The Impact of Traffic Congestion on Logistical Efficiency

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EXECUTIVE SUMMARY

The Government predicts that the total volume of traffic on Britain’s roads will increase by 28% by 2011 and 60% by 2031. These forecasts assume that there will be little further expansion of road capacity and allow for the inhibiting effect of congestion on future traffic growth. The level of congestion is expected to increase sharply; approximately doubling on the motorway network by 2007.

Much of the previous research on traffic congestion has focused on its direct costs to road users. This study has made a broader assessment of its effects on the efficiency of logistical operations. Detailed discussions were held with managers in seven distribution centres to find out how congestion is impacting on the efficiency of their internal operations and how companies are responding.

The report begins by reviewing previous estimates of the cost of traffic congestion to road freight transport in the UK. One of the most authoritative studies suggests that it is in the region of £1.2 billion per annum. The estimation of vehicle operating costs has been fairly crude, however, and is unlikely to provide an accurate estimate of the true opportunity cost of congestion-related delays.

Delays to freight traffic increase the amount of inventory in transit on the road network. An ‘order-of-magnitude’ analysis of the possible impact of congestion on in-transit inventory levels indicates that this is likely to be a minor item in the congestion cost calculation.

The indirect effect of congestion on the efficiency of logistical operations at both ends of the journey are likely to be much larger, but are very difficult to quantify. Previous attempts to measure these indirect costs have relied heavily on managers’ monetary valuation of ‘additional scheduling costs’ and ‘journey reliability’. The approach adopted by this study involved in-depth discussions with distribution managers who have to deal with the consequences of congestion on a daily basis.

The main objectives of the project were to assess the relative impact of congestion on internal warehouse operations, examine the ways in which firms are modifying these operations to minimise the effects of congestion and to try to establish a method of quantifying the associated costs.

It proved difficult to isolate the effects of congestion from other disturbances to companies’ logistical schedules. Congestion-related delays were often amplified by booking-in systems and most disruptive when the distribution centres were working close to full capacity. Only two of the distribution centres suffered significant disruption as a result of congestion. In the others, congestion-related delays were relatively infrequent and could generally be accommodated within normal work schedules.

The study distinguishes regular delays from major congestion incidents and differentiates several degrees of disruption in terms of their resource implications and the consequences for activities further down the supply chain. Most delays were relatively short and could be buffered within the warehouse with minimum additional resource expenditure. The most vulnerable operations were cross-docking operations carried out within a 2-3 hour time frame. Short-term redeployment of staff from other activities could usually recover the situation,
though the most seriously affected companies incurred higher overtime costs. Where this involved temporarily suspending the ‘put-away’ operation, lack of space was sometimes a problem.

Most companies were unable to quantify the effects of congestion on warehouse operating costs, though indicated that they would be relatively weak. Congestion appeared to be having little or no influence on inventory levels and were only marginally inflating labour costs. It had so far had little bearing on companies investment decisions in the areas of materials handling and IT. There is, nevertheless, evidence of firms attaching growing importance to congestion in the strategic planning of distribution systems, with some companies seriously considering an increase in depot numbers.

It will be very difficult to quantify the indirect costs of congestion because of the problems of (i) separating the effects of congestion from other schedule ‘disturbances’ (ii) allowing for variations in logistical process times and (iii) establishing the amount of importance attached to congestion in investment decisions.

This study was based on a very small sample of distribution centres in the fast-moving-consumer-goods sector. The empirical base was too narrow to permit wider generalisation. There is a need to extend the work across a larger and more varied sample of logistical operations and to supplement interviews with direct observation and measurement. This, combined with further refinement to the methods of calculating vehicle operating and in-transit inventory costs, would form the basis of a more accurate and comprehensive assessment of the logistical costs of traffic congestion.
1. Scale of the Congestion Problem

Statistics on traffic congestion make grim reading. The AA’s Roadwatch system, which observes traffic flow across the UK road network, recorded around 350,000 congestion incidents in 1997, each of which took an average of 1 ½ hours to clear [1]. In addition to these ‘incidents’ which cause one-off delays, the gradual increase in traffic density is reducing average speeds and lengthening average transit times. This is reflected in the definition of congestion employed by Trafficmaster whose 2500 infra-red scanners constantly monitor traffic flow on the motorway and trunk road network. According to its calculations, congestion on the British motorway network was 19.3% worse in the first quarter of 1998 than in 1990 [2]. It has predicted that, in the absence of any major transport policy initiatives, the level of congestion will rise by 40% above the 1990 level by 2007 and 120% above it by 2017 (Figure 1.1).

Figure 1.1: Forecast Growth of Traffic Congestion on the Motorway Network

![Congestion on the UK Motorway Network](image)

Source: Trafficmaster. (ref. 2)

This prediction was based on the assumption that the capacity of the trunk road network would increase only marginally, despite the steep growth in traffic anticipated by the government’s National Road Traffic Forecasts (NRTF). The latest NRTF published in
October last year, predict that the total volume of traffic will grow by 28% by 2011 and 60% by 2031 [3]. For the first time, these forecasts were based on the assumption that the capacity of the road network would remain largely unchanged and made allowance for the dampening effect of increasing congestion on traffic growth. So-called ‘stress maps’ compiled on the basis of government traffic forecasts show large stretches of the trunk road network subject to chronic congestion within ten years (Figure 1.2).

Figure 1.2: Forecast Congestion on the Trunk Road Network in 2016.

Source: Department of the Environment, Transport and the Regions.

It is worth noting that the latest NRTF predict that articulated lorries will be the fastest growing category of traffic over the period 1996 -2011, experiencing a 46% increase by comparison with an overall growth in traffic of 28% (Figure 1.3). As lorries represent only around 7% of all road traffic (17% on a PCU\(^1\) equivalent basis), however, their net contribution to overall traffic growth is relatively small. By far the main contributor to traffic growth and hence congestion is the private car. Freight traffic is arguably more a victim of traffic congestion than a cause. This was the view expressed by a group of 42 logistics specialists interviewed by Browne and Allen in 1997 [4]. When asked to what extent goods vehicle contribute to road congestion, 56% of them responded ‘a little’ and a further 26% ‘not at all’.

\(^1\) PCU passenger car unit. Vehicle dimensions are typically expressed in terms of this standard unit.
The main cause of congestion incidents is traffic accidents. AA Roadwatch estimates that accidents (including overturned vehicles) are responsible for around 15% of these incidents. Lorries are directly involved in a very small percentage of these accidents, only 2.7% in the first three quarters of 1997. Accidents involving HGVs are generally more serious, however, and cause much longer delays. Accidents involving lorries, for example, accounted for roughly 20% of the worst 240 traffic jams across the UK between January and September 1997.

Goodwin, nevertheless, observes that ‘the underlying cause of congestion is not roadworks or taxis or accidents: it is trying to operate with traffic flows too close to the capacity of the network, when any of these transient incidents will have a disproportionate effect’ [5]. It is often argued in logistics circles that, as cars account for around 80% of all road traffic, efforts to relieve these pressures should be targeted on private motoring. The Road Haulage Association, for example, has argued that ‘what is needed is an urgent increase in the
proportion of existing public expenditure allocated to our public transport system, and other areas of our transport network, measures aimed at clearly distinguishing between essential commercial traffic and unnecessary social car use’ [6].

Recent surveys have revealed increasing concern among managers about the adverse effects of congestion on economic efficiency and competitiveness. For instance, a survey of 102 managers in 90 firms in the grocery sector found road congestion to be the ‘external issue’ which had by far the greatest impact on the ‘overall grocery supply chain’ [7]. In its recent White Paper on transport [8], the government acknowledges that, ‘Congestion and unreliability of journeys add to the costs of business, undermining competitiveness, particularly in our towns and cities where traffic is worst.’

This report assesses the effects of traffic congestion on the logistical system. It begins by reviewing previous research on the direct, ‘on-the-road’ costs of congestion and then considers its indirect effects on the efficiency of logistical operations. This assessment of the indirect effects is based on a detailed survey of the operations of seven distribution centres in the spring of 1998.
2. Direct Cost of Congestion to Road Users

2.1 Macro-level Assessments of Congestion Cost

Several attempts have been made to quantify the economic cost of traffic congestion to the nation. Most have been concerned solely with the additional cost that it imposes on road users while they are actually travelling on-the-road network. The most widely quoted estimate of this type is a figure of £15 billion originally presented by the CBI in a report back in 1989 [9], but cited once again in the recent transport White Paper. Seldom can such a widely publicised statistic have had such a flimsy empirical basis. It is derived from a fairly simplistic piece of research undertaken in France in the late 1970s which calculated, very crudely, that the total time lost by road users as a result of congestion was valued at 2.6-3.1% of GNP. CBI researchers at the time took the liberty of applying this percentage to Britain’s GNP to arrive at the £15 billion figure. This has since been raised in line with inflation to around £20 billion. Newbery provides some corroboration for this figure [10]. Using UK traffic and cost data for 1993-4, he obtained a congestion cost estimate of £19.1 billion, very similar to the CBI figure.

Goodwin, on the other hand, has described the CBI figure as a ‘convenient and consensual fiction’ and ‘a precise answer to a phantom equation’ [11]. A senior official in the Department of the Environment, Transport and the Regions (DETR) claims that it is a ‘substantial over-estimate’. According to his calculations, if the CBI figure were accurate, eliminating traffic congestion would make every road journey 50% faster [12]. This is clearly implausible. Furthermore, contrary to press claims, the estimates of £15-20 billion do not relate solely to UK industry, but include delays to all forms of personal travel on-the-road network. Newbery applies a congestion cost figure of 4.18 pence per passenger car unit (pcu) kilometre averaged across all categories of traffic, defining a lorry as equivalent to two and half cars.

Two more recent studies, by National Economic Research Associates (NERA) [13] and Black [14], have employed a different methodology and yielded much lower estimates of total congestion costs. Their estimates of, respectively £6.9 billion and £6.2 billion are very similar. These studies have also, for the first time, disaggregated congestion costs by vehicle type, making it possible to isolate those costs associated with freight movement. According to NERA, for example, congestion-related delays to lorries and small vans cost £1.2 billion in 1996, roughly 17% of the total. While this figure is much lower than those of the CBI and Newbery, it still represents a substantial waste of resources.

According to NERA, over 90% of these freight-related congestion costs are incurred in urban areas and two-thirds of them by small vans. Less than 1% of the costs are attributable to
delays on motorways. Articulated lorry traffic accounts for only 8% of the congestion costs borne by commercial vehicle traffic and 92% of these costs are incurred on urban roads.

Given the widely differing estimates of the cost of traffic congestion in the UK, one might expect the government to step in, undertake an authoritative study and resolve the matter once and for all. In the Netherlands, for example, the government employs consultants to make annual estimates of congestion costs on the motorway network. The Department of Transport in the UK, however, has ‘devoted little research effort to this question’ partly because of the difficulty of establishing a ‘clear counterfactual against which to measure congestion’, but also because ‘even if a basis for measuring congestion could be agreed, it is doubtful that it would serve any useful purpose.’ Congestion, after all, ‘is not necessarily inefficient: queues perform an efficient function when increases in supply or other methods of allocating resources, such as congestion charging, are infeasible or more costly than the costs involved in queuing’. 7

Several reasons can be advanced, however, for improving our understanding of the economics of congestion, particularly as it relates to freight transport. First, as congestion cost estimates are frequently quoted and central to the debate on transport policy, it essential that their validity is tested. Second, congestion costs are likely to distort logistical cost trade-offs and thus influence the future structure and operation of logistical systems. Third, in assessing the cost-effectiveness of policies designed to relieve congestion, it is important to have an accurate measure of the scale of the problem.

2.2 The Estimation of Vehicle Operating Costs

A key element in the calculation of congestion costs is the valuation of vehicle operating costs on an hourly basis. 8 When vehicles are stationary in traffic jams or moving below their ‘free-flow’ speed, their operating costs per km are inflated. Drivers’ time is wasted, more fuel is consumed per km travelled and the vehicle asset is under-utilised.

Previous congestion cost studies have used widely varying operating cost estimates. Trafficmaster, for example, in calculating the cost of congestion on the UK motorway network, uses a figure of £80 per hour. NERA, on the other hand, uses the official estimates quoted in the DETR’s Highway Evaluation manual which are around a quarter of this figure. This latter figure is broadly in line with other industry estimates [15] and with the results of ‘stated preference’ research on the value of time for freight vehicles. The hourly rate comprises labour costs and what the DETR calls other ‘resource values of time per vehicle’.

This use of average vehicle operating costs in this context is an over-simplification. In some respects it is likely to exaggerate the transport cost penalty, while in others it is likely to have
the opposite effect. It is assumed, for instance, that if congestion were eliminated, companies would be able to use productively all the vehicle time saved. In reality this over-estimates the true opportunity cost of congestion to lorry traffic as many vehicles stand idle for much of the day. An audit of tractor utilisation by one large logistics company revealed that the average tractor unit was only employed on revenue-earning work for around 44% of the typical working day. A similar audit of the activities of 1300 refrigerated trailers operated by a mixed sample of retailers, manufacturers and logistics service firms over a 48 hour period found that they were empty and stationary for roughly 29% of the time [16] (Table 2.1).

Against this over-estimation of time-based opportunity costs must be set the probable under-estimation of efficiency losses from a reduction in vehicle load factors. Congestion can depress load factors in several ways:

- It can reduce the time available to collect a return load and hence increase the amount of empty running.

- As average speed diminishes on congested roads, fewer drops and/or collections can be made on each delivery round reducing the degree of load consolidation.

- Goods arriving late at a DC because of congestion may not be cross-docked in time for onward distribution with the result that outbound vehicles leave more lightly loaded.

- As journey time reliability declines some companies may enlarge their fleets as a contingency measure to ensure that they have enough vehicle capacity available at all times to meet customer needs.

All of these effects result in an under-utilisation of vehicle capacity which is not captured by conventional congestion 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 the standing charges which lorries incur when not actually travelling. The level of traffic congestion can have an indirect effect on these ‘off-the-road’ operating costs. No attempt has yet been made to assess the magnitude of these indirect, vehicle-related costs.

<table>
<thead>
<tr>
<th>Activity</th>
<th>% of time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 2.1: Utilisation of Refrigerated Trailer Fleets over 48 Hour Period.</td>
<td></td>
</tr>
<tr>
<td>Status</td>
<td>Percentage</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Empty and stationary</td>
<td>29%</td>
</tr>
<tr>
<td>Running on the road</td>
<td>25%</td>
</tr>
<tr>
<td>Being loaded / unloaded</td>
<td>19%</td>
</tr>
<tr>
<td>Loaded and inactive</td>
<td>18%</td>
</tr>
<tr>
<td>Undergoing maintenance / repair</td>
<td>5%</td>
</tr>
<tr>
<td>On the road driver rest period</td>
<td>4%</td>
</tr>
</tbody>
</table>

Source: Energy Efficiency Best Practice Programme.

Previous congestion cost calculations have also excluded two other logistics-related costs: in-transit inventory costs and the indirect costs incurred at industrial and distribution premises.
3. Effect of Congestion on In-transit Inventory Costs

At any given time there is large amount of inventory being carried on road vehicles. If these vehicles travel more slowly or are delayed the total quantity of in-transit inventory increases and with it the corresponding stockholding costs. It is very difficult to estimate the total value of in-transit inventory, as official surveys measure freight only in weight terms. Available data on value-density, derived mainly from trade statistics, suggests that the average tonne of road freight is worth around £1300 [17]. As the average consignment moves around 90 kms [18] over a period of 1 ½ hours, this suggests that at any given time there is around £350 million of inventory being moved on-the-road network, incurring an annual stockholding cost of £35 million (assuming an annual interest rate of 10%). If, because of congestion, the average freight journey were delayed by 10 minutes, the in-transit inventory would rise by approximately £40 million and annual stockholding costs by £4 million (Figure 3.1). Allowing for the fact that these are merely ‘order-of-magnitude’ calculations, the latter figure is fairly negligible when set against estimates of the effects of congestion on vehicle operating costs. This is confirmed by Black [19], who has estimated that ‘in-transit inventory costs do not amount to more than 1 or 2 ecu per hour even for the most valuable cargo’. It is also possible that, in reality, there would be no net increase in inventory. If inventory spends more time in-transit it might simply spend less time at the warehouse, factory or shop.

Figure 3.1: Value and Cost of In-transit Inventory

- **Average Value Density**: £1300 / tonne
- **Average length of haul**: 90 kms
- **Average speed**: 60 km / hr
- **Total Road Tonne - Kms**: 150 billion
- **Total value of in-transit inventory**: £350 million
- **Annual interest rate**: 10%
- **In-transit inventory cost**: £35 million
- **Additional cost of 10 min delay**: £ 4 million /annum
4. Indirect Costs at Industrial / Distribution Premises

The cost of congestion is not confined to the road network. The late arrival of supplies at factories, warehouses and shops can also impair their operating efficiency and sales performance. Very little research has so far been done on these ‘indirect’ or ‘consequential’ costs of traffic congestion. These costs are inversely related to the reliability of the transport operation which diminishes as the density of traffic increases.

4.1 Evaluating the Indirect Costs

Three approaches have so far been adopted to assessing the value of the indirect cost of congestion to logistical operations:

(i) Assessment of the total cost of congestion-related delays and value-of-time for freight

The approach was adopted recently in a study undertaken by the Hague Consulting Group (HCG) for the International Road Transport Union (IRU) [20]. This work was undertaken in the UK, France, Poland and the Czech Republic. Managers in a small sample of firms were asked to estimate the magnitude and cost of delays caused by road congestion. In the UK, congestion was found to be by far the most important of six types of impediment to road freight movement, congestion-related delays accounting for approximately 5% of total transit time\(^2\). The total cost of these delays was evaluated in terms ‘lost revenue, including missed opportunities, due to the forced inactivity of vehicles and transport staff’. Fewer than half the firms consulted were able to provide this data. Previous research by HCG had established ‘value-of-time’ measures for freight traffic which comprised estimates not only of vehicle operating costs but also of the value of inventory in transit. The total cost of congestion-related delays was found to be 2.2 times higher than the previously estimated value-of-time figures. This differential was taken to be a measure of the ‘additional costs of missed business opportunities and estimates of additional scheduling costs, which are not considered explicitly in the value-of-time figures.’

Despite the very small sample size, the lack of stratification and uncertainty about the accuracy of the company responses, the consultants grossed up the survey data to arrive at an estimate of approximately £1.3 billion for the total (freight-related) cost of congestion to business, of which roughly £600 million was attributable to higher ‘on-the-road costs’ of vehicle operation and in-transit inventory. The remaining £700 million represented the indirect costs to the business. This research suggested therefore that indirect costs of congestion exceed the direct costs. The authors emphasise, however, that given the limited

\(^2\) The other five ‘impediments’ were speed restrictions, strikes / blockades, traffic bans, border delays and ‘other delays’.
survey coverage, ‘the results should be taken as general trends or indicators rather than statistically significant findings.’

(ii) Valuation of Delivery Reliability
The indirect costs of traffic congestion are largely associated with unreliability, in contrast to the direct, ‘on-the-road’ costs which are essentially a function of average transit time. By asking firms to attach a monetary value to reliability, it should be possible to gain an indication of the indirect costs of congestion. This approach was adopted by a Dutch study which investigated the case for freight-only lanes on motorways [21]. A sample of 230 hauliers and shippers who regularly used congested sections of motorways were asked to place a monetary value on reliability. Analysis of their responses suggested that unreliability added between 8% and 11% to the direct costs of congestion. If the results of this research were extrapolated to the UK and linked with the NERA data, it would value the indirect freight-related costs of congestion at between £96 million and £132 million, well below the HCG estimate.

The main problem with approaches (i) and (ii) is that they assume managers have sufficient information at their disposal to provide accurate estimates of congestion-related costs. In practice few firms have internal monitoring and cost accounting systems which can readily furnish them with such information. In the absence of this data, there is inevitably a tendency to make crude ‘guesstimates’. These subjective judgements can be distorted in several ways:

a) There is the tendency to use congestion as a handy excuse for a late delivery even where the main problem lies elsewhere.

b) Even when congestion is not simply being used as a ‘scapegoat’, it is still very hard to separate its effects from all the other causes of delay.

c) Logistics managers’ perception of the congestion problem can be coloured as much by their experience as car drivers as by its impact on the efficiency of their freight transport operations.

d) Where the respondents are senior managers, possibly at head office, they may not have close experience of the day-to-day operational problems caused by traffic congestion. Our research suggests that perceptions of the nature and scale of the congestion problem vary between staff at different managerial levels and with different functional responsibilities.

e) Operations managers take pride in their ability to cope with difficult circumstances and are sometimes reluctant to admit that congestion is adversely affecting performance.
One possible way of overcoming these problems is to hold in-depth discussions with logistics managers who have to deal on a day-to-day basis with the consequences of traffic congestion. This ‘exploratory’ approach is outlined in the next section.

**(iii) Investigation of the Consequences of Congestion through In-depth Interviews.**
This approach was adopted in an assessment of the effects of traffic congestion on seven distribution centres (DCs) handling a broad range of fast-moving consumer goods (FMCG). These DCs were located along a corridor extending from South Yorkshire to Hampshire, which contains some of the most heavily congested sections of the UK road network. The DCs varied widely in the nature of products handled, areas served, patterns of inbound and outbound delivery, degree of cross-docking and type of operator (Table 4.1). Detailed interviews were held with an average of three managers in each in DC, in most cases the general manager and managers responsible for the warehousing and transport operations. A total of twenty-three managers were consulted. The main aims of this work were to:

1. Measure the relative impact of congestion-related delays on internal operations.

2. Assess the extent to which firms had to modify their operations as a result of congestion.

3. Consider how this information might be used to measure the indirect costs of congestion.

**Table 4.1: Composition of the Sample**

<table>
<thead>
<tr>
<th>Function</th>
<th>Product type</th>
<th>Area served</th>
<th>Degree of cross-docking</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>non-food</td>
<td>national</td>
<td>none</td>
<td>contractor</td>
</tr>
<tr>
<td>DC</td>
<td>frozen/chilled food</td>
<td>national</td>
<td>60%</td>
<td>manufacturer</td>
</tr>
<tr>
<td>DC</td>
<td>non-food</td>
<td>regional</td>
<td>50%</td>
<td>retailer</td>
</tr>
<tr>
<td>DC</td>
<td>food</td>
<td>regional</td>
<td>minimal</td>
<td>retailer</td>
</tr>
<tr>
<td>DC</td>
<td>non-food</td>
<td>regional</td>
<td>none</td>
<td>contractor</td>
</tr>
<tr>
<td>Primary consolidation</td>
<td>non-food</td>
<td>regional</td>
<td>&gt;90%</td>
<td>contractor</td>
</tr>
<tr>
<td>DC</td>
<td>food</td>
<td>regional</td>
<td>&gt;90%</td>
<td>contractor</td>
</tr>
</tbody>
</table>

The research focused on the cost of logistical operations and did not enquire about lost sales or what HGC call more generally ‘missed business opportunities’. The managers consulted were based at the DCs and, in most cases, lacked direct experience of the downstream effects of traffic congestion at point of sale.
5. Relative Impact of Congestion

5.1 Inter-relationship with other Causes of Delay

To obtain an initial indication of the impact of congestion on their logistical operations, the managers were asked to rate the severity of the problem on a scale of 1 to 5, with the index rising with the seriousness of the problem. This score averaged 3.5, with most managers giving values of 3 or 4. Managers in one company, a distribution contractor involved in retail grocery deliveries in the South of East of England gave it a rating of 2. Across the whole sample the ratings for the effects of congestion on inbound and outbound deliveries were very similar. The mean score of 3.5 suggests that congestion is having a moderate effect on the operations surveyed. There was unanimous agreement that the situation would deteriorate over the next five years, with managers predicting a mean score of 2.7 for the year 2003.

Most of the respondents argued that it was difficult to separate the effects of traffic congestion from other disturbances to logistical schedules. The managers identified a range of other factors which disturbed schedules, often more severely than traffic congestion. The list included delays at retail distribution centres, delays in the production process, failure of staff, particularly drivers, to turn up for work, vehicle breakdowns, problems with delivery paperwork and bad weather.

There is a need, therefore, to put congestion-related delays into perspective. The VERDI study undertaken in the Netherlands by TNO, monitored deliveries to industrial and warehouse premises in the Rotterdam area and found that fewer than half the delays could be attributed to traffic congestion [22]. The survey of 1300 refrigerated vehicles mentioned earlier also collected information on the incidence, causes and length of delays [23]. Altogether these vehicles made 3000 trips during the survey period and travelled half a million kilometres. Analysis of the results of this extensive vehicle audit revealed that roughly 11% of the trips were subject to a delay in excess of 30 minutes (Table 5.1). Only one in five of these delays were attributed to traffic congestion. The remaining delays were blamed mainly on problems at collection and delivery points. The congestion-related delays were, on average, of shorter duration than those caused by other factors (Table 5.1). It should be noted, however, that many of the delivery schedules would already have allowed for congestion (and other sources of delay.) As one manager put it, ‘congestion is often masked by the schedule’. The above figures are likely, therefore, to under-estimate the true extent of the congestion problem. Nevertheless, by measuring deviations from the normal schedule, they focus attention on the reliability of the delivery system which is the main concern here.

Table 5.1: Causes and Duration of Delivery Delays in the Cold Chain.

---

3 Firms were asked to indicate the ‘main cause’ of delay.
<table>
<thead>
<tr>
<th>Cause</th>
<th>% of Delays</th>
<th>Average Duration (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>problem at delivery/collection point</td>
<td>65%</td>
<td>75</td>
</tr>
<tr>
<td>own company action</td>
<td>15%</td>
<td>58</td>
</tr>
<tr>
<td>traffic congestion</td>
<td>18%</td>
<td>45</td>
</tr>
<tr>
<td>vehicle breakdown</td>
<td>2%</td>
<td>60</td>
</tr>
</tbody>
</table>

Source: Energy Efficiency Best Practice Programme.

The situation is complicated by the fact that the various causes of delay are inter-related and often cumulative. For example, a traffic jam can cause a vehicle to miss a booking-in time. It can then be held back until the next available off-loading slot, amplifying the original delay. Where the vehicle is making a multiple-drop delivery, the delays accumulate. Often congestion only becomes a problem when it is superimposed on a series of other disturbances to the logistical schedule. For instance, late completion of a production operation can delay the departure of a vehicle and resulting in it having to travel during a peak period. As the final delay is due to a combination of circumstances, it can be very difficult to apportion blame and hence to allocate any additional costs between congestion and other factors. Further complication is added by weekly and seasonal variations in the relative importance of these factors. In the lead-up to Christmas, for example, many logistical systems are working near full capacity and thus at their most vulnerable at a time when the road network is very busy and weather conditions poor.

5.2 Measurement of Delays

The companies varied in the extent to which they monitored delays. On the whole, they attached more importance to the monitoring of outbound transport operations than to inbound deliveries. The retailers were particularly rigorous in recording late deliveries at store level. Most of the companies did not systematically analyse data on delays at warehouse level. It tended only to be examined where there was a particular problem with a supplier or consignment. Only one of the companies recorded the cause of the inbound delay. Traffic congestion was one of ten possible causes listed in its coding system. In attributing a delay to a particular cause, the company usually had to accept the driver’s explanation.

Companies’ perception of the effect of traffic congestion on inbound deliveries is influenced by the excuses that suppliers offer for late delivery. When asked to rate on a scale of 1 (high) - 5 (low), the frequency with which drivers blame congestion for arriving late (ie. after the booking-in slot), managers’ responses ranged from 2 to 5 and averaged 3.6. They generally believed this explanation. When asked to rate on a scale of 1-5 whether they trusted the supplier’s explanation, they returned a mean score near the top end of the range (2.6). Where the company had a transport operation of its own based at the DC, its drivers were aware of
conditions on surrounding roads and could provide an independent check on suppliers’ claims that traffic congestion had been the main problem. Several firms, however, took the view that it was the suppliers’ responsibility to make adequate allowance for traffic congestion. While they were prepared to tolerate the occasional congestion-induced delay, persistent late arrivals, for whatever reason, were unacceptable.

5.3 Booking-in Times

The proliferation, over the past 10-15 years, of booking-in systems at factories, warehouses and shops has removed much of the earlier flexibility in delivery schedules and made these schedules much more sensitive to congestion-related delays. Typically, inbound deliveries are timetabled to arrive within 30 minute slots. Where a vehicle arrives late, it is usually held back till the next available slot, which in some cases may involve a wait of several hours. In extreme cases, where, for example, perishable goods arrive too late to be cross-docked onto an outbound service, the load can be rejected. The companies surveyed reported that such rejections were comparatively rare and very seldom attributable solely or mainly to traffic congestion. One manager boasted of being able to ‘talk-in’ late deliveries of his own company’s products by negotiating with staff in his customers’ DCs.

The booking-in time that a supplier is given influences the exposure of the delivery to traffic congestion. Suppliers often have a preference for early or late slots which allow their vehicles to avoid peak periods. One manufacturer, supplying large quantities of frozen food to the major supermarket chains on a daily basis, had managed to secure fixed booking-in times at around half of the DCs it served. This enabled it to schedule deliveries on a regular cycle, based on accumulated knowledge of the transit times achievable at the same time each day. Where booking-in times vary from day from day it can be more difficult for suppliers to accommodate traffic congestion in their schedules.
6. Modifications to Logistical Operations

6.1 Sensitivity of Warehousing Operations to Congestion

At an early stage in the discussions, managers were again asked to provide an overall estimate of the extent to which operations had been modified in response to traffic congestion. On a scale of 1 to 5, with 1 denoting ‘major modification’ and 5 ‘no change’, the mean rating was 3.9 for the effect of congestion on inbound deliveries and 3.7 for outbound movements. Most of the values were tightly clustered around these averages, though the distribution contractor mentioned above, for whom congestion was a serious problem, claimed to put considerable effort into minimising the effects of congestion, particularly in vehicle routing and scheduling.

A study by the MVA Consultancy for the Department of Transport in 1995 surveyed a stratified sample of 266 companies to assess their ‘adaptive responses’ to traffic congestion [24]. Almost all the measures that companies had taken or were planning to take related to the transport operation, with changes in vehicle departure times and drivers’ hours the most common responses. Approximately 12% of the companies reckoned that increasing traffic congestion would cause them to increase employment, mainly of drivers and sales staff. Only one of the factors listed, ‘stock replacement policy’, related to the internal warehousing operation. This was mentioned by fewer than 5% of the firms.

Warehousing operations vary widely in their sensitivity to traffic congestion. Even across this small sample of FMCG companies, wide differences were observed, reflecting a number of factors:

- relative importance of cross-docking and storage (‘put-away’) operations
- internal process times for cross-docking, vehicle loading and unloading, paperwork etc.
- scheduling of deliveries over the 24 hour cycle
- dependence on vehicle pre-loading
- stringency of booking-in times

There were wide variations in the proportion of throughput that was cross-docked. Cross-docking operations are clearly the most sensitive to congestion-related delays. The DCs which undertook cross-docking had an average throughput time of around 5 hours. In two of them, however, a significant proportion of the non-stock items were cross-docked within a 2-3 hour time-frame. Even short delays on the road network could disrupt the handling of these problems and possibly result in the rejection of a load. Fortunately, however, these more rapid cross-docking operations occurred late in the evening or in the early hours of the morning when traffic on the road network was relatively light. This sensitivity of a cross-
docking operation to congestion is not simply a function of the speed with which it is performed: it is also affected by its timing relative to periods of peak traffic flow on the road network.

6.2 Degrees of Disruption

In assessing the sensitivity of a DC operation to an inbound delivery delay, several degrees of disruption were differentiated:

1) delay accommodated within normal operating procedures:

2) temporary redeployment of resources at minimal cost: e.g.

   staff redirected from other warehouse activities (e.g. ‘put away’ or quality control to the cross-docking operation: most of the DCs had sufficient warehouse space to allow inbound stock to accumulate until the ‘put-away’ operation could be resumed. Job descriptions were also broadly enough defined to permit this short-term redeployment.

   temporary switch from line- to store-picking: e.g. to assemble more rapidly loads for the most distant shops that required early despatch.

3) temporary deployment of additional resources: e.g.

   extension of warehouse opening hours: to receive a late delivery or complete activities delayed earlier in the day by congestion

   staff overtime: late deliveries can make it necessary to extend the shifts of warehouse operatives. For most of the firms consulted, this was the most clearly identifiable way in which congestion could affect warehouse operating costs.

In stages 1-3 the effects of the delay are contained within the distribution centre (DC) with no disruption to outbound deliveries. Where much of the warehouse throughput is cross-docked within a few hours, contingency measures within the DC may not be sufficient to ‘buffer’ the inbound delay, in which case the outbound delivery will be affected. This, too, can happen to differing degrees:

4) delay to the outbound departure, possibly transmitting the problem to premises further down the supply chain.
5) departure of the outbound vehicle without the product that was delivered late, possibly resulting in stockouts and lost sales downstream and under-utilisation of the outbound transport.

In most of the DCs surveyed, congestion-related delays can currently be accommodated at levels 1 and 2. Only where deliveries are severely affected by a major traffic jam, and/or where serious congestion coincides with other operational delays, does the disruption reach levels 4 and 5. The ability to contain the impact of congestion-related delays at levels 1 - 3 is largely attributable to three factors:

- most delays are short relative to internal process times, providing adequate buffering.
- the degree of flexibility in the redeployment of resources.
- the regularity with which congestion-related delays occur.

There was general agreement that the pattern of congestion is relatively stable. When asked to rate the regularity of congestion on a scale of 1 (high) and 5 (low), the managers returned a mean value of 2.2.

Where delays were experienced by premises at a lower level in the supply chain, this could seldom be attributed to traffic congestion upstream of the DC. There was also little evidence of the utilisation of outbound vehicles being impaired by congestion-related delays on the inbound movement. Even in the most time-sensitive operation, average load factors on the outbound leg were being only marginally reduced.

Figure 6.1 provides a hierarchical classification of congestion-related delays. The primary distinction is between short delays which occur regularly and can be accommodated with little or no modification to warehouse operations and ‘major congestion incidents’ which are much more disruptive. These two general types of delay can be further subdivided in terms of their resource implications and consequences for activities further down the supply chain. Major congestion incidents that seriously disrupt warehouse operations occurred with a frequency of once per annum for the non-food national DC and once per month for the most time-sensitive of the DCs which cross-docked and distributed chilled food within the south east of England.

Figure 6.1: Logistical Consequences of Congestion-related Delay
Three firms were constrained in the extent to which they could cope with a major congestion incident by the dimensions and layout of the DC. In two of the DCs there was little space available for the temporary storage of inbound product during periods when the put-away operation was suspended and staff diverted to the cross-docking operation. Partly because of a lack of space at the despatch bay, one firm preloaded trailers well in advance. If, because of congestion, vehicles were late in returning, the preparation of outbound loads was delayed and the productivity of this part of the warehouse operation impaired. The interaction between inbound and outbound operations was also particularly significant for one DC which had a U-flow layout with all the loading docks on one side of the building. These were used by incoming suppliers’ vehicles during the day and for loading outbound vehicles between 2200 and 0500 hours. The late arrival of inbound vehicles could therefore interfere with the outbound loading operation. This rarely happened, however, as a result of congestion.
7. Asssessing the Cost Implications

Only two of the companies participating in the study attempted to provide estimates of the extent to which their warehousing and outbound delivery costs were inflated by traffic congestion. These costs were raised by 10-15% and 15-20%, respectively, for one company and by 0% and 2% for the other. In our estimation, the operations of the former company were the second most severely affected of the seven DCs visited. The managers in these DC’s conceded that these figures were very approximate estimates and not based on rigorous cost analysis. Managers in the remaining DCs indicated that traffic congestion had only a marginal effect on warehouse operating costs, and were much more concerned about its effect on outbound transport costs.

There was general agreement that it would be very difficult to quantify any congestion cost penalty and do so in a consistent manner. This casts doubt on the validity of the two previous attempts to estimate the ‘consequential costs’ of congestion which placed heavy reliance on managerial judgement.

The effects of traffic congestion on vehicle operating costs were discussed earlier. The focus here will be on the cost of logistical activities other than transport:

7.1 Inventory

There was almost unanimous agreement among the managers consulted that traffic congestion was not affecting inventory levels within their DCs. In the case of ‘storage’ items, even the most severe congestion delays were insignificant relative to the average length of time spent in the warehouse, which ranged from a few days to several weeks. The only example that could be found of inventory increasing was where an inbound order (of non-perishable product) arrived too late to be cross-docked and had to be held back for delivery the following day. This was an infrequent occurrence, however, and so had a negligible effect on the average inventory level. Combining this evidence with the earlier analysis of in-transit inventory suggests that traffic congestion has very little effect on inventory costs.

7.2 Warehousing

There are various ways in which congestion-related delays can inflate warehousing costs, most of them having a short-term impact at the operational level, though as the congestion problem worsens they are likely to affect the economics of warehousing at a higher strategic level.

7.2.1 Operational level
The productivity of the warehouse labour force and equipment can be maximised where the workload is smoothly distributed within and across shifts. The timetabling of inbound deliveries aims to smooth the inward flow of product. Traffic congestion can destabilise this process, causing staff and equipment to be under-employed when vehicles are delayed and over-stretched when several deliveries are bunched. In theory, where congestion causes the inward flow of product to be very uneven, extra staff and equipment will be required to meet peak demands. This will reduce the average level of productivity and raise warehouse operating costs. In practice, there was little evidence of these cost pressures across the seven DCs surveyed. This was partly because congestion was causing only minor disturbance to the goods inward operation but also because most firms were able to shift reasonably flexibly between tasks to keep the workload reasonably balanced. Several firms reported that in recent years they had increased the ‘multi-skilling’ of staff and moved to more flexible shift patterns. This had been done to improve general labour efficiency and not specifically in response to traffic congestion. It, nevertheless, helped firms to minimise the effects of traffic congestion on operating costs.

A second way in which congestion can inflate warehouse costs is by making it necessary to extend warehouse opening times and / or workers’ shifts. Either the warehouse has to be kept open to receive a late delivery or late deliveries earlier in the day cause follow-on activities to over-run their allotted time. A large proportion of DCs, however, are now open 24 hours a day. As mentioned earlier, all but one of the DCs operated on a 24 hour cycle. The one which did not very rarely had to stay open longer as a result of traffic congestion. For those open 24 hours, the main issue was the amount of staff overtime attributable to delays caused by traffic congestion. Managers in the most time-sensitive of the DCs claimed that around 10-15% of their overtime bill was due to congestion. Another company estimated that late deliveries accounted for around 10 hours of overtime each week. Many of these late deliveries were, however, due to factors other than congestion and the 10 hours represented only around 0.3% of total weekly staff time.

7.2.2 Strategic level

There are four ways in which congestion can impact on warehouse efficiency at a higher strategic level:

(i) Internal warehouse system:
In theory, by increasing the capacity and sophistication of handling equipment, firms can enhance the speed and flexibility of their warehouse operations and thus improve their ability to cope with congestion-related delays. Greater investment in handling systems might, therefore, reduce any operating cost penalties associated with congestion. In practice,
however, the managers consulted had given little or no consideration to congestion-related delays when deciding on the provision of handling equipment. When asked to rate the degree of consideration on a scale of 1 - 5 (5 denoting the lowest degree), their average rating was 4.9.

Most of the cross-docking operations examined were labour-intensive and involved minimal use of capital equipment. In the most time-sensitive of these operations, grids of discrete product lines were laid out on the warehouse floor from which items were picked by store into roll cages. Where supplies of a particular product arrived late these were ‘line-picked’, particularly for those shops that were most distant and required an early despatch. If, because of congestion, an increasing proportion of supplies were to arrive late, more line-picking would have to be done before the grid was complete. In extreme situations, this could quickly degenerate into a ‘shambles’. To avert such a crisis, the company would either have to relax its cross-docking schedules or invest in more highly mechanised systems.

(ii) Demand for warehouse space:
A critical determinant of a DC’s ability to cope with unreliability in the delivery system is the amount of space available. As noted earlier, temporarily switching staff from put-away to cross-docking operations requires adequate holding areas where inbound consignments can be left to accumulate until the racking operation is resumed. The seven DCs had all been constructed in the 1970s and 1980s when traffic congestion was a much less serious problem. In only two of these DCs was lack of space constraining short-term adjustments to congestion-related delays. This shortage of space, however, was also adversely affecting the efficiency of the warehousing operation in other ways.

(iii) Allocation of throughput to DCs:
As traffic congestion is concentrated in particular corridors and areas, it distorts the pattern of accessibility across the road network. It has a much greater effect on the average length and reliability of transit times on some routes than others. This should be reflected in the size and shape of the areas served by a company’s DCs. Redrawing the boundaries around DCs, and hence reallocating volumes, in response to traffic congestion could result in some facilities working below capacity and others exceeding capacity. The overall efficiency of the warehousing operations might, therefore, diminish. On the basis of our preliminary research, this appears to be only a theoretical possibility at present. Where firms had redrawn depot boundaries in recent years, changes had been marginal and generally motivated by factors other than traffic congestion. The net effect of these changes on warehouse utilisation had been negligible.

(iv) Number of DCs
If, as projected, much of the road network becomes heavily congested for much of the day, the process of warehouse centralisation, which has been one of the dominant logistical trends of the past 30 years [25], may go into reverse as companies find it increasingly difficult to service customers within the required lead times from their existing DCs. When the MVA Consultancy asked a sample of 50 companies how they would be likely to react to increases in average journey time, only a small proportion indicated that they would increase the ‘number of sites/depots/outlets’. Approximately 6% would do so if transit times increased by over 50%, 3% if the increase was between 11 and 50% and none if it was below 10%.

Nevertheless, several companies are already contemplating increasing depot numbers primarily as a result of congestion. One of the seven companies surveyed, for example, which requires additional warehousing capacity in the south east of England is debating whether to set up one or two new DCs in the region. Largely because of the effects of traffic congestion on delivery times and costs, the company is seriously considering establishing two new DCs to the north and south of the capital. The parcel carrier Nightfreight has also indicated recently that it intends to increase its number of depots by a third (from 48) partly in response to traffic congestion, but also to meet the growth in demand for later collections and earlier deliveries [26]. If traffic congestion induces a more widespread return to decentralised systems of distribution, unit operating costs are likely to rise as firms sacrifice economies of scale in their warehousing operation and incur the additional costs of developing new sites. These higher warehousing costs will be partly offset, however, by reductions in the cost of delivery from more dispersed facilities.

The MVA survey in 1995 found that few firms were formulating a strategic response to the growth in traffic congestion. The consultants concluded that as ‘congestion is an incremental change ....companies clearly believe that they will have sufficient time to make changes as problems arise and there is no need to anticipate these changes’ [27]. This overlooks the fact that when firms are redesigning their logistical systems and considering investing in distribution facilities, they take a longer term view of transport trends. Increasing importance is now being attached to traffic congestion in medium to long term strategic planning, reflecting the widespread view in industry that the level of congestion is certain to continue rising for the foreseeable future.

7.3 IT Systems

Companies can invest in systems which give advance warning of congestion-related delays and / or facilitate short-term adjustments to schedules. Again, the managers claimed that congestion had had exerted very little influence at all on the recent development of their IT systems. They were asked to indicate on a 1 (high) to 5 (low) scale:
(i) the extent to which they had been able to use IT to help reduce the impact of traffic congestion on their logistical operations and

(ii) the importance attached to congestion in IT investment decisions.

The mean scores for these criteria were respectively 4.8 and 4.9, suggesting that IT is currently having very little bearing on the way that these firms’ logistical operations are being adjusted to the growth in congestion. Looking beyond this small sample of companies, there is an increasing demand for IT systems which can help companies manage their logistical systems more effectively in a congestion-constrained environment. For example, improved communication between vehicle and collection / delivery points can give logistics managers more time to plan for late arrivals. If used effectively this advance information can minimise the degree of disruption and any associated costs. Safeway, for example, have developed an ‘integrated transport monitoring system’ in association with Ram Mobile Data and UMIST which provides two-way communication with delivery vehicles and has a ‘forewarning facility’ that alerts store managers 15-20 minutes before a vehicle arrives [28]. It also incorporates an extensive reporting system which, among other things, records details of late running and its causes.

7.4 Problems in Assessing Congestion-related Costs

Having identified the various ways in which congestion can impact on the cost of DC operations, the next task should be to try to quantify the resulting cost increases. This second stage in the process is fraught with difficulty, however, primarily for three reasons:

1. The problem of isolating congestion effects from other disturbances to logistical schedules, particularly as they are often closely inter-related. These inter-relationships have been outlined earlier. Much more accurate systems of delay reporting will need to be installed to establish a fair and credible basis for allocating any additional costs.

2. Differences in the amount of slack in logistical schedules. Ironically, the leaner the logistical operation, the greater will be its vulnerability to congestion. ‘Lean’ operators, which achieve higher productivity and lower unit costs, are more likely to incur overtime or stockout costs than firms with more relaxed schedules with greater internal buffering. In the latter case, congestion costs are absorbed in what is an inherently more costly operation with more staff and larger amounts of inventory. This frustrates any attempt to standardise the measurement of congestion-related cost increments.

The use of the term ‘slack’ in this context is perhaps unduly pejorative. It, after all, gives companies greater opportunity to recover from congestion-induced delays. As the
reliability of transport operations declines, congestion will impose a limit on the extent to which companies can time-compress their internal systems. At present, however, the amount of slack does not appear to have been consciously influenced by the need to buffer against congestion. Standard work schedules were able to absorb most of the congestion-related delays.

3. *The difficulty of establishing the degree of importance attached to congestion in investment decisions, particularly relating to materials handling equipment and IT systems*

Investment in more advanced materials handling and IT systems typically yields a stream of benefits, one of which may be the mitigation of congestion effects. Under these circumstances, it is difficult to estimate the proportion of the capital cost of these systems attributable to the congestion problem, particularly where it is only one of a number of factors influencing the original investment decision.

7.5 Differential Effect of Traffic Congestion

Frequent reference is made in the press to traffic congestion reducing the competitiveness of British industry. By treating ‘industry’ as a single entity, the impression is given that all companies are similarly exposed to the problem. In fact, the burden of traffic congestion is very unevenly spread both geographically and by sector.

*Geographical variation:*
There are pronounced spatial variations in the incidence and severity of congestion between regions and between different classes of road. The geographical extent of firms’ delivery operations and their particular urban / rural split largely determines their relative exposure to congestion.

According to the AA Roadwatch system, the twenty-five most serious congestion incidents in the UK over the period from January 1997 to March 1998 occurred in eleven counties. The AA gives these traffic jams a ‘gridlock rating’ on a scale of 0-200, with a value of 200 assigned where ‘thousands of drivers are affected by widespread gridlock’. Table 7.1 shows how many of these jams occurred in each of the eleven counties and their aggregate ‘gridlock rating’.

*Sectoral variation:*
The time-sensitivity of logistical activities varies enormously both within and between sectors. Time-sensitivity is not only a function of order lead times; it is also affected by the
scheduling of core production and distribution activities over the 24 hour cycle. Where, for instance, these schedules generate heavy freight flows at peak times on the road network, congestion costs will be high.

Table 7.1: Distribution of the 25 Most Serious Traffic Jams: Jan 1997-March 1998

<table>
<thead>
<tr>
<th>County</th>
<th>No. of Traffic Jams</th>
<th>Aggregate ‘Gridlock Rating’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essex</td>
<td>6</td>
<td>967</td>
</tr>
<tr>
<td>Surrey</td>
<td>4</td>
<td>632</td>
</tr>
<tr>
<td>Greater London</td>
<td>4</td>
<td>631</td>
</tr>
<tr>
<td>Buckinghamshire</td>
<td>2</td>
<td>445</td>
</tr>
<tr>
<td>Kent</td>
<td>2</td>
<td>327</td>
</tr>
<tr>
<td>Bedfordshire</td>
<td>2</td>
<td>327</td>
</tr>
<tr>
<td>Herefordshire</td>
<td>1</td>
<td>209</td>
</tr>
<tr>
<td>Hertfordshire</td>
<td>1</td>
<td>155</td>
</tr>
<tr>
<td>Berkshire</td>
<td>1</td>
<td>155</td>
</tr>
<tr>
<td>Yorkshire</td>
<td>1</td>
<td>141</td>
</tr>
<tr>
<td>Staffordshire</td>
<td>1</td>
<td>138</td>
</tr>
</tbody>
</table>

Source: AA Roadwatch.(ref. 1)

Our research also suggests that traffic congestion is having a particularly adverse effect on logistics service providers. For many of these firms, after all, road transport is a core activity. Any loss of efficiency in the transport operation has proportionally a much greater impact on their total costs and profitability than those of their clients and own-account operators. It appears that many hauliers and distribution contractors are unable to recover congestion-related costs in higher rates, with the result that profit margins are being squeezed. Clients are often criticised for being unsympathetic to hauliers’ concerns about the effects of traffic congestion on their businesses. Having ‘offloaded the congestion problem’ to haulage / distribution contractors, some now regard the ability to manage deliveries efficiently on a congested road network (at little extra cost) as part of the service package.
8. Easing the Effects of Traffic Congestion

There are numerous ways in which firms can reduce the vulnerability of their logistical operations to traffic congestion:

8.1 Scheduling Vehicle Movements to Avoid Peak Times

In the recent survey of logistical specialists by Browne and Allen [29], ‘more night / outside peak hours operations and deliveries’ was deemed the most popular option for dealing with congestion, supported by 78% of the respondents. As traffic congestion mounts, the need grows for a fundamental re-examination of the scheduling of deliveries across the supply chain.

8.2 Overhauling Goods Reception Operations

Within FMCG distribution channels, which are among the most time-sensitive, at least as much concern is expressed about unloading delays at retailers’ distribution centres as about traffic congestion. Of 42 frozen food manufacturers surveyed earlier this year, just over 60% expressed concern about goods reception arrangements at RDCs [30]. A frequent complaint was that vehicles arriving at the appointed booking-in time, were having to wait for unloading, sometimes for several hours. Like large sections of the road network, the reception bays of DCs are also working too close to full capacity. They not only lack the flexibility to absorb congestion delays, but can have the effect of amplifying these delays, particularly where vehicles are making multiple deliveries.

8.3 Exploiting New Information Technology

A recent study [31], commissioned by the RAC, outlined a range of IT developments which could help firms manage the movement of freight more effectively on congested road networks. These include in-cab data communication, vehicle tracking, advance warning systems and dynamic routing using real-time data on traffic conditions. An example was given earlier of how improved communication between vehicle and collection / delivery points can give logistics managers more time to plan for late arrivals. If used effectively this advance information can minimise the degree of disruption and any associated costs.

The use of IT systems also enables firms to rationalise their use of road freight capacity. This can moderate the growth of lorry traffic and should thus help to relieve future traffic congestion. As the RAC study noted, however, ‘in helping lorries navigate relatively congestion-free routes across the road network, IT systems may increase the total journey
length’. At a national policy level, there will be concern that increases in the circuitry of routes will generate additional traffic. At the level of the individual operator, a trade-off will have to be struck between distance- and time-related operating costs and between total operating costs and service quality.
9. Conclusion

It is ironic that during an era when logistics managers are preoccupied with accelerating material flow and depressing inventory levels, the road network, which carries over 90% of all surface freight movement in the UK, should become ever more congested, increasing average journey times and reducing their reliability.

Several attempts have been made to estimate the cost of traffic congestion in the UK. Most of these studies have assessed only the direct costs of congestion borne by road users while travelling on the network. The most recent estimates of these direct costs, which have been based on detailed analysis of road traffic flows and used official estimates of vehicle operating costs, suggest that for freight traffic they are in the region of £1200 million per annum. This represents roughly 2.4% of total UK expenditure on road freight transport. As road freight transport accounts for roughly a third of total logistics expenditure in the UK [32], the direct on-the-road costs of traffic congestion could be adding around 0.8% to logistics costs. These studies are, however, based on over-simplified vehicle operating cost estimates and fail to make any allowance for the cost of additional in-transit inventory and for the indirect costs incurred by production/distribution operations at either end of the freight movement.

Preliminary analysis of in-transit inventory on-the-road network suggests that this is a minor item in the congestion cost calculation. The indirect costs of congestion are likely to be significantly greater though their actual value is extremely difficult to quantify. Previous attempts to measure their value have rested heavily on the subjective judgement of senior managers. The research reported in this paper has attempted to explore in greater depth the effects of traffic congestion on the internal workings of seven distribution centres in the FMCG sector. This has revealed that, with two exceptions, the warehousing operations suffered only a minor amount of disruption as a result of traffic congestion. This is because most congestion-related delays can be accommodated within warehouse schedules and are usually quite small relative to other ‘disturbances’. One of the companies whose operations are being seriously affected by traffic congestion estimated that its warehousing costs are being inflated by around 20%. There is also evidence of congestion causing some companies to consider increasing their number of warehouses.

The study has highlighted the difficulty of isolating the indirect costs of congestion and comparing them on a consistent basis between companies. Across most of the DCs examined these costs appeared relatively low. In two of the DCs, however, operating efficiency was being significantly compromised. This was partly because of space limitations which constrained the ability to switch resources temporarily between put-away and cross-docking operations and to prioritise the through-movement of inbound loads that arrived late.
The main purpose of this pilot project was to gain an insight into the consequential effects of congestion at DCs. The survey of only seven DCs in a single sector was clearly too small to permit wider generalisation. The DCs predominantly supplied retail outlets within short order lead times, though varied enormously in their rate of stock-turn, degree of cross-docking operation and, hence, overall time-sensitivity. They exhibited much greater similarity in the effects of congestion on their outbound delivery operations.

The survey would have to be extended to a much larger and more varied sample of firms to obtain a representative picture of the impact of congestion. Parcel carriers and manufacturers operating a tight JIT regime would be obvious candidates for inclusion in future surveys. It would also be desirable to survey production and distribution premises at different levels in the supply chain and more widely spread across the country.

With more time and greater resources it would also be possible to supplement the interviews with direct observation and measurement. Research staff could monitor the movement of supplies into and through the DC over a sample period and construct process maps, similar to those used in time-compression [33] and lean logistics research [34], to assess in minute detail the effects of congestion on internal scheduling. This would be labour-intensive, especially as the relatively low incidence of major ‘congestion incidents’ would make it necessary to collect operational data over a lengthy period.

Even with this broadening of the empirical base, however, it would still be difficult to derive an accurate estimate of the indirect costs of congestion to logistical operations. The problem is as much one of isolating these costs at the micro-scale as generalising them at the macro-scale for industry as a whole.
References:
1. AA Roadwatch ‘Quarterly Traffic Index.’ Automobile Association, Basingstoke.
11. Goodwin, op.cit


23. Energy Efficiency Best Practice Programme, op.cit.


27. MVA Consulting, op. cit.


