Paper to the 6th Conference on Applied Infrastructure Research,
TU Berlin, October 5th-6th 2007

Paper title:

Infrastructure Quality Measures: Trans-Atlantic Analysis and Pilot Indicators for Germany

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Date: 15.9.2007

Abstract: This paper addresses the importance of congestion and looks at ways to improve knowledge of its magnitude and development in Europe. First it addresses selected impacts of congestion: on economic development, technical innovation and transport policy design. By applying industry interviews, market studies and statistics on international trade flows and patent applications it is concluded that the attempt of people and firms to avoid adverse congestion effects even creates markets for new technologies. The paper further explores the current state of congestion monitoring in road and scheduled transport, based on detailed country reports for 27 European countries and the US. Eventually, the application of a low cost procedure for establishing an initial monitoring system on trunk roads is tested and some sample results are shown. Although far from being representative, these results demonstrate that initial monitoring approaches on the basis of spreadsheet models are possible and can be extended to more sophisticated systems.

Keywords: Transport Congestion, Monitoring, System Quality, Economic Impacts

JEL-Code: R41

1 The point of departure:

The European road transport network is characterised by a few large metropolitan areas, partly comprising of several cities, which are connected by a more or less congested network of motorways. In contrast US networks are mainly suffering from congestion in metropolitan areas. Thanks to TTI's annual Urban Mobility Reports, the Californian PeMS system and several other local congestion studies in the US and Canada the transport conditions in North America are known rather well. A comparable compendium for EU cities does not exist. Besides regular congestion monitoring reports for England, the Netherlands and the French capital region of Ile-deFrance only a number of one-off studies for countries, regions and cities exist. Further, all studies largely diverge in the type of data used and the indicators on transport system quality presented. The frequently quoted "continuous worsening of travel conditions in particular in urban areas" can thus not be confirmed on the basis of reliable empirical data. The EU-funded research project COMPETE[1] has collected available data on traffic quality for all modes and has carried out multiple interviews in the 25 EU Member States (prior to 1.1.2007), Switzerland and the US. The recommendations of the project to the EC have been to

- Establish a steady monitoring system of traffic quality as a means to benchmark the necessity for and the success of transport policy initiatives.
- Start with monitoring based on traffic flow data and speed-flow models for selected urban and inter-urban links across the Community. In later stages this system can be improved to cover more regions and other effects than capacity-related recurring congestion.
- Establish a European Traffic Monitoring and Control Centre to collect and clear data on traffic conditions across the TEN networks.

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[1] January to August 2006, co-ordination by Fraunhofer-ISI, website: http://www.isi.fhg.de/projects/compete/index.htm

- Oblige the railways to publish detailled punctuality data which allows to relate late arrivals and missed connections to the number of passengers or shipments affected.

This paper addresses the importance of congestion and looks at ways to improve knowledge of its magnitude and development in Europe. Section 2 deals with selected impacts of congestion on economic development, technical innovation and transport policy design. Section 3 then explores the current state of congestion monitoring and Section 4 examines low cost procedures for establishing an initial monitoring system on trunk roads. Section 5 eventually concludes by working out policy recommendations.

2 Congestion impacts

Congestion has several implications for the decision-making process and the performance of companies and the perception of private individuals. But besides additional costs and dismantles new markets for modern information and communication technologies are created, which also provide opportunities for ICT industries. In the following we will briefly discuss these items look to the challenges and opportunities for transport policy.

2.1 Congestion impacts on the economy

Infras/IWW (2004) find the economic loss due road congestion being €63 billion in Western Europe in 2000, while Infras, ISI and IER (2007) calculate €19.6 billion for Germany. Schade et al. (2006) find that congestion is mainly a problem of urban areas including their access routes for passenger and freight traffic and of specific bottlenecks in the inter-urban freight networks. Particularly for urban areas, where the US provides long time series of sound physical indicators, the situation is reported to have worsened dramatically. But despite that, transport policy, land use planning and people's behaviour has not changed much through the last decades. The results from the interviews carried out within the COMPETE study give rise to the question, whether exact physical measurements of traffic congestion are really relevant for policy makers or whether stated perception indicators would do better. Before concluding on this question a closer look at selected transport sectors will be taken.

Remarkably, congestion is not considered a major problem for most US citizens as the ability to relocate to non-congested areas within a city or across states is high. US Citizens tend to value congestion less critical than e. g. social security, health care, school quality or safety in bigger agglomerations on a national level. Taylor (2002) even suspects that congestion is seen as a side effect of dynamic and successful environments, that it is complemented by positive local opportunities and that travel time on congested freeways still only constitutes a relatively small fraction of daily trips.

In contrast to the US, European cities state moderate congestion problems to date. Nevertheless it needs to be pointed out that the reduction of urban congestion in Europe is partly due to the increasing sprawl of urban areas, which also considerably impacts daily travel, longer commuting times and possibly higher environmental loads compared to a situation where demand concentrates in the city centres. To fight this development the German government recently has abolished the state aids for private homes (mortgage deduction) and has reformed the tax reduction for long-distance commuters. Similar cuts of privileges and subsidies are followed in other countries as well.

To capture the relevance of congestion for the business sector Schade et al. (2006) have carried out a series of interviews with international business companies to get an indication of its perception and relevance across different countries and industry sectors. The firms were asked about the relevance of congestion for their sector, costs and other impacts arising, strategies to tackle congestion and about the expected influence of growing congestion on their competitiveness.

Congestion was reported being a very important issue for the road transport sector. The reasons however have to be differentiated: Only parts of congestion are capacity related (Table 1 and IRU 1998). All respondents have indicated the reliability of transport times, which are determined by incidents and non-recurring congestion, being much more important than the overall level of congestion. This is supported by Bozuwa et al. (1999) for the Netherlands, by the University of Leeds for the UK and by Golob and Regan (2000) for the US. Estimates indicate an average influence of congestion on direct costs of road transport of roughly 10 per cent.

As shifting higher costs to the industry of consumers is practically impossible the haulage business has developed strategies to cope with congestion problems. These include the bundling of shipments to urban areas, the shift to off-peak periods or the use of information technologies for the prediction of congestion and the appropriate adaptation of the tour planning. Thus, night hauls can be seen as a long-term strategy to avoid congestion. The analysis by economic sectors show, that the food and retail markets are most vulnerable to congestion.

Based on the interview results an “Index of the Vulnerability of the Economy to Congestion (IVEC)” was elaborated. This assigns a value of 100 to a medium vulnerability across all commercial sectors and increases in case rising congestion is predicted to cause an over-proportional damages to the sector in the specific country. Additionally, country reports for all 25 EU member states[2], Switzerland, and the US provide information on prevailing infrastructure quality standards. The results are given in Table 1. They present a very inhomogeneous picture for Europe and negative results for the US. With the examples of Germany and the Czech Republic (positive IVEC) and Poland (negative IVEC) the results indicate the companies perception of congestion impacts are negatively correlated to actual infrastructure quality.

Table 1: Index on vulnerability of the economy on congestion, year 2000

Country	IVEC Index points	IVEC qualitatively	Quality of infrastructure	**Overall vulnerability on congestion**
Czech Republic	78	++	0	**+**
Denmark	172	--	0	**--**
Finland	167	--	+	**-**
France	120	-	++	**+**
Germany	86	+	+	**++**
Hungary	91	+	+	**++**
Netherlands	156	--	++	**0**
Poland	125	-	--	**--**
Spain	112	-	0	**-**
United Kingdom	143	--	+	**-**
United States	117	-	0	**-**

Source: Schade et al. (2006)

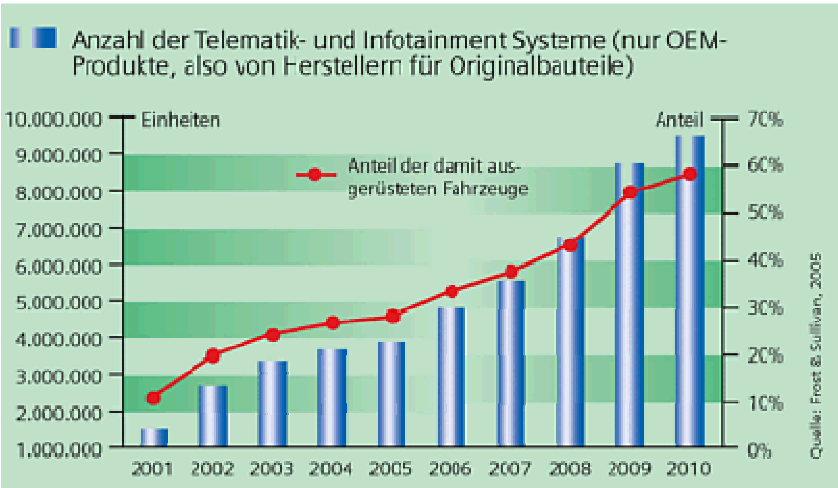
The review of existing congestion monitoring practices and the field surveys in Schade et al. (2006) clearly show that reliable quantitative information to make the discussion on the economic impact as well as on the magnitude of congestion is lagging.

2 As of prior to 1.1.2007

2.2 Congestion and technological innovation

While the previous section has dealt with the negative side of scarce infrastructure capacity, the attempt of people and firms to best cope with it also creates a market for supporting information and technologies. These markets are huge and keep on growing as technologies to process transportation information get more and more available. According to Frost&Sulivan (XXXX) in 2004 4.2 million vehicles, roughly 20%, were equipped with telematics and infotainment by OEMs[3], of which 35% were navigation systems. According to the study, the market volume in Europe will increase from €3.7 billion is 2005 to €5.6 billion in 2010. The figure below taken out of Trage (2005) presents the forecasts for the ICT market in transportation.

Figure 1: Forecasts of ICT markets until 2010



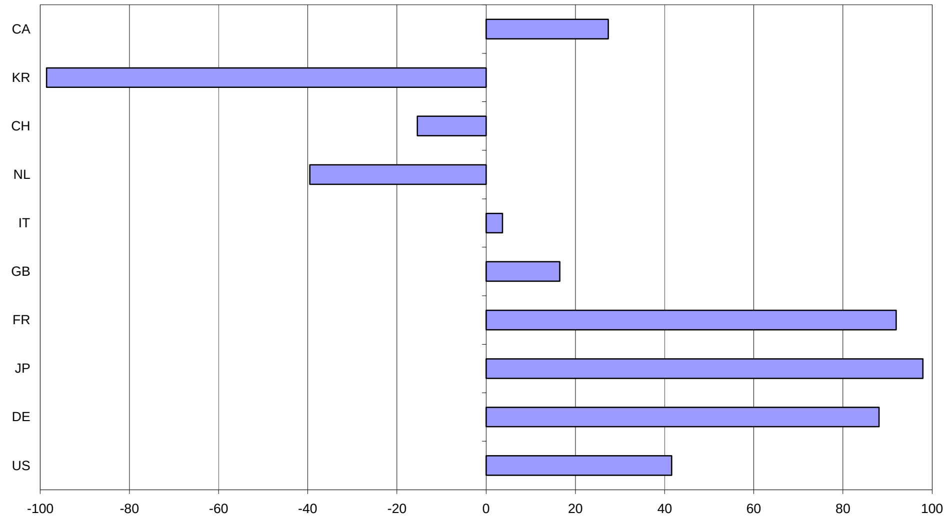
Source: Trage (2005)

3 OEM = Original Equipment Mamufacturers,

Ways to formally describe innovation processes are the analysis of international patent statistics and of subject-specific citation indicators. In ICT the analysis of patents turns out problematic as most of the technology is based on software solutions, for which commonly only few patents are applied. The analysis of literature on the topic would be more feasible, but was not possible within the scope of this paper. As a proxi for innovation and economic importance of ICT in transportation we use trade volumes taken out of the OECD ComTrade Database. For 2004 this reports a share of EU27 countries in the world market of 83%, where Germany holds 20% and France 9%. Outside the EU the biggest market share are held by the US with 10% and Japan with 5%.

As this comparison is biased by the general economic performance of the countries we use the revealed competitive advantage (RCA) indicator to compare the efforts the countries take in providing and marketing ICT technologies in transport. The RCA indicator is defined as the national share of ICT export volumes to all exports divided by ICT share in worldwide trade flows. For the year 2004 Figure 2 presents the results for selected countries. These confirm the picture drawn by the analysis of absolute trade volumes.

Figure 2: Revealed Competitive Advantace in intelligent transportation technologies



Source: ISI (2007)

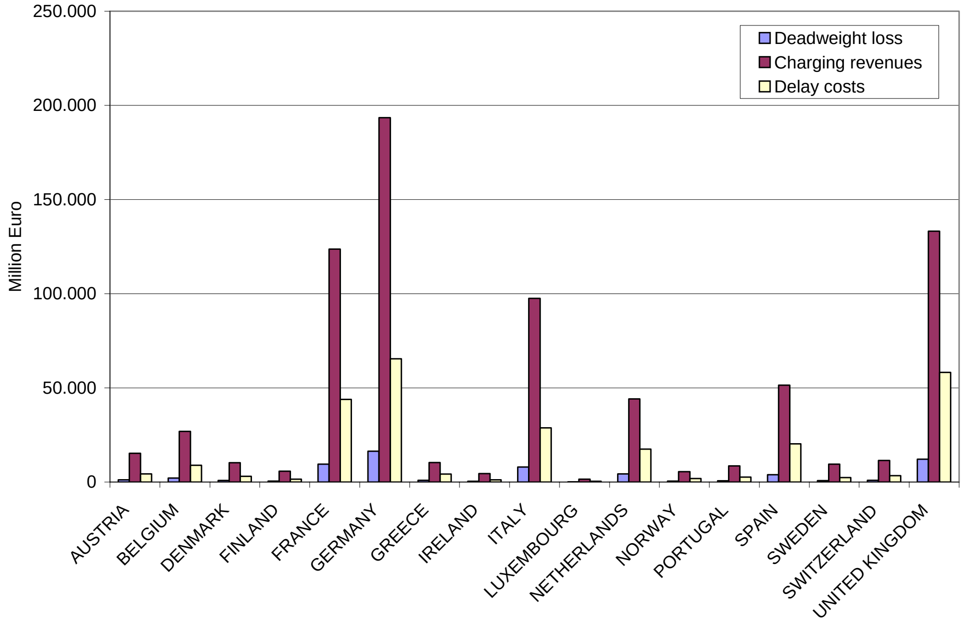
Two conclusions can be drawn our of these results: First, technologies allowing transport users to better cope with congestion, and thus helping to reduce it, are interesting from an economic point of view. Second, Germany and Europe are in an excellent position within this market. Trage (2005) report that ICT solutions would reduce congestion levels by 10% in urban areas where they are applied and have the same potential for inter-urban networks. But the lag in information on the real size and spread of congestion and its development over time makes it difficult to judge such developments are needed or in how far they would help to improve the situation, in particular around agglomeration areas.

2.3 The challenge for transport policy

Since its Green Paper on fair and efficient transport pricing (EC 1995) the European Commission holds on to the principle of principle of marginal social cost pricing to efficiently allocate actual demand to existing infrastructure capacity and to increase overall social welfare. The theoretical framework consists of a rather long list of side conditions, which are not fulfilled in practice, and it is not followed in other economic sectors (e. g. the electricity of telecommunications markets) by the EC. Nevertheless, internalising the external costs of congestion may well help to improve traffic conditions and support information technologies applied by users. But charging for the real external costs of congestion requires very sophisticated pricing systems as congestion costs will change quickly over time and between locations. On the other hand, such technologies improve with the increasing acceptance of dynamic rout guidance systems and may get an additional boost when the Galileo system is operational. Possible technical solutions allowing to implement marginal social congestion charges may be integrated navigation and payment units.

Low implementation and transaction costs of such systems are decisive for achieving a social surplus with congestion charging. Infras/IWW (2004) have demonstrated, that the amount of marginal social congestion charges to be raised is 10 times higher than the maximum achievable welfare gains. This means that system implementation and transaction costs need to be well below 10% of the revenues collected and the use of these revenues must be as welfare-optimal as possible to prevent the charging system from causing losses in social welfare. Figure 3 compares the results for the social surplus (dead weight loss) achievable by MSCP, the charges to be collected and, for comparison, the simple monetary values of traffic delays.

Figure 3: Potential surplus, pricing revenues and delay costs of traffic congestion in western Europe 2000



Source: Infras/IWW (2004)

Recent investigations from the US have revealed, that from peoples' and companies' perspectives physical measures of road quality obviously over-state the role of traffic congestion for economic growth and social welfare. A congestion perception index, generated from polling or observatories, would much better convey the current ranking of congestion problems relative to other needs and problems, such as health care, education, safety, resource availability, etc. These "soft factors" in assessing congestion impact need to be taken into account when setting up congestion charging systems. In this field additional research is required.

But transport policy is often related to investments or technical measures, which need to be justified by cost benefit analysis. The judgement where to invest commonly requires information on problems on the level of single road or railway links. Further, the estimation of likely benefits require quantitative data, such as the reduction in travel times or in delay hours. Moreover, perception measures are rather subjective as people get used to unfavourable situations, in particular in case the change takes place slowly.

This arguments lead to the conclusion, that physical measures are required as a precise and objective way to describe the development of congestion and delays. But accompanying subjective perception measures could provide valuable additional information for a higher level of decision making.

3 Evidence from Europe and north America

In this part of the paper existing approaches to monitoring congestion are reviewed. The work heavily draws on Schade et al. (2006), Deliverable 2. and Doll and Schade (2007).

3.1 Road congestion

The Trans-Atlantic comparison of approaches in the road sector shows that the tradition of monitoring and quantifying congestion is far more developed in the US than in Europe. The annually issued “Urban Mobility Report” of the Texas Transportation Institute (Schrank and Lomax 2005) quantifies delays and the related costs for transport users and the environment by time series for 85 out of 300 US urban areas above 100’000 inhabitants dating back to 1982 on the basis of archived traffic flow data (TTI/SC 2004). On the state level the PeMS project of the UC Berkley (PeMS 2007) follows a very sophisticated approach to measure freeway congestion for all 12 Californian districts by employing loop detector station data. The system provides real time traffic maps and time series of time losses and vehicles travelling under congested conditions by delay purpose. Finally, a nation-wide assessment of freeway congestion of trucks is analysed and forecasted until 2020 by the FHWA's 2005 White Paper on the topic (Cambridge Systematics, 2005).

In contrast the picture received for Europe is scattered and incomplete as different countries and regions follow separate methodologies. Some European studies, however, use very advanced approaches to quantify congestion on the trunk road network as here problems are more expressed than in the US. Further, European Member States traditionally apply advanced assessment frameworks for transport infrastructure project appraisal while the US rather relies on ad-hoc transport planning. The quantification of congestion effects thus experienced attention and improvement over the past decades in Europe as one of the core benefit categories of CBA approaches. On the other hand the US suffers from congestion problems in its fastly growing agglomeration areas, which is not so dominant in Europe.

Congestion on the European trunk road network has been evaluated by a number of studies and is officially observed by some individual countries. On a pan-European level the most comprehensive studies delivering primary data are the UNITE project funded by the European Commission's 5th framework programme (Nash et al. 2003) and the study "External Costs of Transport" launched by the International Union of Railways (Infras/IWW 2004). UNITE has collected delay data for all modes in 12 out of 18 European countries, which were used to assess congestion costs by the difference of actual against average travel speeds. In Infras/IWW (2004) several measures, travel delays, the welfare-economic deadweight loss and estimates of expected road pricing revenues, have been computed from an European road traffic model to quantify urban and inter-urban road congestion. Further the EC-funded study TEN-STAC (NEA et al., 2003) has evaluated several scenarios of Trans-European corridors. As one of the measures applied congestion was computed by comparing actual to free flow travel speeds. Finally, the European Conference of Directors of Roads regularly interviews car and truck drivers at border crossings about their perception of network qualities and delay causes (CEDR 2006).

Congestion monitoring approaches followed by European countries apply different methodologies. The UK Department for Transport (DfT) carries out peak and off-peak speed measurements on trunk roads and in selected urban areas every odd year since 1993 by the floating car technique (DfT 2005 and TfL 2005). A further regular monitoring process accounting for the length of traffic jams on selected motorway sections is carried out by AVV (2006) for the Netherlands and by the Prefecture d'Ile de France (2006) for the Paris region. Finally, the German Highway Research Institute (BASt) currently develops a method for a steady monitoring of congestion on the most busy sections of the national motorway network.

Apart from these regular applications only one-off studies for countries and urban areas have been identified in Europe: IVV / Brilon (2004) have applied a detailed network model to forecast congestion levels on German motorways until 2015 and Hvid (2004) uses observed data congestion in the Copenhagen region. Eventually, model based studies have been found for the southern French motorway network (CETE Mediteraneé, 2004) and big Spanish cities (Munos de Escalgona, 2004). Further, an increasing number of cities worldwide provide online access to real-time traffic quality data for trip planning. But archives of these measurements are frequently not available and are thus not used here.

Table 2 presents the studies reviewed according to the two dimensions “measuring methods” and “output indicators”. First, it reveals that asking users about the perceived congestion levels is, despite its low costs, not a very popular method. Further, looking across the output indicators and the methodologies seems to suggest, that each indicator requires a particular method of data collection. This strict classification is, however, more accidentally than systematic. For example the output indicators “Time lost per vkm” and “% increase of travel time” are very similar.

In fact all indicators of capacity-related congestion can either be derived by directly observing traffic conditions or by applying observed traffic volumes to appropriate speed-flow functions. Direct observations have the advantage of being more reliable and they can take other than capacity-driven congestion, e. g. caused by accidents, road works or weather conditions, into account. On the other hand data bases of traffic volume measurements are often available for past years and thus easily allow to show the development of congestion over time.

Table 2: Method-indicator matrix of road congestion studies

Basic output indicators	Basic methods to measure congestion			
	Observed conditions	**Observed flows**	**Traffic models**	**Polling**
Share of delayed trips				Europe (3)
Share of delay causes	Netherlands (1)	Paris (2) California (22)		Europe (3)
Length of traffic jams	Netherlands (1) Ile-de-France: (2)	Paris (2)		
Speed development	World cities (20,21)			
Network-km by LOS		Copenhagen (6)	Germany (5) France (4)	
Time lost per vkm	England (7) London: (8)			
Extra travel time		Scotland (9) US Cities (10)		
Travel time reliability		Scotland (9) US Cities (10)		
Vkm by LOS		Copenhagen (6) Scotland (9) California (22)		
Travel time by LOS		Paris (2) Copenhagen (6) Scotland (9		
Average time costs			EU17 (11) Germany (12)	
Total time costs			EU17 (11) Germany (12) EU25 (13) US (16)	
Total time + operating costs		EU18 (18) Switzerland (19)		
Total environmental costs			US cities (10) Canadian cities (14) Spanish cities (15)	
Deadweight loss			EU17 (11) Europ. cities (17)	

Symbols: vkm=vehicle kilometre - LOS=Level of Service - EUR17=EU15 plus Switzerland and Norway - EU15: European Union prior to 1.5.2004 – EU25: European Union as of 1.5.2004 – US: United States – CA=Canada

Sources: 1: AVV 2005 – 2: Prefecture d'Ile de France (2006) – 3: CEDR (2004) – 4: CETE Mediteraneé (2004) – 5: IVV and Brilon (2004) – 6: Hvid (2004) – 7: DfT (2003) - 8: TfL (2005) – Scottish Executive (2003) – 10: Schrank and Lomax (2005) – 11: Infras/IWW. (2004) – 12: Schreyer et al. (2006) – 13: NEA et al. 2003 – 14: Transport Canada (2006) – 15: Muñoz de Escalona (2004) – 16: Cambridge Systematics (2005) – 17: Doll (2002) – 18: Link et al. (2000) – 19: Infras (1998) – 20: OECD (1995) – 21: Dunning (2005) – 22:

A comparison of results is presented and discussed in Schade et al. (2006) and in Doll and Schade (2007).

3.2 Delays in scheduled transport

In the scheduled transport modes rail and air, monitoring delays is much straighter forward than in the road sector as here time tables exist to compare actual to planned departure and arrival times and as the demand for vehicle movements is matched to available capacities by planning authorities. The network operators and the transport companies in both modes in all countries keep delay records, usually by purpose, location and severity. But, in the case of rail transport, they are only published as highly aggregated annual figure by many companies. Further, delays in scheduled transport are not only the product of capacity shortage and incidents, but also of the time table construction. Thus, delays in rail and air transport do not necessarily indicate the need for network or operational improvements. But they are an important indicator for the reliability of the system as perceived by the customers.

In the aviation market both, the US and Europe, consist of good statistical sources. The US Bureau of Transportation Statistics (BTS) and the Association of European Airlines (AEA) publish quarterly and annual consumer report containing detailed punctuality rates by airports and airlines. The aggregated results for Europe and the US are presented since 1992.

In the shipping sector Europe still consists of considerable capacity reserves, while the US ports, and there in particular the west coat ports, are overloaded and have little possibilities for further expansion. Port congestion is not so much a problem of landing capacity but more of craning capacity. Quantitative figures have not been found on port congestion. In contrast, the main problem for some European Seaports is short capacity at hinterland access routes by rail in the case of Rotterdam and by road in the case of Rostock at the German Baltic Sea coast.

3.3 Intermodal comparison of delay causes

To address the question in how far congestion constitutes a problem and which policy options are available to fight it, not only the size, but also the cause of congestion and delays constitute an important piece of information. The results of the studies reviewed are presented in Table 3. In the road sector, the difference in capacity-related (recurring) congestion between 30% and 80% can partly be explained by traffic density. In aviation the differences between the studies are more difficult to explain, but here the treatment of “other sources”, mainly related to airline-inflicted delays, impacts the delay categories. Nevertheless, it is important to notice that throughout all modes capacity shortage in most cases is not even the main reason for delays and congestion.

Table 3: Reasons of congestion according to multiple studies

Mode	Study, area	Congestion / delay cause				
		Capacity	Construc-tion works	Accidents	Weathe r	Other
Road	TTI Urban Mobility Rep.	30 %-60 %	40 %-70 %			
	CEDR (2004) [1]:	40%	41 %	18 %	9 %	9 %
	Hessen, Germany	30 %	30 %	10 %	30%	
	France, Ile de France	85 %	4 %	11 %		
	Netherlands	82 %	5 %	13 %		
Rail	UK Network Rail	32 % [1]	44 % [1]		10 %	14 %
Air	US, DOT	36 %			4 %	60 % [3]
	Europe, AEA	30 %			4 %	66 % [3]
	Europe, Eurocontrol [2]	11 %	-	-	11 %	78 % [3]

1) Number of cases; 2) ATFM En-Route delays; 3) Airlines: 51%, Airport: 19%, security: 4%, miscellaneous: 4%, 3) network management, 4) asset defects,

4 Pilot indicators for German road transport

4.1 Idea and outline

Looking at the heterogeneous picture of European and North American congestion monitoring procedures, Schade et al. (2004) have recommended to install a European traffic monitoring centre to generate reliable and comparable indicators of traffic quality across the Union. The implementation of such an institution, which could be part of Eurostat, the OECD or DG-TREN, however, will be costly and complicated as the data quality and structure available at member state level will most likely be very different. This is at least the case if sophisticated measures taking into account real traffic conditions and multiple delay causes are envisaged.

The process should, however, be initiated in order to support the EC objective of a “Common Transport Policy” by a “Common Policy Assessment Framework”. Steps into this direction have been undertaken by the EC-funded research projects HEATCO (Bickel et al. 20006) and EVA-TREN (Scholz et al. 2006). But none of these attempts have proposed an easy to apply and low cost methodology for establishing a monitoring system which would allow to keep track of the effects of EC and national transport policies on transport system quality. As a very first step into this direction this section explores whether a very first congestion monitoring system could be established by national or European institutions at low costs and how this could be developed.

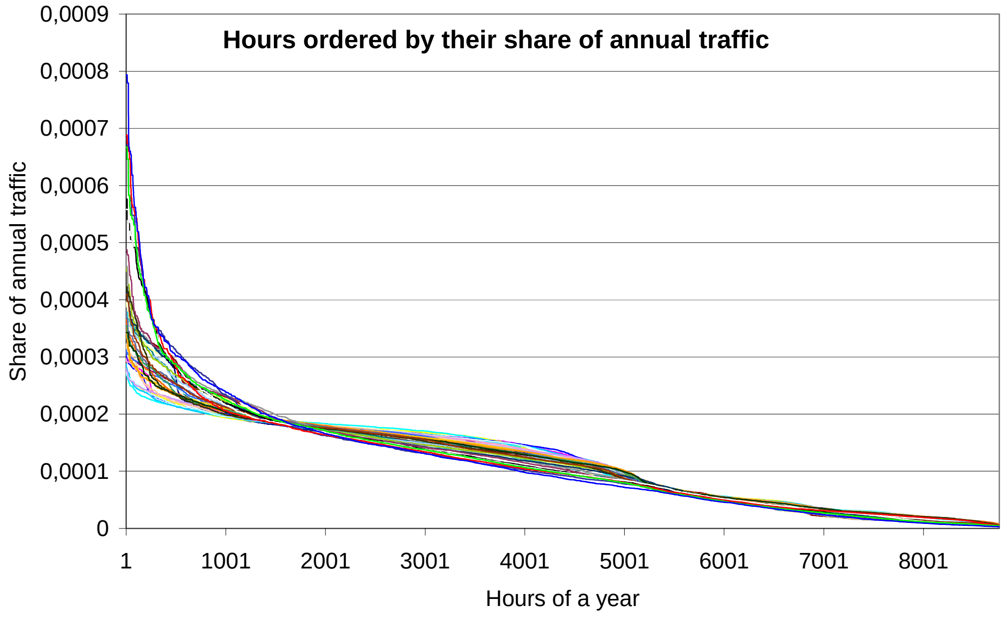
Given that in public transport delay measures are already available or are subject to privacy of companies, the monitoring system is established for the road sector. The development is inspired by the US Urban Mobility Report due to its simplicity. In an initial step the system would focus on recurring congestion, i.e. excluding accident, weather or construction site driven effects, on inter-urban and urban motorways. These restrictions surely ignore a big part of traffic delays, but give a straight forward indication of capacity expansion needs on the part of the road network, which is within the interest domain of the Commission.

4.2 System design

The analysis makes use of the continuous monitoring of traffic flows by the German Highway Research Institute BASt for the years 1998/99 (BASt 2001) and 2003/04 (BASt 2006). The data base contains traffic volumes of passenger cars and goods vehicles for working days, holiday weekdays and week ends for several hundred automatic counting posts across all 16 German federal states. Further, each counting post is assigned to a specific annual and daily traffic patter curve. By this rich information differentiated load patterns are obtained for each road segment, which can be compared over time. Applying the detailed speed-flow functions provided by the road investment manual EWS (FGSV 1997) passenger car and lorry speeds per hour class can be computed.

Sensitivity tests have revealed, that - besides speed-flow functions - the assumptions on the distribution of annual traffic volume on weeks, days and hours are most decisive for the results. Thus, simplifications such as “50% of traffic volume is peak traffic and takes part during four hours in the day” as dome by Schrank and Lomax (2005) would bias the results too much. Thus, BASt traffic patterns have been transformed into the hourly distribution functions as presented by Figure 4.

Figure 4: Hourly distribution patterns of annual traffic volume

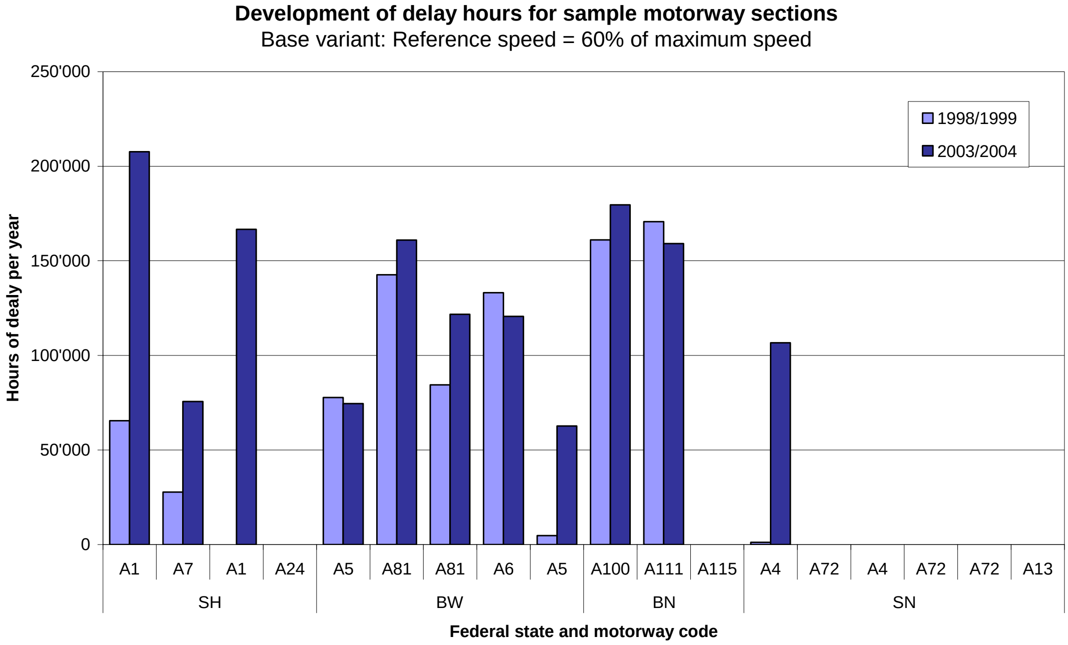


Source: Own elaboration based on data from BASt (2006)

4.3 Sample results

Using three reference travel speeds (50%, 60% and 70% of permitted maximum speed, 130 kph for motorways), total annual delays per road kilometre are calculated to provide a simple figure allowing the comparison of congestion levels across the selected five year period. A sample of measurement points is presented by Figure 5. The figures were picked out of the available results of the most busy links for the four federal states Scheswig-Holstein (SH), Baden-Württemberg (BW), Berlin (BN) and Saxony (SN). Although these samples represent some of the most loaded links, the respective indicators do not show in all cases growing congestion levels. In particular in Saxony it gets obvious that the newly constructed infrastructure of the new federal states still provides some capacity reserves.

Figure 5: Sample congesstion indicators for four dederal states



Besides some limited exceptions, the few selected results do not indicate a severe increase in traffic congestion between 1998/99 and 2003/04. The strong development of delay hours for some links is mainly due to the shift in traffic patterns, and not so much because demand has grown that quickly. In general it can be observed that even the typical shapes of traffic patterns develop over time, such that for each year a separate set of distribution functions needs to be generated.

These figures can easily be transformed into other indicators, such as

- Average delay per kilometre to be compared to the UK results
- Travel time index, i. e. the percentage of travel time increase to be compared to the results of the US Urban Mobility Study
- Marginal external costs of congestion being the first-best congestion measure accordiing to communications of the European Commission
- The deadweight loss of traffic congestion as a measure of social surplus associated with applying welfare-optimal congestion charges.

These results have been computed by an Microsoft Excel Spreadsheet model. The definition and implementation of the functions has been taken a few days only and the figures can easily be extended to many more links and time periods. Even the inclusion of more indicators as indicated above would be easily possible. With this empirical step the paper demonstrates the feasibility of establishing a European monitoring system of road traffic congestion at rather low costs and in short time.

5 Outlook: the policy dimension

The previous sections have shown that congestion is considered a real problem by firms, that it provides a market for new technologies, that, however, consistent empirical evidence does not exist, but that a European monitoring system could easily be started at low costs. Having a standardised instrument to assess the quality effects of transport investments, regulations or pricing policies ex-ante and ex-post appears valuable for assessing European or national transport policies over a longer period of time. In particular when establishing a growing number of PPP projects the existence of an independent quality monitoring system seems to be indispensable.

For such a sophisticated system, one needs to depart from the simplistic one presented here. The following steps could be made without thinking of other modes than road:

- Use real hourly flow and speed measurements instead of AADT data
- Add information on accidents, building sites, weather, etc. to report on delay causes
- Extrapolate links without automatic detectors by traffic models

These steps can be done gradually, such that the possibly high costs associated with them can not be accepted as an excuse for not starting the process with establishing a low-budget European road quality monitor.

References

AEA (2006): AEA Punctuality Data, Annual 2005. Association of European Airlines, Brussels, February 2006

AVV (2005): Filemonitor 2005. Adviesdienst Verkeer en Vervoer, Rotterdam, February 2005.

BASt (2001): Verkehrszählung auf Bundesautobahnen 1999. Bundesanstalt für Straßenwesen. Bad Godesberg.

BASt (2006): Verkehrszählung auf Bundesautobahnen 2004. Bundesanstalt für Straßenwesen. Bad Godesberg.

Bickel, P. et al. (2006): Final Technical Report, HEATCO (Developing Harmonised European Approaches for Transport Costing and Project Assessment) Deliverable 7. Project funded by the European Commission, Co-ordinator IER, University of Stuttgart. December 2006.

Bozuwa, J., Van der Flier, M., Tollenaar, R., Vocks, L. (1999): Transport costs in relation to Europe's competitiveness on a global level. Institute for Perspective Technological Studies. NEI, Rotterdam.

BTS (2006): National Transportation Statistics. Online Document accessed June 2006. URL: http://www.bts.gov/publications/national_transportation_statistics/ .

Cambridge Systematics (2005): An Initial Assessment of Freight Bottlenecks on Highways. White paper, prepared for Federal Highway Administration Office of Transportation Policy Studies.

CEDR (2004): European Road Users' Survey 2004, Conference of European Directors of Roads, I&O Research Enschede

CETE Méditerranée (2004): Analyse de la saturation routière en PACA (Provence – Alpes – Côte d'Azur). Report.

DfT (2005): Vehicle Speeds in Great Britain 2002. Department for Transport, Local Government and the Regions, Statistical Bulletin (03)24. London, June 2005

Doll, C. and W. Schade (2007): European Panorama of Congestion. Paper presented at the 11th World Conference on Transport Research (WCTR), Berkeley, USA, June 2007.

EC (1995): Fair and Efficient Transport Pricing. Green Paper for European Commission. Brussels.

EUROCONTROL (2004): "Challenges to Growth Study 2004 (CTG04)". European Organisation for the Safety of Air Navigation, Eurocontrol.

FGSV (1997): Empfehlungen für die Wirtschaftlichektisrechnung an Straßen (EWS). Research Society for Road and Transportation (FGSV). Köln.

Golob, TF., Regan, AC. (2000): "Freight Industry Attitudes Towards Policies to Reduce Congestion". Transportation Research-E, Vol. 36, pp. 55 - 57.

Hvid EL (2004): Traffic Congestion Costs (in the wider Copenhagen Region). English sum-mary report, COWI A/S, Copenhagen, August 2004.

Infras (1998): Astra - Staukosten im Strassenverkehr. Schlussbericht. Infras, Bern, 31.12.1998

Infras / ISI / IER (2007): Externe Kosten des Verkehrs in Deutschland. Study on behalf of the Allianz pro Schiene e.V., Frankrurt. Maibach, M., Schreyer, C., Doll, C., and Bickel, P., Zürich, Karlsruhe, Stuttgart.

Infras / IWW (2004): External Costs of Transport – Update Study. Final Report to the International Union of Railways (UIC), Paris. Maibach, M., Rothengatter, W., Doll, C., Schneider, C., Schmedding,, D. and Schreyer, C., Zurich, Karlsruhe, October 2004.

IRU (1998): Economic Cost of Barriers to Road Transport. Executive Summary. The Hague Consulting Group on behalf of the International Road Transport Union (IRU). Geneva.

ISI / DIW (2007): Zukunftsmärkte Umwelt. Study performed for the German Ministry for Environment, Consumer Protection and Nuclear Safety (BMU). Kerlsruhe, Berlin, 2007.

IVV/Brilon (2004): Engpassuntersuchung für das BAB-Netz - Stufe 2. Report to the Federal Ministry for Transport, Building and Housing (BMVBS), Referat S10. Aachen, Bochum, October 2004

Muñoz de Escalona, Francisco (2004): La congestión del tráfico urbano. Causas, medidas, costes. Contribuciones a la Economía, September 2004.

Nash et al. (2003): UNITE (UNIfication of accounts and marginal costs for Transport Efficiency) Final Report for Publication, Funded by 5th Framework RTD Programme

NEA (2003): Scenarios, Traffic Forecasts, and Analysis of Corridors on the Trans-European Networks (TEN-STAC), Deliverable D6: Traffic, Bottlenecks, and Environmental Analysis on 25 Corridors. Study carried out on behalf of the European Commission. NEA (Rijswijk), NESTEAR (Paris), IWW (University of Karlsruhe), COWI (Copenhagen). Brussels.

Network Rail (2005): Annual Report 2004. London.

PeMS (2007): Freeway Performance Measurement (PeMS) System. Research project of the UC Berkley (San Francisco), PATH, California Department of Transportation (Caltrans) supported by the US Bureau of Transportation Statistics (BTS). URL: http://pems.eecs.berkeley.edu (accessed 30.4.2007).

Prefecture de la Région d'Ile-de-France (2005): Les Déplacements sur le Réseau de Voies Rapides Urbaines d'Ile-de-France. Année 2003.

Schade, W., Doll, C., Maibach, M., Sieber, N., Lilico, A., Conti, M., Crespo, F and Carvalho, D. (2006): Analysis of the contribution of transport policies to the competitiveness of the EU economy and comparison with the United States (COMPETE). Final report to the European Commission. Project co-ordination: Fraunhofer-Institute for Systems and Innovation Research (ISI), Karlsruhe, Germany. September 2006.

Scholz, A. et al. (2006): Evaluating the State-of-the-Art in Investment for Transport and Energy Networks. EVA-TREN (Improved Decision-Aid Methods and Tools to Support Evaluation of Investment for Transport and Energy Networks in Europe) Deliverable 1. Project funded by the European Commission. Project co-ordinator: TRT, Milan. December 2006.

Schrank, D. and Lomax, T. (2005): The 2005 Urban Mobility Report. Texas Transportation Institute (TTI), May 2005. http://mobility.tamu.edu/

Taylor, B. D. (2002) : Rethinking Traffic Congestion. ACCESS, No. 21, fall 2002.

TfL (2005): London Travel Report 2005. Mayor of London.

The Trans-Atlantic comparison of approaches in the road sector shows that the tradi-tion of monitoring and quantifying congestion is far more developed in the US than in Europe.

Trage, S. (2005): Intelligente Vernetzung – Fakten und Prognosen. Pictures of the Future, issue Autumn 2005. Internet source: http://networks.siemens.com/voip/hipath-de/produkte-loesungen-services/pof-2-05-artikel11-fakten-und-prognosen.html