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Working Party on Rail Transport
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STUDY OF THE SITUATION OF THE RAILWAYS IN MEMBER COUNTRIES

Addendum 4

Transmitted by the Government of the Czech Republic

Information on past and future developments of rail passenger and goods traffic

During the period 1990–2001, a serious decline in demand for **public passenger transport** occurred**,** by nearly 50%, while urban public transport decreased over the same period by approximately 13%. In 2001 the number of passengers transported by **rail** was at the level of 84% of that in 1995. Since 2000 it is possible to trace a turning point of gradual growth of passenger transport by rail, because in the year 1999 its level was at 78% of that in 1995. The growth in the number of passengers carried by **integrated transport systems** is also considerable, where compared to 1995 this number increased in 2001 four times. It represents about 9% of total national passenger transport.

In national **scheduled bus transport** the fall in transport performance since 1990 is more than 50%. In the period 1999–2001, a moderate increase was observed, so the drop in performance in 2001 compared to 1995 was less than 10%.

The number of passengers carried by **urban public transport** in 2001 decreased, compared to the year 1995 by 2 %. However, a permanent stable increase can be seen in passenger transport by metro (with only a slight fall in 2000), where in 2001 the number of passengers carried by this transport mode was by 7% higher than in 1995. It is caused, among other things, by expanding the metro network.

It may be stated that **air transport** in the Czech Republic is the only transport mode which showed permanent growth over recent years. The number of passengers carried by the Czech operators increased from 1993 more than twice and the growth of performance in passenger kilometres was even higher (160%). The number of passengers handled at the Czech airports increased twice over the same period. Over the period of 1993 to 2001, a substantial increase of air cargo transportation volume was observed.

In the period 1990-1997, the **total transport performance of goods** increased slightly (by about 5%), but the share of **road transport** in the total transport performance increased significantly. Its performance increased approximately 2.5 times to the detriment of the rail transport, where the performance was reduced by half. **Inland waterway** transport performance also fell by nearly 50% during this period. In 1998 road transport performance decreased for the first time since 1990. The decline was about 15% compared to the year 1997. In 1999 it started to increase again, especially due to international transport. This trend remained unchanged also until 2001. The **rail transport** started, for the first time since 1990, to grow again in 2000. Compared to the previous year, the performance growth was about 5%. Unfortunately, in 2001 rail transport performance decreased again by 3.5% and amounted to 28% of total freight transport performance.

From the **environmental point of view**, it is worrying that 67% of total international transport performance is realized by road transport. It is, therefore, appreciated that **combined transport** shows slow, but stable growth. Goods transport in containers by rail has an average annual growth rate of approximately 1.1%. On the contrary, a decrease continues in combined transport over a short distance, which caused significant reduction of combined transport terminals.

In **waterway** transport, which in the last period was stable, the performance also decreased in 2001 in comparison with 2000 by almost 17% (its share in the transport market is only 1.02 %).

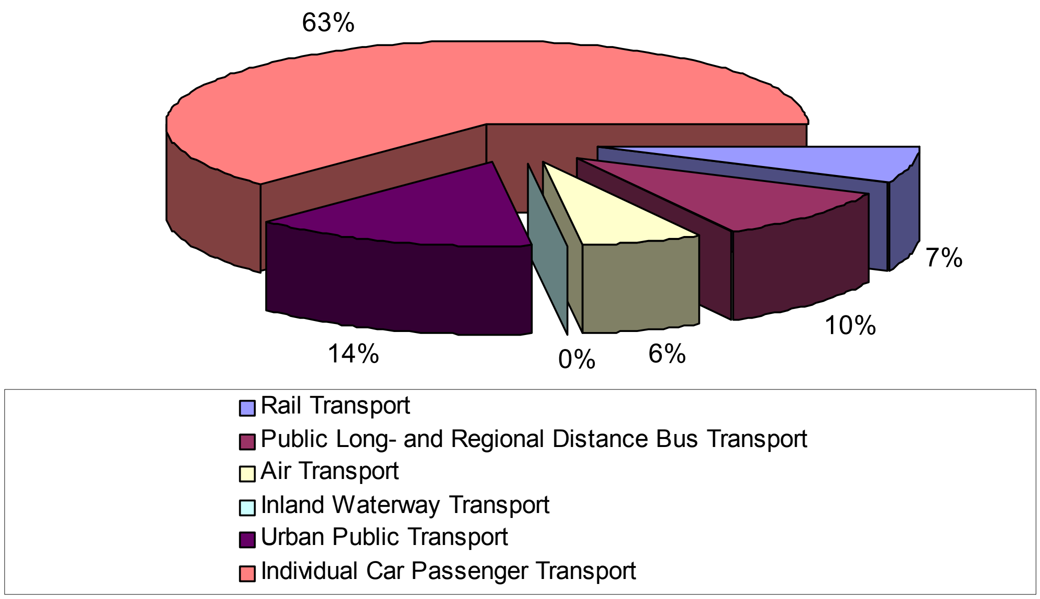
According to the State statistics, the traffic data relating to different modes of transport and the evolution of transport demand performance in the Czech Republic in the period 1995-2001 was as follows:

Comparison of passenger transport performance by mode

Indicator	Unit	1995	1997	1998	1999	2000	2001
Passenger transport							
Total	*mill.pass.*	***4,982.0***	***4,925.3***	***4,868.7***	***4,982.7***	***4,913.7***	***5,024.6***
Railway transport	*mill.pass.*	227.1	202.9	182.9	177.0	184.7	190.7
Public bus service	*mill.pass.*	644.2	465.0	456.0	446.9	438.9	435.6
Air transport *	*mill.pass.*	1.8	2.2	2.4	2.9	3.5	3.9
Inland waterway transport	*mill.pass.*	0.9	0.7	0.7	0.6	0.8	0.8
Urban public transport	*mill.pass.*	2,408.0	2,404.5	2,341.7	2,425.2	2,309.8	2,365.5
Private car traffic	*mill.pass.*	1,700.0	1,850.0	1,885.0	1,930.0	1,976.0	2,028.1
Transport performance							
Total	*mill. pass-km*	***91,662.4***	***93,727.5***	***94,733.9***	***97,144.8***	***101,320.7***	***105,043.5***
Railway transport	*mill. pass-km*	8,005.0	7,721.0	7,018.0	6,954.0	7,299.6	7,298.6
Public bus service	*mill. pass-km*	11,763.2	8,804.0	8,680.9	8,649.0	9,351.3	10,605.4
Air transport*	*mill. pass-km*	2,857.5	3,524.5	3,680.0	4,335.2	5,854.7	6,398.9
Inland waterway transport	*mill. pass-km*	11.9	7.8	7.6	7.5	7.7	7.8
Urban public transport	*mill. pass-km*	14,524.8	14,670.0	14,547.3	14,948.9	14,967.3	15,209.3
Private car traffic	*mill. pass-km*	54,500.0	59,000.0	60,800.0	62,250.0	63,840.0	65,523.5
Average transport distance							
Total	*km*	***18.4***	***19.0***	***19.5***	***19.5***	***20.6***	***20.9***
Railway transport	*km*	35.2	38.1	38.4	39.3	39.5	38.3
Public bus service	*km*	18.3	18.9	19.0	19.4	21.3	24.3
Air transport*	*km*	1,583.1	1,627.2	1,548.2	1,521.1	1,697.0	1,621.5
Inland waterway transport	*km*	13.9	11.1	10.9	11.9	9.9	10.0
Urban public transport	*km*	6.0	6.1	6.2	6.2	6.5	6.4
Private car traffic	*km*	32.1	31.9	32.3	32.3	32.3	32.3

* Data of Czech carriers only.

Transport performance in passenger transport by modal split in 2001



The time series of transport performances in passenger transport were supplemented with a traffic forecast for the next period, including anticipated outlook. The forecast follows from source materials of the urban transport. It was developed following the envisaged development of transport performances, demographic development and other data.

The increase in the **rail transport** is expected due to better integration of this mode into the entire passenger transport system. This will be apparent particularly in residential agglomerations and their immediate vicinity where the integrated transport systems are arising step-by-step. In such systems, the railway is increasingly understood as a core transport system linked to other transport modes, including individual transport (Park and Ride parking places). This is associated with the introduction of the traffic spacing which is very much attractive for the public. Simultaneously, greater involvement of the railway transport in the public transport systems of large cities is to be expected. In the field of long-distance transport, the increase in the competitiveness of rail transport will enable the completion of the modernization of additional sections of railway corridors.

The gradual growth of a **public regular bus service** will also depend on the level of its involvement in the integrated transport systems where the high capacity lines will complement the core rail network with missing segments. Thereafter, the bus service will also perform the function of serving the area with the transportation linked to the core network. The bus service will increase its importance for the settlements outside agglomerations where the standards of the transport service will be guaranteed by public administration. The bus transport development will depend on the economic strength of the

State, local subjects and on funds to be put into the system and, accordingly, it will follow the GDP growth.

As regards the long-distance transport, the segment of non-subsidized transport will continue to grow due to the construction of **new motorways and expressways**, namely in such directions where, at the same time, no construction of rail corridors will be progressing.

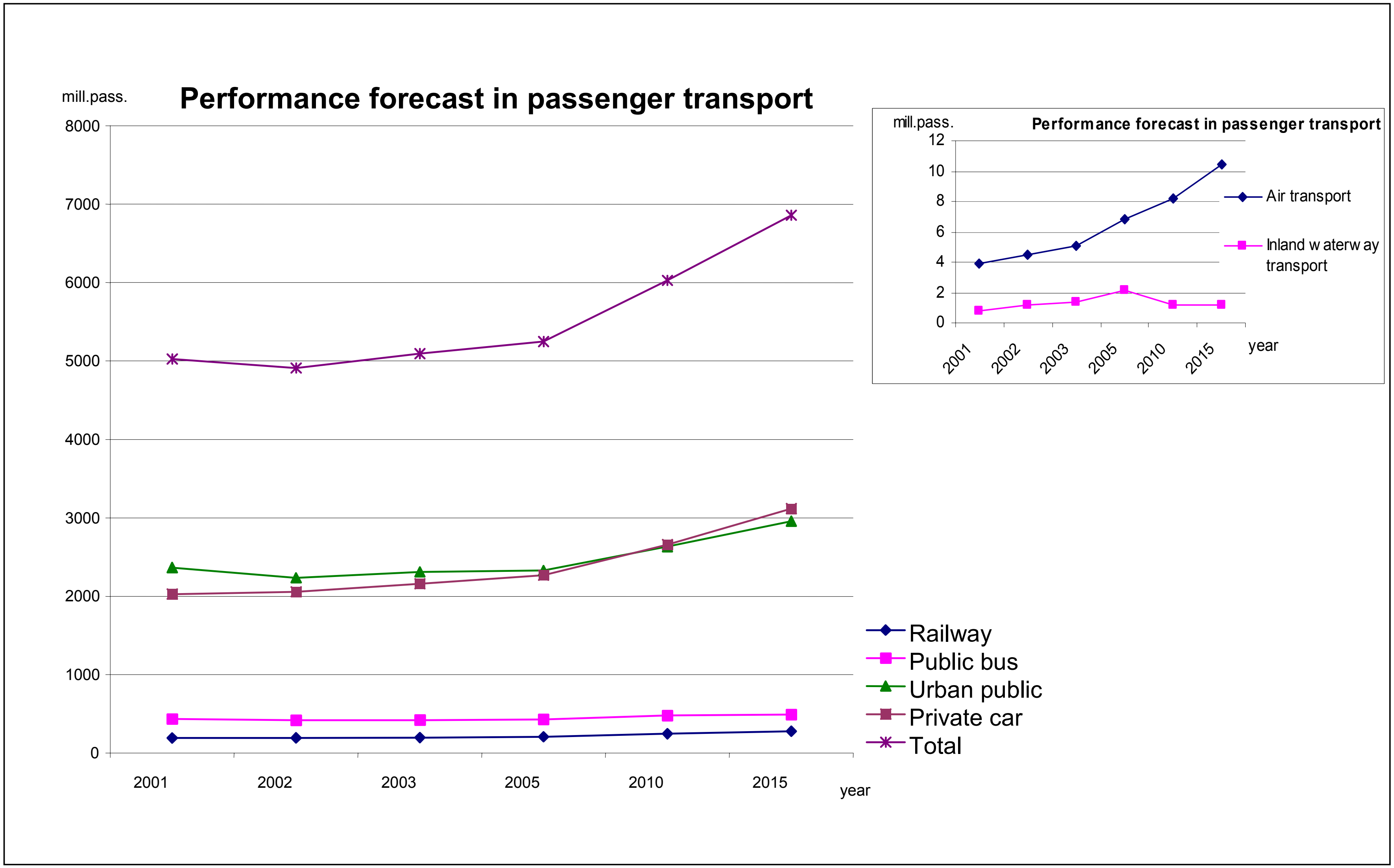
The growth of performance of **urban public transport** will be made possible given the general support from the part of local administrations solving in this way the issues of insufficient capacity of urban communications and of the environment. The attractiveness of this transport mode will grow markedly because of measures improving the reliability and seamless character of the public transport. First results are apparent already at present.

The sharp rise of **private car traffic** is not in the public interest though this mode of transportation finds favour with many people. The individual transport grows not only to the detriment of public transport, but it is also detrimental to pedestrianization in towns. The pressure for accelerating the suburbanization process (the city sprawl) contributes also to important factors of private car traffic growth.

Likewise, the transport infrastructure development is to be adapted to the anticipated traffic performance increase in passenger transport, while taking account of environmental impacts. In the case of insufficient investment of funds in transport modes that are more environmently-friendly, an increase in the negative environmental impacts of the growing transport may take place.

Performance forecast in passenger transport

Indicator	Unit	Actual	Anticipated	Forecast			
		2001	2002	2003	2005	2010	2015
Passenger transport							
Total	mill. pass.	5,024.55	4,911.76	5,095.31	5,246.90	6,029.67	6,857.99
Railway transport	mill. pass.	190.72	193.59	197.07	207.85	248.00	279.00
Public bus service	mill. pass.	435.56	418.98	420.24	430.60	480.00	490.00
Air transport	mill. pass.	390	4.44	5.06	6.87	8.20	10.40
Inland waterway transport	mill. pass.	0.78	1.15	1.40	2.17	1.20	1.20
Urban public transport	mill. pass.	2,365.48	2,235.62	2,311.00	2,329.00	2,632.00	2,958.00
Private car traffic	mill. pass.	2,028.11	2,057.99	2,160.54	2,270.42	2,660.27	3,119.39
Traffic performance							
Total	bill. pass-km	105.04	106.67	111.80	118.82	138.75	160.96
Railway transport	bill. pass-km	7.29	7.38	7.50	7.87	9.56	10.86
Public bus service	bill. pass-km	10.61	9.86	10.04	10.76	11.24	11.52
Air transport	bill. pass-km	6.40	7.29	8.26	10.40	13.03	15.59
Inland waterway transport	bill. pass-km	0.01	0.01	0.01	0.02	0.02	0.02
Urban public transport	bill. pass-km	15.21	15.64	16.18	16.42	18.95	22.19
Private car traffic	bill. pass-km	65.52	66.49	69.80	73.35	85.95	100.78
Shares in transport performance							
Railway transport	%	6.96	6.92	6.70	6.62	6.89	6.74
Public bus service	%	9.90	9.24	8.98	9.06	8.10	7.15
Air transport	%	6.10	6.83	7.38	8.75	9.39	9.69
Inland waterway transport	%	0.01	0.01	0.01	0.02	0.02	0.01
Urban public transport	%	14.51	14.66	14.47	13.82	13.66	13.79
Private car traffic	%	61.94	62.33	62.43	61.73	61.94	62.61


Performance forecast in passenger transport
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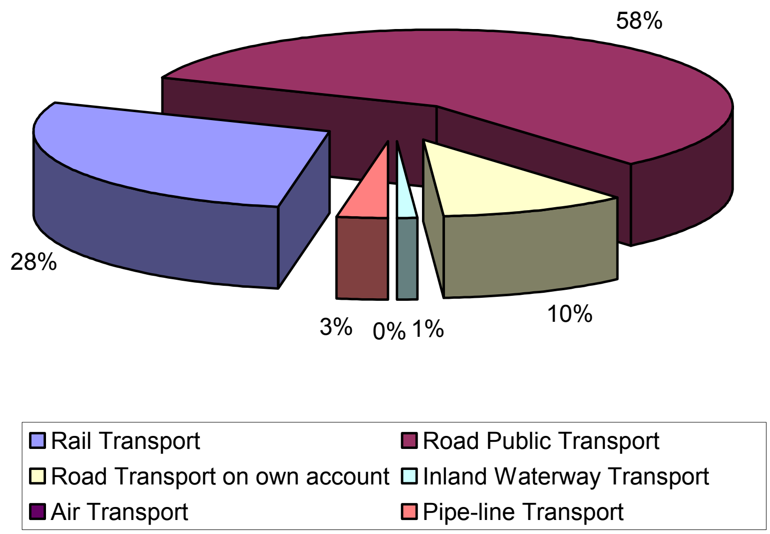
Comparison of freight transport performance by mode

Indicator	Unit	1995	1997	1998	1999	2000	2001
Freight transport							
Total	***thousand tonnes***	***692.125***	***634.703***	***577.366***	***540.928***	***514.902***	***537. 511***
Railway transport	***thousand tonnes***	108.871	111.379	104.788	90.734	98.253	97.218
Road public transport	***thousand tonnes***	360.644	222.642	201.933	207.763	199.565	248.490
Road transport on own account	***thousand tonnes***	218.152	298.840	268.954	240.537	215.159	190.193
Inland waterway transport	***thousand tonnes***	4,441	1,828	1,678	1,877	1,906	1,594
Air transport *	***thousand tonnes***	18	14	13	17	19	16
Transport performance							
Total	***mil.tkm***	***55,272***	***62,460***	***53,592***	***54,620***	***57,343***	***57,777***
Railway transport	***mil.tkm***	22,623	21,010	18,709	16,713	17,496	16,882
Road public transport	***mil.tkm***	26,577	30,781	24,489	26,039	31,363	34,212
Road transport on own account	***mil.tkm***	4,691	9,859	9,423	10,925	7,673	6,048
Inland waterway transport	***mil.tkm***	1,348	783	915	913	773	606
Air transport *	***mil.tkm***	33	27	56	30	38	29
Average transport distance							
Total	***Km***	***81.4***	***98.4***	***92.8***	***101.0***	***111.4***	***107.5***
Railway transport	***Km***	207.8	188.6	178.5	184.2	178.1	173.7
Road public transport	***Km***	74.5	138.3	121.3	125.3	157.2	137.7
Road transport on own account	***Km***	22.4	33.0	35.0	45.4	35.7	31.8
Inland waterway transport	***Km***	303.6	428.3	545.2	486.4	405.6	380.2
Air transport *	***Km***	1,833.3	1,928.6	4,307.7	1,764.7	2,000.0	1,812.5

* Data for Czech carriers only.

Transport performance in freight transport by modal split in 2001



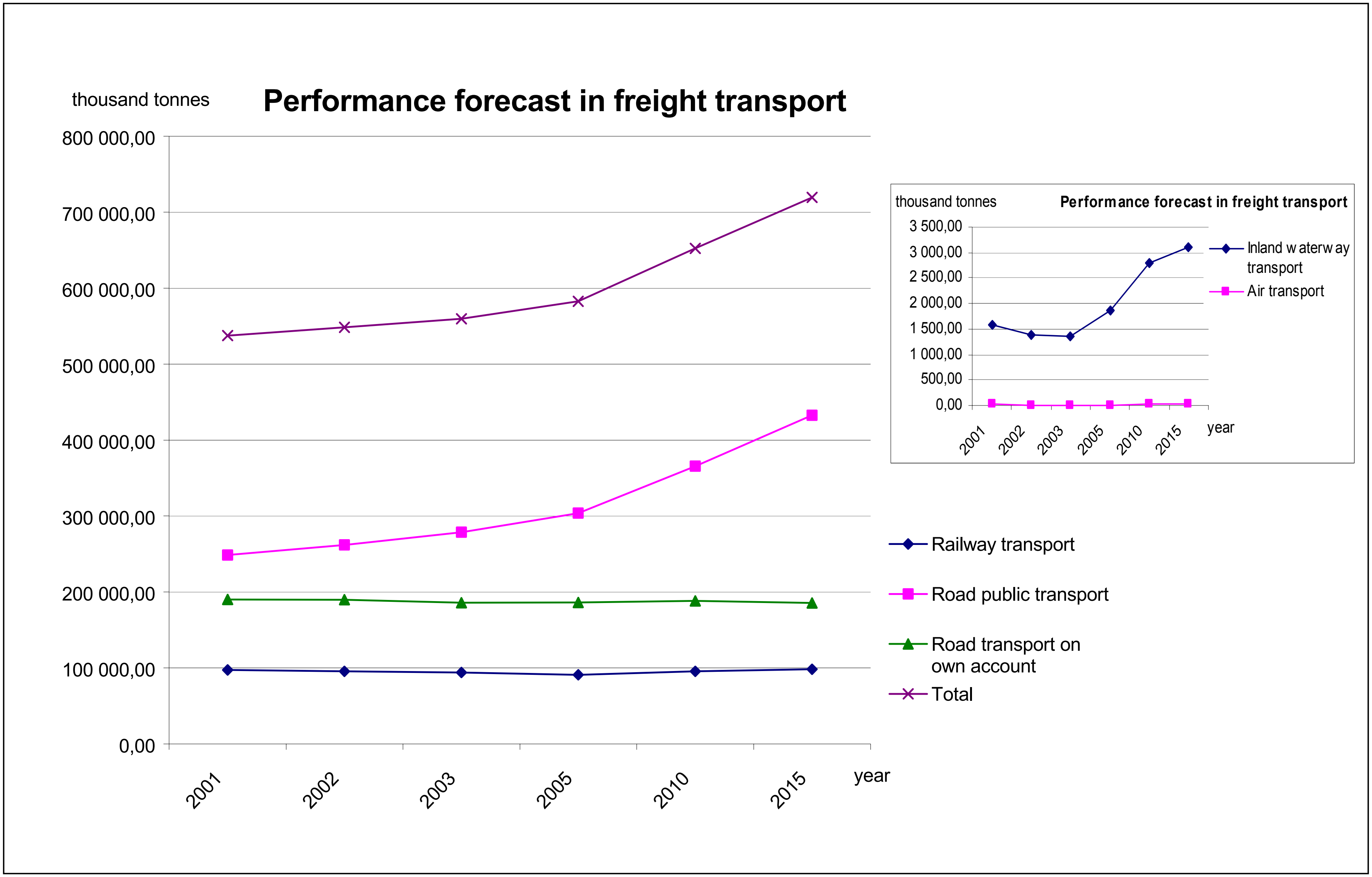
The times series of transport performance in freight transport were supplemented by a traffic forecast for the next period, including envisaged outlook. The forecast follows from own background materials of the Ministry of Transport. The forecast was drawn up following anticipated development of transport performance, GDP development and other data.

The permanent growth of the road transport share (sharp growth) to the detriment of the railway (stagnancy) is given by the development of logistics technologies where large distribution centres and industrial zones are constructed exclusively with respect to be connected to communications of motorway type. New logistics processes require deliveries in time with minimisation of the delivery time and, at the same time, the transports of smaller series in shorter intervals. The unfavourable trend is to be influenced by upgrading the combined transport technologies supported by regionally based logistics the effect of which would be a repeated concentration of traffic flows. The forecast of the inland waterway transport growth is based on anticipated improvement of the River Elbe navigation conditions, thereby increasing the number of days of economical operations. Another assumption is making the River Elbe navigable up to Pardubice, which should facilitate the prolongation of the multi-modal transport distance of the waterway transport in the direction from the Federal Republic of Germany to Moravia and back.

To achieve the anticipated transport performance increase it is also necessary to develop the needed infrastructure. It may be envisaged, that the existing share of the road and rail transport in the total haul will develop at the expense of the rail transport, if there are no restriction from the part of the state.

Performance forecast in freight transport

Indicator	Unit	Actual	Anticipated	Forecast			
		2001	2002	2003	2005	2010	2015
Freight transport							
Total	thousand tonnes	537,511	548,430	559,600	582,720	652,400	719,480
Railway transport	thousand tonnes	97,218	95,560	93,930	90,930	95,630	98,360
Road public transport	thousand tonnes	248,490	261,860	278,580	303,750	365,610	432,600
Road transport on own account	thousand tonnes	190,193	189,620	185,720	186,170	188,340	185,400
Inland waterway transport	thousand tonnes	1,594	1,380	1,360	1,850	2,800	3,100
Air transport	thousand tonnes	16	10	10	10	20	20
Traffic performance							
Total	mill. tonnes-km	57,777	56,930	56,180	55,510	61,100	65,650
Railway transport	mill. tonnes-km	16,882	16,040	15,270	13,960	16,950	19,380
Road public transport	mill. tonnes-km	34,212	34,290	34,590	35,350	37,280	39,050
Road transport on own account	mill. tonnes-km	6,048	6,000	5,740	5,430	5,670	5,900
Inland waterway transport	mill. tonnes-km	606	570	540	740	1,120	1,230
Air transport	mill. tonnes-km	29	30	30	30	80	90
Shares in transport performance							
Railway transport	%	97,218	95,560	93,930	90,930	95,630	98,360
Road public transport	%	248,490	261,860	278,580	303,750	365,610	432,600
Road transport on own account	%	190,193	189,620	185,720	186,170	188,340	185,400
Inland waterway transport	%	1,594	1,380	1,360	1,850	2,800	3,100
Air transport	%	16	10	10	10	20	20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Performance forecast in freight transport
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Air transport

(b) New developments to be observed subsequent to the reorganization of the rail sector with special attention to the setting-up of new railway companies;

The Czech Railways, joint stock company, were established according to the Act on Transformation on the date of adoption by Resolution No 733 of 10 July 2002 of the Czech Republic's Government of the appropriate draft Founding Deed and Statutes. The Czech Railways, joint stock Company, were incorporated on 1 January 2003. On the same date the Railway Infrastructure Administration, State organization, was also incorporated. By that date, the existing Czech Railways, State organization, were also dissolved.

The adopted Act creates conditions for independent business activities of the Czech Railways on a competitive transport market and it assigned full responsibility to Czech Railways for the results of such activities. It also generates a transparent and stable environment for the entry of private capital into the newly incorporated joint stock company, which is necessary particularly in respect of fulfilling basic business activities, e.g. in ensuring urgently necessary rehabilitation of the rolling stock as well as in complementary business activities, as a rule within filial companies for forwarding, passenger services, telecommunications, etc.

Further steps of the Government in the field of Czech Railways transformation are aiming at the economic stabilization of the operations of the two succession organizations to Czech Railways and at the approximation of the Czech law and order to the new EC legislation, in particular, to the adoption of the provisions of the so-called first and second railway package of the EC within the amendment to the Act on Tracks under discussion.

At present, the share of Czech Railways in the volume of railway goods transport amounts to about 90%. The competitive environment, i.e. the carriage of the remaining 10% of freight by other railway operators, has already been made possible by Act No 255/1994 Coll. on tracks.

Investments in rail infrastructure

The length of the **railway network lines** is 9,523 km of which 2,893 km (30.1%) of lines are electrified. All main international corridors are electrified. Almost the entire network of public railways is State owned with the exception of local tracks of Jindřichův Hradec, joint stock company, and two narrow gauge tracks in Southern Bohemia (79 km). The public railway network (Czech Railways) is divided under the Act on Tracks into nation-wide tracks and regional tracks. Nation-wide tracks include lines in the length of 6,305 km, and regional tracks are 3,139 km long. The rail network density is 0.12 km of railway lines per 1 km^2. After the coming into force of the Act on Czech Railways joint stock company, Railway Infrastructure Administration and amendment to Act No 266/1994 Coll. on Tracks, as amended, the railway infrastructure remains State owned. It is generally expected that the ownership of certain regional tracks will be gradually assigned to local administrations or, as the case may be, to other private entities (see the table here below).

Railway lines (in km)

	1995	1997	1998	1999[1)]	2000	2001[1)]
Length of operated lines	9,430	9,430	9,430	9,444	9,444	9,523
by number of tracks:						
single track	7,497	7,490	7,490	7,515	7,515	7,645
double tracks and more	1,933	1,940	1,940	1,929	1,929	1,878
Non-electrified lines total	6,687	6,571	6,571	6,601	6,601	6,630
Electrified lines total	2,640	2,859	2,859	2,843	2,843	2,893

About 3,000 km of the most important lines carry 70% of passenger transport and 90% of goods transport. Compared with foreign railways, the Czech railway transport disposes not only of a relatively dense network with various parameters of lines and structures but also with a high percentage of depreciation and speed restrictions (temporary or permanent). Moreover, the poor quality of connections of main railway corridors to European railway network is considered as a basic shortcoming as well.

As stated above, the network is composed of national and regional tracks. The share of national tracks, representing around 2/3 of the total network, ensures 30% of annual total performance in passengers transport and 10% of annual total performance in freight transport. The part of regional tracks (making about a third of the network) amounts to about 15% in total railway transport performance. Regional tracks carry about 52.5 million passengers a year and the loading or unloading in stations situated on regional tracks amount to 10.5 million tonnes of goods a year. The loading of the railway network is close to the optimum level of the capacity and, thus, there is no need to increase substantially the capacity reserve.

Until the end of 2001, from 385 km of the national railway transit corridor I (TEN corridor IV), which are in the process of modernization, 72% were already modernized, 28% are in progress, and 29 billion of CZK in total was spent for that modernization. Until the end 2001, from 300 km of the national railway transit corridor II – TEN corridor VI (including the Česká Třebová – Přerov branch leg), which are in the process of modernization, 23% were already modernized, 77% are in progress, and 16.8 billion of CZK in total was spent.

Recent progress: the major part of actual investments is directed to the construction of national transit corridors I and II (TEN corridors IV and VI). The modernization of national railway transit corridor I is finished of 89% and the remaining 11% are under construction. The modernization of national railway transit corridor II is 47% finished and the remaining 53% is under construction (32%) or in stage of preparation for construction (processes before signing work contract) 21%.

The electrification of the track between Horní Dvořiště and České Budějovice, which is a part of national railway, transit corridor IV was completed. At the end of the year 2001, the electrification of the remaining section from Horní Dvořiště to the Austria border railway station Summerau was also completed with total expenditures over CZK 3 billion.

Investments in railway rolling stock

Up-to-date **vehicle fleet** at European level standard is available in the railway transport for trains of the highest standard (SuperCity, EuroCity, InterCity), which are providing for connection with important centres in the Czech Republic and in neighbouring countries.
In general, it may be stated that the other railway transport equipment is relatively obsolete. The average age of track vehicles for passenger transport is rather high. For electric locomotives it amounts to 27.8 years, 28.7 years for electric units, 23.9 years for diesel rail cars, 25.7 years for passenger cars in international traffic and 27.6 years for passenger cars in national traffic.

Information on research activities in the field of railway transport

According to Act No. 2/1995 Coll., the former Ministry of Transport and Communications announced a public tender for the solution of **science and research transport-related projects** to be launched in 2001. Based on the results of the public tender, it was decided on the acceptance of bids for projects. The announcement of the overall public tender results was published in the Commercial Bulletin on 20 December 2000.

Subprogram 1
Energy in transport, environment and sustainable development, human factor in the transportation

Research in the environment load caused by transport
Establishment of processes in the implementation of commitments of the Czech Republic accepted within international conferences in the field of environmental impact of transport

Subprogram 2
Position of the transport within the information society, information systems, transport telematics

Comprehensive system of rail transport control under crisis situations
Intelligent transport systems under conditions of transport-telecommunications environment in the Czech Republic
Information support for the transport in the regions under conditions of new arrangement of regional administration
Participation of the Czech Republic in the Galileo Project

Subprogram 3
Development of transport infrastructure and of transport technology

- New constructions and materials of railway permanent way and substructure
- Application of geophysical techniques for checking the condition of railway lines of Czech Railways

Subprogram 4
Social structures, forecasting and transport economics

- Transport infrastructure costs brought about by the operation of means of transport – railway sector
- Methodology of preparing the Czech Republic’s standards in relation to the EC and NATO in the field of preventing crisis situations in the transport sector and in dangerous goods transport
- Development of Czech Railway’s transport networks until 2010 with an outlook to 2015
- Financing the transport services

Information on new efforts by railways to provide a high-quality service to combined transport

Unaccompanied combined transport in the Czech Republic is operated to and from container terminals. The largest contribution for combined transport is coming from the wagonload traffic, namely in international transport. The wagon load traffic within the combined transport is included in the highest category of goods trains – the so-called express goods trains.

In the Czech Republic, the transport in the west-south and north-south direction are the most important. Among the most important links in the direction west-south, the following have to be included: trains from Prague to Rotterdam, Hamburg and Bremerhaven, trains Hamburg/Bremerhaven-Budapest, Prague-Bratislava, Prague Dunajská Streda, Prague – Györ and, as from 2001, new regular links between Prague and Budapest and Prague and Bucharest. In the direction north-south the following trains operate: Prague – Budapest and Prague – Bucharest. In the direction north-south, trains operate between Italy and Poland, and Poland – Austria. Of importance is the link between Přerov and Police (Poland) and Želechovice – Malaszewice (form end of 2002). Beginning 2003, the container terminal of the European Rail Shuttle (ERS) is newly in operation and accordingly a wagon load traffic between Prague and Zlín, and Plzeň and Mělník is in operation.

At the present time, the effort of Czech Railways is focused on the increase in the quality of operations of the existing wagonload traffic within the combined transport. New trains also operate between Šluknov and Bohumín and Prague – West Europe (Antverpen, Paris), Czech Republic – Poland – Hungary.

Such effort manifests itself in the practice by the increase in the volume of transport which more than trebled from 1993. Starting in 1995, the Czech Railways recorded an inter-annual growth of between 15% to 20%. On a monthly basis, the Czech Railways operates within combined transport about 950 wagon load trains ensuring roughly 70% of the total unaccompanied combined transport. About 95% of wagon load trains operate within international transport.

Currently the stopping time of a train in border transit stations fluctuates between 90 to 120 minutes, but the combined transport operators would like to have the stopping time of trains shortened to about 30 to 60 minutes. Another situation has been observed with the ROLA

Lovosice – Dresden line where the railway also ensures that loading and other operations are performed in cooperation with the combined transport operator. The customs clearance of such trains was successfully transferred to terminals and the change in the engine driver at border crossing is already the past.

Practical experiences with the application of global positioning systems in rail freight transport

Making use of the GPS satellite navigation systems has become a current matter in the Czech Republic in a number of practical activities requiring knowledge of the position on the earth surface, even if only an initial use of such technology is involved. Such developments are to be seen primarily in the geodesic and transport sector. Satellite navigation systems are a component of intelligent transport systems (ITS). The satellite navigation provides for new types of transport services which may significantly contribute to improvements in traffic control and traffic safety.

In the rail transport the satellite navigation systems are used for the localization of wagons of individual consignments but the application of this kind is not widely used. The largest carrier, the Czech Railways, makes no use of this application at all. It is only used by certain forwarding companies. This application did not show an expanded usage although "nearly" on-line information for the rail wagon positioning as accurate as possible is available. The currently offered applications based on GPS inform about the vehicle position only, but they do not allow for obtaining all the necessary information exactly about the wagon movement and on operating events which occur during the travel of the wagon from the originating station to the station of destination. Of substantial importance is the information of putting a wagon out of service due to a technical defect or a defect on the goods carried. Accordingly, in any extraordinary situation the forwarder must use an information system (Central Rail Car Information System) or he must get into telephone contact with the appropriate railway officer and inform him about the real situation. Anyway, the monitoring through GPS of a railway wagon or, if necessary, of the condition of the consignment carried, entails for the forwarders neither a simplification of the work nor a financial economy.

As regards the GPS application in rail traffic control or the safeguarding equipment element, the Czech Railways tested the APOLO train locator (within the scope of the EU 4th framework research program), particularly in the field of determining the locator's accuracy within the network in the approximate length of 100 km in Eastern Bohemia where the reception of a satellite signal was rather limited (deep trenches, tunnels, railway lines situated in woods, etc.). Furthermore, the Czech Railways developed and experimentally tested a system which follows information on the position, speed and routing of a train and issues a warning signal when the trains draw near to each other to a less than critical distance. Such a system could be appropriate for branch lines either without block equipment or equipped with outdated equipment.

In 2000, the Ministry of Transport invited tenders for a project which should deal with the above and other issues in a fundamental systems approach whose objective would not be the contribution to the deployment of global navigation only, but the contribution to a qualified development of application superstructure in the transport field, and also the efficient use of the positioning data.

The winner of the tender was the Faculty of Electrical Engineering, Czech Technical University in Prague. The leader of the project "Involvement of the Czech Republic in the Galileo Project" is Prof. Frantisek Vejrazka. Other participants in the project implementation are the Faculty of Transportation Sciences (CTU), AZD Praha s.r.o. (experience with railway signalling systems) and ELTODO EG, a.s. (experience with road and urban traffic management).

The Government Research and Development Council also monitors this project, and about CZK 69 million (2.3 M€) has been earmarked for the six-year project implementation process, including its pilot verification.

The project reacts to a question why the GALILEO system is being developed by the European Union, what is the expected utilization of this system in the national economy sectors, and how these sectors might benefit from this system. The project output will quantify individual systems applications and their impact on the creation of the joint architecture of ground equipment, the creation of telecommunications elements within individual parts of the architecture, and it will also define basic requirements on the locator.

The project will design a systems approach to the development of satellite navigation in the Czech Republic, and it will also define the role of the State in securing systems development of such a system.

In 2002 pilot projects were prepared, the implementation of which will gradually be launched from 2003. The following aspect were selected for the identification of project subjects:

- knowledge of behaviour and of processing of the signal under extraordinary conditions,
- typical and "reasonable utilization" of the system in the rail transport,
- typical utilization in the road transport and the urban transport in particular,
- typical utilization in the integrated transport related emergency system,
- topical use in the air transport.

For the above reasons, the following pilot projects have been prepared for verification:

1. Experimental GNSS receiver.
2. Control and safeguarding of the railway transport on non-corridor lines with the use of satellite navigation.
3. Information system for the dangerous goods transport with the use GNSS system.
4. Optimization of the road traffic control with the use of satellite systems.
5. Monitoring and control of movement of movable objects on a movable airport area with the use of GNSS.

Railway safety: Risk assessment techniques

The Laboratory of Intelligent systems of the Czech Railways tested an application of satellite navigation technology for railway safety enhancement on low-traffic density lines equipped with obsolete or no signalling at all. This work was supported by the European Commission and Grant Agency of Czech Republic under the contracts No. TR4003/IN4003 and No. 102/00/1590.

The monitoring system processes a real position data report transmitted from the trains to the dispatching centre in Pardubice station.

The instant position of trains and their speed are determined by a train position locator based on satellite and inertial navigation. The train position locator is able to distinguish on which of two parallel tracks the train is located. The navigation data is further transmitted from the trains to the way-side monitoring computer by a digital radio network. The monitoring computer processes and evaluates the position and speed data fully automatically. In case the distance between two approaching trains is decreased below the critical one, the monitoring system generates the warning and estimates time to a potential collision.

The other important problem is impacts of driver attention failures on transport reliability and safety and possibilities of its minimizing. Almost all the contemporary transportation systems are based on the necessity of interaction between the transportation tool (road vehicles, trains, planes, ships), the transport control system and human subject. Though a large effort is put into the development of automatic transport systems, none of the present attempts is fully automatic, in all of them the human subject plays some non-negligible role with considerably high impact on the reliability and safety of transportation function. Among such functions, the driving and control activity dominates.

The drivers, pilots, captains and transportation systems dispatchers and controllers are usually exposed to considerably long and exhausting services, which could last up to eight hours or more. The decrease of human subject attention in the course of his/her activity is not monotone; of course, it can involve several periods of temporary increases and decreases. However, without exception, if the exposition is long enough, the subject attention finally falls under the limit of acceptability for safe and reliable activity of the particular type. The subject activity becomes dangerous for him/her, his/her environment and for driven vehicle, plane, ship or controlled transportation system also. Finally, the subject falls in the stage of the so-called micro-sleep, in which he/she is not able to produce the particular driving or control activity at all.

A considerably large effort was given to the analysis of negative impacts of this factor. Unfortunately, the methodology used for such analyses differs up to now in many countries, so that the results are not quite comparable. However, it can be estimated that between 15 and 40% of all the accidents on the roads are caused by the non-satisfactory level of human subject attention. If one takes into account, that the economical loss of one mortal road accident is estimated at more than €1 million and it takes the density of such accidents into account, one comes to a high figure, which has to be enlarged more by the estimation of losses of non-mortal accidents. Also the losses caused by human subject attention limitation in rail, road, air and water transport are very serious.

This fact is that the motivation for considerably intensive research focused on tools for minimizing and prevention of these losses. In the Joint Laboratory of System Reliability, Department of Control Engineering and Telematics, Faculty of Transportation Sciences, Czech Technical University, the Prague research team concentrates on the problems of analysis of acceptable human subject attention limits, to the possibility of its detection and to prediction of its decrease. The methodology, on which our research in this area is based, uses the advantage of the sophisticated analysis of human subject electroencephalographic (EEG) signals, which seems to be more suitable than other approaches, oriented to such physiological factors, like the eye movement, face analysis, electrical resistance of skin, etc., especially because of the higher specification and faster response.

It has shown, that the relevant data are of an individual nature for each particular person; they remain considerably stable and, stored in a special database, can be used for determination of the boundaries of the respective individual regions of acceptable attention level.

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