Ceres Logistics
20 Queen Street, Maidenhead, SL6 1HZ

ROAD CONGESTION

BACKGROUND

Congestion is a condition for which there are few participating volunteers; indeed many people and organisations go to extraordinary lengths in time and distance to avoid it. Congestion can cause significant costs to businesses. Moreover, because congestion is predicted by the Government to worsen in the future, consequential costs will rise accordingly.

Costs directly attributable to congestion are difficult to calculate since the cost basis is, in itself, imprecise and dynamic in response to external influences, for example, fuel costs, wage rates, government policy, etc. The time and cost consequences of congestion also have to be considered in conjunction with additional future time costs that will be imposed by the Working Time Directive (WTD) and other measures that the Government are considering, for example extending congestion charging.

Congestion may be described as the build up of queues and delays that occur generally when the volume of traffic trying to use a road link or junction approaches or exceeds its effective capacity. In such circumstances each additional vehicle causes delays to other vehicles and suffers, in turn, from a slower and less productive journey.

Traffic congestion is a non-linear function. When roads are congested, a small reduction in traffic can provide a relatively large reduction in delays. Conversely, minor incidents that would otherwise be insignificant can cause widespread and prolonged disruption.

The DfT Transport Trends for 2002 reported upon peoples' perceptions, attitudes to congestion and how it is expressed (DfT, 2002). They reported the answer to the question 'What is congestion?' as follows:

Stop-start conditions	38%
Traffic jam with complete stops of 5+ minutes at a time	24%
Moving very slowly at less than 10mph	17%
Having to travel at less than the speed limit	19%

Clearly, defining congestion is subjective, though these results tend to suggest that congestion is anything less than free flow conditions.

Because each vehicle on a congested road both imposes and suffers from the impacts of that congestion, there are two types of costs involved. Firstly, the internal costs that are borne by the road user. Secondly, the external costs that a vehicle imposes through wider social and environmental impacts.

INTERNAL COSTS

Internal costs are those affecting vehicle operators. Congestion affects operator costs on a number of strategic, tactical and operational levels.

Strategic

Forecasting and planning, fleet size and utilisation, standing costs, number of drivers, driver shortage, driver training, opportunity costs of delay (missed/lost business), cost consequences of government policy, implications of WTD.

Tactical

Time allowances for congestion, re-scheduling vehicles and drivers, meeting immediate customer requirements, return load opportunities, vehicle utilisation, number of stops per trip, customer perceptions.

Operational

Wasted time, wasted drivers wages, wasted fuel, late and missed deliveries, missed second delivery time, overtime, hot planning and fire-fighting problems, drivers hours concerns.

For each journey, operator costs can be expressed in a relatively simple matrix equation for a journey:

$$\text{Operator cost}_{ij} = (\text{value of time. time}_{ij}) + (\text{vehicle operating costs. Dist}_{ij})$$

Although the equation above is essentially straightforward, getting at the precise figure for the value of time (V_t) and vehicle operating costs (V_c) is not at all straightforward. As McKinnon (1998) has pointed out in a study: *"most companies were unable to quantify the indirect costs of congestion because of the problems of:*

- *Separating the effects of congestion from other schedule 'disturbances';*
- *Allowing for variations in logistical process times; and,*
- *Establishing the importance attached to congestion in investment decisions."*

Value of Time

From the above, V_t is clearly an important parameter in understanding and calculating the internal costs of congestion. The problem is that:

- It is not easily identified by operators because, for a variety of reasons, allowances are already made to ensure that delivery is undertaken to achieve customer requirements, i.e. congestion effects are already inherently included in

cost calculations. Consequently, future journey times will be difficult to calculate for the WTD and other consequences.

- Vehicles will not always be constrained by a traffic build-up or be present at specific peak times. On the basis of probability, however, longer journeys are more likely to be affected.

- Congestion is highly situation specific; delay caused on journeys at different times also includes different places. Trafficmaster evidence this point effectively with their quarterly statistics on traffic movement and the differences in nodal point time delays.[1]

  For example, in November 2001, Trafficmaster (using their nationwide network of sensors) measured twenty motorway journeys at normal and peak times. They found that the increase in journey time at peak periods ranged from 68% – 265% greater than at normal times, with an average of 142%. They monitored nine key motorway routes that showed 268 accidents or incidents directly causing 402 hours of congestion during the month.

- It is not possible until after the event to calculate lost revenue, missed opportunities due to the forced inactivity of vehicles and transport staff that may arise because of congestion. As a contributory cause, congestion is likely to be a factor, but in combination with other failures it is difficult to discern specifically.

The V_t is clearly an important factor in the overall cost of congestion, but is difficult to calculate in a generic example. Our model calibrates future increases in congestion by assessing reduced productivity. It is, however, entirely possible to incorporate real congestion considerations within the model when calibrated with empirical data.

Given that congestion will rise by between 11-21% by Government calculations (DfT, 2003a), even if all the 10 Year Plan measures are introduced (which seems unlikely), there will be an increasing cost arising from congestion.

Vehicle Operating Costs

V_c are calculated in a variety of ways because of the difference in types of vehicle purchase/lease and what is to be included in generic cost headings, such as accidents, which may or may not be reported as such but are included as repair and maintenance. Industry standard operating costs generally include time related costs per annum and mileage related costs. Generalised costs such as bonuses, subsistence allowances, excess hours or any other inducement to retain drivers and optimise their productivity are not included.

If congestion were eliminated, McKinnon (1998) points out that the impact on V_c has contrasting results. It cannot necessarily be assumed that any time saved in not being in

[1] Available through http://www.trafficmaster.co.uk, accessed on 24 November 2003.

congestion can necessarily be productively utilised, since vehicles stand still for much of the day. Against this, however, are the opportunity costs of a reduction in vehicle load factors, for example, not being able to collect a return load, general reduction in average speed, delay in unloading, etc. Delay will certainly impact upon customer service and persistent delay may result in losing a contract.

McKinnon also points out that:

> "*All of these effects result in under-utilisation of the vehicle capacity, which is not captured by conventional cost models. By confining their attention to vehicle running time on the road network, they fail to consider the overall size and utilisation of the vehicle fleet and standing charges, which lorries incur when not actually travelling. The level of traffic congestion can have an indirect effect on these 'off-road' operating costs. No attempt has yet been made to assess the magnitude of these indirect, vehicle related costs*".

Transport operators generally have a clear understanding of the basic costs outlined above, but not always of the consequential or opportunity costs. This is because the additional costs of missed business and additional scheduling costs are exceedingly difficult and time consuming to calculate.

The FTA believe that for a fleet of 10 trucks, congestion could result in extra costs of £80,000 a year as a consequence of reduced efficiency, increased journey times and extra mileage and the need for scheduling extra vehicles.[2]

EXTERNAL COSTS

The external costs that a vehicle imposes on other road users from congestion are now further investigated.

Various methods have been used to quantify the social and environmental costs of congestion, but in order to do so it is necessary to come to some initial quantification of congestion as a whole, for example:

- Calculate the marginal delay caused by an additional vehicle entering the traffic stream, taking into account the speed-flow relationship of each road segment;
- Determine the user fee needed to reduce demand to design capacity, which reflects road users' willingness to pay for road use;
- Calculate unit costs of current expenditure on congestion reduction measures; and,
- Calculate the difference in costs between the level of costs corresponding to actual speeds and the level of costs corresponding to free-flow speeds.

[2] Comments made by John Allan, President of the FTA, speaking at the Institute of Logistics and Transport Kinnock Lecture 2003.

The first three methods are essentially economic approaches and theoretically should produce similar results.

The last method, however, requires an engineering approach that more closely corresponds with the approach adopted by the DfT.

The DfT measures congestion by the difference between the travel times given by 'actual' travel times with 'free flow' travel times. The 'free flow time' is the speed achieved if all traffic travelled at or close to the maximum design speed of the road.

However, it has been suggested that this method may be limited, in that, "*if all vehicles could achieve a free-flow speed on all roads at all times there would be a tremendously costly over provision of road space*" (Santos, 2000).

Social Impacts of Congestion

There have been a number of attempts to quantify the full social cost of congestion. The most often quoted figure is the Confederation of Business Industry's (CBI) cost of £20 billion to the UK economy from all road users. This calculation is based upon research undertaken in France (Bouladon, 1991; and Quinet, 1994), which suggested that congestion costs were 3.2% of GDP in the UK. Research by Newbery (1995) tended to support this figure with an estimate of £19.1 billion.

In more recent studies, Dodgson and Lane (1997) give an estimate for England of £6.9 billion (at 1996 prices), and that congestion related delays for HGVs and vans cost £1.2 billion.

Black (1998) derived a similar estimate of £6.1 billion for goods vehicles. Both of these studies used a different methodology from that used to calculate the CBI's £20 billion.

Trafficmaster (1996), using their nationwide network of sensors, calculated congestion costs in England for the fourth quarter of 1996 as £2.1 billion, including wasted time, extra fuel, missed deliveries and higher maintenance costs.

With such a range in the cost estimates of congestion, it is not unreasonable for the Parliamentary Select Committee on Transport (2003), when commenting upon the 10 Year Transport Strategy to suggest to the Government that:

> "*We were disappointed to find that there are still no official estimates of the cost of congestion nor its impact on economic growth*".

The Governments response was:

> "*…we do not consider that a single monetary figure for the country as a whole is the best way of illustrating the impact of congestion, nor that a study of the impact is, in itself, a high priority for research*" (DfT, 2003b).

Revised government estimates show that across the UK road network, congestion is forecast to increase by between 11 and 20%, even if all the measures in the 10 Year Plan are put in place. The Secretary of State set out, in a statement to Parliament the reasons for the additional congestion:

> "*the latest analysis shows that there was more traffic in 2000 than had been thought. That, coupled with the fact that economic growth over the next 10 years is forecast to be higher than anticipated, means that the forecasts made two years ago almost certainly underestimate the amount of congestion we face*".

The Government also pointed out in the report, "Delivering Better Transport: Progress Report" (DfT, 2003a), that the latest forecasts suggest that current measures:

> *"may not be sufficient to secure a return to 2000 levels in large urban areas and on inter-urban roads by 2010".*

Whilst there are significant differences between evaluations of the external cost of transport, these seem to be more concerned with difficulties in translating social and environmental issues into a monetary value, rather than the estimation of social and environmental impacts themselves.

What is clear is that the effects from congestion will increase and consequently, so will their social and environmental impacts.

On a disaggregated level Sansom *et al.* (2001), distinguish congestion by road type, estimating low and high Marginal External Costs of Congestion, as shown below in Table 1.

Road Type	Proportion of vehicle miles	Low	High
Motorway	17%	£0.23	£0.23
Urban central peak	1%	£1.52	£1.52
Urban central off-peak	3%	£0.83	£0.84
Urban non-central peak	4%	£0.41	£0.43
Urban non-central off-peak	8%	£0.20	£0.24
Other Urban peak	7%	£0.08	£0.15
Other Urban off peak	15%	£0.01	£0.09
Rural trunk/principal	30%	£0.16	£0.16
Other rural	16%	£0.02	£0.05

Table 1: High and low estimates of the marginal cost of congestion for different road types, averaged for all vehicle mileage (£ per mile at 2003 prices). Source: Sansom *et al.,* 2001.
Notes: Major urban areas refer to London and conurbations.

Sansom *et al.,* note that the high and low estimates do not cover the full range of values that would have been produced under more comprehensive sensitivity testing.

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