

## **Volume of road traffic based on data collection of the Federal Highway Research Institute (BAST)**

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### **1 Introduction**

Information on traffic volume and its development is an important basis for many aspects of highway planning, transport planning, traffic safety and environment. The data demand depends on the task that has to be solved. So we need

- road section-related data
- vehicle-related data
- person-related data

To get such data, different methods have to be applied. The Federal Highway Research Institute (BAST) as a research institute in the responsibilities of the Federal Ministry for Transport, Building and Housing publishes different data of the volume of road traffic in Germany:

- a) Yearly information on traffic volume (average daily traffic) and vehicle mileage on federal trunk roads in Germany (motorways and highways outside built-up areas). To get this information we have established a system of different traffic counts:
  - automatic counting stations: about 600 on motorways and about 700 on highways.
  - the manual road traffic count (Straßenverkehrszählung – SVZ): manual road traffic count on motorways and highways on about 10.000 counting stations every 5 years (last 2005)
  - traffic count of foreign motor vehicles: manual road traffic count on motorways and European highways on about 400 counting stations every 5 years (last 2003)
- b) In irregular intervals the BAST realizes the so-called vehicle mileage survey (last 2002). In this survey information is gathered on vehicle mileage on all German roads and of vehicles registered in Germany. Main part of the study are reports of about 125.000 vehicle owners. These data are basis for yearly estimations of vehicle kilometres (see model of DIW) etc.

The aim of the presentation is to illustrate the different data collection methods.

## 2. Data collection

### 2.1 Road traffic counts

Results of road traffic counts will be needed for many questions concerning of road constructions etc. In this context the BAST is responsible for traffic counts on federal trunk roads: motorways and federal roads. We use two different kinds of data collection methods:

- Permanent Counts
- Short-time Counts

To get extensive information on the traffic volume of federal trunk roads, the BAST has implemented a system of traffic counts:

- Automatic Counting Stations
- The Manual Road Traffic Count (manuelle Straßenverkehrszählung)
- Traffic Count of Foreign Motor Vehicles (Ausländerverkehrszählung)

#### 2.1.1 Automatic Counting Stations

Since 1975 a net of automatic counting stations has been implemented on federal trunk roads. In 2004 the net of automatic counting stations contained about 1.300 counting stations (figure 1). This means that we have traffic volume information for a sample of the total road net.

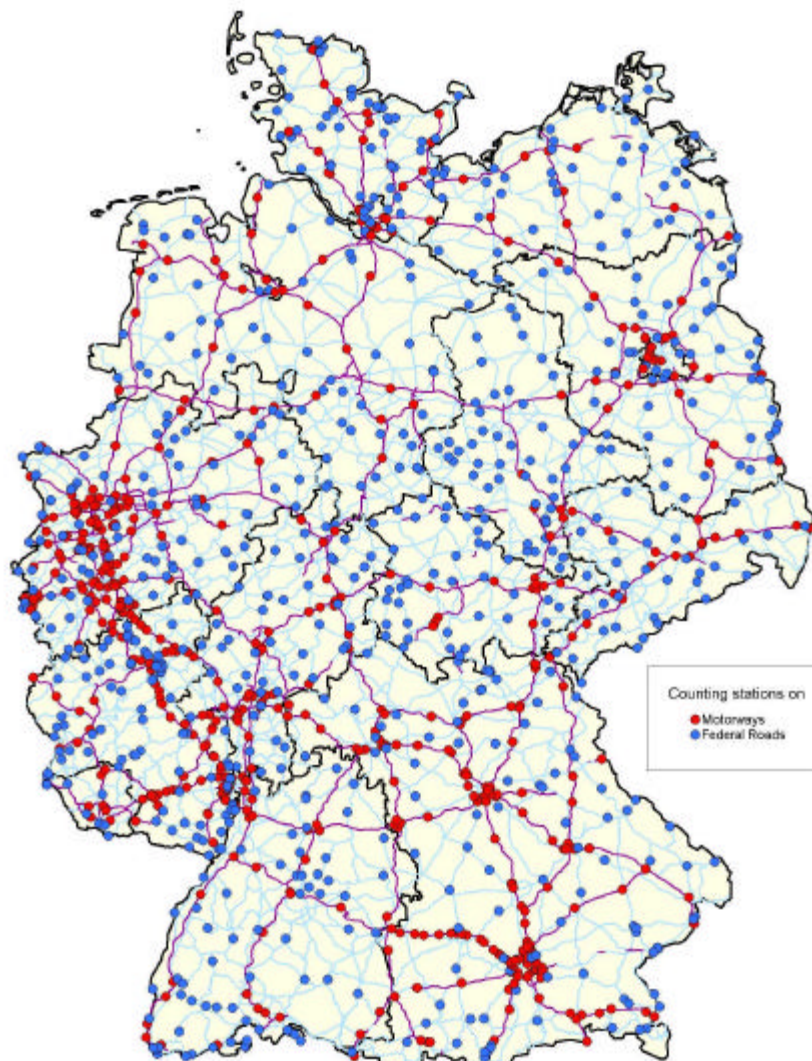


Figure 1 shows that we have all in all a good distribution of automatic counting stations German-wide. In relation to the length of the roads, a counting station is implemented on motorways every 20km on average and about every 50km on federal roads.

Motor vehicles will be counted by using induction loops. This allows a classification of detection up to 9 types of motor vehicles: 8 motor vehicle types and 1 category of non-classifiable motor vehicles (table 1).

**Table 1: Classification of vehicle detection**

classification			
1	2	5+1	8+1
motor vehicle	similar to passenger car	non-classifiable motor vehicles	non-classifiable motor vehicles
		passenger car	motorbike
			passenger car
	similar to truck	passenger car with trailer	passenger car with trailer
		truck > 3.5 t without trailer	truck > 3.5 t without trailer
		towed truck / tractor-trailer	towed truck
			tractor-trailer
		bus	bus

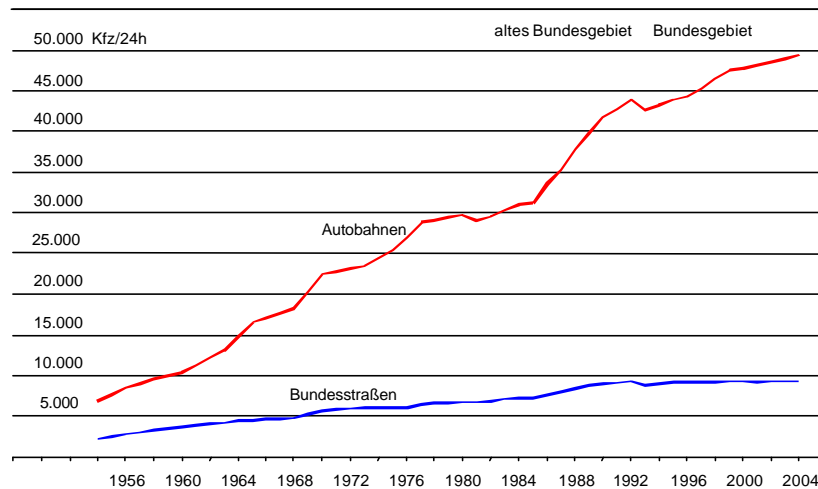
The data collection is permanent so that we have hourly information on the road traffic volume for every motor vehicle type and every lane. In the end we have extensive information on every counting station (see table 2).

**Table 2: Results of automatic counting stations (example North Rhine-Westphalia)**

Nordrhein-Westfalen, Jahresauswertung 2004																															
Allgemeine Angaben				Gesamtquerschnitt														Max. Richtung		Ganglinientypen											
Straße	Zst.-Name TK/ZST.-Nr. In-Richtung Gegen-Richtung Anz. Fahrstreifen Lage bei	GT 2004/03	DTV														MSV <sub>R</sub>		JG WG	RI	TG	RII									
			Kfz		Lkw-Gruppe				Fahrzeugarten (Anteil von Kfz)								Fak- toren	Tag/ Nacht					MSV	Mo-So	Ant.	Rich- tung	Dauer- linien- Typ	Mo	Di-Do	Fr	Sa
			Mo-So	Mo-So	Verand	Mo-So	SV	Lkw- verand	Pkw	Lfw	Krad	Pkw	Lkw	kw m.	Sattel- zug	Bus	nkf.	fcr	M <sub>t</sub>	Mo-So	Mo-So	Ant.	Rich- tung	R I	R II	Mo	Di-Do	Fr	Sa	So	
			W	W	2004/0	W	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
			S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
			[d]	[Kfz/24h]	[%]	[Kfz/24h]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[Kfz/h]	[Kfz/h]	[Kfz/h]	[%]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
A 1	Schloss Burg 4809/5011 RI(N): Dortmund RII(S): Köln FS=6 km 388,2	330/344 208/211 65/74 57/59	75 680 +0,4 77 309 +0,3 76 185 +1,5 68 895 -1,5	10 352 12 448 10 649 2 053	13,7 16,1 14,0 3,0	+2,4 +1,3 +3,1 +0,2	84,7 82,3 84,2 95,4	12,2 12,3 12,6 11,2	0,5 0,4 0,5 0,8	1,0 0,9 1,2 1,1	2,8 3,2 2,9 0,7	10,6 12,6 10,8 1,9	7,3 8,7 7,4 1,5	0,3 0,3 0,3 0,4	0,6 0,6 0,6 0,6	0,99 0,90 1,12 0,6	0,99 0,90 1,12 0,6	4 216 11,9%	6 399 3 417	3 417 3 181	9,1 8,8	R I R I	D D	D D	9 9	18 18	C B	C 8			
B 54	Altenberge 3910/5338 RI(N): Gronau RII(S): Münster FS=2 km 4,7	361/290 227/202 73/38 61/50	24 736 +0,1 26 816 -0,7 24 824 +1,1 16 756 +0,1	2 523 3 050 2 649 373	10,2 11,4 10,7 2,2	+1,6 +1,2 -0,1 -2,2	88,1 87,0 87,4 96,3	5,6 5,9 5,9 3,7	0,5 0,4 0,7 1,1	1,5 1,4 1,7 1,3	3,0 3,3 3,2 0,6	6,8 7,6 7,0 1,3	4,4 5,0 4,6 0,8	0,4 0,4 0,5 0,3	0,2 0,2 0,2 0,2	0,93 0,61 1,06 18,7%	1 422 2 709 2 335 1 621	2 709 1 798	14,6 13,6	14,6 12,2	R II R II	A A	F F	17 17	A A	A A	8 8				

Furthermore the BASt estimates on the basis of these data the average daily traffic and motor vehicle mileages on motorways national/federal roads (figure 2).

**Figure 2: Development of the average daily traffic on federal trunk roads**



### 2.1.2 The Manual Road Traffic Count (manuelle Straßenverkehrszählung (SVZ))

Due the fact that automatic counting stations can only be a sample of the total federal trunk road net, a manual traffic count is realized every five years. The Manual Road Traffic Count started in 1952/53, the last manual traffic count has been realized this year.

Therefore people count traffic volume on all sections of the federal trunk roads and on nearly all sections of the remaining classified roads. So we have about 10.000 manual counting stations on federal trunk roads and more than 40.000 counting stations in total.

With regard to this extensive number of counting stations the Manual Road Traffic Count can only be realised on a few days and a few hours of the year (table 2).

Following the automatic counting stations the SVZ distinguishes between 6 motor vehicle types:

- passenger car
- motorcycle
- small truck < 3,5t / van
- truck > 3,5t without trailer
- towed truck / tractor-trailor
- bus

To get information for a whole year the automatic counting stations were used for estimating. An automatic counting station with a similar traffic characteristic therefore belongs to every manual counting station.

In the end we have detailed information on every section of federal trunk roads (figure 3):

- the average daily traffic for different days
- average hourly traffic volume for day and night
- the relevant traffic volume for designing roads

**Table 3: Results of the manual traffic road count (example)**

Freie Strecken der Bundesfernstraßen							Niedersachsen				
TK - Zst	Strasse (E-Strasse)	Gültigkeitsbereich (bzw. Lage) der Zählstelle (Netzknoten bei fehlender Beschreibung)					ZAL [km]	FS	Bau- amt	Region	
1	2	3					4	5	6	7	
2509 3346	K 1234	AS Norhausen - AS Südhausen					99,9	2	99	1234	
2509 3346	K 1234	AS Norhausen - AS Südhausen					99,9	2	99	1234	
2509 3346	K 1234	AK Oberwiesental-Süd - AS Oberwiesental-Nord					99,9	2	99	1234	
2509 3346	K 1234	AS Norhausen - AS Südhausen					99,9	2	99	1234	
2509 3346	K 1234	AS Norhausen - AS Südhausen					99,9	2	99	1234	

TK - Zst	Obergrenze DTV-Klasse [Kfz / 24h]			DTV-Anteil [%]		Klassenobergrenze [Kfz / 24h]			Anteil GV [%]	
	1993	1995	2000	GV	SV	DTV-W	DTV-U	DTV-S	DTV-W	DTV-U
8	9	10	11	12	13	14	15	16	17	18
2509 3346	100 000	100 000	100 000	12,5	12,5	100 000	100 000	100 000	12,5	12,5
2509 3346	90 000	90 000	90 000	9,9	9,9	90 000	90 000	90 000	9,9	9,9
2509 3346	3 000	3 000	3 000	10,0	10,0	3 000	3 000	3 000	10,0	10,0
2509 3346	1 500	1 500	1 500	7,5	7,5	1 500	1 500	1 500	7,5	7,5
2509 3346	900	900	900	8,0	8,0	900	900	900	8,0	8,0

TK - Zst	Klassenobergrenze [Kfz / h]				M [Kfz / h]		p [%]		L <sub>m</sub> <sup>(25)</sup> Tag	[dB(A)] Nacht	Zähl- art
	MSV	MSV-W	MSV-U	MSV-S	Tag	Nacht	Tag	Nacht			
19	20	21	22	23	24	25	26	27	28	29	30
2509 3346	1 300	1 300	1 300	1 300	1 145	191	11,4	14,2	75,1	69,6	MA
2509 3346	1 000	1 000	1 000	1 000	300	50	11,4	14,2	75,1	69,6	
2509 3346	900	900	900	900	50	2	8,4	10,0	75,1	69,6	
2509 3346	700	700	700	700	1 145	191	11,4	14,2	75,1	69,6	R1
2509 3346	99	99	99	99	1 145	191	11,4	14,2	75,1	69,6	S

Furthermore the Manual Road Traffic Count leads to road-netwide information on traffic volume (figure 3)



### 2.1.3 Manual Road Traffic Count of Foreign Motor Vehicles

Due to the lack of information on cross-boarder traffic in 1998 a road traffic count of foreign motor vehicles was realised.

Therefore a manual road traffic count of foreign motor vehicles on motorways and European highways was realized. A differentiation was made according to nationality and 5 categories of vehicles:

- passenger car
- small truck / van
- truck > 3.5t without trailer
- towed trucks / tractor trailer
- buses

Counting took place at 411 census points in all. There is a differentiation of two types of census points:

- 37 long-term census points (data collection on 15 days a year)
- 374 short-term census points (data collection on 8 days a year)

Furthermore data of automatic counting stations were used for estimation of the average daily traffic (ADT).

The ADT on motorways in 2003 was about 4,000 vehicles (see table 4).

**Table 4: Motor vehicle traffic from foreign countries (all nations)**

	mileage [mill.veh-km]	ADT [veh./24h]	percentage on all veh.	percentage on all veh.
passenger car	8560	1952	48,3%	
bus	219	50	1,2%	
small truck / van	1009	230	5,7%	
truck > 3,5t without trailer	943	215	5,3%	
towed truck / tractor trailer	6999	1596	39,5%	
passenger transport	8780	2002	49,5%	5,0%
freight transport	8951	2041	50,5%	22,1%
all vehicles	17730	4043	100,0%	8,3%

## 2.2 Motor Vehicle Mileage Survey

The above illustrated traffic counts give results for classified roads outside urban area only. But for many aspects (traffic safety for instance) we need information on mileages of motor vehicles on all roads. Due to the fact that the German traffic counts only allow statements with regard to classified roads outside urban areas, the BAST realizes in irregular intervals the so-called “motor-vehicle survey”. These data are also the basis for the DIW to estimate yearly motor vehicle mileages.

In total this survey was realized three times: 1990, 1993 and last in 2002. The aim is to get two basic kinds of information:

- (1) mileages of motor vehicles registered in Germany
- (2) mileages of motor vehicles in Germany

ad (1)

Mileages of motor vehicles registered in Germany contain mileages in and outside Germany. In order to get this information, a survey of motor vehicle owners was realized. For this purpose, owners of motor vehicles were asked over the year in six waves about the readings of their speedometers for two times (time distance 10 weeks). The survey in 2002 covered approximately 127.000 vehicle owners from the master file at the Federal Motor Transport Authority (Kraftfahrt-Bundesamt) using a method based on random sample theory. The overall response quota was approximately 70%.

The analyses show that the kilometres driven by motor vehicles amounted to approximately 703,000 million vehicle-km with a vehicle population of 53.5 million (in 2002). Cars accounted for 85% of the total kilometres in 2002, while vehicles of freight transport made up 11%.

Concerning cars, the average number of kilometres in 2002 was 13,400 km per car. Compared with 1993 this is a decrease of 5.6%. With regard to vehicles of freight transport, the average number of kilometres was about 22,900 km. Towed trucks and tractor-trailor do about 73,000km per year.

ad (2)

The aim of this part is to get information on mileages of motor vehicles in Germany. This includes all motor vehicles being used in Germany.

In order to get this information, the kilometres of motor vehicles registered in Germany must be reduced by mileages in foreign countries and must be completed by information of mileages of foreign motor vehicles on German roads.

Therefore German drivers have to be asked about the kilometres they drove outside Germany, and foreign drivers have to be asked about the kilometres they drove within Germany. In the past the drivers were asked during passport controls at the borders. With regard to the process of the



European Unification in 2002 it was only possible to use this method on the borders to Poland, Czech Republic and Switzerland. To get information for all other countries, an additional survey on service areas on motorways was realized. At about 27 service areas drivers in cross-boarder traffic were interviewed.

In 2002 the results showed that the kilometres of vehicles registered in Germany were nearly the same as the kilometres by all vehicles in Germany at approximately 703.000 million vehicle-km. However, if the data are differentiated according to passenger transport and freight transport, it can be seen that vehicle kilometres are “exported” in passenger traffic. This “export balance” amounts to approximately 4,200 million vehicle-km. In contrast, there is an “import” with regard to kilometres in freight transport. This balance amounting to 4,500 million vehicle-km.

### **3 Summary**

As described above the BAST has implemented a net of different data collection methods to get detailed information on traffic volume in Germany.

With regard to the process of the European Unification it gets more and more difficult to get information on the traffic volume in cross-boarder traffic. Therefore methods of data collection have to be adapted and the data exchange between the European countries should be intensified.

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