

THE VALUE OF TRAFFIC MANAGEMENT

A Note on Traffic Capacity in Central London

By J. M. Thomson

In my paper last January* I estimated that the *road* speed-flow capacity of the central London main road network (*i.e.* the survey roads) increased by 15 per cent between 1952 and 1960 and by a further $6\frac{1}{2}$ per cent between 1960 and 1966. I also estimated that, because of greater journey lengths since 1960, the *true* capacity (*i.e.* the airline speed-flow capacity) of the network had fallen by nearly 10 per cent relative to the road speed-flow capacity; *i.e.* true capacity had actually fallen since 1960. After a lengthy discussion of the statistics I concluded, rather conservatively, "that the true capacity of the network has not increased, and has probably fallen, since the advent of traffic management in 1961".

My estimates of capacity resulted from an analysis of traffic speeds, flows and composition since 1952. On 30 January the Chairman of the Greater London Council Highways and Traffic Committee made the following statement:

"I am myself convinced that the measures taken in the last few years have improved traffic flow, and the M.O.T. and the Police agree. Traffic management measures since 1960 may have yielded proportionately less improvement than before, because traffic had by then reached saturation point. But without going into arguments about our figures, to which Mr. Thomson was given access, members will I am sure be interested to know that between 1960 and 1966 peak traffic rose by 9 per cent and speeds by 10 per cent, but typical journey lengths have increased by only 5 per cent. Off-peak traffic increased by 15 per cent and speeds by 10 per cent."

The same figures have since been repeated in *Traffic Engineering and Control* and in a letter to *The Times* by Mr. A. C. Durie. The only figures which are seriously in dispute are the measurements of traffic flow. My figures, taken from the official surveys, show that flow (in p.c.u.'s) increased by only 1 per cent in both peak and off-peak hours between 1960 and 1966; the G.L.C. figures show increases of "traffic" by 9 per cent and 15 per cent respectively. It has obviously been necessary to investigate the reasons for this difference.

The first reason is elementary: the GLC figures refer to vehicles, not to p.c.u.'s. One cannot sensibly use statistics of vehicles for measuring capacity changes when the proportion of cars is rising and the proportion of heavy vehicles is falling. Conversion to p.c.u.'s immediately reduces the G.L.C. figures, although by how much one cannot say exactly, for reasons explained below.

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The second reason for the difference is much more complicated. It arises from the fact that the surveys carried out every other year since 1952 have not been made on exactly the same set of roads; the original network has been gradually added to, mainly because the introduction of one-way systems has made it impossible for the survey cars to follow the original routes. There was little change of significance before 1960, but between 1960 and 1966 the survey network was increased from 45.3 miles to 53.2 miles. This would not matter if the new roads had on average the same capacity characteristics as the original roads. The new roads include big roads such as Park Lane (west carriageway), Pall Mall, St. James's Street, Russell Square, Hyde Park Underpass, and Gower Street. There is therefore some justification in assuming, as in fact was assumed in my figures, that their inclusion is not a serious cause of bias. But I shall examine this assumption below.

The G.L.C. figures are not measurements of flow on any identifiable network; they are a flow index. The index was first computed in 1963, but it is subject to a number of statistical objections. It is, in fact, inherently biased in three ways, as I shall now endeavour to explain.

The G.L.C. Flow Index

The flow index is calculated by comparing, between one survey and the next, flows on only those roads on which there were no important traffic management changes or road works between the two surveys. Thus if a road is made one-way it is excluded from the index for the survey year following the change, but is brought back into the index for the next survey year. Similarly, if a new road is included it is excluded from the index for the first survey year but brought in for the next. Now this procedure seems quite reasonable at first sight as a means of comparing like with like. On closer examination, however, it is found to be seriously biased and therefore unacceptable.

Let the survey roads consist of x_1 miles of road, of which x_{11} are affected by traffic management between survey 1 and survey 2.

$$x_1 = x_{11} + x_{12}$$

Let the non-survey roads consist initially of x_2 , of which x_{21} are affected by traffic management and included in the survey roads for survey 2.

$$x_2 = x_{21} + x_{22}$$

In survey 1, flow is measured on x_1 ,

$$f_1 = \frac{f_{11} x_{11} + f_{12} x_{12}}{x_1}$$

where f_i is the average flow on roads i .

In survey 2, flow is measured on $x_1 + x_{21}$

$$f'_{1+21} = \frac{f'_{11} x_{11} + f'_{12} x_{12} + f'_{21} x_{21}}{x_1 + x_{21}}$$

In survey 3, if there are no further changes, flow is measured again on $x_1 + x_{21}$,

$$f''_{1+21} = \frac{f''_{11} x_{11} + f''_{12} x_{12} + f''_{21} x_{21}}{x_1 + x_{21}}$$

The flow index, F , is produced to measure the change in flow between surveys 1 and 2 and surveys 2 and 3.

$$F' = \frac{f'_{11}}{f_{11}}$$

$$F'' = \frac{f''_{1+21}}{f'_{1+21}}$$

The comparisons which are required are the changes of flow on x_1 , *i.e.* f'_1/f_1 and f''_1/f'_1 . Do F' and F'' provide good estimates of f'_1/f_1 and f''_1/f'_1 ? First, consider F' . Does $F' = f'_1/f_1$?

$$\text{i.e. does } \frac{f'_{11}}{f_{11}} = \frac{f'_{11} x_{11} + f'_{12} x_{12}}{f_{11} x_{11} + f_{12} x_{12}} ?$$

Since x_{12} are roads recently converted to one-way working and are often paired with minor roads in x_{21} , their flow is likely to fall temporarily in proportion to f_{11} . Hence F' is likely to overestimate f'_1/f_1 .

Secondly, consider F'' . Does $F'' = f''_1/f'_1$?

$$\text{i.e. does } \frac{f''_{1+21}}{f'_{1+21}} = \frac{f''_1}{f'_1} ?$$

$$\text{i.e. does } \frac{f''_{11} x_{11} + f''_{12} x_{12} + f''_{21} x_{21}}{f'_{11} x_{11} + f'_{12} x_{12} + f'_{21} x_{21}} = \frac{f''_{11} x_{11} + f''_{12} x_{12}}{f'_{11} x_{11} + f'_{12} x_{12}} ?$$

Since the roads x_{21} , newly brought into the survey, include some previously minor roads opened up by traffic management, the flow on these roads in the first years after the introduction of traffic management is likely to increase faster than on the other roads. Hence F'' is likely to overestimate f''_1/f'_1 .

Thus the temporary exclusion of certain selected roads from the index is a potential source of bias, and the inclusion of new roads in the index is another potential source of bias. A third source of bias is that roads obstructed by roadworks at the time of the survey have been excluded from the index for that year but appear to have been included for the next year, thus giving a biased estimate of flow increase between the two years.

All three sources of bias are likely to produce an exaggerated estimate of increased flow.

Revised Estimate

It is clear, therefore, that the G.L.C. figures are statistically unsound, while my own figures contain an assumption which may not be valid. The reason I assumed that the enlarged survey network possessed the same speed-flow capacity as the original smaller network was simply that a great deal of data and arithmetic are necessary to isolate the new roads from the old. In view of the importance of settling this matter, however, I have now done this so as to make the 1966 estimates precisely comparable with 1960; in other words, I have compared flows and speeds on the same 45.3 miles of network for the two years. The results are as follows:

	1960	1966	
	45.3 miles	Original estimate on 53.2 miles	Revised estimate on 45.3 miles
Peak hour flow (p.c.u.'s)	2376	2407	2533
Off-peak flow (p.c.u.'s)	2217	2241	2334
Peak hour speed (miles/h)	8.5	9.5	9.3
Off-peak speed (miles/h)	9.8	10.7	10.55

These revised figures show that the flow on the comparable network increased by 6.6 per cent and 5.3 per cent in peak and off-peak hours respectively. This is a larger increase than I originally suggested, but much smaller than that stated by the G.L.C. On the other hand, speeds on the same network rose by a somewhat smaller percentage than on the larger network. It follows that the increase in road speed-flow capacity between 1960 and 1966 was about $9\frac{1}{2}$ per cent, rather than $6\frac{1}{2}$ per cent as originally estimated. If this is so, the *true* capacity of the system (allowing for a loss of nearly 10 per cent due to extra journey length) must have remained stationary, or fallen very slightly.

Thus my conclusions are not altered by the revised figures.

Other Evidence

Finally I would point out that the evidence on the growth of traffic is not limited to these surveys, but is supported by a number of other sources.

First, the police censuses indicate a growth of only about 3 per cent between 1960 and 1966.

Secondly, London Transport showed that the number of cars arriving during the morning peak had risen by the same percentage as that recorded in the traffic surveys. London Transport also showed the number of cars arriving to have declined, for the first time, in 1966, and the number of motorcycles to have halved since 1960. There is no disputing that the numbers of buses and commercial vehicles also fell sharply during the same period.

Thirdly, the only permanent traffic counter in the area (situated in Whitehall) showed a 2.6 per cent fall in peak-hour traffic between 1964 and 1966.

All the available data support the view that the volume of traffic grew very little after 1960 and turned downwards after 1964. Allowing for the fact that extra journey length increases the volume of *traffic* by 5 per cent, it appears that the volume of *travel* by vehicles in the area was virtually no higher in 1966 than in 1960.

This is a very different picture from that painted by the G.L.C. and Mr. Durie.

It is now two years since the last central London traffic survey. Let us hope that the next survey will produce more encouraging results.