Deutsche Bank Research

Economics

Internet revolution and new economy

December 11, 2002

No. 34

Information & communication technologies - panacea for traffic congestion?

- Modern information and communication technologies (ICT) have direct effects on transport via road pricing, telematics and logistics. On the basis of given infrastructure, electronic **road pricing** helps control traffic flows more efficiently. The success of the concept is closely linked with the investment costs. A **common standard** which allows a system to be built up inexpensively across national borders should foster **acceptance in the market**. Germany, as an important transit country, will probably assume a bellwether role in Europe in modern road-pricing technology.
- E-business, telework and the more intensive international division of labour brought about by the internet influence transport developments indirectly. For example, **e-business requires that small batches be delivered** to the customer **rapidly and reliably**. This is predicated on a well-developed transport network, smooth-flowing traffic and optimised logistics. Logistics models are geared to **short response times** and **intensive service**. The related jump in customer addresses raises the volume of traffic in residential areas especially when the normal working day is over. Courier, express and parcel services are particularly suited to the changed business pattern.
- So far, telework has not really caught on in Germany. The **relevance of the telework concept for transport** is **limited** as only selected employees and fields of activity are suitable for this form of business organisation. The impact of telework on traffic volume is often overestimated. Nevertheless, telework creates scope to make more efficient use of the transport infrastructure, i.e. to **spread** the **traffic volume** more evenly **in terms of time and geography**.
- Information and communication technologies affect traffic volumes through various channels, but as a whole trigger only small quantitative effects. For structural reasons, e-business and telework have **a smaller quantitative effect on traffic than widely presumed**.
- All the same, technological progress continues to drive the **evolution** of transport in terms of **quality**. Road pricing, telematics and logistics look set to create considerable stimuli in future; the coming generation of mobile communication technology will lend additional impetus to the trend.
- At the end of the day, the ICT evolution helps to organise traffic flows more efficiently. Thus, the **technology** plays a **supplementary role as transport-relevant instrument, but is not a panacea** for traffic congestion.

Stefan Heng, + 49 69 910-31774 (stefan.heng@db.com)

www.dbresearch.com

Editor
Antje Stobbe
+49 69 910-31847
antje.stobbe@db.com

Technical Assistant
Astrid Petter
+49 69 910-31755
astrid.petter@db.com

Deutsche Bank Research
Frankfurt am Main
Germany
Internet: www.dbresearch.com
E-mail: marketing.dbr@db.com
Fax: +49 69 910-31877

Managing Directors
Axel Siedenberg
Norbert Walter

E-conomics

ISSN 1619-3245

The series E-conomics analyses the economic and social consequences of the increasing use of the internet. It focuses on the effects on different economic sectors, structural changes in the banking sector and financial markets, analysis of the new economy, and economic policy issues.

Information & communication technologies - panacea for traffic congestion?	December 11, 2002
Germany's venture capital market: prospects remain dim	December 5, 2002
Free software, big business?	November 22, 2002
E-government: large potential still to be tapped	October 31, 2002
Business locations in a networked world - No death of distance	August 27, 2002
Taxation of e-commerce - looking for solutions	August 1, 2002
Biometrics - hype and reality	May 22, 2002
Technology and work - the 21st century and its challenges	April 29, 2002
Online brokerage in Germany 2002: strategy changes and market shakeout	April 19, 2002
B2C trading in the automotive industry: the internet is primarily a source of information	April 18, 2002
Framework conditions for e-commerce: all in good order?	February 11, 2002
Virtual marketplaces in the chemicals sector: B2B turnover expanding strongly	January 24, 2002
International capital markets of the future - the impact of the internet	December 10, 2001
E-commerce and the WTO	December 4, 2001
3G - chance for take-off in mobile business	November 16, 2001
Virtual marketplaces: big is beautiful	October 17, 2001
Focus on the new economy and productivity	October 1, 2001
The Digital Divide - focus on Asia	August 15, 2001

For ordering, please contact:

Deutsche Bank Research
Marketing
60272 Frankfurt am Main
Fax: +49 69 910-31877
E-mail: marketing.dbr@db.com

Information & communication technologies – panacea for traffic congestion?

Mobility is said to be not only one of people's basic needs, but also the engine of our economy.[1] However, the strongly rising volume of traffic results increasingly in congestion on the freeways. At the same time, social resistance and tight public budgets restrict the scope for developing the infrastructure. Alternative approaches are needed to lessen the traffic problem.[2] Going forward, intelligent vehicles on intelligent roads[3] should guarantee mobility and secure economic growth. Besides modern information and communication technologies (ICT), use-related electronic road-pricing systems are under discussion. However, it is dubious whether the more intensive use of ICT can make traffic more efficient and perhaps, in fact, keep it from growing as strongly in the future as in the past.

Information and communication technologies have both a direct and an indirect effect on transport development. Electronic road pricing (ERP), telematics and innovative logistics help, with the given infrastructure, to make traffic flows more efficient and avoid congestion. Besides the primary impact on traffic, ICT opens the door to new business fields and paves the way to decentralised structures. These business fields – such as business-to-business e-commerce (B2B) and business-to-consumer e-commerce (B2C) – and process structures – such as telework and international division of labour via the internet – also influence traffic developments, albeit indirectly.

Forwarding companies have to be prepared for quantitative and qualitative demands which continue to change rapidly owing to both the general development of the economy and the emergence of e-business. This study investigates the reciprocal effects of modern ICT that are relevant to transport, looking initially at the direct, traffic-specific instruments road pricing, telematics and logistics. We subsequently discuss the different forms of e-business, globalisation and telework through which the technologies indirectly affect traffic.

Road pricing becoming established practice

Tolls are common in many countries. The systems are largely confined to defined regions, though, and are independent of the capacity utilisation of the respective roads. The traditional procedures are primarily designed to generate revenue, with the avoidance of traffic congestion tending to be secondary. In the 1980s, Hong Kong introduced an electronic tolling system called Automatic Vehicle Identification (AVI). The road fee differed according to the time of day, route travelled and distance, so it also had a traffic-directing function. Even though this very early model was later abandoned because data security was lacking, it nevertheless documented the substantial potential efficiency to be gained by electronic road pricing.

ICT and traffic

Direct, primary influence of technology on traffic	Indirect influence of technology on traffic
• Road Pricing	• B2B, B2C e-commerce
• Telematics via - Fixed installations along the road - Radio - Stationary internet - Mobile communication technology	• Telework • International division of labour
• Logistics	

Glossary

2G	Second-generation mobile telephony
3G	Third-generation mobile telephony
ACC	Adaptive cruise control
AVI	Automatic vehicle identification
CDMA	Code division multiple access
CEP	Courier, express, parcel
DAB	Digital audio broadcast
DMB	Digital multimedia broadcasting
EMS	Enhanced messaging service
ERP	Electronic road pricing
FCD	Floating car data system
GPRS	General packet radio service
GPS	Global positioning system
GSM	Global system for mobile communication
GSM-R	Global system for mobile communication for rail
ISA	Intelligent speed adoption
ITS	Intelligent transport system
IVHS	Intelligent vehicle highway systems
MI	Motorised individuals
MMS	Multimedia messaging service
OBU	On-board unit
PDA	Personal digital assistant
PDC	Personal digital cellular
pkm	Person-kilometres
RDS/TMC	Radio data system/ Traffic message channel
RTI	Road transport informatics
SMS	Short message service
TC	TOLL COLLECT
tkm	Tonne-kilometres
UMTS	Universal mobile telecommunication system
USDC	US digital cellular system

[1] SHELL AG (1999): Mehr Autos - weniger Emissionen, Hamburg, p. 4.

[2] See Conrad, Klaus and Stefan Heng (2002): Financing road infrastructure by savings in congestion costs: A CGE analysis, in: The Annals of Regional Science, Vol. 36, No. 1, February 2002, pp. 107-122.

[3] Barth, Gerhard (1997): Mobilität durch Telematik - Informatik und Kommunikation für zukünftige Verkehrssysteme, in: Krönig, Dirk: Mobilität durch Telematik - Chancen für die Wirtschaftsstandorte Deutschland und Europa, Ulm, p. 87.

Singapore continues to rely on ERP. On a similar note, Norway has a long tradition of financing bridges and tunnels by levying tolls. As an example, Bergen was the first European city to launch an ERP model back in the 1980s; Oslo followed suit in 1990. London has plans for a congestion charge from 2003.[4] In Germany, a field test in Stuttgart proved promising: MobilPASS provided key learnings about a capacity-related fee system. Even moderate fee alterations resulted in noticeable changes in mobility.

Modern technology prompting rethink on tolls

Modern ICT helps in controlling the use of transport infrastructure. Electronic road pricing with flexible rates is only really becoming economically feasible thanks to the advances in technology. When assessing road pricing at the macroeconomic level one should look not only at the cost of investing in and operating the facilities but also at the additional time that users need for the invoicing aspects.

ERP systems differ as regards the methods of data collection and payment. For instance, unlike in continuous pricing, charges incurred in point pricing kick in as soon as a vehicle starts on a journey, regardless of the distance and route taken. Furthermore, drivers are in some cases required to pay in advance, in others only after the trip (pre-pay versus post-pay systems).[5]

Controversy surrounds the social and regional effects of road-pricing systems. For example, the European Parliament warns against overweighting financial criteria in relation to social and area-planning criteria[6] when calculating road-pricing fees. Nobel laureate William Vickrey also looks into the problems of distributional injustices in road pricing. Depending on preference patterns, population groups are burdened differently.[7] The degree to which they are affected varies with their individual mobility needs and the time flexibility dictated in large measure by their jobs. Since working times in the low-wage, low-skills segment are usually fairly rigid, low-income users might be systematically subjected to a relatively heavy burden. The low-wage group would in most cases have to drive to work during rush hour, precisely when the capacity-related fee is particularly high. Thus, road pricing tends to work on a declining basis, bearing on low earners relatively more than on those who are better off. This reduces the political feasibility of flexible fees, especially for passenger vehicles. However, initial plans for goods traffic have been realised.

Tentative steps towards use-related road pricing

TOLL COLLECT (TC), the road-pricing system to be implemented in Germany following the pilot test on the A555 motorway between Cologne and Bonn, combines satellite-based positioning and mobile communication technology. An on-board unit ensures time-efficient billing as it does away with waiting times at invoicing points.

Automatic Vehicle Identification (AVI)

In the Automatic Vehicle Identification system every vehicle is fitted with an "electronic licence" plate. Passing vehicles can be identified without delay by means of this on-board unit (OBU) and inductive loop sensors buried in the roadway. The toll charged is graduated according to time of day, section of road used and distance travelled. If AVI cannot register a car automatically, a camera takes a picture of the conventional licence plate.

The combination of electronic and optical components guarantees nearly complete registration of all users. The recorded data are sent to a central clearing system which prepares monthly invoices and sends them to the user.

Truck tolls in Europe

	Toll (EUR/km)*	Toll roads (km)
Austria**	0.25	1,613
Croatia	0.10 - 0.18	411
France	0.10 - 0.19	7,220
Germany**	0.14 - 0.19	11,515
Greece	0.02 - 0.03	871
Hungary	0.14 - 0.22	115
Italy	0.05 - 0.12	6,469
Norway	0.10	196
Portugal	0.10 - 0.14	808
Slovenia	0.07 - 0.19	249
Spain	0.10 - 0.15	2,083
Switzerland	0.11 - 0.42	1,485
Turkey	0.02 - 0.04	1,724

* depends partly on time of day and specific vehicle features

** from 2003

Source: Bundesverband Güterkraftverkehr, 2002; data as of 2001

[4] See Eisenkopf, Alexander et. al. (2002): Verkehr in Europa – Privatisierung und Deregulierung unverzichtbar, in: Deutsche Bank Research, Sonderbericht, Frankfurt/Main, p. 31f (only available in German).

[5] See Heng, Stefan (2000): Ökonomische Betrachtungen zum Straßenverkehr - Die Modellierung der Verkehrsproblematik in der Bundesrepublik Deutschland, Hamburg, p. 62.

[6] European Parliament (1991): Die gemeinschaftliche Politik im Bereich der Verkehrsinfrastruktur, Brussels, p. 16.

[7] Vickrey, William (1955): Some implications of marginal cost pricing for public utilities, in: American Economic Review, Vol. 45, No. 2, pp. 605-620.

The annual costs for installing and operating TC come to EUR 700 m; 15% of the sum alone will be used for measures to thwart system abusers. The overall costs will be set against estimated annual receipts of close to EUR 3.5 bn.

Flexible ERP allows traffic flows to be controlled more efficiently – with the given infrastructure. This means the system has to include important parallel routes that are subject to congestion in order to avoid evasive reactions. All in all, the possibility of widening the scope of ERP hinges strongly on the investment costs and, in this context, on technological progress. A common standard which allows a system to be built up inexpensively across national borders should greatly foster acceptance in the market.

Owing to Germany's major importance for rapid, time-critical European transit traffic via motorway and trunk routes, that country's choice of a modern electronic tolling system will probably have a strong influence on the pan-European standard. Such an agreement should, when implemented, strongly promote first road pricing and then ultimately telematics.

Telematics – broad field with considerable potential

The term telematics refers to innovative technologies which link information technology and telecommunications applications. Up to now the main area of application has been the transport segment. Thus, the terms road transport informatics (RTI), intelligent vehicle highway systems (IVHS), intelligent transport system (ITS) and telematics are usually used synonymously.

Fundamentally, (transport) telematics breaks down into four fields, i.e. tracking/tracing, navigation/information, traffic avoidance and traffic management. The focus of telematics services differs internationally. In the USA, help facilities for breakdowns and emergencies are considered particularly important, whereas in Asia the focus is more on infotainment. In Europe, the primary goal is to redirect transport flows and utilise the infrastructure more evenly. Currently, this redirecting is done mainly via variable message signs (intelligent signs), radio equipment, mobile communication technology or the internet, with the low operating costs strongly arguing in favour of radio as communication channel. Besides, radio allows the provision of both pre-trip and on-trip information.

Telematics: various building blocks

In Germany, the conventional driver radio information ("Autofahrer Rundfunk Informationen") system offers unsorted information on the radio at fixed times. Owing to the jump in traffic density over time, the system is now considered outmoded. The Radio Data System/Traffic Message Channel (RDS/TMC) upgrades the system and couples digital newsbites with the analogue radio signal. RDS/TMC enables drivers to sort traffic information according to geographical relevance through an individual filter and receive it via display or speech module. The next technology generation, digital audio broadcast (DAB), will make bespoke services available at any time during a trip. Supplementing DAB, digital multimedia broadcasting (DMB) will offer graphically supported information for additional services (e.g. traffic news, tables, schedules).

Apart from radio, the internet provides information on the traffic situation. In this case, information is backed up with graphics. Projects such as KOELNVERKEHR.DE in Germany are currently confined mainly

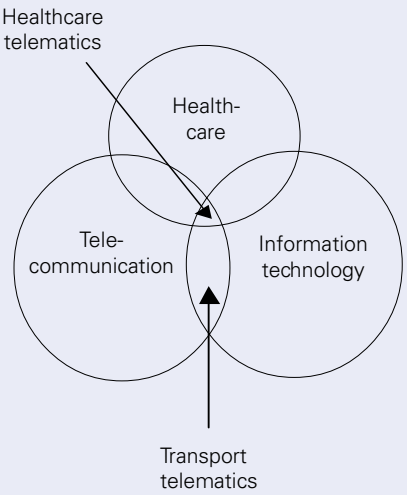
TOLL COLLECT (TC)

TOLL COLLECT invoices truck tolls exactly in line with vehicle characteristics and distance travelled. Using a fully automatic or manual registration procedure, the system guarantees both the one-off user and the multi-user – such as a forwarder with a large truck fleet – simple, coordinated invoicing. The manual variant depends on the internet, call centres and ticket machines, while the fully automatic variant combines the features of mobile communication technology and global positioning system (GPS). For automatic booking, a vehicle needs to be fitted with an electronic transceiver (OBU). Via GPS, the OBU recognises what route the vehicle takes. On a toll road, TC calculates the individually applicable fee on the basis of the number of kilometres driven and specific vehicle data (number of axles, weight, emission class). This information is transmitted to the TC Centre for clearing, where the amount is deducted from the multi-user's account.

For manual registration of one-off users, it is not necessary to have an OBU in the vehicle. Instead, drivers must specify their exact route before setting out and then book it via the internet or call centre. It is also possible to buy single tickets which permit a driver to use a particular section of road.

Additional supplementary services can help forwarding agents monitor the progress of each and every vehicle in their fleets and thus reduce delays in the transport chain.

Telematics segments



Source: BMBWF, 1997

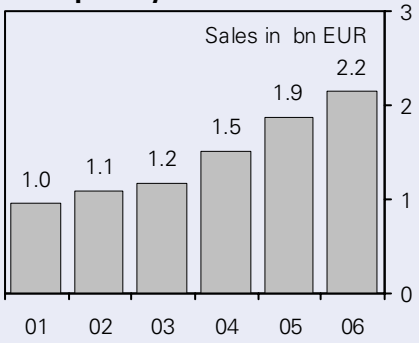
Low operating costs argue for radio

Way of the future: traffic information via internet

to the use of a PC and thus to the information known before a trip starts; so far, drivers are cut off from this channel once they have set out. The goal of obtaining access via mobile terminal (mobile phone, personal digital assistant (PDA)) during a trip is not yet practicable in second-generation (2G) mobile telephony owing to narrow bandwidth and high connection costs.

Germany's Federal Ministry of Education and Research launched an urban mobility programme called Mobilität in Ballungsräumen back in 1998 with the aim of promoting information services to make traffic flows more efficient through the use of modern ICT. Some of the first local projects to get off the ground were CASHCAR (Berlin), INTERMOBIL (Dresden), MOBILIST (Stuttgart), MOBINET (Munich), STADTINFOKÖLN (Cologne) and WAYFLOW (Frankfurt/Main). New-generation systems, such as MOVE or CITY-ON-AIR, include modern navigation and mobile communication systems in addition to sensors along the road to steer the flows.

European market for intelligent transport systems



Source: Frost & Sullivan, 2002

Thanks to the evolution of technology and the decline in system costs, the market opportunities for all-encompassing, flexible traffic management are on the rise. Frost & Sullivan predict that sales of intelligent transport systems will double in the European market between 2002 and 2006, to EUR 2.2 bn (see chart). Further advances in mobile communication technology are likely to lend additional stimuli to modern transport telematics – combining navigation with information on traffic bottlenecks – and to innovative traffic management as a whole.

Mobile telecommunication: a future pillar of telematics

Mobile telecommunication an attractive information channel

With general packet radio service (GPRS) and universal mobile telecommunication systems (UMTS) advancing as the next generations in mobile telephony, the outlook for mobile, location-related telematics services should brighten significantly. Thanks to the option of being permanently online (always-on) for a cheap price, the scope of services will change radically. The pull services common in 2G mobile telephony, in which customers actively call up specific information themselves, will be replaced in the coming generation by push services which automatically feed in user-related information.

Push services replacing pull services

The idea of sending traffic information via short message service (text messaging) to a mobile phone appears promising. This is all the more true since the SMS system, which is confined to 160 simple text characters, will be supplanted by enhanced messaging service (EMS) and/or multimedia messaging service (MMS) in the medium term. These extended options are not restricted solely to simple texts; they can also back up the traffic-relevant information with user-friendly graphics. This will make navigation and detour recommendations much easier to grasp and thus more practical.

Technology makes information easier to grasp

Internationally harmonised mobile frequency ranges and standards will lower the cost of research and development in mobile-supported telematics systems. In Europe, the global system for mobile communication (GSM) has become established as 2G standard; Japan focuses future developments on personal digital cellular (PDC); and the USA has two competing systems: code division multiple access (CDMA) and the US digital cellular system (USDC). For the 3G standard, agreements have been reached on the use of UMTS. This enables development costs to be slashed substantially, further encouraging the use of telematics in practice.

Tracking/tracing and information making headway

Borders between general and individual location tracking becoming blurred

Individual, vehicle-linked mobile systems based on the global positioning system (GPS), GALILEO or cell location in the mobile communication system will increasingly replace fixed road sensors used for the general monitoring of traffic (inductive loops, photoelectric switches). Cell location works on the principle that the mobile phone passes on local coordinates to the central facility even in standby mode. The system is favourable in price but also relatively imprecise, since it initially only determines the coordinates of the active cell. Especially in rural areas, the simple 2G tracking procedure can harbour a degree of imprecision of up to 80 km. Compared with GSM, UMTS needs more intensive cell coverage, i.e. smaller cell sectors. The precision of cell location will rise substantially in tandem with the introduction of 3G.

Mobile telecommunication creating scope for telematics

The US-based GPS service allows objects to be located reliably. The system was deployed for the first time in the 1991 Gulf war and geared primarily to military use. The GALILEO project currently under development in Europe is the strictly civilian counterpart to GPS. The investment being poured into GALILEO is estimated to total almost EUR 4 bn, not including operating costs of EUR 220 m per year. Unlike GPS, GALILEO is not subject to military constraints, so it is more reliable for civilian users and also promises functional precision of down to just a few centimetres.

GALILEO focuses especially on civilian users

For the foreseeable future, telematics will continue to follow a two-pronged approach of very precise satellite-based positioning and cheap cell location. Even though cell location is catching up in terms of precision thanks to the advances in mobile communication technology, telematics will in the medium term continue to use GPS or GALILEO wherever exactness of detail is critical.

Telematics in practical application

Germany's Federal Ministry of Transport, Building and Housing (BMVBW) estimates that adaptive traffic signal controls can reduce trip duration in urban centres at peak hours by up to 6% on average. Fleet-management, information and navigation systems in vehicles can help improve road and rail utilisation for goods transport by 4% by 2010. According to Pauli and Schindler[8] telematics can, under very favourable conditions, reduce traffic bottlenecks by 15%, accidents by 20% and environmental strains by 10%. This is likely to lower the annual costs linked with traffic jams by about EUR 10 bn, accidents EUR 5 bn and environmental protection EUR 1 bn.

German market particularly relevant for telematics applications

Currently, around 60 computerised traffic-flow systems – mainly using intelligent signs – cover just over one-quarter of the German motorway network. In Europe, 1.4 m customers now use telematics services; in the USA the figure is 1.2 m, and in Japan 2.5 m. Owing to the large number of new-vehicle registrations and thanks especially to the large proportion of high-end vehicles, Germany is an extremely attractive telematics market, considerably ahead of Italy, France and the United Kingdom. In the coming five years the number of users should rise noticeably around the globe. Gartner Research says that by then Europe and the USA will boast 20 m customers each, with the figure in Japan coming to 15 m. Today, more than 80% of the global telematics market

[8] Pauli, Bernhard and Thilo Schindler (2001): Telematikdienste - Ein Ausweg aus dem drohenden Verkehrschaos?, TU Munich, mimeo.

focuses on hardware. By the end of the decade the focus will probably shift substantially and the ratio of hardware to services should reach 2:3.

Significant improvement in capacity utilisation in reach

Upgraded speed-regulating systems, such as adaptive cruise control (ACC) or intelligent speed adoption (ISA), which can not only keep a vehicle travelling at a constant speed, but also adjust the pace automatically to the given traffic situation might help drivers decrease the distance required between vehicles while adhering to the same safety requirements. The BMVBW estimates that shortening the distance between vehicles alone could increase capacities on motorways and along main railway corridors in Germany by 10% and 20%, respectively. By 2020, this could probably lower the number of accidents in Germany by a full 36%; in fact, the number of fatal crashes could drop by 58%.

Floating car data system transforms motor vehicle into a bidirectional communication system

In the floating car data system (FCD), a central traffic system sends traffic-relevant data to vehicles, and vice versa. FCD is an intelligent system which learns from past experience and factors not only fleet data but also latest news on construction sites, accidents and other traffic obstructrions into its forecasts and recommendations. Reliable statements on rural traffic will be possible as soon as every fortieth vehicle supports FCD; in urban areas, the ratio has to be ten times higher. If system penetration is at an adequate level, FCD can deliver a more detailed picture of the current traffic situation and road conditions than a purely static measurement network. Since FCD users also feed information into the system, the value of the system grows exponentially with the number of users (network effect). Despite the fundamentally optimistic prospects it remains dubious whether many drivers will relinquish certain liberties in favour of automatic systems such as ACC, ISA or FCD; in other words, whether these systems will enjoy broad acceptance.

So far, no technological standard has been established for telematics services. The agreement in Germany on a modern electronic tolling system should have a strong harmonising effect. After several institutional issues have been settled, the road-pricing technology could easily be upgraded to handle telematics jobs. The coming generations of systems should allow voice recognition, graphics operation and biometric identification for a low price and on a user-friendly basis. The reduced system requirements in cars themselves will slash costs considerably and thus create the basis for volume business in the private and business client segments.

Modern logistics counts on telematics

Reduced system requirements are basis for volume business

The combination of logistics and telematics is gaining importance in the business sector, especially in route planning, tracing/tracing and invoicing. Forwarders increasingly use modern ICT in fleet management. The concept of a central server that is accessible to various forwarding agents for specific basic logistics services is very interesting economically since it significantly reduces equipment costs for the individual users.

Just-in-time transport will play an even bigger role going forward. Inventory structures and distribution runs have to be adapted. In road haulage, many little trucks will replace a smaller number of large ones; physical warehouses will lose their relevance.

Internet-based freight bourses which use modern telematics will help to avoid empty runs. In Germany, the capacity reading for loaded kilometres per truck rose from 71% to 76% between 1995 and 2001 thanks to modern fleet management.

Modern logistics counts on telematics. Ideally, the technology helps people use the specific advantages of each individual means of transport, control traffic flows more efficiently and thus optimise the transport chain.

Railways pushing into the modern transport chain

According to BMVBW calculations, rail transport will increase by about one-fifth in Germany over the next ten years. However, the competitive opportunities open to the railways compared to road traffic are limited for structural reasons. The advantages of the rails lie primarily in bulk point-to-point traffic that can be planned well in advance. Moreover, the European Commission's white paper on transport policy for 2010 criticised the poor market conduct of national railway companies in the Union. It results in the average speed of international rail haulage being 18 km/h, or „slower than an ice-breaker opening up a shipping route through the Baltic Sea"[9].

Therefore, the railways have to prove – especially for time-critical transport needs of modern business – that with new logistics concepts they can supplement road haulage. Deutsche Bahn AG, for example, is currently working on a very innovative project called COLLABORATIVE PLANNING (CP). One of the targets to be achieved by 2003 is to equip about 13,000 freight cars with devices that allow the system to track the location of cars and freight at any time. This will enable cargo traffic to be integrated into the overall transport chain keeping frictional losses as low as possible. The new CP system draws on the strengths of the digital global system for mobile communication for rail (GSM-R) and the GPS navigation system. Via exchanges of information along the value chain, Deutsche Bahn wants to make transport runs plannable on a medium-term horizon and catch up to competing means of transport. However, despite the planned innovative measures it is not very realistic to expect the German rail operator to actually reach a logistics potential comparable to that of road haulage in the next 10 years.

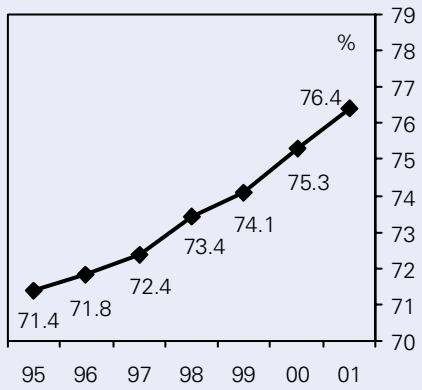
For one thing, the effects of ICT feed through directly to road-traffic volumes via electronic road pricing, telematics and logistics and the technologies can be strategically deployed accordingly. For another, the technologies affect traffic indirectly also via new business fields (e.g. B2B, B2C) and innovative processing forms (e.g. telework, international division of labour via the internet).

E-business still on the starting blocks

In principle, online business encourages the development of global procurement structures. In the globalised world, the average distance that consignments travel is set to rise, boosting total transport volumes on land, at sea and in the air in turn.

However, e-business is still in its infancy around the world. The ratio of B2C to total retail sales is about 1:150 in Germany, and 1:100 in the USA. According to the BMVBW, German mail-order houses – which

Capacity utilisation of trucks in Germany: loaded kilometers

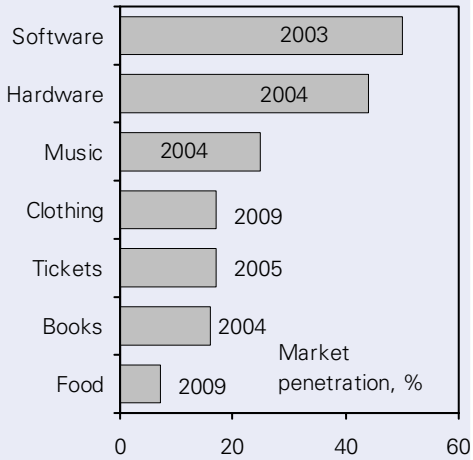


Sources: KBA, BAG, 2002

Simplify integration of railways in the transport chain

Deutsche Bahn wants to make transport runs plannable on medium-term horizon

Maximum share of online sales*), USA



*) Max. penetration will be reached in ...

Source: Forrester Research, 2001

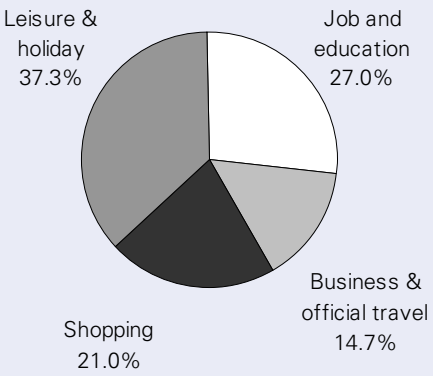
[9] European Commission (2001): European transport policy for 2010 - time to decide, White paper COM 2001/370, Brussels, p. 28.

have welcomed the new distribution channel with open arms – generate only about 0.5% of their total revenues online. Besides, the business deals initiated on the internet are not confined to digital goods, but instead largely involve physical goods. At peak times, the German subsidiary of internet book dealer amazon.com ships up to 100,000 packages every day. The market penetration process evolves very differently depending on the product group. An estimate by Forrester Research indicates that, in the US, the software segment will generate half its total sales online by 2003; by contrast, the food segment will generate only about 7% even in 2009.

The transport infrastructure has to fit the new logistics models. Even though Germany has a very good road network by international standards, the growing number of motorised individuals, the related increase in traffic congestion and the resultant delays in goods deliveries curb not only e-business, but also the overall development of the economy. Up to today, one-fifth of all trips taken by motorised individuals in Germany have traditionally been to go shopping. A significant share of mobility is still attributable to conventional shopping habits. Even though e-business will ultimately have an only small volume impact on overall traffic, transport patterns will shift in the context of both time and geography. This suggests that technology promotes the evolution of the transport sector in quality terms and thus influences the traffic segment in conceptual terms.

Trips by motorised individuals, Germany, 1999

Reason for journey as % of total traffic



Sources: Verkehr in Zahlen 2001/2002, DB Research calculations

E-business demands new logistics concepts

Core criteria: transport network and logistics

Under certain circumstances, ICT will probably reverse retail distribution paths. Especially in conurbations, the customer will no longer have to drive into the city centre to go shopping, but will instead be able to order goods directly for home delivery. In rural areas, however, this service is not very likely to catch on for the foreseeable future. Alternatively, customers could conceivably arrange for delivery to a convenient „pick-point" near their home or to a specific shop for pick-up. Since with the latter options the forwarder does not have to go to the given address more than once in order to meet the customer, this offers considerable savings potential over personal deliveries. Besides first-time deliveries, trips made for returned goods entail major costs for the forwarding companies. Looking specifically at Germany, the right in personal online business to return items at no extra cost increases people's willingness to send them back. The longer it takes for goods to be delivered, the greater the likelihood of their being exchanged, so logistics specialists constantly face a major challenge. A BMVBW study has found that goods ordered and delivered within several hours are practically never returned. Of consignments that are delivered in two days, some 10% are returned; in four days, 25%; and in seven days, some 40%.

Internet business requires optimised logistics

Internet business promises to deliver small batches quickly and reliably to the customer. This is predicated on a well-developed transport network, unhindered traffic and optimised logistics. The job of the logistics operator is to concentrate on the regional distribution of warehouses and pick-points, the optimisation of routing plans, and increasing parcel numbers in the delivery vehicles. The new business model is geared to short response times and intensive service. In the medium to long term, this leads to an increase in the number of customer addresses and a growing volume of traffic in residential areas when the normal working day is over. A network of efficiently spread pick-points mitigates the traffic growth and allows the forwarders to tap considerable efficiency gains.

Opportunities for courier, express and parcel services

Courier, express and parcel (CEP) services are particularly suited to meet the changes in demands.[10] All in all, CEP services handled about 1.4 bn consignments in Germany, for instance, in 2000; they were split between business and private customers in the ratio of 4:3. Nearly 6% of these CEP deliveries were triggered by an order via the internet. Germany's Fraunhofer Institute for Material Flow and Logistics estimates that a tenfold increase in online business in the CEP segment in Germany will entail the deployment of about 8,000 additional trucks. This corresponds to a roughly 50% increase in the CEP fleet, but it will have an only marginal impact given a current total of 4.6 m trucks.

Will telework reduce the volume of traffic?

Indirectly, ICT has an influence on transport development not only via the newly arising business segments, but also via new forms of internal business organisation. These include, in particular, the possibility of using ICT to relocate work processes to places outside traditional plants and offices. Common alternatives are the employee's home, the rolling office with changing locations, and the firm's own outsourced satellite office or the office used jointly by several companies near the employee's home.

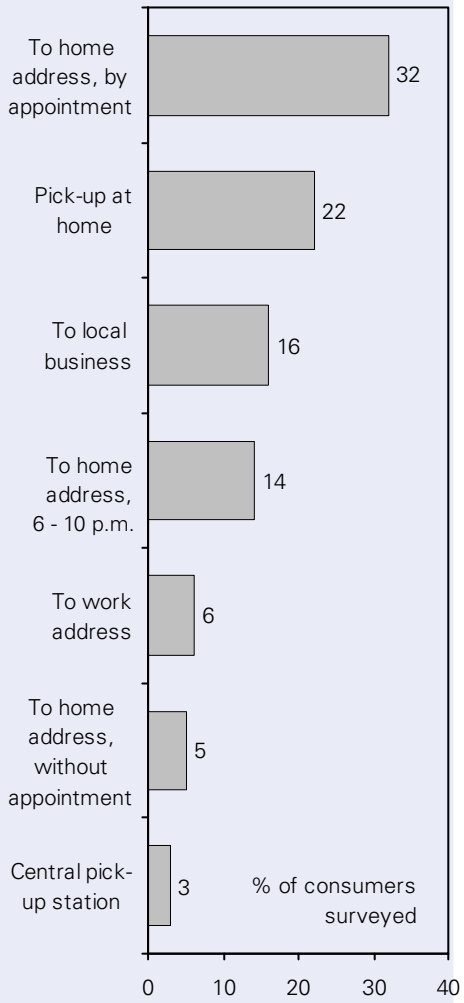
So far, telework has not really caught on very much in Germany. According to the BMVBW, only every seventieth employee is truly a teleworker; in the medium term the ratio is likely to be one in ten. The relevance of the telework concept for transport is limited as only selected employees and fields of activity are suitable for this form of business organisation. Furthermore, telework harbours the risk that the employee will be decoupled from internal work and information flows, i.e. digitally desocialised. Therefore, everyday practice usually sees combined, alternating jobs being set up instead of pure telework jobs, with the employee spending part of the working week at a telework station and part of the week in the office. This organisational practice of alternating jobs limits the mitigating effect of telework on traffic.

Some transport experts have expressed the fear that the job-related travel which disappears thanks to telework will be offset by the ensuing leisure travel. Taking an extreme view, telework could conceivably even encourage an increase in traffic. So far, though, empirical tests have not borne out these presumptions. Teleworkers' contribution to working-day traffic declines by about one-third, with over 550,000 or so telejobs saving 1.5 bn person-kilometres (pkm) in Germany per year. This corresponds to less than 1% of the country's total job-related travel, and only close to 0.2% of traffic as a whole. The traffic-reducing effect of telework is thus pretty low. All the same, it creates scope for traffic flows to be shifted in terms of time and geography. Traffic volume is spread more evenly over the day and the area, ultimately making more efficient use of the infrastructure.

ICT aiming for new transport concepts

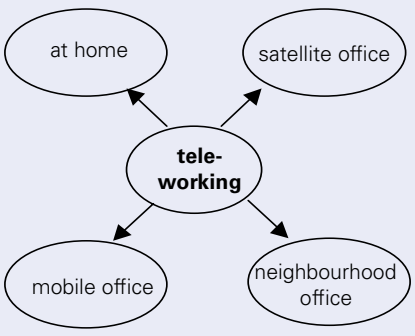
Particularly telematics and flexible electronic road pricing aim primarily at making traffic flow more efficiently in a given infrastructure. Flanking this, logistics is gaining significance for value added and transport development. Modern ICT is increasingly gaining a foothold in traffic management. Future generations of equipment should make operation user-friendly, flexible and inexpensive, and transform the motor vehicle

Delivery conditions desired by customers



Source: BMVBW, 2001

Options for teleworking



Source: Deutsche Bank Research

[10] See Eisenkopf, Alexander et. al. (2002), op. cit., p. 52f.

into a bidirectional information system. Especially the advances in mobile communication technology will pave the way to the mass market for the telematics sector.

Road pricing allows active control of traffic flows

The railways also want to demonstrate that with innovative logistics concepts they can meet the time-critical transport demands of modern business and thus supplement road haulage. Nevertheless, despite their innovative ideas it is not very realistic to expect them to actually achieve a logistics potential in the coming years that would equal that of road haulage.

Traffic flows disappear if digitised goods are channelled to the customer directly via the net

But ICT does not just have a direct impact on traffic. It also has an indirect effect. The virtual world gives rise to new business fields and innovative processing forms which also affect transport development. However, even with modern ICT, e-business will only cause traffic flows to disappear and not be replaced if digitised goods, such as tickets, software, music and information, are channelled to the customer directly via the communication network. The business deals initiated on the internet are not, however, confined to digital goods, but instead largely involve physical goods. Therefore, e-business has at most a peripheral effect on traffic volumes.

ICT plays a supplementary role in traffic management

Information and communication technologies affect traffic volumes through various channels, but trigger only fairly small quantitative effects. E-business and telework have a much smaller effect on traffic than widely expected. The influence of general economic growth on traffic exceeds the influence of ICT by a significant degree. All the same, technological progress drives the evolution of the traffic segment in terms of quality and taps important potential ways to use the transport infrastructure more efficiently. ERP, telematics and logistics create considerable stimuli, and the coming generation of mobile communication technology with UMTS will lend additional impetus to the trend. ICT helps in organising traffic flows more efficiently. The technology plays a supplementary role as traffic-relevant instrument, but is not a panacea for traffic congestion.

Stefan Heng, + 49 69 910-31774 (stefan.heng@db.com)

Printed by: HST Offsetdruck Schadt & Tetzlaff GbR, Dieburg.
ISSN Print: 1619-3245