

Knowledge Of A Very Meagre And Unsatisfactory Kind

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When you can measure what you are speaking of and express it in numbers, you know that on which you are discoursing. But when you cannot measure it and express it in numbers, your knowledge is of a very meagre and unsatisfactory kind.

- Lord Kelvin

The above is a frequently quoted passage found in textbooks; the message is that numbers as an essential vehicle for information should be used whenever possible. This advice was echoed by Richard Bellman, who concluded that "theories stand or fall, ultimately, upon numbers".

It does not mean, however, that whenever someone produces a number, he or his audience will automatically have a clear idea of what he is talking about. Too often we find figures, tabulations, charts, graphs, etc. flaunted here and there in speeches and reports in support of ideas or claims. Many people tend to equate "data" to "evidence", and are unwilling or unable to probe deeper into the true meaning of the numbers beyond their face values. Engineers, unfortunately, are not necessarily the exception, despite the fact that they have to deal with numbers most of the time.

Take, for example, the following caption for the cover photograph of the 1983 Yearbook of the Institution of Engineers, Singapore:

PWD's CENTRAL CONTROL ROOM. This picture shows the central control room of the Public Works Department's computerized area traffic control system. The system which was implemented in 1981 controls 161 traffic signalized junctions in the city. The signal co-ordination provided by the central computer has resulted in an increase of travel speeds by 20% in the city area. (By Courtesy of Public Works Department).

We shall not question the actual effectiveness of the computerized area control system here, but are more interested in what this statement is supposed to tell us, "an increase of travel speeds by 20%". Perhaps a traffic engineer would understand completely what it means. But the intended readers of the statement are not specialists. If they are to take the statement seriously, many questions can be asked:

- Is the 20% based on simulation study or an actual survey?
- If this 20% is based on measured data, is it the result of a "before/after" type of comparison?
- If this "before/after" type of comparison was valid at the time of implementation of the computerized system, how is the situation now (i.e. 1983)? As the number of vehicles on the road is likely to have changed, would this 20% still be a valid figure?
- "Travel speed": What speed? maximum? median? average? Based on what kind of averaging scheme?
- Does the increase in speed apply only to motorcars, or motorcycles, or buses, or transport trucks as well? Perhaps a combination of all? How are they "combined"?
- Even if there is a standard means of obtaining the "travel speed", what is the basis of comparison? Does 20% increase reflect a change from, say, 5 kph to 6 kph or 50 kph to 60 kph? i.e. the actual difference in speed could be anything from insignificant to dangerous!
- Whatever the absolute increase in speed, has the higher speed been found satisfactory? e.g. if the increase is from 5 kph to 6 kph, what is there to crow over?
- Where did the increase take place? On a continuous stretch of a particular street, or a certain distance covering several traffic lights, or a specifically chosen route or routes from one end of city area to another, etc.?

- When was the increase found to take place? During rush hours? At 2 o'clock in the morning? Calculated for several periods of time during the day? What day or days (weekday or weekend)? If averaging was used, what kind of weightage, if any, has been used and why?
- More basically, is increasing travelling SPEED the real objective of a traffic signal control system? From a city traveller's point of view, would it not be the travelling TIME that matters? Since vehicles on the road do not maintain a constant speed, spurts of higher speeds do not necessary lead to an overall reduction in travelling time (not to mention their impact on passenger comfort, etc.)
- For that matter, is not throughput in terms of number of vehicles cleared per unit time a better indicator of traffic flow? A direct measurement of performance is always preferable to an indirect one.
- Even assuming that "an increase of travel speeds by 20% in the city area" is a meaningful statement, can one simply give all the credit to the computerized area traffic control system? Could it not be due to the fact that the expressway system in Singapore began to operate at about the same time as the computerized system, so that there was a reduction of traffic through the city area in the first place? How about improvements in traffic conditions due to recent instances of road widening, creation of more filter lanes at road junctions, conversion to one-way traffic in certain areas, etc.?

The list could go on. Someone has measured something, summarized it to a number, but to any serious reader, the resulting statement is not useful at all. We have seen how a number can open up more questions than it answers, and it is not true that "some number is better than no number". Having numbers is one thing, having them understood and correctly interpreted is quite another. Here we are not picking bones with the computerized traffic control system. We are only using a very simple example to illustrate how numbers could still lead to knowledge "of a very meagre and unsatisfactory kind". To extract more out of numbers, one needs to be able to look at them in the proper statistical perspective. Indeed, it would be useful to bear in mind what H.G. Wells pointed out long time ago, "statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write".