The Future Role of Traffic Engineering

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At the beginning in 1930, when the Institute of Traffic Engineers was founded, the profession of traffic engineering started its struggle for recognition. Traffic engineers have often complained that the public does not understand what their work really is—confusing it with traffic law enforcement or "sign hanging" and "pavement painting."

Today this picture is rapidly changing. There is still some misunderstanding, but the public image of traffic engineering in many localities is associated with the broad aspects of traffic operations and in some places it is already transportation-oriented. The modern challenge to traffic engineering is not just one of *obtaining recognition* in order to accomplish the objectives of the work, but is also whether traffic engineering itself fully recognizes the important part it must play in the urban transportation improvement program needed to help solve the complex transportation problems now confronting this nation. In my opinion, the ability of traffic engineers to meet this responsibility during the next 10 to 20 years will determine the stature and growth of the profession. Traffic engineering now, as never before, has the opportunity to be recognized for its *deeds* instead of its *desires*.

Purpose and Scope of Traffic Engineering

Modern transportation demands on traffic engineering do not impose any *new* responsibilities on those working in the field. For many years the definition of traffic engineering has called for traffic planning, geometric design and operation of streets and highways in the interests of safe, convenient and economic transportation of persons and goods.

More recently there has been some controversy within the membership of the Institute of Traffic Engineers concerning whether it should change its name. Some members proposed the name be changed to the Institute of Transportation Engineers, at one extreme, or the Institute of Traffic Control Engineers, at the other. During 1963 a special committee of the Institute of Traffic Engineers was charged with review of the organization's purpose and scope. This committee found no *com-*

pelling need to change the basic definition of traffic engineering. However, the committee elaborated on the definition in terms of modern needs, as follows:

> "The traffic engineer can no longer be content with the *geometrics* of design or the *mechanics* and *hardware* of traffic operations. He must look beyond the technical requirements of his work and give consideration to patterns of land use trends, to the desires and needs of people for transportation as well as the effects of all other means of transportation on street and highway traffic."[1]

There are several reasons why current and expected developments in transportation promise that the traffic engineer must continue to broaden his outlook and must step up his activities to keep ahead of the growing traffic problem.

Increases in Traffic Volumes

Traffic volumes are increasing at the rate of 4 percent to 5 percent each year and more than three-fourths of future growth in motor vehicle travel will take place in urban areas.[2] No great amount of imagination is required to visualize the magnitude of the traffic problem which will exist in, say, 1980, unless street capacities are increased as these loads develop.

The Interstate System and its urban connections will be completed within the next ten years. Recognizing the feasibility of the Interstate System in terms of its ability to safely accommodate high volumes of traffic at high speeds, the fact remains that this system, as it is now defined, will represent about 2 percent of the total road mileage in the U. S. and it will accommodate only an estimated 20 percent of the total traffic.[3] But, what about the other 80 percent of travel?

It seems evident that not only must more mileage of expressways be constructed in urban areas than now called for, but present streets must be engineered *so they will operate at their optimum levels of performance.*

Perhaps the greatest contribution the traffic engineer can make in helping solve the urban transportation problem will be through improvements in the operations of existing street systems. In the interests of

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[1] Institute of Traffic Engineers, Report of Special Committee on Purpose and Scope, "Purpose and Scope Committee Reports," *Traffic Engineering,* March 1964, Washington, D. C.

[2] Automotive Safety Foundation, "What Freeways Mean to Your City," 200 Ring Building, Washington, D. C., January 1964.

[3] Williams, James K., "Coping with Driver Failure," paper presented at Liberty Mutual's Council, Boston, Mass., November 22, 1963.

conservation of resources and preservation of the proper ratios of land use, the potential capacities of existing streets must be developed before new systems of costly freeways, with their extensive right-of-way requirements, will be justified.

Numerous examples have demonstrated the ability of traffic engineering techniques to improve the safety and capacity of existing streets. Street widening and extensions, intersection redesign and channelization, appropriate traffic controls and regulations, curb-parking controls with provisions for off-street parking and other traffic engineering improvements will often double the capacity of a street and increase safety.

Accident Prevention

Still another development, in addition to growth in traffic volume, is pushing the traffic engineer to the forefront of the highway transportation scene. All of us are aware of the steady increase in the number of fatal traffic accidents throughout the country in recent years. In view of this upward trend in fatalities, safety officials are taking a "long hard look" at the traffic safety programs of the past and the results they have produced.

For many years the search for "accident-prone" drivers, so they may be removed from the road, has continued with little success. The few drivers who may be classed as accident-prone cause a very small percentage of total accidents. On the other hand, those who are familiar with accident "spot maps" know that there are a large number of accident-prone *locations* in our road systems about which little has been done.

A new philosophy that drivers may be expected to make mistakes sometimes, and that they deserve the opportunity to avoid an accident when they do, is placing increasing demands on traffic engineering to achieve a higher degree of accident prevention through physical and regulatory improvements.

There is a growing apprehension, among leaders in the traffic safety field, that too much of the responsibility for accidents has been placed on the shoulders of the driver and this has delayed traffic engineering programs which could have eliminated many accidents at their sources.

Urban Transportation Planning Requirements

The increasing pressures of accidents and congestion are the forces behind new federal legislation which impels an accelerated program of traffic engineering in urban areas. The Federal Highway Act of 1962 requires that after July 1965 a "transportation plan" is a prerequisite

for approval of the expenditure of federal aid on any program of highway improvements in urban areas over 50,000 population.

The legislation, according to the Bureau of Public Roads,[4] is "concerned with all facilities used for the movement of persons and goods, including terminal facilities and traffic control systems." The required planning process calls for studies of traffic and its growth, which includes forecasting travel demands and modes, and the making of plans for the development of new expressways and for increasing the operational efficiency of existing streets and mass transportation systems.

Traffic engineers have fundamental knowledge of the principles of traffic characteristics and controls. Their knowledge of "cause and effect" is an essential part of the urban transportation planning process. Futhermore, they are best qualified to determine what the maximum potential operational efficiencies of existing facilities are as a part of the planning process. Traffic engineers must contribute heavily to the urban transportation planning effort if a well balanced, coordinated and integrated plan is to be developed.

However, many traffic engineering agencies must "gear up" their activities and broaden their scope to meet the responsibilities imposed on them by modern urban transportation demands. Obstacles to contend with include (1) the current shortage in qualified traffic engineering personnel, (2) inadequate funds to finance traffic improvement programs for existing streets, and (3) need for more research to develop promising new traffic engineering devices and techniques.

The Shortage of Qualified Traffic Engineers

A shortage of qualified traffic engineers is being felt at all levels of government throughout the country. A study of the urban transportation activities in 14 cities with population varying from 75 to 600 thousand was made by the Bureau of Highway Traffic in 1959.[5] Close inspection of the traffic engineering function of five of these cities having records suited to this purpose disclosed an average of one professional traffic engineer employed for each unit of 50,000 population. No attempt was made to judge the level of service of street operations in these cities but this ratio of professional traffic engineers to population seemed to meet requirements.

The 1960 national census disclosed 211 metropolitan areas with population over 50,000. By applying the above ratio to the populations

[4] American Society of Planning Officials, "BPR Details Transportation Planning Rules," *Newsletter,* Vol. 30, No. 1, January 1964.

[5] Seburn, T. J., and Marsh, B. L., "Urban Transportation Administration," Bureau of Highway Traffic, Yale University, New Haven, Conn., 1959.

of these metropolitan areas up to 500,000 population and decreasing the ratio to 1 per 100,000 for large cities, a need for 1,500 professional traffic engineers employed in urban area traffic engineering work is indicated.

It is believed that membership in the Institute of Traffic Engineers is a reasonable indicator of professional traffic engineering qualifications. According to the latest figures, the institute now has 550 professional members who are city or county employees in the United States. Therefore, there is a shortage of about 950 professional traffic engineers in metropolitan areas at the present time.

An independent study made by the National Safety Council based on reports from about one thousand cities estimates that the present shortage of qualified traffic engineers in cities is 600.[6] The same study reported a current shortage of 1,130 traffic engineers throughout the country. This figure may be compared with a shortage of 1,400[7] reported by a committee of the Institute of Traffic Engineers.

While these estimates do not check each other closely, there is no doubt that a critical shortage in professional traffic engineering personnel exists. Since all cities are desperately in need of traffic engineering services, the shortage has caused a sizable number of positions to be filled by nonqualified persons.

Experience has proven that those with an *engineering* background of experience and/or training are best suited for traffic engineering work. In view of this, the shortage of professional traffic engineers may best be relieved by encouraging more young people to enter the engineering field with specialization in traffic engineering or transportation. This encouragement should start at the high school level and should continue through undergraduate and graduate work in college. The Institute of Traffic Engineers has developed a booklet on "Careers in Traffic Engineering" which may prove useful for this purpose. In-service training programs can also qualify engineers for traffic operations work.

A study conducted by the Institute of Traffic Engineers reveals that there was an increase of 70 percent in the number of graduate and undergraduate traffic engineering students in this country and

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[6] National Safety Council, 'Status of the Action Program," Report to the President's Committee for Traffic Safety, Chicago, Illinois, February 1964.

[7] Institute of Traffic Engineers, Informational Report of ITE Technical Committee 2F, "The Present and Future Need for Professional Traffic Engineers," *Traffic Engineering,* March 1964, Washington, D. C.

Canada in 1961 compared with 1957.[8, 9] This was accompanied by an increase of 30 percent in the number of colleges and universities offering graduate majors in traffic engineering.

While these increases are laudable, it is clear that the total number becoming qualified each year for traffic engineering work falls drastically below the increasing demand for this service. Growth of the professional membership of the Institute of Traffic Engineers indicates that the number of qualified traffic engineers is increasing at an average rate of about 10 percent each year. At this rate, it will take 8 to 10 years to overcome the 1964 shortage of qualified traffic engineers working on the urban problem. This does not, of course, provide for the needs of the growing population and its spreading urbanization during the decade.

Funds for Traffic Improvement Programs on Existing Streets

At least one city has obtained information on the costs of meeting present and future urban transportation demands. Phoenix, Arizona, a pilot study city for the National Committee on Urban Transportation, has estimated that an expenditure of 25 million dollars a year, over a period of 20 years, will be needed to accommodate its urban transportation needs. One-third of this is associated with facilities to be developed by the State Highway Department. Funds for the remaining two-thirds needed for major and local street development and improvement must, under present law, be the responsibility of the city.[10]

Funds to be expended on street improvements are difficult to find. It has often been observed that it is easier to obtain millions for a freeway than a few thousand dollars for traffic signal improvements. The processes of Federal and state government for financing state highways and their connectors are well established, but city finances do not normally permit appreciable expenditures on street improvements. Cities need *additional* sources of significant funds for the improvement of streets which are not state highways or their designated connectors.

The solution to this problem is not clear. The urban transportation planning process required by the Federal Highway Act of 1962 should reveal present and future transportation deficiencies and dollar

[8] Institute of Traffic Engineers, Report of ITE Technical Committee C2, *Traffic Engineering,* April 1958, Washington, D. C.

[9] Institute of Traffic Engineers, Report of Committee 2E on Traffic Engineering Education, "1961 Survey of Traffic Engineering Education," an informational report, Mimeo, July 1962, Washington, D. C.

[10] Hall, Edward M., "Financing of Streets for Phoenix," *Traffic Quarterly,* The Eno Foundation for Highway Traffic Control, Saugatuck, Connecticut, January 1964.

needs. It should also provide the information required to classify streets and to designate urban *systems* of streets for fiscal, and other, purposes. The jurisdictions responsible for development of each portion of the system should then be defined so funds and authority are properly channeled.

Recognition of the need to do this was reflected in a resolution passed by the Institute of Traffic Engineers at its last annual meeting.[11] This resolution asked the U. S. Congress to authorize a comprehensive study of continuing and future highway transportation requirements which would review the resources available for transportation and define the responsibilities of the several levels of government for improving the components of street and highway systems.

Need for More Traffic Operations Research

The techniques of traffic engineering have advanced rapidly since 1930 when the profession was established. Yet, there are many things traffic engineering still needs to know. Better standards and warrants for traffic engineering improvements should be developed so traffic engineers may make optimum application of old techniques. The perfection of promising new "tools" of traffic engineering is even more important. For example, more research is urgently needed in the areas of traffic simulation, surveillance and communications. Simulation may lead to a "breakthrough" of flow theory knowledge which could provide a method for quickly determining how to deal with a given problem, such as at a complex intersection. Better means of traffic surveillance and understanding of its results may help traffic engineers devise methods for deploying traffic over parallel facilities so all will be used to capacity and none will break down in operations. Improved communications, of one type or another, between drivers and vehicles in the traffic flow could appreciably reduce safe headway required between vehicles at higher speeds and thereby increase road capacity as much as ten times the present values. Exploratory and development studies of these "new tools" are already in progress.

The principal source of financial support for traffic operations research is the National Cooperative Highway Research Program. This program was started in 1962 and its funds are derived from 5 percent of the one and one-half percent of federal aid called the Highway Planning Survey Funds. The program consists of a three-way agreement among (a) those highway departments participating, (b) the American Association of State Highway Officials and (c) the Highway

[11] Institute of Traffic Engineers, "Highlights and Reports—33rd Annual Meeting," *Traffic Engineering,* October 1963, Washington, D. C.

Research Board. The funds provide financial support to other bodies for research on highway planning, design, construction, maintenance and operations. Of the 56 projects supported by these funds, about 40 percent of them deal with traffic planning and operations.[12] It is likely that over 100 projects supported by this program will be underway by 1965, and hopefully a higher percentage will be in the areas of traffic operations.

The remaining portion of the Highway Planning Survey Fund which is not administered by the NCHRP is available to the various highway departments for research. A number of projects dealing with traffic operations are funded from this source.

The Institute of Traffic Engineers has a Technical Development and Research Fund which is limited in amount but is available for research on matters of traffic engineering. In addition, a number of bureaus, foundations and institutes have funds available for certain types of highway operations research.

Contrary to conditions of the past, the availability of funds does not seem to be a limiting factor in the accomplishment of the type of research needed for traffic engineering. The problem now is to develop new research ideas accompanied by good experimental design and to find adequate personnel to conduct the projects. Regardless of pressing problems of accidents and congestion to be solved in practice, traffic engineers must find time to carry out traffic operations research.

Conclusions

The *modern* challenge to traffic engineering is its recognition of the responsibility it has to help solve broad urban transportation problems. Steadily increasing traffic volumes and traffic fatalities call for status "go" rather than status quo traffic engineering improvement programs.

To achieve its objectives and optimum effectiveness the urban traffic engineering program must have increased professional personnel. Increased funds for improvements of existing facilities must become available and old tools of traffic engineering must be sharpened as well as new tools developed through research.

The Federal Highway Act of 1962 calls for a continuous urban transportation planning process in order to qualify for federal aid in most cities. The future role of traffic engineering is to contribute heavily to this effort to help plan and implement an adequate, well balanced, coordinated and integrated transportation system.

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[12] Highway Research Board, National Cooperative Highway Research Program, "Quarterly Progress Report Three," December 31, 1963, Mimeo, Washington, D. C.