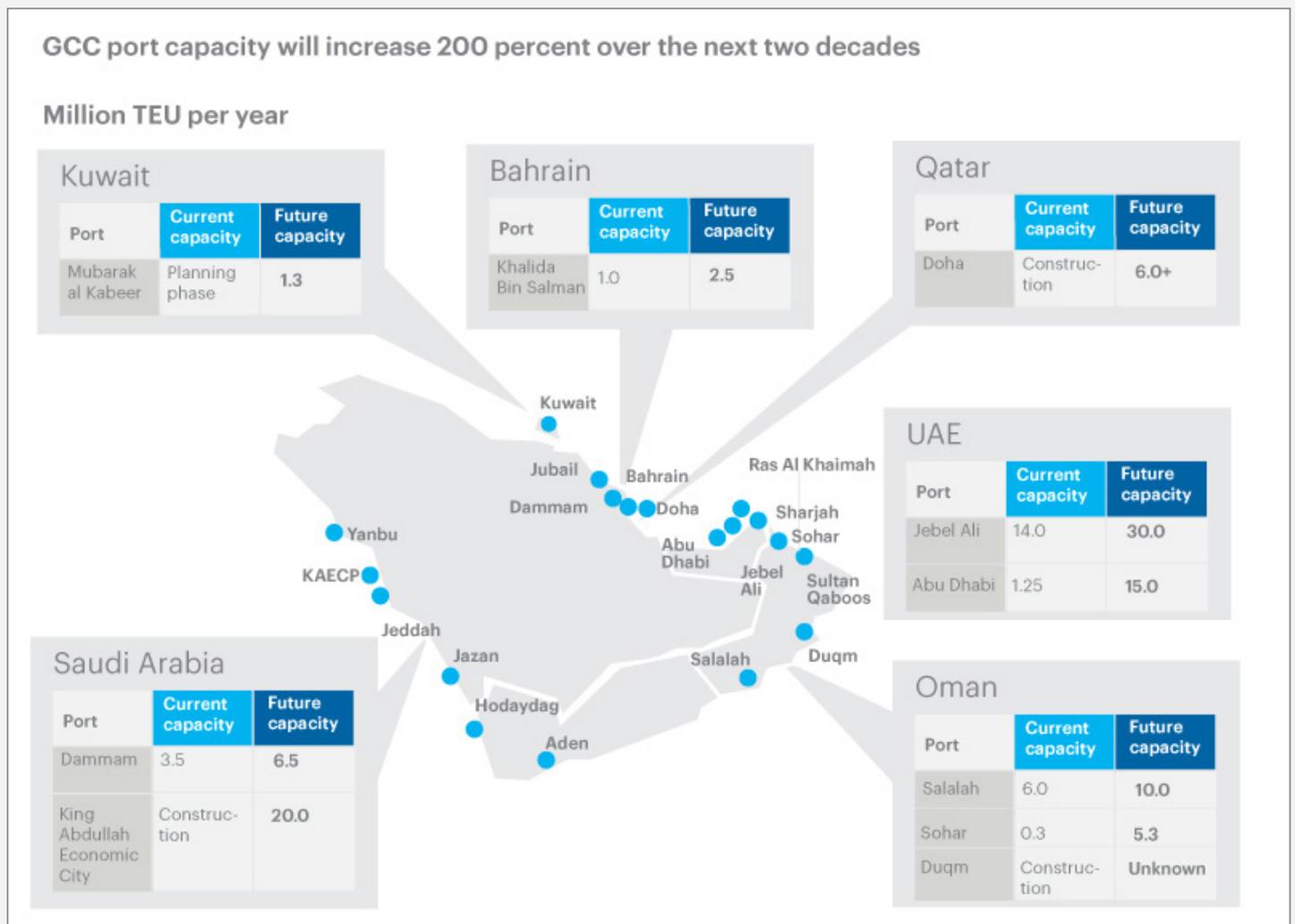
Appendix K7: Stages of hyper-speed evolution

Figure 9: Stages of hyper-speed evolution
Source: ATKearney Analysis



Appendix K8: GCC port capacity through next two decades

Figure 10: GCC port capacity over next two decades
 Source: Drewry, Oman Ministry of Transport and Communications, AT Kearney Analysis



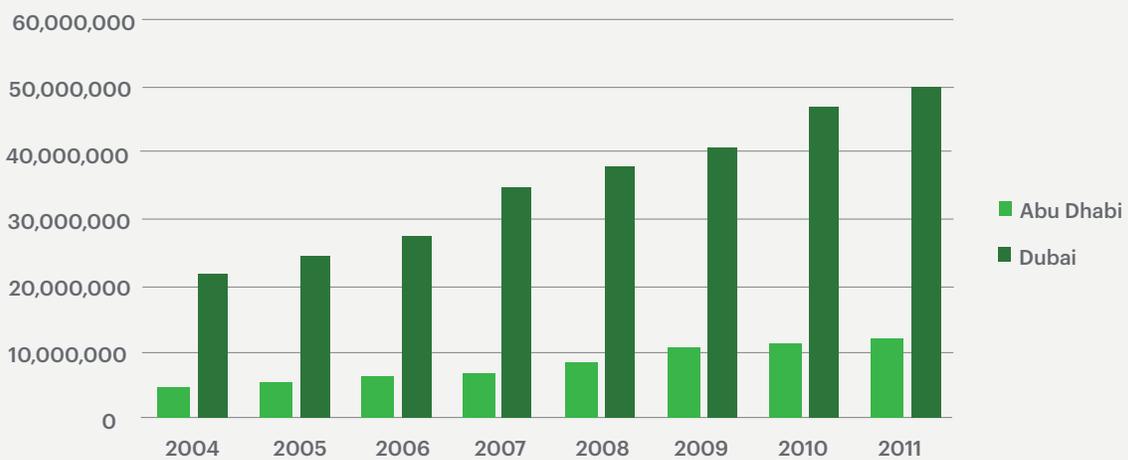
Appendix K9: UAE airport aircraft movement projection

Table 3: UAE airport aircraft movement projections 2013, 2015, 2020, 2030
Source: UAE GCAA

Airport	2013		2015		2020		2030	
	Total	Avg/Day	Total	Avg/Day	Total	Avg/Day	Total	Avg/Day
Abu Dhabi	135,213	370	187,573	514	280,542	769	475,652	1,303
Al Bateen	31,571	86	32,803	90	30,198	83	25,609	70
Al Ain	93,404	256	106,018	290	107,015	293	108,417	297
Sir Baniyas/Delma	2,300	6	2,440	7	2,828	8	3,800	10
Dubai & DWC	381,153	1,044	441,493	1,210	634,208	1,738	996,240	2,729
Sharjah	69,610	191	84,228	231	117,980	323	192,177	527
Fujairah	14,222	39	15,088	41	17,491	48	23,506	64
Ras Al Khaimah	13,747	38	15,156	42	19,343	53	31,508	86

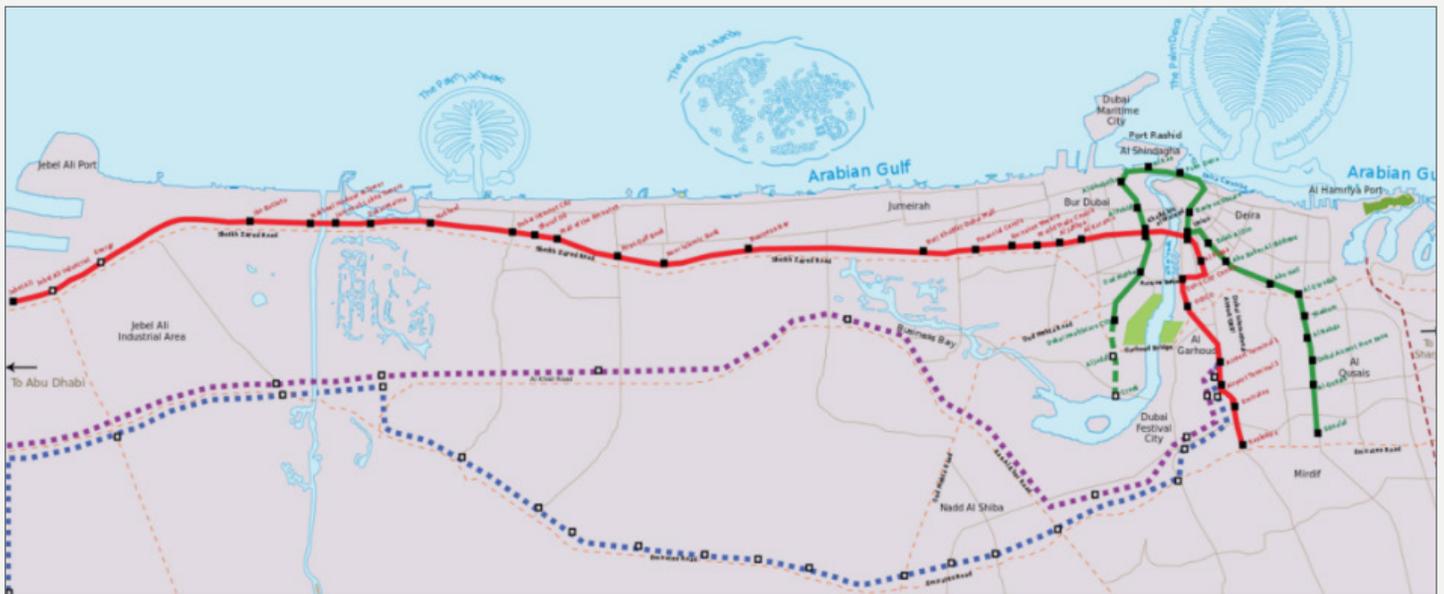
Appendix K10: Evolution of passenger traffic 2004-14

Figure 10: Evolution of passenger traffic from 2004 through 2014
Source: UAE GCAA



Appendix K11: Map of Dubai Metro

Figure 10: Map of Dubai Metro (dotted lines indicate planned future routes)



Appendix K12:

Figure 11: Metro line extension to Expo 2020



Conclusion

It is given that populations expand, trading routes shift, countries develop and technology advances. The world is continually changing and transportation infrastructure must change with it in order to meet the world's needs. Transportation development is expected to experience major growth over the next decade, especially rail and seaports. However, it faces a tremendous challenge in overcoming a funding deficit that has historically plagued infrastructure. Privatization and sustainable development may be the solution to the challenge.

Thanks in large part to China, over half of global transportation infrastructure development occurs in the Asia Pacific region. Nearly 60% of global rail development occurs in the region and 80% of all high-speed rail currently under construction is located in Asia. High-speed rail in general is gaining popularity, with more than 34,000 km of system currently being planned. Rail infrastructure is predicted to grow by 113% by 2025. This growth will be led by the Latin America and Asia Pacific regions, which are expecting 6% and 4% growth, respectively, between 2017 and 2019. This growth will be integral to the continued development of international freight transportation routes over interior lands.

The continued reliance on private vehicles continues to fuel strong roadway growth. This trend fuels congestion, which plagues cities across the world, such as Mexico City and Istanbul. This directly impacts a country's productivity and has far-reaching effects outside of commute time. In response to this issue, an estimated US\$80 trillion will be required to add an additional 25

million km of road by 2050. This growth is led by non-OECD nations, particularly India and China. Simultaneously, systems such as bus rapid transit can help alleviate the issue, and electronic tolling collection can make infrastructure more attractive for private investment.

The airport industry is slated for substantial growth in future years. The Middle East in particular is showing strong signs, spending US\$5.3 billion in 2013, which accounted for more than 15% of global aviation investment. Airports are also a strong source of private investment opportunities. Over the last two years, a large amount of public-private aviation deals have been struck and many more are currently underway. This will be essential to maintaining growth projections and reducing congestion, which has become increasingly worrisome for the industry.

Seaport infrastructure is critical for international trades, with 90% of global goods traveling at least partially by sea. The trend toward mega-ships places the industry in a pivotal position. Seaports must be updated to accommodate ever-increasing ship sizes, and technology must be integrated in order to improve handling efficiency. Of all the sub-sectors studied, seaports are expected to experience the greatest growth—130% between 2013 and 2025. Global fleet capacity grew a record 8.5% in 2015 and is expected to continue its unprecedented growth in the near future. To maintain this growth, it is critical that infrastructure connectivity between the ports and the interior land areas be established.

Global transportation investment will triple by 2050, led by strong investment growth in Africa, South America and the Asia Pacific. Seaports and rail in particular will see the greatest growth of the four sub-systems examined. Achieving funding necessary to fuel this growth will be difficult, but successful privatization

in aviation has led privatization to become more commonplace in other sectors. It will be crucial to integrate sustainable policies into development, not only to comply with global regulations but to ensure that new development can sustain the increased burden of growing populations and lengthier lifecycles.



Research team

The Global Leaders in Construction Management (GLCM) is a research initiative founded in 2012 by Professor Ibrahim Odeh and the Fu Foundation School of Engineering and Applied Sciences of Columbia University. Every year, seven to ten graduate students from the Department of Civil Engineering and Engineering Mechanics are invited to join the initiative and take part in a research project that spans six months.

Dr. Ibrahim Odeh is currently the research director of the Global Leaders in Construction Management research initiative at Columbia University. Dr. Odeh has ongoing studies in several countries with a particular focus in the GCC region. He received his doctorate in civil engineering with a concentration in construction management from the University of Illinois at Urbana-Champaign, and holds a Master of Business Administration with an emphasis on finance from Minnesota. He serves as a member of several advisory boards and committees such as CG/LA infrastructure Columbia Global Centers.

Houssam Akra is a graduate student at Columbia University majoring in civil engineering with a concentration in construction engineering and management, and graduated in May 2016. Prior to Columbia, he received his bachelor's degree in civil and environmental engineering from the American University of Beirut in 2015. Houssam has done similar reports in his research about sustainable infrastructure with Skanska.

Victor M. Alves Daporta is a candidate for a master's degree in construction management from Columbia University. He began his career with a mid-size construction management company in Venezuela. He has had the opportunity to directly manage residential projects in his hometown, Caracas, as a construction manager or field engineer for a total of 1,140 residential units built.

Omar Matar is currently a graduate student at Columbia University majoring in civil engineering with a concentration in construction engineering and management. Omar was an instrumental member of the team managing Qatar's government infrastructure projects. This entailed full monitoring of large project sites and managing people at different levels, ranging from engineers to on-site workers.

Rich McDonald is a project management consultant with Turner and Townsend. He graduated with a Master of Science in construction engineering and management from Columbia University and received his bachelor's degree in civil engineering from the University of Florida in 2014. He previously worked with UF and the Florida Department of Transportation on multiple transportation and construction research projects.

Yasmine Oukrid is currently a graduate student at Columbia University in construction engineering and management and graduated in May 2016. Prior to Columbia, Yasmine received her bachelor's degree in Ecole Speciale des Travaux Publics, du Batiment et de l'industrie, Paris, France. Her internships in Singapore and Paris helped her forge a great international experience.

Shivani Patil graduated with a master's degree in civil engineering, focusing on construction engineering and management, from Columbia University in May 2016. She graduated from VJTI, India with a bachelor's degree of technology in civil engineering, 2014, after which she worked

with Oberoi Realty Limited, India for a year. Shivani will be working as a deputy project manager with AECOM, from June 2016.

Henyl Shah graduated from VIT University, India, with a BTech degree in Civil Engineering in 2015. Thereafter he pursued a Master of Science degree focusing on construction management at Columbia University. He has also interned for Larsen and Toubro, in India, on the Mumbai Monorail project. After graduating from Columbia University, he will be working as a deputy project manager for AECOM.



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