find acceptable substitutes;
3. To meld the special skills, disciplines, and talents of people who have historically acted in isolation into a cohesive forum for mutual problem-solving; and
4. To explore new ways of getting things done, including new forms of joint enterprise among planners and engineers and transit operators, and among all levels of government.

The Federal Highway Administration believes that the thrust of TSM is aiming all of us in the right direction. If we have the wit to perceive the raw materials around us and the will to use them creatively, often in nontraditional ways, we can shape a present and a future that can promote better transportation management, improve downtown commercial activity, and enhance the livability and environmental quality of the urban center.

IMPROVING PUBLIC FACILITY SYSTEMS

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This paper seeks to evaluate TSM within the larger context of the problems and characteristics of transportation and other public facility systems. Necessary to this are two other objectives: identifying the problems and characteristics of public facility systems and identifying strategies for improving their performance. The discussion is cast at the level of a class of systems. No attempt is made to evaluate the degree to which each public facility holds to the characteristics of the class of systems, though particular systems will be referred to in order to illustrate points or where an exception is illuminating. TSM is addressed at the end of the paper to provide a perspective on the problems it seeks to solve and on our expectations from it.

The term public facility systems refers to public and private transportation systems, electric and gas utilities, telephone utilities, water supply and sewage systems, public schools, welfare programs, health services, and other goods and services supplying activities that are either in the public sector or in the private sector in a public utility format.

The systems appear in diverse forms. They have differing histories and differing institutional forms; some are completely within the public sector, and others have certain private sector features. Their similarity is in the extent to which they exist within a strong context of public sector rules, organizations, and decision making.

Public facility systems are not the only entities affected by government actions. Governments provide legal context for free markets—including providing for property rights and their transfer and assuring competitive conditions. The public sector affects the distribution of the income and wealth; its actions express social preferences for good things (preservation of historical artifacts, for example) and against bad things (elimination of unsightly billboards); and it attempts to stabilize the economy. Public facility systems are not uniquely related to governments; government interaction is everywhere.

Economists distinguish usefully, but not absolutely, between private goods and public goods. Private goods are privately consumed and the consumption of the good by one person excludes consumption by all others. Public goods are those for which the principle of exclusion fails for one reason or another. In some cases exclusion may not be desirable either for public or efficiency goals. Although it would be possible to exclude some children from the education system, it would not be socially desirable. Although it would be possible to keep some licensed drivers from using the roadway system, no efficiency would be gained as long as roadway capacity is available. The results of some activities, such as the cleaning of the air, are so widely diffused that there is no way to exclude individuals from enjoying them. As a result of these features of public goods, voting is substituted for the market mechanism, and the public expresses its preferences in a collective way.

Distinguishing between public and private goods is useful. It is one cornerstone for the theory of public finance, which enables economists to apply normative economic principles to public sector matters while recognizing the differences between the public and the private sectors. But while useful, the distinction between public and private goods does not neatly distinguish public facility systems from other systems. Many public goods are provided by the private sector (armorments, for example), and many private goods are provided by the public sector (lumber from the national forests).

Another point to be considered in approaching public facility systems is the potential for spatial monopoly combined with the efficiencies to be gained from spatial monopolies: In a service area, one water supply facility is less expensive than many, one highway system is less expensive than many, and one electric utility is less expensive than many. The spatial monopoly potential and government activities to deal with that potential are another consideration bearing on public facility systems. Again, however, this is not a distinguishing dimension, for there is potential monopoly in most if not all forms of endeavor. The neighborhood drugstore or a steel rolling mill serving a regional market enjoy degrees of monopoly power from their spatial location.

So when considering public facility systems, one should bear in mind that their common feature is the degree to which they perform within the context of public sector rules and organizations. On other dimensions, some of which were mentioned, they are quite different. This context of public organizations and processes should not be dismissed as an accident of history or as incidental to other major dimensions. Each facility system was brought into a strong public format for good reasons. Attentive publics claimed rights, and politicians responded to these rights as political imperatives. Politicians crystallize claims, and they use those claims to rights as a basis for political power and political action. Although not all rights recognized by attentive publics result in the creation of public facility systems, all public facility systems were knit in a response to claims to rights. The systems' past, present, and future turn on the manner in which those rights are viewed by the public and treated in the political process.

The right of access to the transportation system was
well established in medieval Europe; that right continues to be expressed about the public road system and common carriers (1). The right to health, first recognized in this country around 1900 as public health, accelerated the deployment of water and sewage facilities; and the right to health, somewhat more broadly expressed, is currently a matter of great public debate. The right to service from electric and telephone utilities, in parallel with monopoly and efficiency issues, left strong imprints on those systems earlier in this century, and rights continue to be a matter of public debate.

It is important to note that, to the extent that service from a public facility system tends to be claimed as a right, the political process treats that service as an absolute and a thing by itself. As Braybrooke and Lindblom (2) point out, activities become disjoint; trade-offs, benefits, cost, and program coordination become secondary matters. The economists cry for rationality, the consideration of costs and benefits, the consideration of the impact of one program on another, and the consideration of efficiency takes second place in the debate. The plaintiffs and defendants of economic col-lide with the logic of political process: the logic of "fair shares" and "rightful entitlements." Equity concerns, mediated by political power, must be considered along with efficiency before economic rationality can claim strategic value.

The concerns of this paper are the problems of public facility systems and what might be done to ameliorate those problems; transportation system management is of particular concern. The remarks just made provide a strong, overarching context for those concerns. The context of rights to goods and services, the political process and the manner in which it treats those rights as imperatives, and the intertwining of political institutions with public facility activities are a first consideration for individuals or institutions striving for change.

CHARACTERISTICS OF PUBLIC FACILITY SYSTEMS

Public facility systems are shaped by their response to rights and goals framed in terms of those rights, and they operate within a public sector context. The characteristics to be emphasized in this section are those reflecting goals and context. One normative criterion would be that of how facilities perform under those conditions. Another appropriate normative criterion might stem from the ways in which attentive publics judge the systems: Is the public unhappy or not? A few normative statements will be made in the discussion to follow; for the most part, these are based on the criterion of public satisfaction. Public satisfaction is noted for two reasons: (a) Dissatisfaction is a basis for system change vis-à-vis the political process, and (b) satisfaction is an effectiveness measurement. It is a measure of how the public views the relations between resources used and outputs obtained, and their distributed impacts.

Control

While the day-to-day control of public facility systems is in the hands of facility managers, overall control is housed in regulatory or standard-setting agencies, such as the Interstate Commerce Commission, and sometimes funding agencies, such as the Environmental Protection agency and state and federal education agencies (3). Regulatory and standard-setting agencies are creatures of legislative processes, and both are hierarchical, representing local, state, and federal interests. Consequently, control is fragmented. Fragmented control leads to conflicting outcomes depending on divergencies in interest and conflicting control procedures and policies. For example, electric power sold at wholesale by a public utility in California to a local community for distribution is price regulated by the federal government; retail prices to other customers are controlled by the state public utility commission. Procedurally, federal regulators admit implementation of a price increase at the time it is requested, and the state public utility commission does not implement until after proceedings. Consequently, in California higher prices for electricity are currently paid by final users who purchase from local delivery systems than by those purchasing directly from the utility. Differences between regulation of intrastate and interstate transportation and telephone charges also lead to discrepancies between prices charged and services received. A within-state phone call or shipment often costs more than a longer interstate activity.

The facility manager operates the system from day to day within a context of standards and regulations. Mechanisms controlling managers' actions are revised from time to time through legislative and political processes. The style today is for changes in circumstances or public expectations to lead to a debate about a public facility; boards and commissions are established, studies are made, legislative revisions are made, and action is taken. Once action is taken there is a tendency to shield the day-to-day operations of the facility from the political process. Institutions such as boards of education or highway commissions are created and serve as surrogates for the political process in dealing with small matters affecting the operations of facilities.

When major issues arise, they are redebated through the political process and solved through institutional revision. So a debate about transportation results in revising state highway commissions into state transportation commissions or boards and giving them new authority and responsibility. For example, an act recently revised (or attempted to revise) the authority and responsibility of the Interstate Commerce Commission with respect to the railroads. So there is always a low level of public debate about facility control. In the main, it emerges as statements of frustration about fragmented responsibility, facility managers' lack of responsiveness and authority, and unevenness in performance. From time to time major matters are debated and major control mechanisms are recast in order to change a system. (The ability to obtain change and the cooptation of control by those with special interest in a system are discussed later.)

The cost of control, usually expressed as a cost of regulation, and the inequities associated with regulation are not a matter of much public debate, although regulatory control reform growing out of efficiency arguments is much pressed by professional economists.

The question of degree of control is not much discussed for public facilities; they are nearly completely controlled, although government control of activities generally is much discussed. As Weidenbaum points out, public control extends into every nook and corner of modern life. But that control is not total system control; it is control of an aspect of a system and a constraint or subsidy under which it operates. The debate runs to whether the government should require air bags in cars, fair employment practices, fire exits from buildings, and safe working conditions. We leave this debate aside for purposes of the present discussion.

Bargaining About Rights

There is a strong spatial-population content to claims of rights. This stems from the spatial-population basis of
political power in this country. Congressmen, senators, and state representatives serve places and the people who live at those places. As a consequence, there are claims for the provision of goods and services and the rights they represent throughout the country. One consequence of this is that there is gross cross subsidy from one part of a facility to another. In many of the facility systems, it is less costly to provide the good or service in a dense market than in a sparse market. So the pattern of subsidy has been from cities to rural areas and, in transportation, water supply, telephone, and sewage systems, from densely used routes to lightly used routes.

These cross subsidies have had enormous impacts on national developmental patterns. Cross subsidy has made public facility infrastructure everywhere available in some equalized way regardless of the cost of providing the good or service. The availability of telephone, sewers, water, and transportation has surely supported the explosion of the suburbs. The magnitudes of these cross subsidies are enormous, and they have been staked out to a degree in literatures with respect to particular facilities. The cross subsidy in telephone service is rather well known: approximately one-half of the telephone system income is in long-distance calls. This income from long-distance calls subsidizes other telephone operations, particularly the operations of companies serving relatively sparse markets. Gasoline taxes collected in the larger cities subsidize the provision of rural roads, and fares charged on long-distance air flights subsidize short-distance flights.

By and large the geographic claim to rights and the resulting spatial cross-subsidy are not subject to public debate. (The shift of political power from rural areas to the cities has had little effect on the older public facilities. However, some urban-centered rights have been recognized as new political imperatives, e.g., the right to have transit service.) On occasion, professionals debate the causes of suburbanization and professional economists debate pricing and efficiency issues. Service is not only a right with respect to space but also a right with respect to time. There are two consequences of this: (a) Facilities are sized to the highest level of demand, and (b) costs to users, whether in taxes or in user charges, do not reflect the cost of their demanding a service at a particular time. Electrical networks must continue to function in spite of the millions of turkeys being cooked in electric ovens on gray, cold Christmas eves; highway systems are not supposed to overload; Friday afternoon air travelers expect space to be available at the usual price; and everyone wants to telephone home on New Year’s Day. Every user has rights, and these rights are to be met regardless of when they are demanded.

Temporal service costs and prices are debated by economists, whose central concern is that the marginal user pay marginal costs. Economists suggest that much demand for capacity could be averted if the marginal cost of capacity was charged to the user during congested periods. But this is not, by and large, a matter of debate by the general public, and temporal pricing does not appear as an imperative on any politician’s agenda. From the point of view of system users, there is a simple reason for this. Over and above the claim that the service is a right, users are not just people who make claims for services at particular times; they make demands on public facility systems at many times. They may heat their water at night as well as during the day or drive during congested periods as well as during noncongested periods. There is in general no neat division of users into black hats, those who are occasioning all the cost, and white hats, those who are not occa-

sioning costs, a division that might provide a power base for political action.

Claims to rights are put forward by interest groups, by actors, or by institutions acting for interest groups. One class of claim has deprivation as its base. It is argued, for example, that the elderly are transportation deprived and the poor have the right to telephone service. Exceptional children form a special group with a special claim on education rights.

There is another way in which claims to rights are formed. The products of public facility systems are valued more highly by some groups than by others, and a group that values a facility system product is naturally quicker to claim the right than are groups that place less value on the product. So industry and commerce have demanded that the public school system train students in business arithmetic, and professional groups press the universities to provide professional training. The (sometime) users of railroads are vocal on matters of railroad branch-line abandonment.

Rights are thus expressed at the extremes; groups that are deprived are as quick to argue rights (or someone argues rights for them) as are groups that are advantaged. These groups bargain for their rights against less attentive publics. Attentive groups argue for representation on control mechanisms. A government regulatory agency typically contains representatives of geography and special interests.

From time to time, bargaining about rights has led to political action and major revisions of public facility systems. The 1916 highway legislation, which brought the federal government into the highway business, was responsive to the mobility rights of rural dwellers, as an examination of the preamble to that legislation will reveal. The Rural Electrification Administration was created to provide electric energy to spatially disadvantaged consumers, and public utility commissions are currently being pressed to provide life-line rates for utilities. This pattern of the claim to rights and bargaining about rights is thus one force of change in public facilities systems. The pattern is also a strong brake on change, for it is difficult to deprive any group of an existing right, and change that would do so is not likely to succeed. (The attitude of the Congress with respect to gasoline prices is most illuminating. In spite of the inevitability of petroleum energy problems and professional advice with respect to letting price increase dampen demand, the Congress seems to regard inexpensive gasoline as the right of the public. Possibly inexpensive gasoline translates into the right to transportation.)

Capital Intensiveness

For a variety of reasons, public facility systems are biased toward capital intensiveness. Rate making for utilities based on return to capital is one source of such bias. Another source of bias is the shelter of regulation under which a number of the facilities operate; bankruptcy is not at issue (many railroads excepted), and the cost of capital does not provide for such risk or other market tests. Consequently, capital is relatively cheap. Finally, those facilities that are entirely within the public sector reflect legislative and voter biases toward expenditures to capital as opposed to operations. Excepting some recent thrust for better management of urban transportation as opposed to solving urban transportation problems by additional investment, this matter is not one of public debate.
Technology for Public Facility Systems

Creation and deployment of technology for public facility systems suggest several issues. The nature of the systems is such that the technology is typically purchased from suppliers as a physical product. Suppliers are often oligopolies, and there may not be competition among suppliers based on creation of new technology. In addition, the bias toward capital intensity occasions emphasis on corresponding technologies. Consequently, new technology is readily available for larger pipes and pumps for sewage systems, stronger pavement for freeways, larger capacity generating and transmission facilities for electrical facilities, and electronic aids to learning suitable for use in large schools. In short, technology competition may be limited; technology responds to the capital intensiveness and scale economies of the facilities; it is produced by suppliers whose profits result from technology in physical forms. Again, the technologies are aimed toward the large-scale facets of the system where efficiencies can be readily captured by increasing scale.

Suppose these facilities did not provide cross-subsidy to small-scale markets. Would a family of technologies have been developed for these markets? Air service is a case at point. Aircraft have been designed for dense, line-haul routes; that is where the profits are. Cross-subsidy has been used to provide service to sparse markets. The airlines have directed efforts to reducing service in those markets; there has been little or no effort to develop technologies suitable to sparse markets. This is a sensible question for which there is no answer. There is great pressure for standardization of technology. This is in the interest of suppliers, for it enables them to produce a many more copies of a given product. Efforts by standard-setting and control agencies to ensure that a right is indeed served are also a force for standardization. It is easy to see why not too many decades ago the school books to be used in state-supported school systems were adopted by the state legislatures. This assured the legislatures that the quality of education was everywhere the same, and it served the interest of the larger textbook companies. Today, this adoption process is mainly in the hands of state or local school boards which is consistent with the concern made earlier about shielding public facilities systems from day-to-day political processes.

The need for system articulation also is a force for technological standardization, a point to be discussed later. There are two primary results of standardization. One result is that there is little market segmentation; the products of public facility systems are the same everywhere. The product is standardized so that it fits somewhat to every need but fits few needs perfectly. Standardization also serves as a brake on technological change. Any new technology that changes the nature of the product has to meet the standards (which means that the technology may not be so new after all) or obtain a revision in standards. Because so many actors are involved, obtaining a revision in standards is resource demanding, and generally only large suppliers have the resources necessary to occasion a change in standards. Aircraft under instrument landing control used to descend at 155 m/min (500 ft/min) and queue for landing under a first-come, first-served system, according to standards adopted by the Federal Aviation Administration for air traffic control. Modern jet aircraft do not perform well when restrained to those standards, and their introduction required a change in the standards. Certification of a new aircraft is, of course, an enormously expensive undertaking.

Each public facility system has been professionalized to a considerable degree, and acceptable technologies for a system tend to be those acceptable to the styles and tools of the profession dominating that system. Some of the system needs for technology and suitable technologies are selected through civil engineering paradigms. Education technologies dictate appropriate technologies for the public school systems, and electrical and (now) nuclear engineers make the judgments for electric utilities. Transfer of a technology not within an existing professional paradigm is difficult for reasons that are completely understandable. The power and prestige of a profession are based partly on the jobs in systems, and there is a great reluctance to give jobs to others.

Most issues with respect to technology are hardly debated at all, not even by professionals. The public does not seem to be sensitive to lack of market segmentation. It does respond to "small is beautiful" and "if we can put a man on the moon why can't we..." assertions, and this response is sometimes a base for political action and change.

There is some public debate about the results of deploying technologies. Some of the debate is location specific, for example, with the location of particular large electric generating plants, high-capacity freeways, or large schools. There is some debate at a general level with respect to location policies and the location-impact implications of deployment of particular technologies.

Incremental, Disjoint Decision Making

Public facility systems are such that once a technology is adopted and is the basis for a growth path, that growth path is difficult to change. This is partly a matter of capital intensiveness, as mentioned before. It is also a matter of facilitywide integrity and the incremental, disjoint character of decision making that characterizes these facilities. With respect to facility integrity, this is especially marked in transportation and communications systems. Freight cars and, increasingly, locomotives must be able to operate anywhere on facilities. Incremental changes in braking systems or track gauges are unthinkable given operations requirements. Terminal switching and transmission requirements impose similar contraints on communications and electrical facilities. This need for standardization and commonality is reinforced by the interest of equipment suppliers, who naturally desire aggregated, standard markets.

In incremental, disjoint decision making, any single actor is constrained so that he or she cannot make a unilateral decision to change the path of system evolution. Shippers' desires for larger and larger rail cars are constrained by the reluctance of the railroads to operate them. The junior high school graduate must be ready for high school; teachers are thus constrained in what they can do. Sewage plant operators' desires for homogenous inputs to their plants are thwarted by the unthinkable of arranging the pretreatment of sewage at every origin. Decisions are constrained as well as disjointed, and new directions for system evolution would require agreements between many parties, suppliers, users, and operators.

As a consequence of the pattern of decision making, change undertaken by facility managers is incremental and facility system improving rather than system changing.

There are some sharp conflicts between how facility systems are able to change and public expectations about systems. Demands for changes in goods and services lead to political action and the creation of new programs,
Public facility systems are viewed by private developers, planners, and policy makers as instruments for development or for control of development. Canal, railroad, and road programs were early used to foster settlement and development. The Tennessee Valley Authority and the U.S. Bureau of Reclamation have been viewed as development instruments. Recently, provision of facilities has been an important ingredient of regional economic development programs, and the Federal-Aid Highway Act of 1976 noted needs for highways that are necessary to increase coal production. Nonprovision of facilities has also been proposed as a way to prevent development, and some communities have attempted to control urban sprawl by limiting water and sewage supply.

The use of facilities as instruments for control of land development or nondevelopment is a matter of considerable public debate. Debate is often somewhat incomplete; it focuses on one or two of the facilities without recognizing that all are necessary for development. And debate often focuses on instruments without attention to the working of land markets and supply and demand forces. For instance, considerable attention is currently being given to the use of rail transit as an instrument to create activity centers in urban areas. That debate fails to use the recent evidence from Toronto, Philadelphia, and San Francisco, where it is clear that transit has not as yet been a sufficient instrument to induce activity center development.

Organization and Roles

The organizations that provide and operate public facilities and the individual roles within such organizations reflect the characteristics of the systems, the goods and services that they provide, and the constraints within which they operate. They also reflect historical circumstance. Those created early, such as railroad, water supply, and sewage facilities, have a paramilitary character. The bureaucratic precedent for the railroads was the military establishment; the Public Health Service is paramilitary in character. The geographic expanse of systems is reflected in the strong geographical divisions of the organizations, and railroad divisions and geographically organized divisions of highway departments provide examples. The division between line and staff roles within those organizations is sharp, as are the divisions between line operations.

In light of the systems' functions of providing for the general welfare (health, mobility, energy, and so on), the performance measures used by the facilities seem, at first glance, rather strange. There is a tendency to describe performance in terms of throughput quantities or the size of the facility managed. The school superintendent discusses the number of pupils in his district, the county highway engineer describes the number of kilometers of road he or she builds and maintains, and the electric utility operator refers to joules produced and sold. Status, organization to organization, is based on such measurements of size. Performance effectiveness is measured by comparing cost to the number of units managed or processed, and measurements run to cost per joule, cost per student, or cost per megagram-kilometer. There are other kinds of measures that are sometimes used such as accident rates and the percentage of on-time arrivals (for air operations) or departures (for railroad freight trains).

That performance is discussed in this manner is completely explainable. First, the facility manager has little or no control over the shaping of grand goals or over programs for their pursuit. These goals and
programs are a matter for public, political processes. Often the manager is a technician who advanced through a particular facility, and the traditions of a facility profession may not be articulated in terms of social goals. Moreover, the entrepreneurship opportunities left to the manager are severely constrained by regulations, standards, and so on, and about the only outlet for his or her managerial skills is cost cutting. Preoccupation with cost cutting in management circles in public facilities is unlike what in most large enterprises, where cost management is forced down within an organization to profit centers. Another preoccupation is that of trying to increase or maintain the size of the organization. One can readily understand why highway organizations want to build more highways and electric utilities want to increase generating capacity; for, within their ground rules, increased size means increased importance.

The organizations are bimonopolies and to some extent trimonopolies. They are bimonopolies in the sense that there is a facility monopoly and a labor monopoly that operate the facility. They are trimonopolies to the extent that suppliers of equipment and construction organizations (and shippers, in the particular case of railroads) also have various degrees of monopoly power.

There is a tendency for management to pursue capital intensiveness as a method of reducing cost. However, labor monopolies in some instances thwart this effort through job rights agreements. At some organizations, job rights have geographical territory.

That organizations have narrow views of their roles and behave accordingly is a matter of some public debate. Disenchantment with highway department bureaucracies and telephone and electric utilities is much discussed, and other facilities organizations have been the targets of similar discussions in the past. The bimopopoly character of labor negotiations results in negotiations only in a limited sense. The tendency of management to accede to any labor demand and pass the cost on to the public is currently a matter of some rather unfocused debate about transit systems.

Other Characteristics

Not all facility systems characteristics have been described. In particular, the systems enjoy degrees of public subsidy, and, if prices are charged, there are some distinctive characteristics of those pricing patterns. These matters of costs and pricing are treated in the literatures of cost allocation; federal, state, and local taxation; and public system economics. These characteristics reflect the dimensions of social purposes and government control in a manner similar to the reflection of those dimensions throughout public facility systems.

CHANGING PUBLIC FACILITY SYSTEMS

This section poses and addresses the question of change in public facilities. In approaching the problem of change, one should note that these systems have changed, are changing, and will change, because of

1. Improvements in the technologies used by the facilities and improvements in the human resources that manage and work within the organizations;
2. Changes in demands for their goods and services and in public expectations about goods and services;
3. Changes in the availability of resources for the provision of facility goods or services; and

There will continue to be improvements in facility management and operations. Other changes will occur through processes of public debate about the systems and realignment of the resources available to them, the standards to which they are expected to perform, and the control mechanisms that condition their operations.

These changes and improvements provide one future for public facility systems. Might there be other, more desirable, futures? Could creative system changes be imagined and implemented so that the systems evolve on paths closer to the evolution of public expectations? These changes should be creative in the sense that they improve the ways in which public facilities provide for grand goals. In addition, they must pass tests of feasibility and implementability in light of systems characteristics.

Public Facilities in the Service Society

Most public facilities were deployed some decades ago, and at that time the role of those facilities in society seemed rather clear. For when society was primarily extractive-industry based, and when it became manufacturing and extractive-industry based, the relations between what public facilities provided and production and consumption activities were relatively clear. The relations are less clear today as society has become more service-industry based and as consumption patterns have changed with increasing incomes and increases in the discretionary time available to individuals.

The puzzle posed by the service industries and by the changes in consumption patterns, life-styles, social expectations, and so on is of interest to social theorists, and there has been some exploration of that puzzle under the rubric of the post-industrial society. The puzzle is more than an intellectual exercise for social theorists, however; it is an important practical matter. The need for increased productivity in the service industries is an integral part of the problem of increasing the general welfare, providing for the expansion of employment opportunities, and managing inflation. The issues of what citizens want from their society in the last decades of this century is an important practical matter for those concerned with national planning and those who govern.

Public facility system matters enter the puzzle in two ways. First, many of the systems provide services, and the question of how to increase productivity in the service sector applies directly. Second, the goods and services that the systems provide have very much to do with the way productivity can be achieved and the ways in which society uses the fruits of that productivity. This is certainly true for educational activities, for the supply of human resources is critical; and personal transportation and communications surely have much to do with the way in which the service industries perform and the ways in which the goals of individuals are now sought.

The first recommendation for creative change is easy to make: Align the public facilities with the contemporary and fast-growing service society. This alignment is, of course, difficult because no one has much of a substantive idea of how to better align public facility systems with the service society. Interestingly, the recommendation would not seem to founder on either implementability or feasibility grounds. Political processes are such that there is a continuing effort to realign social purposes and adjust the workings of government, including the workings of public facility systems, in light of political imperatives defined around social purposes. Facility managers are well aware that the performance measures with which they have been comfortable in the past are no longer very acceptable, and
they likely would quickly accept some more convincing description of what their business is about.

Given sufficient time, public facility systems will be adjusted to the changed nature of society; so, subject to enough time, the present recommendation does not lie outside of trend changes described earlier. However, it is desirable to press the alignment of public facility systems with the service sector as a specific change because that force for change needs to be more explicitly recognized.

How are public facilities to be better aligned with the service sector? Understandings about this sector are bound to come slowly. Service activities are heterogeneous; some are public facility systems, and others are completely in the private sector. Although analysts and social theorists are concerned with the service with postindustrial society, they are few in number. Nor do our government institutions seem to recognize the service society. Governments have institutions for industry and agriculture, but not for service activities except in those cases in which government is a producer of service. Government economic accounts say little about the service sector.

If political actors, actors in control institutions, and facility managers were to recognize more fully the service facets of society, then they might behave somewhat differently. Knowing that change is needed, there might be less resistance to suggested change. Knowing that change is needed and that the required nature of such change is unknown, they might be more willing to experiment, monitor, and learn from experiments. The mechanism for change would simply involve wider recognition that we are dealing with unknown needs and a willingness of all actors involved to behave more flexibly to try to meet those needs.

Scaling

It might be useful to adjust the boundaries within which public facility systems operate. There are two or three aspects of this, depending on how the topic is viewed. One aspect has to do with the extent to which the provision of goods and services is monopolized by a public facility system. A related matter is the extent to which a public facility system is institutionally with the public sector. Public facility systems in the United States range from public utilities to activities completely within the public sector. Recently, the device of the public corporation has been to provide goods and services. In spite of the nation's long experience with degrees of public control and willingness to experiment with new institutional forms, not much is known about which institutional form is best for which purpose. One grand effort to develop such insights comes to mind, namely, the argument that the TVA was to provide a yardstick for measuring the performance of public utilities; but a comparative evaluation has never been made. The existence of the public and private school system side by side is an important exception to the monopolistic characteristics of public facility systems, and it is an interesting exception. It provides a choice for the consumer, at least for those who are wealthy enough to make the choice, and, more important, it provides a yardstick for the performance of the public system in the delivery of educational services.

So one suggestion about boundary conditions is that it might be useful to change the boundaries that circumscribe public facility institutions. The boundaries on present institutions were set to some extent by trial and to some extent by historical accident, and there is no reason to believe that institutional arrangements are optimal. Trying out some other forms with experiments supported by studies and educated guesses would seem a most reasonable suggestion. Furthermore, with several institutional forms and players, there would be a semblance of competition in the delivery of public goods and services. This would provide, at least to a limited extent, increased range of choices by consumers: Markets might be better segmented. It would also provide the public and politicians with information about alternative ways that goods and services might be supplied.

This suggestion is easy to state and understand; it also is likely to be feasible and acceptable as historical precedent suggests. It may fail, however, on the criterion of not amounting to very much. For as the discussion of the characteristics of public facility systems stressed again and again, the institutional arrangements of particular facilities seem somewhat incidental. Systems would be very much as they are today, even if they were in different institutional forms.

Another class of boundary condition changes is suggested by observations made recently about electric power systems and energy conservation. Analysts have suggested that ways to increase efficiency and achieve conservation in electric power systems would be through cogeneration of electricity by industrial plants, conservation techniques by residential consumers, and certain changes in consumption patterns such as heating hot water during off peak. A class of coactivity suggestions might have wide applicability throughout public facility systems. The boundary between what is supplied by the public facility system and what the user does would be shifted.

This class of boundary condition change is easy to imagine and would have the desirable feature of giving the consumer some considerable sovereignty about the goods and services that he or she chooses. With the technologies and skills now available, it would be easy to undertake certain educational activities in the home (using program learning, TV instruction, and so on), cogenerate or adjust (or both) use of electric energy in the home or industrial plant (steam cogeneration, solar energy, seasonal heat storage systems), provide for interplant and interneighborhood communications (telephone-like systems), provide for neighborhood transportation (neighborhood ownership and control of local access streets), and provide fire extinguishers in the home and spend less money for fire departments.

Another way to describe this kind of boundary change would be to term it rescaling. The conjecture is that, if we rethought the way the good or service might be delivered, facility technology and facility control might be rescaled spatially. This idea is in the air currently, and it surfaces in discussion about developers providing integrated utility systems, about how valuable Sesame Street is for children, and about the desire of residents of neighborhoods to control the quality of local streets and the quality of their local environment.

However, the issues of implementability are real. There is the problem of standards. Also, rescaling would be threatening to public facility managers. For managers, it is clearly a bigger job to run an 80,000-km (50,000-mile) road system than a 40,000-km (25,000-mile) system or to run a school system with 50,000 students instead of one with 35,000. Consequently, public facility managers have a bias toward increasing their output and span of control. Public facilities managers have tremendous bias against privately owned roads, customers using their own phone systems, cogeneration of electric power, water systems under the management of students, independent package sewage plants, and anything else that individuals or groups might do to reduce the quantity of the output of a public facility. Public facility managers
find rationale after rationale for protecting the spans of their systems. Of course, some of this rationale is sensible.

The discussion of boundary shifts or rescaling leads quite naturally to a related recommendation: the understanding of shadow activities. The suggestion of moving a facility boundary so that the user of the good or service would produce it suggests the alternative that the user might shift consumption. A firm locating its headquarters in the suburbs would expect its employees and customers to use the suburban transportation system. To the extent that those employees or customers might impose new burdens on the system, system managers might ask that the firm engage in the supply of transportation services; they might be asked to put on a bus line connecting their site to an existing arterial route. The firm has another option, namely, not placing a burden on the transportation system. Perhaps the firm would choose a site having excess capacity in transportation. The activity engaged in as an alternative to transportation may be described as a shadow project, and shadow projects can take a number of different forms, some of which overlap with actions mentioned when boundary shifts were discussed. A meat slaughtering plant, for example, placing heavy demands on a sewage treatment system might choose to engage in the pretreatment of sewage or storage of sewage. This would reduce facility service cost.

The term scaling was used as the heading for this section, and that term seems to characterize the class of changes suggested by the language of the discussion—shadow projects, privatization, increasing efficiency, achieving conservation, and market segmentation. The actions required for rescaling are

1. Restructure public facility systems geographically so that they are scaled to markets and to technologies appropriate to market segments (this may also involve shifting the boundary between what is private and what is public and may involve breaking some of the public monopoly characteristics of facility systems);
2. Provide appropriate interfaces between the system parts; and
3. Provide necessary institutional, control, and financial mechanisms for rescaled systems and develop necessary technology.

These steps may be illustrated by subjects discussed in the previous part of this section. Some of the changes in electric energy production and conservation involve creation and deployment of technologies, including conservation technologies, other than at the central generating plant. System scaling is required.Cogeneration of electricity by manufacturing industries, solar energy generation and use at the residential site and elsewhere, seasonal and temporal storage of energy, and so on require the rescaling of the system so that these technologies become viable. They would require appropriate interfacing of the parts of the rescaled system. Interfacing is a tough problem. The quasi self-contained utility system in the home, industrial plant, or other activity would generally require that self-contained unit to interface the larger system in some way. The same is true for the rescaled communications systems, rescaled educational systems, and so on.

Suggestions for improving intercity freight transportation are scaling suggestions. Both line-haul and collector-distributor routes now use the same technology. It is suggested that line-haul traffic be densified and appropriate technologies be used so that economies of scale may be achieved. At the same time the technology for collector-distributor systems needs to be readjusted so that it better tailors to markets. There is need for vast improvements in switching capabilities to connect line-haul and collector-distributor operations.

To a degree, the public school system involves a set of activities using different technologies and scaled to particular functions. To the extent that the highway system involves local access streets provided by one unit of government, arterials and major highways provided by another, and expressways provided by another, there is some scaling of that system. But in both of these cases the scaling is very partial. In highway transportation, for instance, the roadways are scaled but vehicle technologies and control systems are not.

The notion of scaling is not separate from the concentration-dispersion debate that surfaces in discussions about urban growth centers and regional development, government organization, provision of recreational facilities, and on and on. The notion of scaling presented here simply focuses that public debate on public facility systems. If the concept could be sharpened somewhat and focused on particular public facility systems, then scaling might enhance the matching of goods and services to public expectations, scaling might permit the deployment of technologies appropriated to segmented markets, and scaling opportunities might become political imperatives and a base for political action and system change.

TRANSPORTATION SYSTEM MANAGEMENT

Transportation system management is an intervention strategy for a part of a public facility, namely, the urban part of the transportation system. Will the previous discussions of the characteristics of public facilities and intervention strategies for public facilities provide a basis for the evaluation of TSM? How do TSM intervention strategies relate to the processes of system change? The discussion will first present TSM and then move to these questions.

TSM appears to stem from three postulates. The first is that the dollar cost and direct and indirect energy requirements of new facilities are now sharply limiting. The capital is simply not available to continue capital-intensive programs as in the past, and forecast petroleum fuel shortfalls or increased costs or both mandate that adjustments to the urban transportation system begin. New capacity is simply unthinkable unless it drastically reduces petroleum fuel requirements. A second postulate is that the physical transportation system is essentially in place. Priorities should now go to better management of existing facilities, especially in managing the system as a whole. The third postulate is that urban transportation serves clientele unevenly. The right to transportation of the transportation deprived is not being met by automobile transportation. Transportation system management is to ensure a diversity of service to all.

The tools of transportation system management flow from the notion that managerial action should be taken to improve the operating efficiency of the urban transportation system. Strategies involve the rationing of road-space through pricing and traffic management and giving preferential treatment to high-occupancy vehicles. Staggered and flexible workhours are to be sought, and movement efficiencies are to be sought through car pooling, van pooling, subscription bus services, and expansion of transit service.

What of TSM? Is TSM too small to matter? Will it, at the other extreme, force change in urban transportation? Might it serve to exemplify how change might be sought in any public facility system?

A perspective on TSM may be obtained by comparing it with public facility system characteristics. A convenient way to do this is through a set of summary statements.
1. Control. TSM is a facility manager's activity. It is not an activity in the political process that might lead to major institutional revisions. If facility managers are limited in their actions, we should expect little from TSM.

2. Claims to rights. Spatial-population claims to rights are ignored; temporal rights are challenged by TSM. The rights of a minority are advocated (transit users); the rights of the majority are challenged (automobile users). If facilities supply goods and services that are rights, TSM is inconsistent with facility purposes.

3. Capital intensiveness. TSM undertakes to deploy management solutions to avoid continued capital investment. If there is a bias toward capital investment, capital intensiveness will not be avoided.

4. Technology supply. TSM will deploy certain technologies familiar to system managers (traffic engineering); other of its technologies are foreign to the delivery system (pricing, for example). If facility actors use only those technologies familiar to their professions, TSM will be a traffic engineering activity.

5. Incremental, disjoint decision making. TSM favors facility-improving measures to be deployed in a manner consistent with current incremental, disjoint decision-making procedures. If this decision-making procedure results in changes that are slow, change from TSM will be slow.

6. System robustness. TSM is addressed to heavily used routes. If improvements in one part of a system are limited by other system parts, then TSM will not be very effective even on those routes where it is applied.

7. Location conflicts. Again, TSM is addressed to heavily used routes. If facility improvements result in location conflicts, then there will be location conflicts.

8. Land development. TSM is focused on the transportation plant alone; development consequences are ignored. If facility services affect land development, there will be development consequences.

9. Organizational roles and perceptions. There are several organizations in urban areas providing transportation services (transit systems, local public works agencies, and so on). TSM is to orchestrate these organizations. In addition, TSM emphasizes operations versus facility deployment. If extant roles and perceptions limit change, then change from TSM will be limited.

TSM managers and those who formulate TSM strategies may wish to make their own evaluations of the correspondence between TSM strategies and the characteristics of public facility systems. They may wish to alter old strategies or adopt new strategies (5).

The opportunity to better align the transportation system with the service society is of special interest. TSM strategies ought to be formulated so that they can be quickly readjusted as it is learned that they are counter to, neutral about, or supportive of present-day social activity patterns. The TSM manager will have considerable help discovering how effective strategies are. As strategies are deployed that are counter to today's needs, then he or she will be quick to hear about that. If those strategies are supportive of those needs, then those processes by which the rights to service are claimed, especially political processes, will begin to come into play to support TSM activities.

Urban transportation provides many opportunities for scaling. It is easy to imagine a rescaled system where special roadways, small vehicles, and appropriate traffic controls provide for those short trips, approximately half of all trips, that are neighborhood in orientation. This would increase neighborhood accessibility, reduce resources used in transportation, and improve the environment of the residential neighborhoods. Access throughout sectors of the city might be provided by urban cars operating principally on what are now arterials. Over-the-road vehicles or commuter cars might provide for the longer journey to work via freeways. Line-haul transit might be served by collector-distributor neighborhood transportation vehicles.

If urban transportation management seeks to direct the evolution of urban transportation in new directions, as opposed to making the present path of development work somewhat better, then transportation system management strategies of the very demanding sort are required, strategies that will have to be based on a rich understanding of the question of how public facility systems may be changed.

REFERENCES