

Societal Issues and Transportation Education

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In the field of transportation today, a number of factors are evident: the emergence of a new profession; the emergence of new institutions; the emergence of new forces influencing transportation decisions; and the current backdrop of existing institutions.

We can indeed say that there is now a profession of transportation or, as some prefer to call it, transportation systems analysis. This profession has emerged during the last 10 years and is characterized by a number of features:

1. It is multimodal in perspective;
2. It is multidisciplinary, using the techniques and concepts of engineering, economics, systems analysis, operations research, management, law, political science, and the social sciences; and
3. It is multisectoral in that transportation system problems are treated from a variety of perspectives, including carriers, shippers, travelers, transportation operating agencies, state governments, local governments, federal governments, and international organizations.

The emergence of this new field is evidenced in several different ways.

1. There is now an intellectual coherence and unity to the field. The theory of transportation systems analysis has become clear, involving applications of economic concepts and using systems analysis tools. This theory has been used in a variety of applications, beginning with the urban transportation planning studies required in the United States by the Federal-Aid Highway Act of 1962; the Northeast Corridor project and other regional transportation studies; the Harvard-Brookings study of transportation policies in developing countries; and statewide, corridor, and new systems planning studies in North America and around the world.

2. The body of knowledge is now sufficiently large that no longer can one be a generalist in the field of transportation. The field is so broad that no single professional can comprehend and keep up with the current work in all aspects of transportation. Therefore, we now see the emergence of a variety of specialists such as demand experts, technology experts, evaluation experts, and network modelers.

3. A recognized professional community has developed. Within North America, the Transportation Research Board and the Transportation Research Forum are the

leading professional organizations. Internationally, a variety of transportation journals specifically address the international professional community in transportation. Most recently, the First International Conference on Transportation Research was held in Belgium, and 140 papers were presented on various aspects of transportation research and policy.

In addition to the emergence of the profession, we should also note the emergence of new institutions oriented toward transportation. Multimodal transportation planning agencies and regional planning agencies with strong transportation capabilities have been established. And, in response to the Federal-Aid Highway Act of 1973, which includes significant changes in funding provisions for transit and highways, we are likely to see even more significant changes in the nature of the institutions in the transport field, especially in implementing agencies. In parallel with the above, a new set of forces have arisen to shape transportation decisions.

1. Citizen opposition to highways, airports, and other forms of transport as well. In response to this opposition, new legislation provides effective compensation to displaced families. Greater emphasis is given to citizen participation in the transportation planning and decision-making process, and a wide range of deep-seated and far-reaching institutional changes are in process.

2. Citizen concern for the incidence of effects. Which interests gain and which interests lose from various transportation decisions? The pressures of today are such that transportation professionals can no longer ignore these incidence issues even if they wanted to.

3. Greater public concern for the environment in all of its dimensions, especially as reflected in the National Environmental Policy Act of 1969 and in the Federal-Aid Highway Act of 1970, Section 136 (B). These pieces of legislation require procedural changes in transportation planning and decision-making to ensure more substantial consideration of adverse social, economic, and environmental effects throughout the course of transportation planning and decision-making.

4. A rising distrust of the professional, especially the transportation planner and engineer, and a crisis of confidence in the institutions, as well as the professions, involved in transportation planning and decision-making.

These forces have only recently emerged, and their power has only scarcely begun to be felt. As a consequence, transportation professionals, whether in the public or private sector, must be concerned with criteria encompassing a far wider diversity of considerations than efficiency, profit, and other narrowly defined criteria that historically were the basis for transportation decision-making. Even the very professional roles and attitudes of transportation professionals must change.

With the emergence of a new profession, new institutions, and a new set of forces to shape transportation decisions, we cannot but feel a sense of elation and excitement.

Yet, we feel also a sense of frustration. There are still large numbers of professionals whose education and on-the-job environments have not equipped them for these new conditions and in fact may hinder their abilities to adapt. For example, professionals such as civil engineers or economists each wear particular cultural blinders as a consequence of their education and training. The ability of most of the professionals involved in transportation to respond to the new forces has caused the crisis of confidence. Although new organizations with names such as "department of transportation" or "comprehensive planning agency" have been established, the job of bringing about attitudinal changes in a way that significantly changes operative behavior has just begun.

Even in the universities, we find great resistance to the changes required by this new field of transportation. The disciplinary structures and orientations of academic departments are significant barriers. Promotion and reward structures in many universities are still designed to reinforce individual egos rather than the ability to participate in a truly joint research or teaching effort, which may require significant changes in previous views. Although universities may pretend that they are capable of mounting mission-oriented interdisciplinary work, the production of a synthesis that is truly

interdisciplinary and truly problem-related is often more the myth than the reality. The final report of a typical university interdisciplinary project is a compendium of separate chapters written by authors who do not even understand each other's jargon much less the substantive content behind the ideas.

Universities are static rather than dynamic institutions, resisting change rather than encouraging it. Severe limits on funds greatly constrain what they teach and the research they can do. Funds for basic research in transportation are almost nonexistent, and funds for significant curricular development efforts are likewise almost totally lacking. Therefore, it is difficult for universities to adopt new orientations and to make major curricular changes to respond to these new conditions.

Thus, a sense of elation comes from the excitement of what has been achieved in the short history of the transportation profession and the corresponding institutions. The frustration arises out of how far we have yet to go: how deep is the problem of institutional change, and how difficult the task of reeducation of present professionals to a new perspective. Some may say we are too impatient and unwilling to wait a generation of 15 years (or more) until graduates reach positions of middle management where they can in fact operate with the new transportation perspectives. This impatience reflects, however, the conviction that the challenge posed by emerging new forces is too important to wait.

One way of summarizing the above discussion is to identify the basic substantive principles that must be addressed in incorporating consideration of societal issues into transportation education.

1. Transportation affects society. Any change in the transportation system of a region affects human behavior. In the short run, behavior of travelers is affected. In the long run, human behavior is changed in a variety of ways in that the location and structure of social and economic activities may be significantly influenced. Because of the significant effects of transportation decisions on human behavior in the short run and the long run, transportation must be seen explicitly as only one set of instruments within a broader set of more comprehensive planning and public decision-making options.

2. The effects of transportation must be viewed in terms of the differential incidence of gains and losses: which interests benefit and which interests lose from each course of action. This is both a moral imperative and a politically pragmatic one. As a matter of political reality, neither transportation analysts nor decision-makers can ignore any longer the issues of which groups benefit and which groups lose.

3. Transportation decisions are influenced by what happens in society in that all of the interests that may potentially gain or lose from a transportation decision on a particular course of action will play some role in influencing the decision that is taken. From a practical point of view, this means that the transportation analyst cannot assume that he or she can operate in a rational, objective manner completely aloof from the political process and deliver recommendations from a supposedly objective and value-free perspective. Such a perspective does not and cannot exist; and if the analyst pretends to be value free, he or she will reflect a set of biases that is perhaps worse than an explicit value bias. In other words, transportation professionals must realize that they are inevitably actors in the political process and cannot escape this. They must, therefore, define their professional responsibilities accordingly.

4. As a consequence, professionals in transportation have a role that is changed significantly from that which was visualized in the past. The professional can no longer hide behind a shield of supposed expertise. Rather they must be on the firing line of the political process, interacting with a wide variety of different interest groups, taking responsibility for what they analyze and how they analyze it, and exposing their professional judgments and value biases (implicit or explicit) to scrutiny, hostility, and criticism.

5. Change is required in our institutions to allow the transportation professional to take on this new role.

The above observations imply a general need for a new kind of professional not just

in transportation but in all of society. The new professional must have expertise in 3 major areas: technology; interactions between technology and society; and role perception and capabilities.

By technology, we mean an understanding of the performance and characteristics of a particular set of physical systems. For example, in transportation, what is required is a mastery in a fundamental way of behavior of transportation systems and of the methodological techniques useful in analyzing those systems.

By interactions of technology and society, we mean the understanding of the way transportation can influence the structure and functioning of social, economic, and political systems and the way these systems in turn influence the decisions that can and will be taken about transportation. In the short run, transportation influences the activity system in terms of changes in travel behavior; this is the problem of forecasting the demand for various transportation systems and services. In the long run, transportation influences the activity system; this is the problem of predicting land use and other long-term effects of transportation on society. In both the short run and the long run, there are elements of understanding cause-and-effect relations—what transportation system changes cause what changes in the activity system—and of understanding the institutions that are affected by, and that can affect, transportation decisions.

To master the technology and the interactions between the technology and society, transportation system professionals must acquire substantive knowledge about cause-and-effect relations within transportation and between transportation and society. They must also develop skills with a wide variety of methodologies (often referred to as "systems" techniques) including statistics, social science research methods, computers, economic concepts, and visual design capabilities.

Since 1966, the transportation systems analysis educational program at M. I. T. has been based on the premise that the transportation professional must have a deep understanding not only of the technology of transportation but also of the interactions between transportation and society. The program is also based on the concept that each student should master the substantive material—the methodological material, the systems techniques, and some aspect of the environment of transportation. The transportation and systems analysis requirements have been met by a mixture of core courses in multimodal transportation system analysis and systems techniques and of a wide variety of electives in various areas of transportation and systems analysis. The requirement for competence in some aspect of the environment of transportation has been met by requiring courses in areas such as urban politics, social policy, economics, management, and law. These concepts have been applied to doctoral programs as well as master's and undergraduate programs.

However, we have only recently begun to realize the need for material in the area of role perception and capabilities. This recognition has come about because of field work with state highway departments and the U.S. Department of Transportation and because of the frustration in the face of elation with which we closed the discussion in the first section of this paper. By role perception and capabilities, we mean the development of an individual's sense of himself or herself as a person and as a professional. This includes

1. A sense of history and destiny through understanding the changing world of humanity and the changing role of institutions in that world as reflected in a deep knowledge of history and humanity;
2. Understanding of the processes of innovation and change and of the means of change, achieved through historical studies of changes that have occurred, through evaluation of particular changes from various value perspectives, and through appraisal of the strategies and tactics by means of which various changes have occurred or could occur;
3. A sense of values in the senses of "ethics", of understanding how value conflicts arise, and of a deep-felt humility about the individual professional's role and capabilities in society (out of such a sense of values can come the basis for an individual's formulating a personal value position, especially with respect to the objectives of change);

4. A variety of personal skills, including understanding strategies of change in complex institutional environments, understanding the tactics of change, and developing management skills and skills required to operate effectively as a member of a team in an interdisciplinary context; and

5. A personal philosophy and articulation of personal objectives in the sense of arriving at an individual position as to one's personal and professional role in society.

Essentially what this means is that, in addition to an understanding of technology and of the interactions between technology and society, transportation professionals need strong convictions about their roles as individuals and as agents of change in society. These convictions must be rooted not only in a sense of history and an understanding of the historical processes of change but also in a personal value position—a clear articulation of personal professional goals in society.

This general philosophy can be brought into focus by a description of how this can be reflected operationally in the actual work of a transportation system professional. The analysis of the transportation system analyst should be structured in a way that is relevant to the political context in which he or she operates. This includes

1. Recognition of the incidence of gains and losses;
2. Recognition of the value biases that can be hidden in modeling assumptions or interpretations of data;
3. A concern for bringing out trade-offs and for clarifying objectives through analysis in a politically relevant way; and
4. Conscious and deliberate structuring of strategy of analysis to use effectively scarce resources of computer time, dollars, and skilled workers to accomplish an analysis that can influence the individuals and institutions that have the capabilities to make decisions and that can thus bring about change in the real world.

Perhaps one way of summarizing this concern is as follows: We as transportation professionals are in fact "change agents" in society. We need to educate ourselves to operate effectively in that role.

Thus, when we consider the topic of societal issues in transportation education we conclude that a new educational concept is necessary. This concept, although perhaps not so new in other professions such as business or social work, is new in engineering and in transportation particularly. The concept is that transportation professionals must understand their technology; the interactions between their technology and society; and their professional roles and capabilities as change agents. The real challenge is to work out precisely what this concept implies in terms of specific curricula. This concept should apply at each educational program level:

1. The professional or engineer's degree, which requires 6 to 7 years of total professional training with some kind of practical training in an internship (2 to 3 years beyond the bachelor's degree).
2. The preprofessional or bachelor's degree.
3. Certificate programs of 1 to 2 years and short-course programs of 1 week to 3 months for practicing professionals.

The development of such programs is not at all easy. There are a number of problem areas:

1. Resources. Significant resources will be required to develop the substantive material to put flesh on the bones of this program.
2. Relations with other disciplines. In developing such a program, we need to draw on the insight and experience of applied social scientists in fields such as organizational behavior, cultural anthropology, and sociology. However, pressures on individuals in these fields are toward a disciplinary orientation to their own professional peer groups, and present university structures do not effectively reward work of such professionals on a team basis to develop transportation or other similar curricula. Furthermore,

the problem of building communications at a level of operative understanding is extremely difficult and takes an investment of several years on the parts of all concerned.

3. Research base. To teach the kind of things we want to teach, we need to do research in these areas so that we are at the frontiers of knowledge and are able to communicate that excitement and insight in the classroom. At M.I.T. we have been very fortunate in recent years to be able to do some applied research in this area, but the funding and nature of that work have been such that we have only made uncertain approaches like children groping in the dark rather than acquired the knowledge that we really should have mastered in order to do the research we are doing.

4. Faculty roles and life-styles. We can no longer operate as self-centered professionals, striving to reinforce our own egos by producing our own identifiable pieces of work in a relatively abstruse, narrow area. Rather, to be effective as teachers in this new kind of curriculum, we ourselves have to be far more willing to work closely with others.

To summarize, if we look at the issues of societal concerns as they impact on transportation education today, we must conclude that transportation is an important agent of change. Therefore, our highest priority must be to develop a deep understanding, in ourselves and in our students, of our professional roles and capabilities as agents of change in society.