Rising Demand for Rail Vehicles but Downward Pressure on Prices to Continue

The division of the German railway system into separate operating areas as part of the "rail reform" and the regionalisation of local passenger rail transport from 1 January 1996 are having their effects on the rail vehicle industry. Rising domestic demand for new and improved rail vehicles is to be expected in future as a result of the more stringent requirements made of rail vehicles in terms of adjustment to customer preferences and profitable operation. On foreign markets, too, sales opportunities are good in certain market segments. However, the industry's turnover is unlikely to rise significantly because prices are expected to continue to fall.

Within the framework of a study for the Federal Minister of the Economy[1] the DIW has forecast the demand for rail vehicles in Germany. This demand consists of the replacement of vehicles that have reached the end of their working life, the premature renewal of vehicle fleets due to changes in the framework of conditions (e.g. technical standards, goods-structure effects) and requirements resulting from the need to meet the rising demand for transport. The demand prognosis was then differentiated by the different vehicle types deployed.[2]

Domestic demand

Trams, local electric trains and underground vehicles

Over the last 35 years investment in rail vehicles for urban local transport in West Germany totalled DM 11 billion (at 1991 prices). Of this, around DM 5 billion, i.e. almost half, was accounted for by local electric "city trains" and underground trains. Investment in this vehicle category was predominant in 1969 and 1970 and in the period 1978 to 1983. On the basis of past investment trends, gross fixed assets at the end of 1993 amounted to DM 7.1 billion, of which the two categories city and underground trains and trams each accounted for about half.

According to the DIW's calculations, replacement investment of DM 5.2 billion would be necessary to maintain the existing supply of rail transport services to the year 2010; again this is split roughly evenly between the two vehicle categories mentioned. By 2010 around three quarters of the current stock of vehicles would be replaced.

Besides the need to replace stock, the expected increase in demand for local public transport needs to be taken into account. The volume of bus transport is forecast to expand faster than local public transport as a whole (by 10% and 8% respectively by 2010 compared with 1992). One reason for this is the higher cost of rail transport compared with buses. Although the expectation that the regionalisation of public transport will lead to competition between a greater number of carriers to provide public transport services will not initially be fulfilled,[3] in the case of buses certain routes and services will be contracted out to private carriers. This will improve the cost situation in bus transport, in contrast to rail transport, where such opportunities are practically non-existent.

The transport prognoses for the year 2010 suggest the need for 3 800 tram vehicles and 4 900 underground and city train vehicles in Germany. This marks a fall in the number of tram vehicles of around 3 000 and an increase in underground and city train vehicles of 900. The decline in the number of trams reflects developments in the new federal states, where a decline of almost one quarter in the volume of transport by tram is to be expected (compared with 1992 levels). There are two reasons for this. In the large cities (Berlin, Leipzig, Dresden) trams are being replaced to some extent by

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[1] The full report is available in German. R. Hopf, H. Kuhfeld, H. Link, J.-P. Weiß, H. Wessels with the collaboration of A. Haid and K. Hornschild, Lage und Perspektiven der deutschen Schienenfahrzeugindustrie. *Gutachten des DIW im Auftrag des Bundesministers für Wirtschaft,* Berlin 1995.

[2] (Translator's Note) The typology of rail vehicles used in the study is complex and necessitates the use of at times rather clumsy terminology in English. The primary distinction is between the vehicles that run on the public railway network, the Deutsche Bahn (DB AG), and those operated by local public transport authorities. The former deploys locomotives, goods waggons, passenger carriages and "railcars" (i.e. self-propelled carriages for Rapid Transit – S-Bahn – and other mainline rail transport); the local transport companies deploy trams, faster, local electric trains that usually run on their own track, i.e. the "city trains" (Stadtbahn), not to be confused with the "local mainline trains" (S-Bahn), and the underground vehicles. The term "vehicle" refers to one unit (e.g. self-propelled or rolling carriage) of a given type of train (e.g. underground); see also footnote 6.

[3] Generally local authorities have an interest in retaining their public transport companies: because of the definition of community and public tasks under the law on local public transport (§ 13/13a PBefG) the obligation to invite tenders for transport services is practically meaningless.

Table 1

Passenger Volume in Public Transport in Germany, 1992 to 2010

in billion person-kilometres

	1992			2010		
	West Germany	East Germany	Germany	West Germany	East Germany	Germany
Public transport (total)	124.0	22.7	146.6	140.0	31.5	171.4
Bus, light rail[1)]	76.5	12.9	89.4	84.3	18.9	103.2
Heavy rail [2)]	47.5	9.7	57.2	55.7	12.5	68.2
Short-distance transport	69.3	12.9	82.3	71.2	15.6	86.8
Bus	40.4	5.6	46.0	42.9	7.7	50.6
Short-distance rail transport	28.9	7.3	36.2	28.3	7.9	36.2
Tram	5.5	3.5	9.0	5.7	2.7	8.4
Underground, city train	5.4	0.4	5.8	5.2	1.6	6.8
Rapid Transit train	11.8	2.3	14.1	11.8	2.5	14.3
Other local rail transport[3)]	6.3	1.1	7.4	5.6	1.1	6.7
Long-distance transport	54.6	9.8	64.4	68.9	15.8	84.7
Bus	25.2	3.4	28.6	30.5	6.9	37.4
Long-distance passenger rail transport	29.4	6.4	35.8	38.3	8.9	47.3
ICE/IC/EC	14.4	1.0	15.4	23.0	3.0	26.0
Other long-distance passenger Rail transport	15.0	5.4	20.4	15.3	5.9	21.3

1) Underground, tram, city train, bus. — 2) Incl. Rapid Transit (S-Bahn). — 3) Largely regional trains.
Sources: German Railways; VDV; DIW calculations.

more efficient electric city trains, while in smaller towns (e.g. Pirna, Halberstadt, Gotha) trams are being replaced by buses. Not only has the "motorisation wave" in eastern Germany led to a generalised and drastic decline in the number of public transport passengers, the change in the spatial distribution of transport flows (the spread of urban settlements, shopping centres on greenfield sites) are also exerting a negative impact on public rail transport.

The values for the number of vehicles calculated on the basis of expected supply of transport form a quantitative framework for calculating the turnover volume in this market segment.[4] In interpreting the forecast for the requirement for new vehicles, it should be borne in mind that most of the "Tatra" trams[5] currently in operation in eastern Germany are not to be taken out of service and replaced, but converted and retained until the year 2010.[6] Overall the conversion potential amounts to around 1 500 vehicles, leading to orders totalling DM 1.1 billion. This reduces the need for new vehicles to around 2 000 to the year 2010. At current prices this implies an order volume of DM 3.5 billion for the tram segment of the market. For city trains and underground trains the value of orders to the year 2010 is expected to total DM 8 billion.

Rapid Transit (S-Bahn) and regional train vehicles

The Deutsche Bahn AG currently holds a stock of around 4 000 Rapid Transit train vehicles.[7] Half of this stock runs on the Berlin and Hamburg networks (direct current networks). These vehicles are in some cases more than 60 years old and are currently being replaced.

[4] The current maintenance of the vehicles is not included in the calculations, i.e. it is assumed that such maintenance work is performed by the transport companies' own workshops – as is currently very largely the case – and not by firms from the rail vehicle industry.

[5] Within the framework of COMECOM the member countries were specialised in producing and distributing certain products while other countries were obliged to shut down the same production: Czechoslovakia was in charge of producing trams, the so-called "Tatra" trams which were operated e.g. in Eastern Germany.

[6] For instance, the Berlin local public transport company (BVG) has commissioned three companies (Mittenwalder Gerätebau, DWA and DUEWAG) to convert 447 "Tatra" vehicles at a cost of DM 330 million.

[7] The number of "vehicles" given here refers to the number of (self-propelled or rolling) carriages, whereas in other statistics the figures are often based on the smallest unit that can be ordered (a "quarter train" consisting of a railcar and supplementary carriage) or the smallest operating unit (2–4 carriages with a driver's cockpit at either end).

Table 2
Rail Vehicle Requirements in Germany, 1994 to 2010

	Units	Value[1)] DM billions
Trams		
Modernisation	1 500	1
New vehicles	2 000	4
City train/underground vehicles	3 600	8
Rapid Transit trains	5 000	11
Regional train vehicles	5 000	8
Long-distance passenger train vehicles	6 000	11
Goods waggons	165 000	22
Locomotives	4 300	14
Total vehicles	–	79

1) At 1994 prices.
Source: DIW calculations.

Some of the vehicles running on overhead-wire alternating current will also have to be replaced: the carriages purchased for the Olympic Games held in Munich in 1972, for instance. In addition to self-propelled railcars, other carriages of which differ only marginally from the other types of local transport carriages are also in service.[8] It is assumed that by 2010 local rail transport will in general have been converted to railcars.

This is also true of large sections of the remaining rail network. Especially on routes for which demand is low, railcars are far more cost-efficient than trains in which a locomotive pulls a small number of passenger carriages. The rail vehicle industry has developed a whole range of vehicle "families" for regional passenger transport:[9] the Regiosprinter (DUEWAG AG), a double-decker railbus (DWA), Regio-Shuttle (ABB Henschel), Eurailbus (Neoplan and De Dietrich), and the Talent vehicle family (Talbot). The replacement of existing vehicles is expected substantially to exceed that required by purely technical considerations, as the newly developed vehicles are far more cost-efficient to operate and offer passengers greater comfort (access, luggage and bicycle space etc.). Demand to the year 2010 is estimated at 5 000 Rapid Transit train vehicles and 5 000 vehicles for regional rail transport. This implies a financial volume of around DM 19 billion (DM 11 billion for local and DM 8 billion for regional rail vehicles).

Long-distance rail passenger vehicles

Given the growth in the market for long-distance rail passenger transport, the transport volume in this segment is expected to increase by one third to the year 2010. In purely quantitative terms the existing stock of passenger carriages (18 000) would suffice, but the quality of the existing fleet of vehicles will not be up to requirements, not least because the forecast increase in transport volume will largely be in high-speed transport.

This leads to a greater demand for replacement vehicles than would be expected purely on the basis of wear and tear. On the other hand, faster average speeds reduce the demand for vehicles because the carriages permit a higher transport volume (measured in person-kilometres) in a given period of time.

Given these trends and the product policies expected to be pursued by the Deutsche Bahn AG,[10] vehicle requirements of around 2 500 carriages[11] for the ICE and around 1 500 carriages for the supplementary network, whereas the demand for conventional carriages will probably be very largely covered by converting existing vehicles.

Over recent decades the (west) German public railway network has laid great emphasis on the idea of universality. New and modernised routes were constructed and equipped so as to carry both passenger and goods transport. Vehicle development concentrated on universal electrical locomotives suited for both heavy goods trains and fast, long-distance passenger travel. It is only now that the economic advantages of a separation between passenger and goods transport and of an optimal form of propulsion for each task have been taken into account. As a result, in high-speed transport the trend is towards trains consisting of self-propelled carriages (railcars), which permit flexible train lengths without the problems of adjusting motive power.[12]

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[8] These carriages are equipped with one engine on the top and one steering cockpit at each end of the train and may be operated on a route in both directions without any need to shunt the locomotive.

[9] Cf. German Rail Vehicle Construction in the Context of Market Globalisation, in: *Economic Bulletin,* vol. 33, no. 4, April 1996.

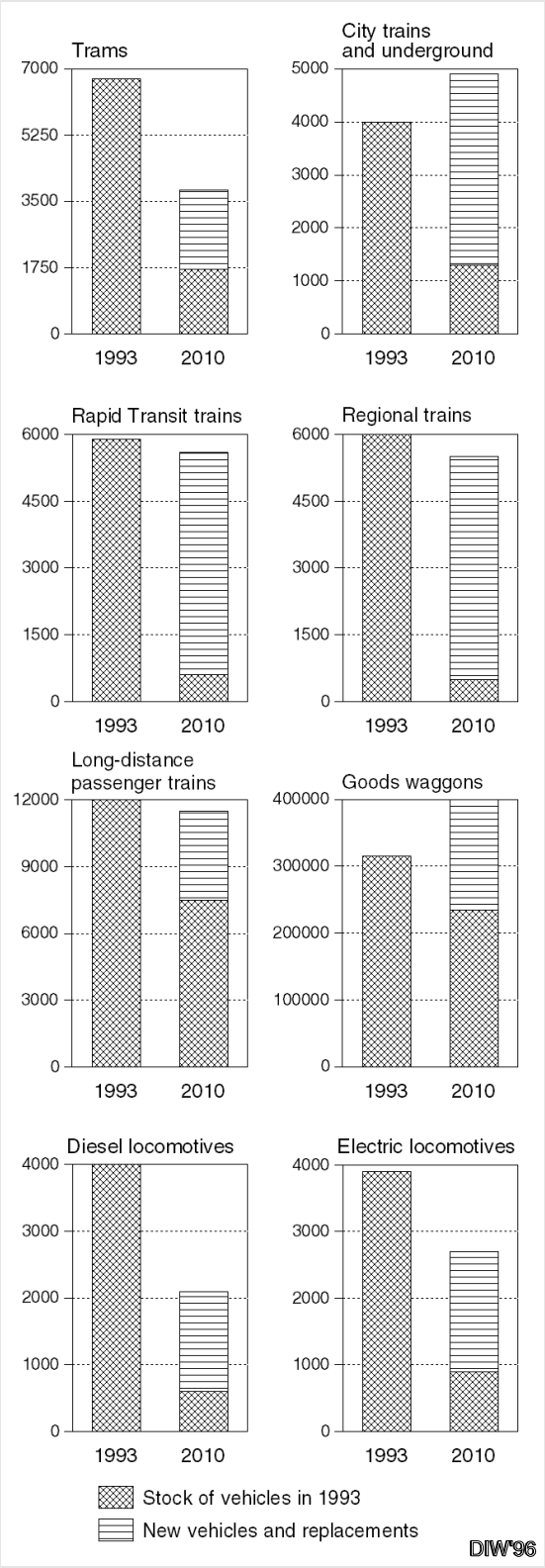
[10] ICE (Translator's Note: Inter-City Express, the fastest, most modern trains in Germany, comparable with the French TGV) between large cities to compete with road transport and domestic air travel, a supplementary network of fast inter-city and inter-regional trains to link up the remaining cities, and conventional trains for a number of foreign connections and in tourist areas.

[11] As with local rail transport, vehicle requirements are calculated in terms of individual carriages as the smallest unit. For long-distance travel a capacity of between 60 and 75 passenger seats per carriage is assumed for the calculations.

[12] An additional advantage consists in the improved dynamics resulting from the more even weight distribution.

Figure 1

Stock of Rail Vehicles in Germany, 1993 and 2010



Currently ICE trains have two engines. The successor model (ICE 2) is being produced at half the length, and with one engine and one steering cockpit, permitting more flexible adjustment to low-demand transport situations. The 50 third-generation ICE 2/2 trains ordered in mid-1994 will consist of railcars in which every second axle is driven. Up to the year 2010 an additional 200 to 300 trains of this type are likely to be required. At current prices this represents orders worth between DM 6 and 7 billion.

For the remaining long-distance network the DB AG has ordered 43 IC-railcar trains with a tilt system and 50 Interregio trains, also with a tilt system. Overall a fleet of vehicles valued at DM 4.5 billion will be required for this market segment. All in all vehicle orders totalling between DM 11 and 12 billion are to be expected for long-distance rail transport.

Goods waggons

In 1993 the overall stock of goods waggons in Germany amounted to around 315 000. Of these more than a quarter were privately owned, in most cases specialised waggons; tank waggons used to transport hazardous cargoes (gases under pressure, petroleum products, chemical products etc.) accounted for 50%.

The DIW's demand forecast for goods transport by rail suggests that the transport volume will increase to 135 million tonne-kilometres (tkm) by 2010.[13] Thus in the longer term a renewed increase in the number of goods waggons will be required. For the year 2010 a requirement of 400 000 goods waggons is estimated. This implies an additional requirement (including replacements) of 165 000 waggons. This will lead to a renewed and marked increase in orders from goods transport rail carriers.

In order to estimate the turnover volume generated by these additional orders, it is necessary to make assumptions about price trends. In this context two contrary trends must be taken into account. On the one hand, the pressure on prices will continue,[14] while on the other the incorporation of innovative technology into some products will increase the average value of goods wagons.

The equipping of goods waggons with new reloading technology, for instance, serves to simplify and

[13] This implies an increase of 8% as against the base year of the prognosis (1988), but virtually a doubling of the current transport volume; it is thus to be seen as highly optimistic.

[14] According to figures published by the branch association (Verband der deutschen Bahnindustrie) the average value of a goods waggon declined from DM 219 000 to DM 141 000 between 1991 and 1993.

Table 3

Volume of Goods Transport in Germany

in billion tonne-kilometres

	1988	1994	2010 DIW	2010 BVWP
Railway	125	71	135	194
Long-distance road haulage	118	162	257	238
Domestic shipping	62	62	103	116
Total	305	295	495	548

Sources: Bundesverkehrswegeplan 1992 (Federal Means of Transport Plan); DIW calculations.

accelerate the switch-overs between transport systems (combined transport). Even more far-reaching concepts focus on the reloading of goods between different trains in order to avoid the time-consuming and labour-intensive shunting of individual waggons. For 70 years now the European railway companies have been working on an automatic coupling system that has been standard practice in Russia, the USA and Japan for many years. On optimistic assumptions, waggons and trains with an automatic coupling system could form part of the DB AG network by 1997. Projects to study the introduction of new braking systems are also being conducted within the DB AG. The most far-reaching concepts involve the introduction of automatic transport of individual waggons, each with its own energy supply and/or propulsion. A pilot project "Innovative Goods Waggons" has been initiated by the DB AG.

By the year 2010 these new concepts are unlikely to be of relevance for more than a small proportion of the fleet of waggons, however. By far the greatest proportion of the demand for new and replacement vehicles must therefore be calculated at the current price level. This implies an order volume of around DM 22 billion to the year 2010.

Locomotives

The German railway network maintains a fleet of more than 10 000 locomotives (1993), roughly one third of which consists of diesel and of electric locomotives for pulling trains and of smaller locomotives, largely diesel-driven, for shunting.

Given the scope for rationalisation and the increased use of railcars for passenger transport, the demand for locomotives will expand more slowly than rail transport services. In 2010 around 2 700 electric locomotives, 2 100 diesel engines and just under 2 000 small engines will be required.

The demand for replacements is contingent on the age structure of existing locomotives. The locomotives of the (west German) DB are superannuated – with an average age of 27 years (electric), 25 years (diesel) and 32 years (small locomotives) – and must be replaced within the forecast period. The situation is more complex with regard to the locomotives formerly owned by the (east German) Deutsche Reichsbahn (DR). The main lines in the GDR were electrified later than in the Federal Republic, with the result that the DR electric locomotives, with an average age of 13 years, are substantially younger than those of the DB. In particular, the Series 143 vehicles produced in Hennigsdorf (around 600) will still be operational in the year 2010. The more modern diesel locomotives produced in the Soviet Union (around 600 Type 232) are being modernised in the Cottbus works of the DB AG and will therefore also be available in the longer term. Consequently, an order volume of 1 800 electric, 1 500 diesel and 1 000 small locomotives is to be expected to the year 2010. At current prices this represents an order volume of around DM 14 billion.

Total domestic demand

Overall the domestic demand for rail vehicles for the period 1993/94 to 2010 is estimated to total around DM 79 billion. At DM 22 billion, goods waggons constitute the largest market segment.[15] However, this prognosis

[15] In 1993/94 prices. The figures given here are oriented towards the value of the orders placed by transport companies. Thus they include value-added tax and additional equipment (such as in-train radio) and thus cannot be compared directly with the value of output of the rail vehicle industry.

is based on very optimistic assumptions concerning rail transport trends. The prognosis is only realistic if, in addition to the establishment of a market and customer-oriented railway system, the following supportive measures are initiated by transport policy:

- further improvements to the rail network;
- reduction in border difficulties resulting from differences in technical standards and regulations on security and vehicle checks etc.;
- a pricing policy that avoids setting the wrong signals on the transport markets, but rather takes full account of the different incidence of external costs between different modes of transport.

For German suppliers the demand trends forecast by the study imply a stagnation of their turnover – provided they maintain their market shares. The growth effects resulting from the forecast increase in rail transport and the earlier replacement of vehicles due to modernisation and the changes in policies introduced by the DB AG, will be offset by:

- continued pressure on prices;
- products more closely tailored to transport demand, which can be deployed more flexibly and for longer;
- high rail productivity with faster trains and better vehicle deployment logistics.

Foreign markets

The potential demand of a country for rail vehicles depends on the importance of rail transport in that country, which in turn is contingent on the surface area, population, settlement structure, historical development, and on current priorities and the funds available for the public infrastructure.

Local rail transport

New York, London, Moscow, Paris and Tokyo have the largest stocks of rail vehicles (underground train vehicles) in the world. It seems likely that for some time to come the requirements for replacement and expansion of these cities will be covered by national producers[16]. Initially at least, the German rail vehicle industry only has opportunities in the market for vehicle components. In the case of suburban trains, on the other hand (Rapid Transit, Suburban Rail) export opportunities do exist. One example is the "Heathrow Express", electrical railcars which were supplied by Siemens.

The tram is a European mode of transport: nine trams out of ten are located in Europe. Elsewhere, substantial networks only exist in Egypt (Cairo, Alexandria), Canada (Toronto), Australia (Melbourne) and India (Calcutta). There are currently no signs of a global renaissance of the tram.

Sales prospects for the German rail vehicle industry are better with regard to the development of new local transport networks. As the process of urbanisation continues worldwide, there is clearly a need for continued extension of urban local transport networks. The lack of public resources constitutes a limitation on such expansion, however. Local rail transport networks are under construction in Istanbul and Kuala Lumpur. City-train networks are being built or have entered operation in many newly industrialising countries.[17] Underground rail systems have been set up in Singapore, Hong Kong and Seoul. City and suburban trains (Light Rail/Rapid Transit) are running or are being developed in Taipei (88 km track) and Manila respectively. In Jakarta, Kuala Lumpur and Bangkok the rail track is being raised to run overhead, a step linked to the extension of local rail networks. China has 31 cities with more than one million inhabitants. Underground or city-rail systems are planned or under construction (Peking, Tianjin, Shanghai, Canton) in 18 of these cities. In a study conducted for the EU, the global market potential is estimated at a total of 30 000 underground waggons and 16 000 vehicles for city and suburban rail systems (Light Rail).[18]

Rail transport

Almost one fifth of global rail passenger transport (measured in person-kilometres) and around 6% of rail goods transport (measured in tonne-kilometres) occur in Europe (excluding the CIS countries).[19]

The volume of European high-speed rail transport is expected to increase by three quarters by 2010. In the course of this trend there is likely to be a split in the

[16] Many national rail carriers signed long-term contracts – prior to the obligation to invite tenders from all over Europe – with domestic suppliers or formulate technical requirements in such a way that contracts will continue to be awarded to national suppliers.

[17] Cf. Sugawara M., Urban Transportation in Asian Countries, *Japan Railway and Transport Review,* March 1995.

[18] Booz-Allen & Hamilton, Study of the Competitiveness of the EC Rail Equipment Industry, commissioned by the EC Commission, Directorate General II/C/1, Brussels 1990, p. 33 f.

[19] The percentage figures are based on UN statistics, which are however only available as an annual report for 1991. The figures for 1993 are in some cases calculated by extrapolating monthly figures (source: United Nations, *Monthly Bulletin of Statistics),* and in others taken from the statistics published by the International Railway Association UIC. Not all the countries with a rail network are represented as members of the UIC, however.

Table 4

Locomotive Fleet of Leading Rail Companies Worldwide

Company, country	Number				% proportion of traction 1992		
	1970	1980	1990	1992	Steam	Diesel	Electric
BR Great Britain	4 499	3 527	2 227	1 991	.	88	12
DB German Railway	8 050	7 095	5 952	5 896	.	57	43
DR German Reichsbahn	.	.	5 893	5 557	3	72	24
DSB Denmark	426	392	328	296	.	97	3
FS Italy	3 581	3 724	3 165	3 208	1	37	62
NS Netherlands	676	574	522	506	.	67	33
RENFE Spain	1 701	1 206	1 287	1 192	.	52	48
SNCB/ NMBS Belgium	1 080	1 178	1 040	1 031	.	63	37
SNCF France	6 072	6 060	5 654	5 664	.	59	41
CFF/SBB Switzerland	1 328	1 451	1 435	1 469	.	19	81
NSB Norway	415	443	326	324	.	55	45
ÖBB Austria	1 204	1 217	1 231	1 277	1	40	59
SJ Sweden	1 589	1 375	1 015	854	.	43	57
VR Finland	871	734	562	671	.	84	16
SPOORNET South Africa	3 895	4 907	.	4 404	16	32	53
CR China	.	.	13 372	1 4083	39	47	14
AAR USA	.	.	.	18 421	.	100	.
IR India	11 343	11 068	8 590	8 268	30	47	23

Sources: UN statistics; UIC.

market. The French TGV has established a significant competitive advantage in terms of time over the German ICE in the market for vehicles for long-distance travel without intermediate stops. The Eurostar tunnel trains, the AVE for Spain, the TGV Atlantic and the (ordered) multisystem PBKA-TGV (Paris, Brussels, Cologne Amsterdam) constitute an extended family of vehicles.[20] No market leader has as yet emerged, however, for trains that serve the supplementary network while also able to travel at high speeds.

High-speed tracks have not yet been constructed outside Europe and Japan. The next link-ups are to be built in south-east Asia. In South Korea the main axis Seoul – Pusan (445 km) is being modernised to enable it to carry trains at speeds of up to 300 km/h. A similar scheme exists in Taiwan: rail transport in the approx. 400 km long corridor between Keelung (Taipei) and Kaohsung is to be supplemented with a high-speed track. In the People's Republic of China, rail transport capacity is insufficient to meet demand. In particular the Peking – Tianjin-Nanking – Shanghai route requires modernisation. Around 40% of China's output is produced in this corridor. A new high-speed track for around 60 million passengers by the year 2000 and 95 million passengers by the year 2010 is planned. In Australia a high-speed track between Sydney and Canberra (326 km) is planned.

In the USA[21] the importance of rail travel has steadily declined relative to air and automobile transport. The annual passenger transport volume is around 20 billion person-kilometres (compared with 33 billion pkm in Germany). One of the reasons for this is the low population density. This is reflected in an average flight distance of 1 300 km in domestic air travel, a distance over which the aeroplane enjoys advantages in terms of travel time even over very fast trains. The rail system is further disadvantaged by the low prices of competing modes of transport (petrol prices, deregulation of air transport). There appear to be only a few routes on which a high-

[20] Cf. Ellwanger G., Wilkens M., High Speed for Europe, *Japan Railway and Transport Review,* October 1994.

[21] Thompson, I. S., High-speed Rail in the United States. Why Isn't There More?, *Japan Railway and Transport Review,* October 1994.

speed rail link would be competitive. These include Boston – New York – Washington, Los Angeles – San Diego and Miami – Tampa.

Overall the demand for high-speed trains outside Europe is likely to remain modest.[22] Requirements are greatest in China, but it is very uncertain whether the projects mentioned above will actually be realised.

In goods transport it is the great expanses of the CIS countries, the USA and China that dominate in international terms. In the USA the railways, following restructuring and privatisation in the 1970s, have managed to maintain their share of goods transport at around 38%. This achievement is based on high productivity, with double-deck container transport, triple-deck automobile transport waggons etc., which over long distances enjoy a cost advantage over road transport. The growth of combined transport has been particularly strong. The goods trains are pulled almost exclusively by diesel locomotives. The US railways have a fleet of more than 18 500 engines. So far their replacement requirements have been met exclusively by American producers.

In China around 14 000 locomotives are deployed for both goods and passenger transport, of which more than a third are still steam-powered. In India, too, the proportion of engines still powered by steam is very high (30%). Both countries suffer from bottlenecks in goods transport and have substantial modernisation and replacement requirements. Export opportunities for the German rail vehicle industry exist here in the areas of electrification, the extension and the modernisation of track, and the provision of modern locomotives. There is little scope for exporting goods waggons, on the other hand, as domestic production capacities are being extended.[23]

Conclusion

The demand forecast for Germany and the analysis of global markets indicate a marked increase in rail vehicle requirements to the year 2010. In view of tough price competition, there will not be a corresponding increase in turnover, however. German rail vehicle firms have successfully adjusted to the changed market conditions.[24] The importance of the high-speed passenger segment of the market for Germany should not be overstated. Outside Europe there are few locations in which substantial demand is to be expected. Within Europe France is likely to remain the leading producer country. Of greater importance are the markets for traditional propulsion vehicles, i.e. for locomotives and local transport vehicles. In these areas many countries have major modernisation and replacement requirements.

In local rail transport the growth regions of south-east Asia and China are expected to generate fastest demand growth. The environmental damage associated with the massive increase in motorisation in the urban agglomerations of these countries has reached a point where an expansion of a rail infrastructure is a necessity.

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[22] This evaluation is in line with the conclusions of an EC study: "The market for High Speed Systems outside of the EC and Japan is small and questionable, while the EC market is large and definite." (Booz-Allen & Hamilton, op. cit. p. 29)

[23] China produces around 20 000 goods waggons and almost 2 000 passenger carriages a year (according to the state statistical office).

[24] Cf. German Rail Vehicle Construction in the Context of Market Globalisation, in: *Economic Bulletin,* vol. 33, no. 4, April 1996.