Possible Applications of Computers for Transportation

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INTRODUCTION

The development of large scale computers with easily programmable languages has allowed for the rapid expansion in the analysis of transportation problems. This expansion has been both of a qualitative and quantitative nature. We are attempting to analyze situations that just a few years ago would have been considered to be too complex and time consuming. The speed, of course, is the prime factor which allows for the investigation of very large and complex problems. However, the ease with which a transportation engineer can adapt himself to the use of large scale computers is also of importance. This presentation will only briefly review some of the current applications of computers in transportation. Yet, an attempt will be made to suggest some possible new applications and the requirements for attaining these goals.

URBAN TRANSPORTATION PLANNING

In the urban transportation planning process, computers have been the main force that has permitted such a diverse and complex analysis. Without the availability of the computer, we would still be using the older mundane approaches to the planning process. It would be almost impossible to perform a detailed trip generation analysis by hand. The procedures employed in regression analysis as well as the other techniques used require efficient mathematical capabilities. To perform these by hand is neither efficient nor interesting. The distribution of trips in the planning process requires the use of large scale models such as the gravity or intervening opportunities model. To perform sensitivity analysis with these models without the aid of a computer is fruitless. The evaluation of both the present and future network requires the use of models in the trip assignment process. Again to solve minimum path algorithms and to load networks on any basis requires great computational ability. Likewise, our modal split models
require as much capabilities as other aspects of the transportation planning process.

REAL-TIME PROCESS CONTROL

We have also seen the use of computers in traffic control, although perhaps not as much as should be. Small, inexpensive computers are used to control the traffic at a single intersection. More complex computers are used to control multiple intersections. One of the limiting factors to the use of computers in this area has been the expense involved in furnishing traffic inputs to the computer. However, our technology is rapidly changing and this may not be a deciding factor before long.

In the area of control, computers are being used in both private and public transportation systems. Freeway control (ramp metering) is highly dependent upon the capabilities of the computer. This is especially true if a systems approach is taken to freeway control rather than the treatment of isolated bottlenecks. As a spin-off from the ramp metering, information systems are being developed to operate in real-time. These information systems furnish traffic information to freeway users about the traffic conditions ahead. The information system relies heavily upon the capabilities of the computer to continuously monitor the freeway and make programmed decisions for informational displays.

We also have automated automobiles, highways, and route guidance systems. General Motors has in operation a unicontrol car. It has no steering wheel, no gearshift lever, no accelerator, and no brake pedal. All of these items are replaced by a single knob that is computer controlled. Likewise, completely automated highways are operational on a test basis. By computer, an automobile travels along the road and maintains acceptable speeds and headways. Similarly, much resources have been used to develop a sophisticated route guidance system. At each intersection the driver can be furnished the appropriate turning movements so that he may stay on his correct route—all by computer control. The full implementation of all of these is mainly restricted by economics.

In public transportation systems, the computer is becoming indispensable. New subways, elevated systems, commuter rails, etc., are all relying on computer guidance and control. New proposed systems such as the Demand-Scheduled-Bus systems cannot function without computer scheduling. Our high speed ground rail as well as our air traffic depend heavily upon computers and this dependence will in-
crease. We see new transportation systems often referred to as "people movers" being proposed for the CBD, shopping centers, airport terminals, etc. These are all computer dependent to some extent. The control, if the system is to be successful, has to be by computer. We are obsessed with the importance of time, and as long as this obsession remains, the computer becomes not a luxury but a necessity.

So far, we have commented a lot on process control. There are, of course, just as many applications in other areas of transportation. A brief comment has already been made on the transportation planning process. Let's now look at some other applications.

GENERAL APPLICATIONS

In many transportation agencies of a local, state, federal, or private nature, there is really little need for draftsmen. Some firms are paying many times more than they have to for drafting work. The computer with the ever increasing sophisticated plotters can relieve much of the drafting work from the human. There is very little need for a draftsman to make any kind of charts, graphs, various line drawings, etc. It is generally a waste of resources for humans to perform these tasks. Likewise, many, or perhaps we should say, most highway departments still do all of the geometric design of highways by hand. Except in very limited and special cases, this hand method is no longer needed. Consider the activities that are performed by automation in banks, industrial firms, etc. We have as many functions that likewise can be automated in our state, city, and county transportation departments. Of course, many activities are automated in our transportation oriented departments.

There are so many good potential uses of computers that it is difficult to explore them all. There is no reason why an analysis of various geometric designs cannot be analyzed for their operational characteristics before they are built. All of our plans should be tested before the facility is constructed. This also holds for public transportation systems. Presently, much emphasis is placed upon the computer simulation of public transportation systems to analyze their performance before they are built. Why has not this same philosophy filtered into the highway system? Every major expenditure for construction of new facilities or systems should be thoroughly simulated to allow for a complete and thorough analysis.

The transportation engineer, of course, is relying more and more on the computer to solve his day to day problems. Some state highway
departments have remote terminals at the district offices tied-in to a large scale central facility. This permits the day-to-day problem solving to be computer oriented. However, the number of highway departments doing this seems to be small. Yet the need for automated data collection, analysis, and dissemination is needed for every state highway department. In addition the city and county agencies should have access to much of the information. This access should be in real-time.

RETARDATION OF COMPUTER USAGE

Let's explore for just a few moments why we are not really moving rapidly into some of these computer applications. Generally, there are two types of attitudes expressed by engineers concerning computers. There is the engineer that believes every job should be computer oriented. The other extreme is the engineer that is still convinced that the computer is a fad and that one should not waste his time with such activities. Most of the time, both of these individuals are completely ignorant concerning computers. Seemingly there are few engineers that lie in between these two extreme positions. And this is where our greatest need arises. We might ask ourselves why we are experiencing such incompetence in the computer field.

This problem is partially due to our engineering colleges and universities. Whenever we decide that a thorough and complete education in computers is as important as a thorough and complete education in transportation, structures, sanitary, water resources, etc., we will begin to make progress. Until then, the present state is merely perpetuated. Our thinking on engineering curriculums needs revisiting again and again. We are often too structured for a changing environment. We so desperately need engineers that lie between the two extremes. Engineers that will become managers, supervisors, decision makers on a very high level will not be able to properly evaluate various alternative courses of action without a good background in the computer science area. The gap is widening and unless we meet the challenge, we of all disciplines will be most miserable.