

Up-rise and Decline of the World's Railways – A Bird's Eye View of a 200 Years Development of a Big Infrastructure

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We live in a world which is characterized by global infrastructure networks for communication and transport. These networks are growing rapidly since 200 years. It is unquestioned that they changed the societies of the Western world. The positions about their impact are extremely contradictory and there is often a wide gap between visionary imaginations and real outcome. At the beginning, when technological systems for communication and for transport were ready to be set into business visions spread out how these systems might influence the future of society. The expectations were in many cases not very modest. What had been developed to serve a certain purpose and should ease daily life somehow suddenly was not only by a few envisaged as of fundamental importance and would at minimum contribute to the birth of a totally new and even better society which then was offered to be wealthier, more democratic, peaceful, and more enlightened.

Many of these options and hopes failed and one knows technology is neither good nor bad; nor is it neutral and there are a lot of shades of grey in between.¹ But what does that mean? In my paper I will discuss the development a worldwide and very huge infrastructure on the example of the railways. Therefore, I try to answer the following questions: What are the historical experiences with these infrastructural networks? How should we qualify their impact on society? How should we interpret their advantages and disadvantages, and what can we learn from up-rise and decline of such a 150 to 200 years old global infrastructure? I start with a short description about the reasons why railways appeared in the world around 1800?

Although, Europe possessed good transport networks that were more efficient than the even good transport networks of the Chinese Empire, the great success in modernising passenger transport by post coaches could not hide the great problems in transport of goods at the end of the 18th century.² It was the transport of mass goods and heavy loads that increased together with industrialisation, but the capacity of land transport by carts was limited by the power of horses and the fragility of modern road which consisted of loosely poured sand and rock layers. Technical measurements as broader wheels did not solve the general problem and so transport was shifted to rivers and canals when possible. The advantages of water transport for mass and heavy load were obvious. But there existed a lot of disadvantages too. The length of rivers and canals one could make use of was only a fraction of the length of the road system and then depended shipping on sufficient rain in summer and moderate temperatures in wintertime. All in all there was enough pressure to think about a fundamental innovation in land transport, of transport facilities independent from roads and waterways around 1800. The thinking, but also practical experiments, – especially in the heart of industrial progress, the regions of coal mining and furnaces – led to practical achievements: the system of railways, *fer de chemins*, *Eisenbahnen*.

The concept of railways was based on the fundamental physical idea that hard wheels on a hard ground would reduce frictional resistance and therefore minimise the energy for the transport process. At the beginning of the railway age we find extremely fragile steam engines on iron wheels and rails pulling some wagons in British coal mines. These experiments of a non animal driven system showed two things: Iron on iron means more than 90 per cent less energy than traditional road transport on sandy runways.

Beside that, iron roads solved the problem of fast destruction of roads by heavy load and permanent use. It were these railways which eliminated the bottleneck in long distance transport of goods and – what was not aimed – increased passenger transport to unknown dimensions. The speed – 20 to 30 kilometres per hour – and an astonishingly capacity of the new transport system revolutionised transport in Europe since the 1830s.

Technical but even more economic success caused the railway mania, i. e. an enormous flow of investment capital spurring on hopes of extraordinary profit. But the investments for construction of a second and totally new transport web beside the old one were tremendous expensive. Railway construction afforded up to 50 per cent of capital investments of a developed industrial economy. This was why the construction of the net of iron roads needed several decades for completion.

The construction of railways had started in Western Europe in the 1820s and was up to the 1860s characterised by private committees in cities. The big wave of nationalisation of railway companies did not began before the last three decades of the 19th century, continued in the 20th century and then ended in some countries in the 1980s, in a big wave of reprivatisation. However, the contradiction of private and state railways companies existed from the beginning onwards where the relationship of the two models was different and particular in every country. Extreme examples are countries as the UK at one hand and Belgium at the other. In between we find many mixed systems. I will not to go too much into details about this, but it is important to consider that a good deal of the growing network was developed and financed by private entrepreneurs.³ With the help of these also transnational active investors Europe got a network and it was this internationality of investors and their product that we could speak of an European network beside all national characteristics.⁴

Therefore developers needed good arguments to convince potential investors. Many arguments were overdrawn and far from reality.⁵ Nevertheless, many memorandas were right: Railways would have far reaching consequences on economic, social, political and cultural matters of society. But these consequences differed from place to place and from time to time. Let us look a bit closer at the network that were realised in the world up to World War One.

Around the 1870s Europe and North-America was covered with a rapidly growing railway network for multidimensional purposes in the field of transport of passengers, goods and information. Railways impacted on Western societies in numerous ways by accelerating all transport and distribution processes in economy but also in social respect for example by mobility of labourers or in political affairs by accelerating administrative processes and flow of information. The efficiency increased by intertwin-

ing railways with the telegraph network. Not by accident telegraph lines grew rapidly alongside railway lines since the 1850s.

Most impacts had railways on increasing industrial countries and this was why in Western and Central Europe the 19th century became the age of railways. There the networks were growing steadily attached thousands and thousands of kilometres of new lines. The German network for example increased in 70 years from 35 (!) to 60.000 kilometres and connecting more or less all cities. Although the railways were built for goods transport they had extreme importance for passenger transport too which exceeded for some decades clearly the income form goods transport.⁶ The passenger transport covered all social classes but was sharply divided into different classes of comfort.

Railway transport had impacts on all parts of society. They distributed raw material as coal and ore. They carried workers which were essential for the establishment of a modern industry and they supported migration in the nearer surrounding and into far regions of the transatlantic world.⁷ They served business travel of merchants and bankers, allowed politicians to travel to congresses, meetings and so on. Architects, city planners and engineers undertook long journeys just to collect information and artists travelled for inspiration or to exchange with other artists just to look for a market for their oeuvre. Militaries thought over their strategic principles in the light of the logistical possibilities of railways and politicians and administrations made use of railways for a more efficient administration in time-compressed countries. Education travels developed into tourism in spas or just for sightseeing of natural or cultural monuments or just for beautiful landscapes. All in all transport costs decreased and this was one of the pre conditions for the long lasting industrial rise of Europe which led to the economic hegemony over the rest of the world. Already in 1914 the European economy achieved a degree of interdependence that they only reached again in the 1970s.⁸

But this wide spectre of functions, the multidimensional use of railways depended on a dense structure of the net. And the European net was in this respect not homogeneous. We find remarkable distinctions in its density. Full developed railway networks which served all functions railways are made for were growing only in Western and Central Europe. At the periphery in Europe's South, North and East railway construc-

tion started with a delay of two or three decades and did not achieve a density similar to that of railways in the middle of Europe.⁹ This had economic reasons as late industrialisation but resulted also from political influence of the state. The European space in the East was dominated by four Empires: Prussia (i.e. Germany), Habsburg, Russia and the Ottoman Empire.

These were – with the exception of Germany and parts of the Habsburg Empire political and military strong powers but with great deficits in economic modernisation. Strategic innovations were always connected with affords for internal stabilisation and for territorial expansion. The infrastructure of railways was formed by massive intervention of the state and less developed by private investors. Last but not least, railways in Eastern Europe had to cover wide spaces with less dense population. This corresponded with a less dense railway network. The result speaks for itself. We find long connecting lines between the distant bigger agglomerations. These extended sometimes to single transcontinental links.¹⁰ However, in Eastern Europe the economic and social effects of railway contributed to a more intense traffic, but they were not able to create additional traffic as consequence of a flourishing economy. Moreover, some of these railway constructions were contra productive because they absorbed the capital necessary for investments in manufactures. It was not rare that railway lines in Eastern Europe failed to be successful.

Delays in construction, less density, political and administrative orientation, all together, this was the reason why railway in Eastern Europe did not show the same revolutionary effects as in other parts of Europe and this had consequences. The societies in Eastern Europe never had left the path of a “catch-up industrialisation” (*nachholende Industrialisierung*).¹¹

What could be said about railways in other regions of the world?¹² There are some remarkable observations. Only in North America do we observe a development comparable to that of Central and Western Europe. On that continent the European dynamics were even surpassed. With the opening of the line from Baltimore to Ellis Mills in 1829, the railway era even began before the construction of the Liverpool-Manchester railway. The line was part of a huge project to connect Baltimore to Ohio. From these modest beginnings a dense network soon covered the Eastern states of the Union. This furious start had its reasons. Hence, there existed some important

differences between American and European railways. Instead of governmental guarantees of the interest rate or railway construction by the state, the Union supported many railway projects by generous donations of land. Furthermore, the ongoing expansion to the West played an important role. In contrast to the European railways the American ones served the big colonisation process of an entire continent. Railways were not only involved in settlements and in the development of an urban landscape but were also used by settler groups who were recruited to cultivate the land donations. Thus, railways did not simply connect urban areas with each other but supported their foundation and developed in this way their own transport market in the Middle West and alongside the transcontinental lines.

As a result of these specific circumstances the American railway network soon exceeded that of Europe by far. Within a few decades the largest share of the worldwide railway network was developed in North America.¹³

However, also the American continent had its periphery. The densest parts were the American East and the Midwest of the United States, but then only some main axes from East to the West coast could not hide that we find in between big holes related to only less dense populated areas. Although the railway network in the North of the continent were not very dense. In Canada railway constructions started very early in 1836 but nevertheless longer lines followed very late. It was not before the 1880s when the Canadians made serious attempts for the construction of a transcontinental line from a dense city landscape the East to the West coast. In 1881 the Canadian Pacific was founded and in 1885 the whole line could set into business. Construction work was expensive and the company nearly went bankrupt but afterwards the railway developed to a flourishing trust with a wide range of business activities.¹⁴

Also in Central and South America first railways were constructed very early in the 1830s (f. e. Cuba 1837), but single lines and sometimes regional networks followed late. A transcontinental network or even a throughgoing line was not achieved. The construction of even a part of such a line as the Trans-Sandine Railways lasted decades before it could be finished. There existed neither connections from North to South nor connections from East to West.¹⁵

The rest of the railways in the world formed only fragments of a network too. In many cases we find only single lines which served the interest of colonial powers. The gauge of these lines differed, they were less compatible and formed an extra hindrance for later connections to larger entities.¹⁶

A good example might be China. The administration of the Empire resisted railway construction for a long time. They feared the influence of foreigners when they got easy access to the inner territories of the country and they feared a destabilisation of the Chinese economy. Railway construction began not before 1876 which was a 24 kilometres railway from Shanghai to Woosung.¹⁷ After 1895 colonial powers as Great Britain, France, Japan and Germany choose the imperial capital Beijing as the centre of the future Chinese railway network. Several lines were stretching out from Beijing. By 1911, there were around 9.000 kilometres of tracks in China in the possession of foreign companies.

More developed networks had been created in Japan and India. In Japan the first line was built not before 1872 and connected Tokyo with Yokohama. But up to 1900 the network increased with the support of German advisors to 6.000 kilometres.¹⁸

Pretty much earlier than in China and Japan railway construction in India started with the project of the Great India Peninsula Railway already in the 1850s.¹⁹ Around 1880 no less than 15.000 kilometres on tracks existed and in 1910 no less than 50.000 kilometres. This was five times the size of the Chinese railways and nearly as big as the German one. But because of the great expansion of the land the density of India's network was only one tenth of the German one.²⁰ Railways transported the products of the continent as coal, wheat, tea and cotton, from the interior provinces to the harbour cities. And the Indian Railways initiated mass passenger transport by cheap tariffs.

Let us have a short look at the two continents that remains. Australia got his first railway line in 1846 and five decades later the Australian network included 21.000 kilometres tracks. This was only two fifth of the Indian railways.²¹ Africa then "occupied among all continents the last position."²² In Africa France were active in Northern Africa and in the Sub Sahara region and Great Britain in Egypt and South Africa. Other colonial powers were engaged in Kongo (Belgium), Angola (Portuguese) and South

West Africa (Germany) or in other parts of the continent. Most of them built single lines from the interior to the next harbour. Small networks developed only in Egypt and South Africa. South Africa alone possessed 8.000 kilometres line. This was nearly the half of the total network which did not exceed the 20.000 kilometres margin. This was only one twentieth of the US American network.²³

Map Railways and Telegraphs in the World around 1910 and table Length of Railways in the world 1850 to 1930²⁴

YEAR	USA	RUSSIA	CANADA	INDIA	GERMANY	FRANCE	UK
1850	14,500	500	100		2,100	900	3,900
1870	85,000	11,000	4,000	9,000	19,000	16,000	21,000
1890	335,000	31,000	23,000	27,000	43,000	33,000	28,000
1910	566,000	67,000	51,000	53,000	61,000	40,000	32,000
1930	692,000	78,000	91,000	71,000	58,000	42,000	33,000

The table shows the situation of the developing network up to the interwar period. Although, we clearly have a progress in the expansion of the railways network in the world from a length of some hundred kilometres in 1840 to 670.000 kilometres²⁵ 50 years later, we must consider that most of the development took place only in two spots in the world: Western Europe and the East, Middle West and West of the United States. We have only two main centres with efficient and dense networks which could serve a multitude of purposes: economic, social services as travel and migration, political purposes, administration, meetings, cultural effects and military logistic. Unlike to such limitations the transport system worked as a very efficient mean for military purposes too. This was impressively demonstrated after 100 years existence of railways in World War One which was also named a Railway War.²⁶

Let us summarize the development of the world's railway network so far. The multi-dimensional outcome of a dense railway infrastructure in Western and Central Europe and in the United States stayed to be an unfulfilled dream for the rest of the world where only fragments of a network or single lines often for colonial interests were installed up to the interwar period. Although the lines outside the dense railway networks in Europe and North America did contribute to world trade and freight transport when they were connected with shipping lines and road transport, nobody can deny the shortcomings of the railway networks in a global perspective. Rail transport not only had difficulty bridging the gap formed by oceans and seas between

Europe and the Americas, Europe, and Australia, or even Europe and Africa, but they also faced great problems trying to conquer the landmasses on the way from Europe to Asia.

However, in light of all this, the idea that the railway had a monopoly on transportation at the end of the nineteenth and the beginning of the twentieth century can be refuted.²⁷ In many parts of the world road transport stayed to be without any alternative. Additional arguments speak against the monopoly thesis. Even during the so-called Railway Age in the two hot spots of the world's railway net, most transportation took place on roads. The vehicles included carts, coaches, horsebusses and bicycles, and, indeed, at the end of the nineteenth century the first motor cars and motorbusses. The problem is that these forms of transport appeared in statistics only in exceptional cases. In fact, we have no reliable statistics on short-distance transportation within villages and cities, or between villages and cities that were not part of the rail network. In Germany, only 9.000 out of a total of 24,000 villages and cities had a railway station.²⁸ This means that even in a country with one of the densest railway networks in the world 15,000 populated settlements had no direct connection with the railway network. Moreover, many parts of the world had, as mentioned above, no railway lines at all. In sum, railways were always far from having a global transportation monopoly.

This led us to the conclusion that railway transport was internal at any time related to street transport and external to ocean shipping. It served only very particular kinds of transport: mass transport, heavy load, and speedy travel. It depended in most cases on further transport facilities at the beginning and end of the transport chain. Nevertheless railways were the element that made transport and mobility dynamic, feasible over long distances, time saving and cheap. We must keep that in mind when we should understand the development in the 20th century, because it was totally different in the decades that followed World War One. One can speak without any exaggeration from a turn around. What was at the bottom now increased considerable and what was at the top lost its importance and dropped. We consider a decline of railways in the developed countries and a remarkable increase of railway development in many less developed countries.

The US Railway network reached its greatest extension in 1925 with 420,580 kilometres (not included the urban rail networks). In the 1930s we are faced with first route closures and around 1950 the net had shrank to 364,000 kilometres. In 1980 the American railways published figures of a net of 550,000 kilometres but this included all urban railway tracks.²⁹ Similar tendencies we know from Europe and Japan. Stagnation and decline characterises former centres of the world railway net.

This happened, although railway companies undertook enormous strength in modernisation. They successfully raised the speed, reduced energy consumption, shifted from coal to electricity with less emissions and offered more comfort. Electricity made the railway to an ideal transport facility for cities and indeed the introduction of this kind of railways started in cities and developed there since the 1880s.³⁰ Again the metropolises of North America and Europe stood at the beginning of this development. But for several reason the distribution of electric railways into the general networks for far distance travel needed several decades. Here is not the place to discuss this. Also a second innovation, the diesel traction could only be mentioned. There were a lot of further modernisation efforts as automatic signalling, telephone, modern management and computerised logistic.³¹ But all these modernisation efforts could not avoid the decline in the hot spots of world's railway network.

They lost competition with increasing motorisation. Right from its beginning, the modernisation of coaches, carts and roads had consequences for all sorts of land transport. Transport historians reflected on this shift and drew the conclusion that the period from the 1920s to the 1950s was characterised by sharp competition between rail and road – *Straße und Schiene* – *chemins de fer et routes*, and so on.³²

But why did railways lost this competition even if they were faster, safer and more comfortable for several decades. For the answer we have to plunge deeper into the relationship of networks. Motorisation based on the road system had some fundamental advantages which offered solutions for the deficits of railways. This was why beside all modernisation and innovations railways had been marginalised by modern road (and air transport) in the second half of the 20th century. Streets, the fundament for any motorised road transport, formed at any time a pretty much denser network than the networks of railways – even when great part of these net were in a miserable condition for a long time. The street network had already achieved, what rail-

ways – beside all gigantic construction efforts – never reached, a density that made possible that every city, every village, even every house become connected to one big net. Railways, also in their best time, always depended on streets, because alongside streets begin and ends most transport in the chains of passenger and goods transport. In time of motorisation it became visible that road transport vice versa depended pretty much lesser on rail transport.

Comparison of the railway and road network in the world in 2002 (in thousand kilometres)³³

World area	rail network	road network	relationship of rail and road
Central Africa	9	375	1:42
Southeastern Africa	39	709	1:18
Northern Africa	32	847	1:27
Southern Asia	75	3,899	1:52
Asica Pacific	65	1,788	1:28
Middle East	125	1,421	1:12
Eastern Asia	71	1,941	1:27
South America	94	2,703	1:29
Eastern Europe	109	1,900	1:17
North America	218	8,283	1:38
Western Europe	157	3,884	1:24
Japan	20	1,172	1:59
Total	1,014	28,921	1:29

Numerous initiatives took place worldwide to reconstruct and modernise the road system in order to make it accessible to cars.³⁴ This is why in the interwar period and in the decades after World War Two a gigantic second transport network developed parallel to the railway network, with tremendous impacts on society. A clear sign for this shift is the length of both modern transport networks. Although the railway network grew steadily, it fell far behind the road network. In 2002 there were one million kilometres of railway in the world. If this railway were evenly spread out in a grid system, the furthest one could ever be away from a railway would be 65 kilometres. Of the seven territories with the largest land areas, six also have the longest distances of railway. With all the progress the network has made it is only one thirtieth, i.e., circa three per cent, of the modern road network. In 2002 there were 29 million kilometres of road in the world. If the network of roads were evenly spread out in a grid system, the furthest one could ever be away from a road would be 4.5 kilometres. Cities are mazes of roads, often congested with traffic. In cities most people live, work, and sleep within a few metres from a road. Regionally the highest number of

roads per square kilometre is found in Japan and the lowest in the Middle East, where most of the world's petroleum, the precondition for motorisation, is extracted.³⁵

There was a second competitor. Air transport on the other side gave answer to other deficits of railways we had talked about. Railways and ships formed a world net long before World War One. But as we had seen this world wide web consisted with many gaps and holes because of deserts, isolated seas, less dense populated regions or poor states that could not afford the investments for infrastructure. A further aspect was the slowness of shipping. In both concerns the air plane presented solutions.

This was why railways of Western Europe and North America and Japan lost competition with motorisation and airtransport. In the hot spots of motorisation which were identical with the former hot spots of rail transport, railways successful defended their transport volume in absolute figures up to today. Sometimes they even achieved some increases in goods and passenger transport. But their share on the increasing transport market permanent shrank in all developed countries of the Western hemisphere. A strong shift from rail to road cannot be overlooked. Latest, the decades after World War Two were characterised by the definitive breakthrough of mass motorisation and of modern road construction. It happened at first in the United States in the interwar period and after World War Two in the rest of the Western World. From a dominant transport system for passengers and goods traffic, railways have now declined to become a niche business of the worldwide transport market. Nearly 83 per cent of personal transportation is done by automobiles and only 7.3 per cent by railways worldwide.³⁶ Only 13 per cent could be achieved in Europe in 2002. In Germany its share on the passenger transport market declined from nearly 40 per cent in the 1950 to less than ten per cent since the 1980s.

Does this mean the railway has gone from being a monopoly to near-nonexistence – from being a provider for all to a *quantité négligeable*? Sometimes observers have interpreted the conflict between rail and road as an insurmountable contradiction that would end with the defeat of one of these systems. Most believed that the railway – a child of the nineteenth century – would lose, or already had lost, the contest. Indeed, present-day statistics show impressive shifts in the relationship between rail and road transport during the twentieth century. We have presented the quantitative relationship in length of both networks. Rails achieved only three per cent of the total net of

all land transport systems. Additional arguments support the thesis that railways would vanish. But such a position is hardly convincing and does not take all developments in the world into consideration. There we find not only railways in decline but also opposing developments: Outside the centers of the Western World railways are growing rapidly. Because there motorisation is developing on a lesser speed and we can consider an ongoing increase in railway construction since decades. In Eastern Europe, Asia and Africa developed considerable railway network during the 20th century. We can only present some short lists to shed light on this remarkable aspect that stood in opposite to the railway development in Europe and North America.

Russia extended the railway lines in Siberia in large infrastructure projects in the 1930s, 1940s and even 1950s. To mention only two the so-called Turksib from Arys over Alma Ata to Semiplatinsk or the famous BAM, the Baikal-Amur Magistrale, which was important for the connection of the Russian with the Chinese network. All in all, the Russian network doubled between 1920 and 1980 and became extended from 76.000 to 143.000 kilometres.³⁷

The next example is India. By 1947, the year of India's independence, there were forty-two rail systems that formed a multi-gauge network. In 1951 the systems were nationalised as one unit, becoming one of the largest networks in the world. Since then the Indian Railways extended the size of the network from 50,000 to more than 64,015 kilometres of tracks. This is today the fourth largest railway network in the world. The railways traverse the length and breadth of the country and carry over 20 million passengers and 2 million tons of freight daily.³⁸ Even the Indian railways did not share the dynamic of the Russian network it made progress.

After the revolution of 1912 and during World War One the Republic of China up to the 1930s extended the Chinese railway system from 14.500 to 22.000 kilometres. But this looks modest compared with the expansion of the network after World War Two. After the establishment of the People's Republic of China, the new government invested heavily in the railway network. During the 1950s through to the 1970s, especially lines in Western China were expanded. China maintains about twenty principal domestic railway routes with a total length 86,000 kilometres (including 24,100 kilometres of multiple track and 18,900 kilometres of electrified railways) by the end of 2009. This is the third biggest railway network of the world.³⁹ Moreover, there has

been significantly progress in the efficiency of the system. Until 1980 most trains in China were driven by steam locomotives because of cheap coal. But in the 1980s and 1990s they were replaced by electric and diesel engines. The result of this innovation was a remarkable increase in the maximum speed of express trains from 120 to 200 kilometres per hour since 1997, and some passenger trains already have reached a maximum speed of 350 kilometres per hour on certain sections of main lines.⁴⁰ Moreover, as of 2012 China has the world's longest high-speed-rail network with over 10,000 kilometres of routes in service, including the world's longest line, the 2,298-kilometre Beijing-Guangzhou High-Speed Railway.⁴¹ Since high-speed rail service in China was introduced on 18 April 2007, daily ridership has grown from 237,000 in 2007 to 1.33 million in 2012, making the Chinese high-speed rail network the most heavily used in the world.⁴² All in all, Chinese railways are carrying 25 per cent of the world's total railway workload in the present.

Even we have progress in railway construction in Africa too the situation looks by far not as impressive as in China. Ideas of the French colonisers for a line through the Sahara to connect their Northern colonies with these in the Sub Sahara region failed and were later replaced by road construction. Also other big projects as the Cape to Cairo plan failed.⁴³

However, there are bigger projects as the TAZARA Railway (Tanzania-Zambia Railway, also called the Uhuru Railway) was built between 1970 and 1975 by the Authority to give landlocked Zambia a link to the Tanzanian port of Dar es Salaam, as an alternative to export routes via rail lines to Rhodesia (now Zimbabwe), South Africa, and Mozambique. The 1860 kilometres long railway was a turnkey project financed (US \$500 million) and executed by the People's Republic of China. On September 6, 1967, an agreement was signed in Beijing by the three nations. China committed itself to building a railroad between Tanzania and Zambia, supplying an interest-free loan to be repaid over 30 years.⁴⁴ The construction and opening of the line was because of its tremendous costs criticised. Indeed the company went bankrupt five years after the completion of the line.⁴⁵

However, other projects were more successful and a lot of new railway lines at the periphery of the Western World are opposing the decline in the core of the metropolises.

Also the decline of the network in the Western World has stopped. Railways still exist and there must be some reason for this fact. Of course, there was a downward trend, but one must pay attention to several details that affect the data. First, not everything can be transported by cars, trucks or air planes. And not everything transported by cars or planes is cheap.

Moreover road transport faces serious problems when the capacity of the road network reaches its limit. Mass and heavy loads, as well as traffic jams secured the existence of old transport media as railways.

Second, the statistics are relative, expressing a relationship. This includes the fact that in absolute figures, rail transport has increased in most countries during the twentieth century. The background is the tremendous increase in global mobility and freight transport. This is why all transport systems: shipping, air transport, cars, and also railways, win. Third, there has been a change in the relationship between rails and roads in the most recent two decades, a slight increase in the proportion of rail transport vis-à-vis road transport. This is why some feel encouraged to speak of a “renaissance” of railways.⁴⁶ This opinion is based on three areas of positive development in rail transport in comparison with its competitors, airplanes and automobiles: First we should mention through going transport corridors for containerised goods transport. We have discussed losses in the interbellum and after-war period. But in the past few decades rail freight has been regaining strength in some countries. Special services in goods transport are flourishing, for example container transportation from harbour to hinterland, bringing national railway companies back into global transportation networks.⁴⁷

An example might be German Railways. Here we have a significant increase of railway goods transport from 70 to 110 billions of tons kilometres, i. e. an increase of 58 per cent. The down going process clearly has been stopped. The share on total goods transport increased slightly from 16.8 to 17.2 in two decades. The consequences are far-reaching. Today many European railway companies are forming strategic alliances and taking over companies in neighbouring countries to compete more efficiently on the European goods transport market. The *Union Internationale des Chemins de Fer* (UIC) also speaks of success stories and global perspectives for rail freight.⁴⁸

Second, high-speed trains successfully compete with airplanes for distances up to 1,000 kilometres. Railways may make further inroads into the business travel market if airlines have to raise their prices as a result of additional taxes, increase in fuel prices, and political decisions to protect the environment. Growing extra time for security reason is another disadvantage of air transport.⁴⁹ Meanwhile, the high-speed rail networks are becoming denser, more transnational, and more efficient. And they are not only in Europe and Japan anymore: they are spreading out to North America, Russia, and China.⁵⁰ Especially the first and last ones are good examples. Plans for high-speed rail in the US, i.e., with speeds over 177 kilometres per hour (110 mph), date back to the High Speed Ground Transportation Act of 1965. Various state and federal proposals have followed, with limited success. But since 1993 ambitious plans have been developed for ten rail corridors for high-speed rail in many parts of the USA, including California, the Midwest, New England, Florida, Texas, Pennsylvania, and the Pacific Northwest, as well as the southwestern states. A federal initiative has provided eight billion dollars to develop high-speed rail projects and to stimulate US federal and state planners to coordinate the expansion of high-speed services.⁵¹ Other projects have followed, such as the California High-Speed Rail for a High-speed rail connection from Anaheim to San Francisco via San Jose, which should be completed in 2028, and two years ago Amtrak made a 151-billion-dollar proposal for the construction of a high-speed-capable rail line that would allow for a speed of more than 350 kilometres per hour and would cut trips between New York City and Washington, DC to only 94 minutes.⁵²

German railways successful attracted new customers in passenger transport. Alone the highspeed service increased from 21 million to 81 million passengers per year. In total there was realized an increase from 65 to 90 billions of passenger kilometres, a plus of 36 per cent. This was an above average increase in relation to other modes of transport. This is why the share of railways on the passenger transport market the first time since the 1950s shows an increase from 6.7 to 8.2 per cent. Very interesting is also the very strong increase in regional and urban transport.

Convincing is also the development of urban rail systems. It is a fact that rail transport increases in urban agglomerations when the capacity of the road network reaches its limits. What were the consequences of motorisation and of the moderni-

sation of the road network in the knots of the net, i.e., the cities, and what does this mean for the rail systems?

Meanwhile, this renaissance of rail transport in urban areas has spread across Europe. In many countries, local and regional public rail transport has increased in the last 30 years.⁵³ Since the start of the new millennium many cities have experienced a comeback of streetcars and trams and also of U- and S-trains. But it is not only Europe that rediscovered the efficiency of urban rail systems. Metropolises in the USA and in Asia have made large-scale investments in urban rail systems, too.⁵⁴ Remarkable is the change in the United States – the motherland of motorisation! Since the oil crisis of 1973 there has been a slow rethinking among American city planners and clear signs for a renaissance of public rail transport. Glenn Yago analysed this shift already in the 1980s and described how easily German, French, Swedish, and Canadian cities were able to switch back to urban and regional rail systems in answer to increasing fuel prices.⁵⁵ In contrast, American cities had to deal with severe problems in that area because the technological knowledge had vanished together with the decline of public transport since the 1920s.⁵⁶ But despite these disappearances almost all larger cities were forced to develop systems of public rail transport again – even in Chicago, the forerunner of motorisation.⁵⁷ This demonstrates that also in times of mass motorisation there is a need for balanced public transport on rail, such as streetcars, U-, S- and regional trains.⁵⁸

However, as the examples show, there is a clear renaissance of rail transport in urban environments on long-distance high-speed lines and in some parts of freight transport. All in all, experts predict an increase in rail transport in the near future: in exact figures, from 7.3 to 8.3 per cent by 2025.⁵⁹ Can we therefore speak of a shift back from roads to rails at the beginning of the twenty-first century, a reversal of what happened at the beginning of the twentieth century? This is not very likely. Most transportation experts see a continuation of car mobility for the foreseeable future. But the question probably is wrong, and we ask it because we are looking too closely at the aspect of competition and underestimating the fact of the interdependence of the two networks. The facts are very clear: The rail network developed successfully as an answer to the limited capacity of road services in the nineteenth century, but it only broadened the transport market and did not generally replace road transport. The increase in the importance of road transportation in the twentieth century was the

answer to the limitations of rail transport, for example its unsuitability for cargo freight or door-to-door service. But rail transport did not vanish in the twentieth century any more than road transport vanished in the nineteenth century when railways revolutionised the transportation of goods and human mobility with far-reaching consequences.⁶⁰ Obviously there is room for both kinds of transport, and it is not controversial to speak of them as interdependent.

Conclusion

Rails are a network that exists in many countries of the world. They were preconditions for economic growth in the 19th and first half of the 20th century. But they always depended on dense networks of roads transport and on connections to shipping lines. All in all we have in Asia and Africa a delay of 100 years. Whereas the size of railway networks in Europe and North America peaked in the 1910s and 1920s, railways in Asia today extended to their maximum. And how the railways became influences by motorisation in the second half of the 20th century begins now at the beginning of the 21st century with the catch-up motorisation in the Asian world. But it is an open question, if the development of railways in Asia and Africa will follow the pattern of the Western world. Probably they learn from the situation at the end of the 20th century and become influenced by the renaissance of railways in parts of the Western world. However, the shift from rails to roads will not bring the end of the railways. They will survive in some niches of the traffic market as transport in urbane agglomerations, high-speed travel at the ground and container transport over long distances. Key questions for the efficiency and attractiveness will be the transfer from and to other transport media.

References

- ¹ Taken from Kranzberg, Melvin (1986) *Technology and History: "Kranzberg's Laws"*, *Technology and Culture*, Vol. 27, No. 3, pp. 544–560.
- ² See Rolf Peter Sieferle, *Transport und wirtschaftliche Entwicklung*, in: Rolf Peter Sieferle (ed.), *Transportgeschichte*. Berlin 2008, 1–39, here 13–18.
- ³ See Rondo Cameron, *France and the Economic Development of Europe 1800–1914*. Princeton 1961, 338f., and on the Belgian example Sabine Van Dooren, *Private Spoorwegen in België 1830–1914. Een dynamische interactie tussen Staat en Private Sector*, University of Louvain, master thesis, 2000, 103, Leon Avakian, *Le rythme de développement des voies ferrées en Belgique de 1835 à 1935*, in: *Bulletin de l'Institut de Recherches Economiques* 7, 1936, 449–482, Bart Van der Hertem, Michelangelo Van Meerten und Greta Verbeurgt (eds.), *Sporen in België: 175 jaar spoorwegen, 75 jaar NMBS*. Leuven 2001, 27ff., and Frans Buelens, Julien van den Broeck and Hans Willems, *British and French Investments in the Belgian Railway Sector During the Nineteenth Century*, in: Ralf Roth and Günter Dinshobl (eds.), *Across the Borders – Financing the World's Railways in the Nineteenth and Twentieth Centuries*. Aldershot 2008, 95–108.
- ⁴ See Ralf Roth, *Wie wurden die Eisenbahnen der Welt finanziert? Einige Vergleiche*, in: *Zeitschrift für Weltgeschichte* 10, 2009, 55–80. See also Jürgen Osterhammel, *Die Verwandlung der Welt. Eine Geschichte des 19. Jahrhunderts*. Munich 2009, 1023f.
- ⁵ See Ralf Roth, *Das Jahrhundert der Eisenbahn. Die Herrschaft über Raum und Zeit 1800 – 1914*. Ostfildern 2005, 28–32, and Ralf Roth and Günter Dinshobl (eds.), *Across the Borders – Financing the World's Railways in the Nineteenth and Twentieth Centuries*. Aldershot 2008. This was one reason why hopes and visions skyrocketed up to the heaven and since the very beginning of the so called “age of railways” railway committees argued very often on a global perspective making the public becoming interested in their tiny projects and their need for investments. Johannes Scharrer, leader of the railway committee in Nuremberg which successfully constructed the first railway line in Germany, only a six kilometre long line to the neighbouring city Fürth, argued without any provincial modesty that this would be only the first step to a transcontinental transport route which would serve the demands on transport from the Netherlands in the North up to the Black Sea in the South. See Johannes Scharrer, *Deutschlands erste Eisenbahn mit Dampfkraft oder Verhandlungen der Ludwigs-Eisenbahn-Gesellschaft in Nürnberg. Von ihrer Entstehung bis zur Vollendung der Bahn. Nuremberg 1836*. His conviction was shared by Michael Alexander Lips, *Deutschlands Welthandels- und Wiedergeburt oder die deutschen Eisenbahnen*. Nuremberg 1836. At the same time an anonymous writer of a memorandum about some railway connections between the German kingdoms Prussia and Hannover was absolutely convinced that therefore the public should pay attention to the system of world trade. See G. v. S., *Der Welthandel und die Eisenbahnen in ihrer Wechselwirkung oder Betrachtungen über ein preußisch-hannoveranisches Eisenbahnsystem*. Halle 1838. At this time the German railway network barely exceeded the length of 50 kilometres.
- ⁶ See Christoph Maria Merki, *Verkehrsgeschichte und Mobilität*. Stuttgart 2008, 47f., and Osterhammel, *Verwandlungen*, 1020. See also See Lothar Gall, *Eisenbahnen in Deutschland: Von den Anfängen bis zum Ersten Weltkrieg*, in: Lothar Gall and Manfred Pohl (eds.), *Die Eisenbahn in Deutschland. Von den Anfängen bis zur Gegenwart*. Munich 1999, 13–70, here 28f. See also Rainer Fremdling, *Eisenbahnen und deutsches Wirtschaftswachstum 1840–1879*. Dortmund 1975, 17f., G. Stürmer, *Geschichte der Eisenbahnen. Entwicklung und jetzige Gestaltung sämtlicher Eisenbahnnetze der Erde*. Bromberg 1872, 77–85, 90f., 137–148, 154–158, 161f. and 171–176, and Theodor Schieder, *Staatsystem als Vormacht der Welt 1848–1918*. Frankfurt am Main 1980, 424f. See also Harold Pollins, *Britains Railways: An Industrial History*. Newton Abbot 1971, 89, and Philip Bagwell, *The Transport Revolution from 1770*. 2nd ed. London 1988, 107ff. On the background see Carlo M. Cipolla, *The emergence of industrial societies*, in: Carlo M. Cipolla (ed.), *The Fontana Economic History of Europe. The Industrial Revolution*, 6 vols. Glasgow 1975, vol. 4.2, 719–794, here 748, und Dionysius Lardner, *Railway Economy. A Treatise on the New Art of Transport, its Management, Prospects and Relations, Commercial, Financial and Social*. New York 1968, 154f. and 409.
- ⁷ For workers and the poor companies in some countries offered extra cheap tariffs in carriages without any seats which increased for example in Germany passenger transport. Beside all strength masses of poor people, journeyman, workers and women could make use of speedy

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- transport and vice versa it made most people becoming mobile over far distances. The labour market – one precondition for industrialisation – increased and this effected tremendously on the extreme rise of urban agglomeration in the time of the German Empire. Similar developments we can consider in other parts of Europe. See Roth, *Jahrhundert*, 137ff., Michael Robbins, *The Railway Age*. 3rd ed. Manchester 1998, 54ff., and Robert E. Carlson, *The Liverpool and Manchester Railway project, 1821–1831*. Newton Abbot 1969, 235–238. On the size for goods transport see Michael J. Freeman und Derek H. Aldcroft, *Transport in Victorian Britain*. Manchester 1988, 74 and 124f., Fremdling, *Eisenbahnen*, 17f., Rainer Fremdling, Ruth Federspiel and Andreas Kunz (eds.), *Statistik der Eisenbahnen in Deutschland 1835–1989*. Historische Statistik von Deutschland, vol. 17. St. Katharinen 1995, 522–524, Herten, Meerten und Verbeurgt, *Sporen in België*, 90, Brian R. Mitchell and Phyllis Deane, *Abstracts of British Historical Statistics*. Cambridge 1962, 6, Pollins, *Britains Railways*, 56 and 89, René Tiessing et Maurice Paschoud, *Les chemins de fer suisses après un siècle, 1847–1947*. Neuchâtel 1949, 399, and Jean-Claude Toutain, *Les transports en France de 1830 à 1965*, Cahiers de l'Issea, Série AF. Paris 1967, 157f.
- ⁸ See Paul Bairoch, *Commerce extérieur et développement économique de l'Europe au XIXe siècle*. Paris 1976, 36, and Matthew S. Anderson, *The Ascendancy of Europe, 1815–1914*, 2nd ed. London 1985, 20.
- ⁹ See for example Ralf Roth and Henry Jacolin, eds., *Eastern European Railways in Transition, Nineteenth to Twenty-first Centuries* (Surrey 2013).
- ¹⁰ One example was the Orient Railway that served the colonial interest of European powers into the Middle East. See Kurt Grunwald, *Türkenhirsch. A study of Baron Maurice de Hirsch. Entrepreneur and Philanthropist*. Jerusalem 1966, Bülent Bilmez, *European Investments in the Ottoman Railways, 1850–1914*, in: Ralf Roth and Günter Dinhl (eds.), *Across the Borders – Financing the World's Railways in the Nineteenth and Twentieth Centuries*. Aldershot 2008, 183–206, Basil C. Gounaris, *Steam over Macedonia. Socio-economic Change and the Railway Factor*. Boulder Col. 1993, 42f., Yakup N. Karkar, *Railway Development in the Ottoman Empire, 1856–1914*. New York 1972, 134f., and Shereen Khairallah, *Railways in the Middle East, 1856–1948. Political and Economic Background*. Beirut 1991, 62. See also Michael Geistbeck, *Weltverkehr. Die Entwicklung von Schifffahrt, Eisenbahn, Post und Telegraphie bis zum Ende des 19. Jahrhunderts*. ND. Leipzig 1986, 99–112, 235f.–245, and Ralf Roman Rossberg, *Geschichte der Eisenbahn*. Akt. Neuaufl. Frankfurt am Main 1984, 122–129. But the biggest project in this respect was the Transiberian Railway which connected the Asian parts of the Russian Empire with the capitals in the West of Russia. It was seen as a developer railway for a gigantic colonisation program on the model of the United States. But this failed. The railway did not create a stream of humans as it was the case in the settlement of North America. The Transib was only a thin path which connected far away parts of the world. See Osterhammel, *Verwandlungen*, 1022f. See also Mathias Beer and Dittmar Dahlmann (eds.), *Über die trockene Grenze und über das offene Meer. Binneneuropäische und transatlantische Migration im 18. und 19. Jahrhundert*. Essen 2004, and Eva-Maria Stolberg, *Sibirien: Russlands „Wilder Osten“*. Mythos und soziale Realität im 19. und 20. Jahrhundert. Stuttgart 2009. For a long time Siberia continued being a people's dessert and line served above all the imperialistic expansion program of the Russian elite in Far East. Which then collided with the imperialistic ambitions of Japan in Korea and Manchuria. See Ralph William Huenemann, *The Dragon and the Iron Horse: The Economics of Railroads in China, 1876–1937*. Cambridge 1984, 252–257, und Jonathan D. Spence, *Chinas Weg in die Moderne*. Bonn 2008 (orig. München und Wien 1995), 310–317.
- ¹¹ See Iván T. Berend and György Ránki, *The European Periphery and Industrialization 1780–1914*. Cambridge 1982, 71, 91 and 99, and Iván T. Berend and György Ránki, *Foreign Trade and the Industrialization of the European Periphery in the 19th century*, in: *Journal of European Economic History* 9, 1980, 539–584. See also Sidney Pollard, *The Peaceful Conquest. The Industrialization of Europe, 1760–1970*. Oxford 1981, 130, and Jörg Fisch, *Europa zwischen Wachstum und Gleichheit 1850–1914*. Handbuch der Geschichte Europas, vol. 8. Stuttgart 2002, 244–248. For other regions at the periphery (Northern Europe) see Rossberg, *Geschichte*, 95–99.
- ¹² Early literature on world railways: Fifteen years after the first introduction of a railway line in the UK first description appeared which discussed the question of real impact on European railway transport for world trade. See Friedrich Wilhelm von Reden, *Die europäischen Eisenbahnwege für den Welthandel mit 2 Tabellen: Landfrachten mit Eilfuhr 1845*, in: *Eisenbahn Zeitung* 1845, 391. Around 1870 the German railway historian G. Stürmer wrote a book about the railways of the world and included short descriptions of all railway lines of the world. See G. Stürmer, *Geschichte*

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- der Eisenbahnen. Entwicklung und jetzige Gestaltung sämtlicher Eisenbahnnetze der Erde. Bromberg 1872. And at the end of the 19th and beginning of the 20th centuries impressive books appeared discussing the real “World on Rails”. See Geistbeck, *Weltverkehr*, 297–308; W. Goetz, *Die Verkehrswege im Dienste des Welthandels. Eine historisch-geographische Untersuchung samt einer Einleitung für eine „Wissenschaft von den geographischen Entfernungen“*. Stuttgart 1888; Artur Fürst, *Die Welt auf Schienen. Eine Darstellung der Einrichtungen und des Betriebes auf den Eisenbahnen des Fernverkehrs. Nebst einer Geschichte der Eisenbahn*. München 1918. For more modern studies see Rossberg, *Geschichte*.
- ¹³ On American railway construction see Derek Avery, *The Complete History of North American Railways* (Secaucus, NJ 1989), Ralf Roman Rossberg, *Geschichte der Eisenbahn*, sec. ed. (Frankfurt am Main 1984), 151, and Ralf Roth, *Das Jahrhundert der Eisenbahn. Die Herrschaft über Raum und Zeit 1800–1914* (Ostfildern 2005), 34–6 and 142–53.
- ¹⁴ See Rossberg, *Geschichte*, 161–164, and Geistbeck, *Weltverkehr*, 299.
- ¹⁵ Before World War One only some fragments were built. From these the most developed were built in Mexico, Brazil and Argentina. See Rossberg, *Geschichte*, 165–173, and Geistbeck, *Weltverkehr*, 308–320.
- ¹⁶ See Douglas J. Puffert, *Tracks across Continents. Paths through History: The Economic Dynamics of Standardization in Railway Gauge*. Chicago 2009, und Clarence B. Davis and Kenneth E. Wilburn (eds.), *Railway Imperialism*. New York 1991.
- ¹⁷ The railway was demolished one year later by the Qing government. Until the defeat of China in the First Sino-Japanese War in 1895 only little development had been made. See Rossberg, *Geschichte*, 118.
- ¹⁸ See Eiichi Aoki, Dawn of the Japanese Railways, in: *Japanese Railway and Transport Review*, March 1994, 28–30, and Mitsuhide Imashiro, Nationalisation of Railways and Dispute over Reconstruction to Standard Gauge, in: *Japanese Railway and Transport Review*, March 1995, 42–45. See also Geistbeck, *Weltverkehr*, 280ff., and Rossberg 113–122.
- ¹⁹ See See Ian J. Kerr, John Chapman and the Promotion of the Great Indian Peninsula Railway, 1842–1850, in: Ralf Roth and Günter Dinshobl (eds.), *Across the Borders – Financing the World’s Railways in the Nineteenth and Twentieth Centuries*. Aldershot 2008, 225–240.
- ²⁰ See Rossberg, *Geschichte*, 113, and Geistbeck, *Weltverkehr*, 280–292.
- ²¹ See Geistbeck, *Weltverkehr*, 320–324, and Rossberg, *Geschichte*, 173–188.
- ²² Geistbeck, *Weltverkehr*, 292.
- ²³ See Rossberg, *Geschichte*, 128–147.
- ²⁴ Based on Daniel Headrick, *Tentacles of Progress*. New York 1988, 55. See John R. McNeil and William H. McNeill, *The Human Web. A Bird’s-Eye View of World History*. New York and London 2003, 220.
- ²⁵ See Geistbeck, *Weltverkehr*, 342–343.
- ²⁶ See my paper *On the Way to War: The Role of German Railways in Military Strategic Planning, 1830 to 1914*, for the session “The Wheel That Broke. The Contribution of Railways to the Great War” at the 12th Annual Conference of the International Association for the History of Transport, Traffic and Mobility (T2M): *Spinoffs of Mobility: Technology, Risk and Innovation* at Drexel University, Philadelphia, PA, USA, September 18–21, 2014.
- ²⁷ Kolb characterised the position of the East German Reichsbahn as a *de facto* monopoly, and Schulz said the same about the West German Bundesbahn. See Eberhard Kolb, ‘Die Reichsbahn vom Dawes-Plan bis zum Ende der Weimarer Republik’, in Lothar Gall and Manfred Pohl, eds., *Die Eisenbahn in Deutschland von den Anfängen bis zur Gegenwart* (Munich 1998), 109–63, here 154–5, and Günter Schulz, ‘Die Deutsche Bundesbahn 1949–1989’, in *ibid.*, 317–76, here 336.
- ²⁸ Andreas Predöhl, *Verkehrspolitik* (Göttingen 1958), 127.
- ²⁹ See Rossberg, *Geschichte*, 151.
- ³⁰ See Ralf Roth, Die Entwicklung der Kommunikationsnetze europäischer Städte unter besonderer Berücksichtigung der Eisenbahn, in: Ralf Roth (ed.), *Städte im europäischen Raum. Verkehr, Kommunikation und Urbanität im 19. und 20. Jahrhundert*. Stuttgart 2009, 23–62; Ralf Roth, Zur Geschichte der Eisenbahn in Deutschland und ihr besonderes Verhältnis zur Stadt, in: Deutsche Akademie für Städtebau und Landesplanung (ed.), *Stadt und Bahn. Almanach 2006/2007*. Berlin 2006, 24–36; Ralf Roth, Die Eisenbahn verändert die Stadt – die Stadt verändert die Eisenbahn, in: Wolfgang Kos und Günter Dinshobl (eds.), *GROSSER BAHNHOF. Wien und die weite Welt*. Wien 2006, 36–42, and Ralf Roth, Die Finanzierung der Verkehrssysteme in europäischen

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- Hauptstädten: London, Paris und Berlin, in: Wolfgang Ribbe (ed.), Hauptstadtfinanzierung in Deutschland. Von der Reichsgründung bis zur Gegenwart. Berlin 2004, 263–287.
- ³¹ See Ralf Roth, Delayed Modernisation – The Long and Winding Electrification of the German Railways, in: Magda Pinheiro (ed.), Railway Modernization. An Historical Perspective (19th and 20th Centuries. Lisbon 2009, 21–33, and Hans-Joachim Braun and Walter Kaiser, Energiewirtschaft, Automatisierung, Information seit 1914. Propyläen Technikgeschichte, vol. 5, ed. by Wolfgang König. Berlin 1997, 97ff.
- ³² On the topic see Colin Divall and Ralf Roth, eds., From Rail to Road and Back Again? A Century of Transport Competition and Interdependency. Ashgate: Farnworth (forthcoming).
- ³³ For the railway network see data source World Bank, World Development Indicators (New York 2005). Data are from 2002. 64 territories had no recorded rail system. The World Bank defines railway line as the length of the route available for service, irrespective of the number of parallel tracks. Rail Network <http://www.worldmapper.org/display.php?selected=36> (last accessed 17 February 2014). For the road network see data source World Bank, World Development Indicators (New York 2005). Data base from 2002. Roads include motorways, highways, main/national roads, secondary/regional roads, and all other roads in a territory. On statistical information see Road Network http://www.worldmapper.org/posters/worldmapper_map35_ver5.pdf (last accessed on 17 February 2014).
- ³⁴ On the example of US investments in road construction in South America see Bruce E. Seely, Der Pan American Highway – eine Straße zwischen zwei Kontinenten, *Zeitschrift für Weltgeschichte*, 12, 2, 2012, 141–74. The United States was the forerunner in the development of modern roads for mass motorisation. At the time, different lobby groups attempted to continue to build on visions for a nationwide modern road network that had been developed at the end of the war. A decade after the report of the National Interregional Highway Committee established by Roosevelt, one of his successors, Dwight D. Eisenhower, also appointed a presidential committee, chaired by General Lucius D. Clay, which should evaluate the demand for highways in the USA. Later on, Clay became, not by accident, a member of the board at General Motors. Moreover, other members of the Eisenhower administration had close ties with General Motors, for instance the secretary of Defence, Charles Wilson, and one of his advisors, Francis du Pont, who became director of the Bureau of Public Roads. The Clay Committee emphasised the construction of Interstates as a national necessity. Legislation to underscore this consisted of the Federal Aid Highway Act and the Highway Revenue Act of 1956. See Richard F. Weingroff, 'Federal-Aid Highway Act of 1956: Creating the Interstate System', *Public Road*, 60, 1, 1996 (online, no pagination), <http://www.fhwa.dot.gov/publications/publicroads/96summer/p96su10.cfm> (last accessed 28 February 2014). See also History of the Interstate Highway System, <http://www.fhwa.dot.gov/interstate/finalmap.cfm> (last accessed 28 February 2014). The planning included eventually some 70,000 kilometres, which should be finished in 1972. But in the 1980s there were still some gaps waiting to be closed. Nevertheless, the construction of the Interstates was one of the biggest infrastructure projects in the world. Lay, *Geschichte*, 260.
- ³⁵ See http://www.worldmapper.org/posters/worldmapper_map35_ver5.pdf (last accessed on 17 February 2014).
- ³⁶ World Transport Report 2010/2011, ProgTrans AG, Basel. http://www.progtrans.com/html/wtr_2010.html (last accessed 12 August 2010). Quoted in Christoph Ruhkamp, 'Kein Auslaufmodell. Das Auto wahrt seine Dominanz im Personenverkehr fast ungeschmälert', *Frankfurter Allgemeine Zeitung* of 11 August 2010.
- ³⁷ See Rossberg, *Geschichte*, 108–111.
- ³⁸ It is one of the world's largest commercial or utility employers, with more than 1.6 million employees. As to rolling stock, IR owns over 200,000 (freight) wagons, 50,000 coaches and 8,000 locomotives. See Indian Railways Year Book (2006–2007). Ministry of Railways, Government of India. Delhi 2007, 53. For further information see http://www.indianrailways.gov.in/depts/stat-eco/YearBook_06_07.htm (last access 10.10.10). See also Rossberg, *Geschichte*, 116f., and Geistbeck, *Weltverkehr*, 280–292.
- ³⁹ One example is the 1900 kilometres railway from Lanzhou to Urumqi that was built between 1952 and 1962. In Southeastern China were also railways constructed, for example the Baoji-Chengdu Railway built in 1950s and Chengkun Railway in 1970s. The railway to Xizang (Tibet) was finally completed and opened in 2006. See <http://www.railcn.net/news/tiedaobu/railway-99672.html> (last access 10.10.10).
- ⁴⁰ See <http://www.railcn.net/news/tiedaobu/railway-99672.html> (last accessed on 10 October 2010).

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- ⁴¹ See 'China's railways mileage tops 100,000 kilometres', *Xinhua* of 28 December 2013, and 'World's longest fast train line opens in China', *The Associated Press* of 26 December 2012, <http://bigstory.ap.org/article/worlds-longest-fast-train-line-opens-china> (last accessed on 17 February 2014).
- ⁴² See 'China's high-speed programme back on track', *International Railway Journal* of 10 January 2013, <http://www.railjournal.com/index.php/high-speed/chinas-high-speed-programme-back-on-track.html> (last accessed on 17 February 2014), 'China High Speed Train Development and Investment', *The China Perspective* of 27 December 2012, <http://www.thechinaperspective.com/articles/chinahighspeedr-9905/> (last accessed on 17 February 2014), and <http://whhh.fc2web.com/ktx/hikaku.html> (last accessed on 17 February 2014), and http://en.wikipedia.org/wiki/High-speed_rail_in_China#cite_note-10000_km-1 (last accessed on 17 February 2014). See also 'China wird zum Exporteur von Superschnellzügen', *Frankfurter Allgemeine Zeitung* of 15 July 2010.
- ⁴³ The most famous of them was the Cape to Cairo plan that lasted back to the 1860s. First the realisation was hindered by the rivalry of colonial powers. After 1918, when the British Empire had taken over German colonies, the British would have possessed the political power to complete the Cape-Cairo Railway, but now economic issues precluded its completion in the interwar period. After World War Two, the national struggles of the African peoples and the demise of colonialism removed the foundations for its completion. See Lewis R. Freeman, Rhodes's "All Red" Route: The Effect Of The War On The Cape-To-Cairo And The Control Of A Continent, in: *The World's Work: A History of Our Time* 29, January 1915, 327–355, and George Tabor, *The Cape to Cairo Railway and River Routes*. London 2003, and Rossberg, *Geschichte*, 141.
- ⁴⁴ See Thomas W. Robinson and David L. Shambaugh, *Chinese Foreign Policy: theory and practice*. 1994, 287, and Richard Hall and Hugh Peyman, *The Great Uhuru Railway: China's Showpiece in Africa*. London 1976, 31, and Rossberg, *Geschichte*, 147.
- ⁴⁵ See Die Tan-Sam-Eisenbahn, Pekings Renommierbauwerk in Afrika, ist pleite. Jetzt will Bonn die teure Entwicklungsruine aus Bundesmitteln sanieren, in: *DER SPIEGEL* 36, 1980.
- ⁴⁶ Bund Deutscher Architekten and Deutsche Bahn AG, *Renaissance der Bahnhöfe*, Katalog der Ausstellung mit gleichem Namen in Kooperation mit Meinhardt von Gerkan (Berlin 1996).
- ⁴⁷ See Predöhl, *Verkehrspolitik*, 125.
- ⁴⁸ See Ulrich Friese and Kerstin Schwenn, 'Rivalen zwischen Luft und Schiene. Die Zukunft der Mobilität. Bahn drängt nach Europa, Luftfahrt unter Kostendruck, Straßenverkehr dominant', *Frankfurter Allgemeine Zeitung* of 11 August 2010', and the SCI Verkehr GmbH, *The Worldwide Market for Rail Freight Transport and its Operators: Markets – Trends – Players of 2008*, http://www.sci.de/uploads/tx_edocuments/Product_information_MC_SGV_eng.pdf (last accessed on 28 February 2014). For UIC see Press Release No. 8 /2014: 4th UIC Global Rail Freight Conference – 'GRFC 2014' – organised with the Austrian Federal Railways (ÖBB) and to be held from 23–25 June 2014 in Vienna, http://www.uic.org/com/IMG/pdf/grfc_en.pdf (last accessed on 28 February 2014).
- ⁴⁹ Rüdiger Soldt, 'Mit Tempo 300 durch die Champagne. Vom Wochenende an fahren TGV and ICE regelmäßig von Stuttgart und Frankfurt nach Paris', *Frankfurter Allgemeine Zeitung* of 8 June 2007, 'Fliegen auf der Schiene', *Frankfurter Allgemeine Zeitung* of 29 March 2008, Friese and Schwenn, 'Rivalen zwischen Luft und Schiene'.
- ⁵⁰ On high-speed railway in Russia see Anthony Heywood, 'Back to the Future? Russia's Railway Transport and the Collapse of the Soviet Union in Historical Perspective', in Ralf Roth and Henry Jacolin, eds., *Eastern European Railways in Transition: Nineteenth to Twenty-first Centuries* (Surrey 2013), 257–86, here 277–80.
- ⁵¹ See US Department of Transportation and Federal Railroad Administration, *Vision for High-Speed-Rail in America*, 1 April 2009, <http://www.fra.dot.gov/eLib/details/L02833> (last accessed on 3 March 2014). See also Thomas J. Billitteri, 'High-Speed Trains: Does the United States need supertrains?', *CQ Researcher*, 19, 17, May 2009, <http://library.cqpress.com/cqresearcher/document.php> (last accessed on 28 February 2014).
- ⁵² See Alex Goldmark, 'Amtrak Updates High-Speed Rail Vision, What's Changed', *Transportation Nation* of 9 July 2012, and high-speed rail in the United States, http://en.wikipedia.org/wiki/High-speed_rail_in_the_United_States (last accessed on 1 March 2014).
- ⁵³ See Massimo Moraglio, 'Light Rail Renaissance in European Cities: Urban Mobility Agenda and City Renewals', in Ralf Roth and Paul van Heesvelde, eds., *The City and the Railway in the World 19th to 21st Centuries* (Surrey 2014 [forthcoming]).

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- ⁵⁴ On India see Anupama Mann, 'A Symbiotic Relationship: The Delhi Metro Rail and the National Capital Region', and Chigurupati Ramachandraiah, 'Urban Mega Projects and Civic Conflict – The Case of Hyderabad Metro Rail Project (India), both in Ralf Roth and Paul van Heesvelde, eds., *The City and the Railway in the World 19th to 21st Centuries* (Surrey 2014 [forthcoming]).
- ⁵⁵ Yago, *Decline of Transit*.
- ⁵⁶ The nearly total loss of know-how is surprising because the United States is the country where this technology was more or less invented or where the most important steps towards practical solutions were taken in the 1880s. One might mention the name of Frank J. Sprague, a naval officer and inventor who contributed to the development of the electric motor, electric railways, and electric elevators. His contributions were especially important in promoting urban development by increasing the size cities could reasonably attain – through better transportation. He became known as the 'Father of Electric Traction'. See Frank J. Sprague. IEEE Global History Network. IEEE. http://www.ieeeahn.org/wiki/index.php/Frank_J._Sprague, and http://en.wikipedia.org/wiki/Frank_J._Sprague (Last accessed on 28 February 2014).). But after six or seven decades of intense motorisation the technology of urban rails had not only stagnated but had totally disappeared. For the planning of modern streetcar or other urban rail systems in Los Angeles the authorities had to import know-how from Sweden and Western Germany. Similar problems appeared with S- or U-trains. Urban planners had rediscover technologies that were lost during motorisation. Yago, *Decline of Transit*, 207–10.
- ⁵⁷ See Complete Guide to North & South American Metro rail and Light Rail Systems, including Subways, Els, Peplemovers, Subte networks, <http://www.urbanrail.net/am/america.htm> (last accessed on 10 January 2014).
- ⁵⁸ Yago, *Decline of Transit*, 213.
- ⁵⁹ Ruhkamp, 'Kein Auslaufmodell'.
- ⁶⁰ See Predöhl, *Verkehrspolitik*, 127 and 130.