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Traffic Jam: Sic Transit

In this nation of laissez-faire individualists (and status-seeking car owners: the "bigger the better") in recent years, transportation has been based on the use of the private automobile. But the possibility that we may soon be unable to get from here to there by car easily, economically and safely now seriously concerns planners, educators, and citizens in the major urban centers of the country. Freeways have not really been a solution to the problems of traffic congestion — rather they have encouraged increased automobile use and extended low density urban development over wider areas — and the inefficiency of the automobile is more apparent than ever. With the related questions of population growth, resource management and environmental pollution, an alternative to the automobile has become imperative.

It is difficult to accurately assess the costs and benefits of freeway development — but there is more and more evidence to indicate that freeways may not be a sound public investment. According to *Look* magazine it now costs some 5 million dollars per mile to build one lane of urban expressway. The yearly cost to pay off these central-city roads adds up to 7¢ for every mile every commuter car travels, yet revenues from gas taxes and tolls pick up only 1¢ of the

The MTC: What is Its Responsibility?

The Metropolitan Transit Commission, working in the context of the Metropolitan Development Guide developed by the Metropolitan Council, has called on a 41-member Citizen's Advisory Committee on Transit to guide its recommendations.

In addition, the direct costs to commuting drivers are going out of sight: parking charges, tolls, mounting costs of insurance and maintenance are making automobile commuting costly and much less convenient.

There is general agreement that there must be an effective mass transportation alternative to the automobile — but as yet there have been no decisions made as to what form that mass transportation should take in the Twin Cities Area. There are many opinions about what that form should be — such as those expressed by Prof. J. Edward Anderson in this issue of the Reporter.

The Urban Mass Transportation Administration is concerned with transportation as a system, combining various modes of travel in a complementary way — utilizing present technology and developing new technology in a system of "getting it all together".

This issue of the Reporter directs attention to the transportation planning now going on in the Twin Cities Metropolitan Area: What groups are engaged in attacking our urban transportation problems? How do they coordinate their efforts? What role does the University play in this problem area? And what national solutions might be generated here in Minnesota?

This committee is chaired by Warren Ibele, Associate Dean of the Graduate School and Professor of Mechanical Engineering at the University of Minnesota.

The Transit Commission and its Advisory Committee have been examining a portrait of the seven-county metropolitan area, circa 2000:

- There will be 3.4 million residents (compared with about 1.9 million at present).
- There will be 1.2 million housing units (there are now about 600,000). Almost three-fourths of the additional units will be high-density, multiple unit.
- There will be almost three times as many automobiles as at present, and their owners will make four times as many trips!
- Employment will more than double, as more women will enter the work force, and more persons will work beyond usual retirement.
- Demand for office space, will triple, with about 40 million new square feet envisioned as new employment is generated most rapidly in banking, finance, law, insurance and government.

One of the major premises of the Metropolitan Development Guide calls for development to occur in regional, Major Diversified Centers. The term refers to a center containing sufficient commercial, cultural and educational activity to support a regional population of between 200,000 and 300,000. It is in this context that the Metropolitan Transit MTC (Cont'd on page 5)

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Coordination in Transportation Planning

Major transportation planning in the metropolitan area is presently being carried out by the inter-agency Transportation Planning Program (TPP) established in 1969 and fully staffed and financed in 1970. Its purpose is to carry out coordinated transportation planning for the seven-county Twin Cities metropolitan area. Chief participants in terms of financial participation are the Metropolitan Council, Minnesota Highway Department, Metropolitan Transit Commission, the seven metropolitan counties, and the central cities of Minneapolis and Saint Paul. A central staff has been recruited. Staff members are Metropolitan Council employees and are housed in the Council offices. It thus serves as transportation staff for both the Metropolitan Council and the inter-agency planning organization. The staff serves in both a plan production role and in a coordinating role. TPP Director is Eugene Avery, Donald Carroll is Senior Transportation Planner.

The TPP has the general responsibility of turning out metropolitan-scale integrated transportation plans and transportation development programs by late 1972. But before those recommendations can be made, basic questions of a transportation development strategy for the metropolitan area must be answered.

One of the early needs was that of gathering travel data pertinent to the metropolitan movement system so as to be able to update the entire system of travel forecasts for the metropolitan area. No comprehensive metropolitan travel surveys had been done since 1958 and there have been obvious major changes since that time in metropolitan development and in the travel patterns based on that development. Data collection activities were carried out in 1970 and travel data is now being machine processed for use in analysis and plan-program development. Development of urban activity and travel forecast models is now well under way. The new survey data will be used in these models in mid-1971 to produce a set of revised travel forecast data for the metropolitan area.

Systems development work in 1970 was heavily concentrated upon trans-

portation policy development for the metropolitan area as a whole. Two areas received the most attention.

- First, the need for establishment of a comprehensive framework for metropolitan transportation planning was addressed through the drafting of the Metropolitan Council's Development Guide for Transportation. As a major metropolitan transportation policy statement, the Guide emphasizes a multi-criteria approach in transportation development. It stresses the importance of considering the disruptive effects of new urban highways and problems of neighborhood preservation. At the same time it emphasizes the critical objective of furnishing accessibility to opportunity for the urban population — accessibility to jobs, to recreation, to shopping facilities. It stresses the importance of such accessibility for all segments of the population — not just auto drivers — and recommends substantially increased attention to transit. Further, the Guide emphasizes the context of transportation development as a part of general metropolitan development and the need for planning of transportation facilities.

- Second, the publication **Transit in Transportation** recently published by the MTC reflects elements of general transportation policy as well as specific transit policy and concept plans. The document, basically prepared by joint staff effort, was approved by the TPP organizational structure and reflects a substantial degree of unanimity among agencies and governmental bodies having diverse interests.

The primary task now in transportation systems planning is to develop proposals for physical improvement in metropolitan transportation within a general framework of metropolitan development policy. Systems planning must include plans for highways, transit, and terminals, put together in an integrated fashion. It must consider environmental factors and problems of preservation of neighborhood units. Further, it must consider the importance of transportation development as one of the tools which the public can use in determining the nature of future metropolitan development.

Work oriented to specific corridors within the metropolitan area seeks to

resolve often long-term transportation problems in various parts of the metropolitan area. Corridors southwest and northwest of downtown Minneapolis and east of downtown Saint Paul are examples. Such areas are generally those in which several governmental units have jurisdiction. The "problems" and "solutions" must include streets and highways, transit, land use plans, and a variety of social and economic considerations. Achievement of a "solution" then, depends upon coordinated action of a number of governmental units applied to a complex bundle of problems. For this reason committees or task forces are often established to advise or conduct area or corridor studies.

Systems planning, because of the large scale involved, must concentrate on fulfilling metropolitan needs, shaping major developments, and providing a complete, continuous, interconnected and area-wide system. Project planning, on the other hand, starts with the general location, timing, and service level of a transportation facility as a given, and concerns itself with a variety of detail, from center-line location to design details to precise scheduling.

Corridor or area or sub-metropolitan studies are an attempt to bridge the gap between general system premises and project planning. They begin with system planning assumptions, as to the magnitude and direction of travel and end with the general location, timing and service level needed to start project planning. They can be much more comprehensive within a given area than systems planning. They can consider the small scale effects of the large scale decisions, the goals and values of neighborhoods and communities as well as the metropolitan area. They can coordinate transportation improvements with other developments or activities at a manageable scale.

These sub-metropolitan studies are therefore considered to be an important part of metropolitan transportation planning. Separate studies are now under way in five areas — the TH 494-100/Southdale area, an east-west corridor (Northtown) north of Minneapolis, a major preferential bus-on-metered-freeway demonstration project on I-35

COORDINATION (Cont'd on page 4)

Coming: A New Era in Urban Transportation

J. Edward Anderson

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Interstate Highway 35W carries a maximum of about 6000 people per hour into Downtown Minneapolis. Each of its three lanes in each direction can carry a maximum of a little over 1500 cars per hour; and, with an average of 1.3 people per car, you get 6000 people per hour. To move this many people by auto requires a freeway almost 300 feet wide; it requires the people who live along the freeway to put up with unhealthy noise levels; it divides communities and displaces many families. To park an hour's worth of cars from I-35W, i.e., 4500 cars, in single-entranced parking ramps requires about 10 such ramps. In these terms, a capacity of 6000 people per hour is quite impressive. To attain it by automobile, the cost to the community is very high.

Isn't there a better way? When we look for one, we see that a number of problems must be solved at once: the problem of the exorbitant amounts of land required to move automobiles, the problem of ever-increasing air pollution, the problem of congestion which will get considerably worse in the next decade if we continue to rely on the automobile, the problem of high and rising costs of the auto, the problem of deaths and injuries, and the problem of immobility of the considerable number of non-drivers in our cities.

In trying to devise systems which can solve these problems, we must remember that our new systems must have enough appeal so that people will voluntarily choose to ride them for a significant fraction of the trips they make. Conventional busses and subways have been unable to do this. Even shiny, new, air-conditioned busses and trains have not been very effective. When they have a choice, people still prefer their autos.

The trouble is with the basic concept — the concept that the way to move more people is to use large vehicles. If everyone was coming from the same place and going to the same place, large

vehicles would be fine. In most metropolitan areas, however, people come from many places to go one place, from one place to go many places, and most commonly, from many places to many places. As far into the future as we can see, it will be this way.

To go by bus or train requires many stops and starts, and often more than one transfer. The result is that no matter how plush the vehicle, it simply takes more time and is more inconvenient than the auto. In the larger metropolitan areas of the United States where the congestion is much, much worse than in the Twin Cities, people still use their autos.

Any new system of urban transportation must match as closely as possible the advantages of the auto, i.e., its convenience, short travel time, privacy, and its ubiquitousness. We need to try to combine as many as possible of the advantages of the auto with advantages of transit without the major disadvantages of either. The main advantage of conventional transit is that you can use it if you don't have a car, can't drive, or are willing to put up with one set of inconveniences in order to avoid another. Rail transit has the additional advantage that, because of its exclusive guideway, it may be faster than the auto for some trips.

Now let's consider what can be done. To get a system that is sufficiently fast we need to use an exclusive guideway. But we can't use large vehicles. Large vehicles are needed on a conventional guideway system simply because one has to space them far enough apart to allow for the time required to stop at the stations. Typical minimum time headways are of the order of two minutes. With the 6000 people per hour given in the above example, one must move 200 people in two minutes. In other words, each train must carry 200 people. Then all these people must stop at all the stations between their respective origins and destinations.

Why can we move 6000 people per hour by car with only 1.3 people per

vehicle? Simply because each trip on the freeway is non-stop. Obviously we must design the transit system to operate in the same way, i.e., we must put the stations on bypass tracks off the main line. We have come to call this an "off-line-station transit system," somewhat clumsy but descriptive.*

With an OLSTS, we can expect to attract more people into each car during the rush hour than we do in the case of the automobile for the simple reason that the stations act as gathering points. A reasonable capacity for an OLSTS vehicle is six people and its length would be about 10 feet. This would allow people to travel with a reasonable group of friends, but is not so large that we could not run them routinely during off-peak hours with only one person in them. With auto-sized cars on a guideway switching in and out of stations, the safety and economy of operation would be much more favorable if the vehicles were controlled automatically under the guidance of a central computer. Thanks to developments in the aerospace industry over the past two decades, the theory and practical components for performance of these automatic-control functions are available.

By properly designing the operating procedures of an OLSTS, it is reasonable to expect to average four people per vehicle. Going back to our comparison with I-35W capacity, to move 6000 people per hour with an OLSTS, will require 1500 vehicles per hour. This is equivalent to one vehicle every 2.4 seconds. A reasonable line speed would be 50 mph. At this speed the nose to tail spacing between vehicles would be 165 feet or 55 yards. A considerable amount of analysis and simulation has indicated that with regular maintenance and redundant components, the above spacing can be maintained at acceptable levels of safety for public transit.

Now let's look at some of the advantages of OLSTS. In the first place, the guideway structure required to support 10 foot, six-passenger vehicles at nose-to-nose spacings of 175 feet is extremely light weight compared with the structures required to support conventional trains. These structures could be installed along

*These systems are also called *Personalized Rapid Transit (PRT)*. We have avoided this term in this article because of misunderstandings which surround it.

railroad tracks, along the edges of free-ways, and down the middle of arterial streets where conventional transit would be unthinkable because of requirements for space and because of noise. The OLSTS vehicle would glide along at no more than 50 mph as compared to speeds up to 70 to 80 mph for conventional rail transit. (The higher speed is needed because of station stops.) Both because of this difference in speed and because of the huge difference in the size of the vehicles, the OLSTS would be considerably quieter.

Most stations need only be long enough to handle two vehicles, and five such minimum stations will be able to handle the capacity of the entire line. In a downtown, the line speed would be reduced to about 20 mph enabling stations to be placed every block if desired. Because of these small stations, because of the lightweight guideway structure, and because of the minimum land requirements, the cost per mile of an OLSTS would be considerably less than in the case of conventional rail transit. Estimates now indicate the cost per mile will be from one fifth to one tenth of that of a conventional rail transit system. This would enable a community to install a considerably greater number of lines than with conventional hardware.

Because the stations are off the main line, each trip on an OLSTS would be non-stop at least on one line. This gives the passenger a much more comfortable ride, it increases the average speed to almost the line speed instead of half the maximum line speed and results in an energy requirement to move a given number of people a given distance to less than one tenth of that required with conventional transit. The comfort, convenience and speed of the trip will make transit considerably more attractive than conventional transit and promises to attract a significant number of people out of their automobiles.

With off-line stations, the stations can be placed as close as a quarter of a mile apart without affecting the line speed. For both this reason and because of the much lower cost per mile of line, our calculations show that about 15 to 30 times as much of the metropolitan area can be placed within walking distance of stations with OLSTS as compared to conventional rail transit.

During a rush hour, vehicles would be continuously circulating around the guideway — emptying in one direction and filling in the other. During one peak period, each vehicle could make at least six round trips with three times as many people as carried by automobiles. This means that one OLSTS vehicle could take the place of 18 or more autos! In an era of material scarcity, this could be of considerable importance. Each OLSTS vehicle would be powered by approximately a 30 hp motor — much less than an auto. With vehicle spacings of 175 feet, each 100 miles of two-way track would contain 6000 vehicles — replacing 108,000 autos — and, if all these vehicles were running at once, the electric power required would be about 70,000 Kw. This could reduce the air pollution levels in a city by a very considerable amount. Electric power is generated in large plants where pollution can be controlled much, much better than in individual automobiles. As oil becomes scarce, effective alternate transit could be essential to economic viability.

With OLSTS it is possible to consider vehicle transfers from line to line. Some recent work at the University of Minnesota has shown that this can be done with very little sacrifice in land. It has obvious advantages in terms of convenience and comfort, especially for elderly and handicapped people and for movement of goods.

Because of the advantages given above, it appears very probable that the construction and operating costs of OLSTS can be recovered from operating revenues. A recent study by the Bendix Corporation for Columbia, Maryland has shown this to be the case. This, in itself, is a revolution in the transit industry!

Many companies are developing OLSTS both in the United States and in Germany. At least five of these systems are in such an advanced state of development that operating demonstrations in real people-moving situations could be constructed and operating within two years from contract. In the Mechanical Engineering Department, we have been improving our understanding of these systems for two and a half years. Since June, 1970, CURA has sponsored a faculty task force to work with the Metropolitan Transit Commission in developing plans for demonstration of an

off-line-station transit system in the Twin Cities. In February, 1971, the MTC voted to seek funds for such a demonstration, and plans are currently underway to develop a proposal to the Federal Government.

To bring the ideas and progress on OLSTS before the public, KTCA recently completed a 12-week series of programs entitled, "Urban Transportation: A New Era," which concluded on March 26 with a report of a group of 23 senior engineering students whose project was to design a demonstration of an OLSTS.

Any new technology, however favorable it appears, should be studied carefully before it is deployed. To this end, an interdisciplinary group of faculty members from engineering, geography, economics, architecture, and political science is seeking funds for a Technology Assessment study of the direct and indirect costs and benefits to the community which would accrue if an OLSTS were deployed over a period of time to become the major transit system in the Twin City Area. Information we have now indicates these new systems will have a very significant positive effect on the entire fabric of urban life.

COORDINATION (from page 2)
south, in St. Paul's east side, and a Midway-University of Minnesota corridor.

At the general system scale, a number of physical, social, and economic objectives have been identified, not the least of which is coordination of planning and development — of highways, transit, land development, parks, sewers, and housing, for example. The objectives include not just the qualities of each physical system, but the functional relationships of one to another and their general interaction with people, neighborhoods and environment. One way to ensure that these objectives are met is to plan comprehensively within a multi-community area having some commonality of problems or needs for physical service systems.

The total metropolitan transportation enterprise is large and diverse. If integration and comprehensiveness are to be achieved a first and continuing planning function must be that of communication — and communication through proper liaison and coordination has been a major part of the work of the TPP organization.

University "in-PUT"

Since the Spring of 1969, CURA has encouraged the development of an active Program in Urban Transportation (PUT), at the University of Minnesota which is coordinated by Dr. Daniel L. Gerlough, Professor of Civil Engineering. This program was organized to bring the abilities of a variety of University departments to bear on problems of urban transportation. Efforts of the program lie in both training and research. An interdisciplinary committee consisting of nine University faculty members from eight different academic departments provides program direction.

Central to PUT is the "core seminar" which brings together all interested participants for the purpose of interdisciplinary discussions of various aspects of urban transportation. In addition to faculty and students from a variety of departments, this seminar has enjoyed active participation from representatives of the Minnesota Highway Department, the Metropolitan Transit Commission, the Metropolitan Council, City of Minneapolis Departments of Traffic and Urban Planning, U. S. Bureau of Public Roads (now known as the Federal Highway Administration), several consulting firms, 3M Company, Honeywell, etc.

Seminar sessions have featured faculty and student speakers plus many distinguished speakers from a variety of agencies in the U. S. — and two English authorities. Attendance at these sessions has averaged 30. During the Winter Quarter, the attention of the seminar participants has been directed to an interdisciplinary attack on a specific problem: "Transportation Policies for the Southwest Sector." As a result of the enthusiastic response to these transportation seminars, a formal interdisciplinary course in urban transportation will be organized during 1971-72.

Since July, 1969 there have been several research projects underway. The areas into which these projects fall include:

- Forecasting future transportation demands
- Problems in urban mass transit
- Miscellaneous problems of operation and control in future mass transit systems

One new project scheduled for 1971-72 will deal with policies and techniques for assessing tolls for use of certain roads during peak travel periods. When these studies are complete the data will have relevance for transportation planning in Minnesota. One of the products of the research effort is the plan of Dr. J. Edward Anderson, Professor of Mechanical Engineering, for "Personalized Mass Transit", a term he eschews (see Article this issue: — Coming: A New Era in Urban Transportation).

To aid the research and training efforts an Urban Transportation Literature Collection has been started. This collection has as its primary focus material relating to transportation, but the ranges of topics within this field gives the collection general applicability to many phases of urban problems. Such topics include transportation planning, new transit systems, land use and property value, mobility and job opportunities, policy sciences, information systems, metropolitan and regional planning, community values, population and forecasting.

The collection is housed in Room 195 Experimental Engineering Building on the main campus of the University. Documents in the collection are generally not available in other campus libraries, but rapid processing and cataloging make material quickly available. About eighty percent of the collection is on microfiche, and the remainder is made up of books and hard copy reports. There is a computer-produced index to the reports and books which has detailed subject entries as well as an author index. Additional copies of the index are available at the Public Administration Library and the Engineering Library.

Since July 1, 1969, grants totalling \$413,000 have been received from the Urban Mass Transportation Administration of the U. S. Department of Transportation. Among other things, the grants from the Federal Government have been providing financial assistance to students in the form of fellowships and research assistantships. Thirteen students have received fellowships, and 24 have received Research Assistantships.

MTC (from page 1)

Commission has carried on its long-range planning. It has stressed the concept of operating high-speed rapid transit vehicles in major corridors between major centers and the central business districts, with "feeder" collection and distribution systems on either end of trips.

The MTC's Citizens Advisory Committee on Transit has engaged in "shirtsleeve" work since October, 1970, meeting with planners every other week to react to their current efforts. The committee's major findings to date are summarized in its six recommendations, all of which have been incorporated into the MTC's planning documents:

1. The committee favors the development of a mass transportation system as a competitive alternative to the private automobile. The mass transportation system should be developed within the family of vehicles planning concept. Fully-automated, fixed-guideway, fast links coordinated with collection-distribution and circulation systems utilizing the most current technological advances should be employed.

2. The MTC should proceed to identify the major transportation corridors and major station terminals in the area to be served. Experience in other communities suggests that the time-lag between initial discussion of a high-level transit system in a community and the initiation of construction can be as long as ten years. Until such time as the decision is made to embark on a program involving major capital expenditures all possible preliminary steps should be taken expeditiously and judiciously in order to minimize this time lag.

3. The MTC should proceed to further identify potential systems with the view to selecting that combination which will serve our area in most efficient and economical fashion. Systems presently under development and current technology should be evaluated for their ability to (1) shape in an orderly way the desired growth of the area, (2) provide a level of mobility adequate to the needs of all segments of the area's population and (3) preserve and enhance those aspects of the metropolitan area which make it an attractive region in which to live.

MTC (Cont'd on page 6)

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MTC (from page 5)

4. A limit should be placed on highway construction in the metropolitan area. Developing truly competitive transit facilities will reduce peak-hour highway demand, provide off-peak mobility and cause more efficient utilization of the existing highway network. Moreover, the presence of these facilities will move the area significantly toward the goal of a balanced integrated, transportation system. Increased coordination between highway and transit planning and funding is necessary to accomplish the most effective total transportation system. This coordination should be accomplished through a regional transportation planning unit.

5. A plan for financing transit improvements should emphasize (1) equitable distribution of local share funding according to benefit received and (2) effective coordination of capital budgeting between transportation agencies. The financial plan should be as broadly based as possible. Since as much as 2/3 of all capital costs are available from Federal sources, all sources of federal funding should be actively pursued. Highway funds should be used to construct all highway-related transit facilities. Local share financing should consist of three elements: (1) an inter-

modal transportation fund for all transportation capital improvements within the metropolitan area, (2) special benefit districts to allocate certain costs according to benefits received, and (3) general tax sources to support that portion of the costs which benefits the region as a whole.

6. The committee recommends that the Commission seek legislation which would permit a wheelage tax to be levied on the various metropolitan areas and used for ground transportation purposes (i.e., moving people). The committee further recommends that legislation be sought which would enable metropolitan regions to determine, on the basis of their needs, the distribution of state gasoline taxes and license fees collected in the metropolitan area to the various ground transportation systems (e.g., highways, public transit). Though certain highway needs remain in the metropolitan area, the portion of the total transportation needs which can appropriately be met by highways have been substantially completed. Since the state gasoline taxes and motor vehicle license fees will continue to generate income from seven-county residents, equity requires that these funds be made available to meet the total transportation needs of the metropolitan area.

As the Advisory Committee has noted in its deliberations, the seven-county metropolitan area is at a major decision point regarding how it wishes to serve the mobility needs that have been projected for the year 2000 and beyond. In the face of rapid growth and urgent needs, what should be the response of public agencies — particularly those controlling such growth-shaping public works as transportation, sewage, open space and zoning? Should agencies be passive, responding to growth as it occurs? Should they actively assert themselves to ensure that growth occurs in orderly fashion, with proper regard to what Minnesotans have come to know and appreciate as "quality of life?" Should they work to reorganize the decision-making processes to allow input from all affected persons—with the risks and delays it entails?

We can build another freeway network—and accept the financial and social sacrifices involved, including displacement of families, loss of acres and acres from tax roles, further imposition on open space, greater air pollution, less mobility for the nearly one-third of the population unable, for one reason or another to drive — or we can look to another mode, mass transit, to meet travel demand, particularly in the peak hours, and substantially reduce the need for covering our cities with concrete.