Although the information contained in this paper is the most comprehensive to date, it represents only a small portion of what could have been available had arrangements been made to make appropriate counts and selected surveys. This effort should be included as part of future world's fair management activities, perhaps being encouraged by the U.S. Departments of Transportation or Commerce.

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The Transport Versus Land Use Dilemma

STEPHEN POTTER

ABSTRACT

The transport sector seems remarkably inflexible to changes in fuel prices and energy measures. The suggestion is made that the long-term land use and social effects of cheap motorized travel has produced a land use and transport system that is dangerously inflexible to changing needs and that planning and transport investment methods tend to unnecessarily heighten such problems. The degree of land use conflict between alternative modes of travel is examined in a case study of the British new towns. These have been built to a wide variety of land use and transport designs, some specifically intended to reduce the degree of transport conflict. The nature of this paper is necessarily strategic and general. It seeks to identify the key factors involved and broad social and planning principles rather than specific details. The case study of the British new towns suggests that it is possible to provide urban structures that are capable of accommodating wide variations in travel patterns and energy availability. Yet, 10 years after the 1973-1974 energy crisis there seems to be little political interest to take such ideas seriously. It was concluded that equitable and energy-efficient land use policies are entirely feasible, but the political status of planning is too weak for them to be implemented.

Ten years have passed since the 1973-1974 energy crisis signaled the end of an era in which it was confidently assumed that cheap motorized transport was a permanent feature of our society. Today, instead of seeking new and improved ways to accommodate high energy travel, transport planners are beginning to realize how unsustainable such a scenario is and are trying to promote more energy efficient transport methods. Yet, while energy conservation in most other fields has yielded significant savings, energy use in transport has increased (Table 1).

Two interrelated aspects of the inflexibility of the demand for motorized travel are examined in this paper. The first is the hypothesis that the long-term land use and social effects of low-cost motorized travel have produced a land use and transport system and cultural conditions that are dangerously inflexible to changing needs. A city structure that

TABLE 1 Energy Consumption in Great Britain 1971-1981 *(14)*

	1971	1981	Change (%)
Petroleum (m. tonnes)			
Cars and motorcycles	12.13	16.09	+33
Goods vehicles	2.52	2.35	-7
All transport	26.07	30.63	+18
Nontransport uses	38.52	22.84	-41
Total petroleum used	64.59	53.47	-17
All Energy Sources (m. therms)			
Transport uses	11,634	13,618	+17
Nontransport uses	45,367	41,302	-10
Total energy used by final consumers	57,001	54,920	-4

has adapted to low-energy-cost travel is virtually incapable of adapting to minimized travel needs in less than 50 to 100 years. To look at the nature of the operational conflict between the different transport modes, a study was made of the different land use and associated transport structures used in Britain's new towns. This method has been used in the past by researchers such as Hillman et al. (1); but it is only recently, with the near completion of several important new towns, that it has become possible to assess this experience fully.

The study of the new towns indicates that it is possible to provide a land use and transport system capable of accommodating widely differing transport needs. Such an approach has rarely been used; therefore, the second aspect of this paper addresses the question: If it is technically possible to provide an equitable, energy efficient, and flexible land use and transport system, why has this not been seen as a politically important objective?

INHERENT TRANSPORT CONFLICTS

Historically there have always been three main forms of travel (i.e., walking, public transport, and private vehicles), but the technology and availability of the latter two have changed dramatically in the last 100 years. This has had major implications for the way towns and cities have developed and the social and economic activities that occur within them. From the 1880s the development of public transport systems encouraged a separation and specialization of land uses. Those functions most dependent on good transportation links and high population hinterlands (e.g., government, commerce, and retailing) pushed other land uses toward the periphery of cities. Also those most able to pay for more spacious housing and the higher transportation costs at a city's edge did so, reinforcing patterns of social segregation.

This loosening of urban form and the greater specialization of land uses was reinforced and accelerated by the development and increasing availability of the private automobile. A more diffuse and fragmented city structure has emerged, replacing the traditional land use specializations, such as city center shops and offices, suburban industry, and residential areas. Public transport operators have found it difficult to adapt to such structural changes in their operational environment. Not only have they lost passengers because of rising car ownership, but their operating costs have increased because the environment has adapted to the needs of car users.

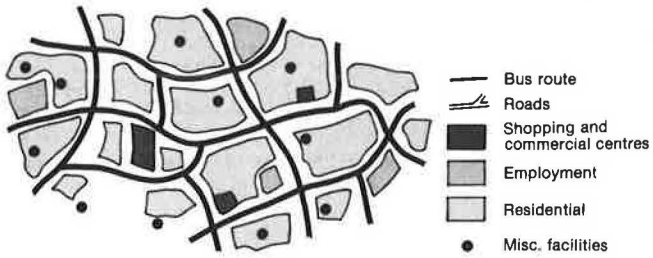
This process is familiar to planners throughout the world, yet it represents a frightening dilemma. To the affluent and politically influential car user such trends seem entirely beneficial, but to those dependent on public transport or pedestrian access, the hardships inherent in getting around in such car-oriented places are all too apparent. In addition, the planner may ask whether our cities are being molded into an urban form that may not be sustainable for many more years.

In Britain the question of whether there is a major urban conflict between the land use pattern and operational requirements of public and private transportation was not addressed before a series of theoretical urban form studies were made in the mid-1960s. One of the earliest of these was conducted by the planning consultants Jamieson and Mackay (2) who together with the new town plans for Redditch (3) and Runcorn (4) identified the conflict between land use and the operational requirements of public and private transportation to be a major concern.

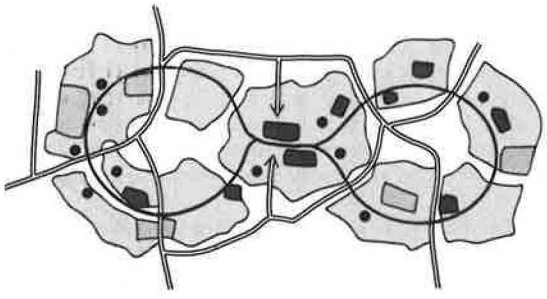
Jamieson and Mackay considered the operational requirements to be "diametrically opposed . . . public transport requires a concentration of generators and facilities to maximize the number of people and activities within easy reach of the transport route and thus induce a high level of use. On the other hand, the highway network for private transport requires a dispersal of generators and facilities to achieve maximum (vehicle) accessibility at low capital cost" (see Figure 1). Is this conflict absolute or are there ways of minimizing or resolving it?

EXAMPLES OF THE CONFLICT BETWEEN LAND USE AND TRANSPORT DESIGN

The British new towns have a tradition of being pioneers in planning techniques and among them can be found strongly contrasting land use and transport



(a) Optimal structure for private motorized transport. Uniformly low-density to reduce traffic intensity and random distribution of facilities to even-out loading on roads



(b) Optimal structure for public transport. Urban facilities located along corridors hence concentrating demand to maintain a high frequency service. Facilities located evenly along corridors to avoid peaks in loading. Increase in density towards public transport route to minimize distances

FIGURE 1 Optimal urban structures for private and public transport.

structures. These include towns in which plans have been predominantly influenced by the requirement to provide for high levels of car use and others in which plans have sought to resolve the conflict between transportation methods.

Full Motorization Designs

Planning studies show that the optimal urban form to accommodate high levels of car use is a low density urban fabric with a random distribution of facilities to spread vehicle loadings over as wide an area as is possible. The land use designs of the early new towns were largely an idealized imitation of existing towns. Typically a plan would consist of clusters of neighborhoods of about 5,000 population around a town center with a radial/concentric road network and a single industrial estate on the periphery. Although these towns functioned adequately with existing traffic flows, by the 1960s it was felt that such structures could not accommodate forecast levels of car ownership and use (Figure 2). In practice car ownership has not risen by as much as was forecast, but these forecasts did significantly influence new town plans.

The plan that took the operational requirements of the private car virtually as the design requirement for its land use and transport structure was the Plan for Milton Keynes (5). The land use and transport design of Milton Keynes consisted of a grid of dual carriage highways combined with the dispersal of all traffic generating land uses (Figure 3). Residential areas were planned at 70 persons per hectare, with an overall population density of 27 persons per hectare. With a reduction in Milton Keynes' population goal and a drop in household size, this overall density is now down to 22 persons per hectare.

Although the published plan referred to a high quality public transport service, with a 2.5 to 5 min frequency on all routes, the Transportation Technical Supplement (6) admitted that "in the light of the selected land use plan, the provision of a competitive form of public transport is not practical. This consideration . . . has therefore been discounted. The appropriateness of providing a public transport service beyond the minimum level necessary . . . is solely a matter of policy."

This clearly indicates that the designers of Milton Keynes did not consider this urban structure to be capable of supporting more than a minimal level of public transport without substantial subsidies. However, Milton Keynes Development Corporation was politically unwilling to change their strategic plan. Therefore, Milton Keynes was built to the original 1970 design. Over £100 million was spent on grid and trunk roads. The dispersed, low-density design of the town has added to the costs of housing and services unrelated to transport. (This aspect is considered below.) By the early 1980s it became clear that a policy of substantial subsidies would be needed not just to maintain a high-quality public transport service, but to maintain any service at all. In 1982-1983 subsidies totaling £997,000 (42 percent of running costs) kept a basic bus service (11 routes, 30 min frequency) in operation for the town's 107,000 people.

In the mid-1970s, Milton Keynes Development Corporation experimented with Dial-a-Bus in the hope that a technological solution could be found to the hostile operational environment of Milton Keynes. However, these buses experienced a larger loss than conventional services and were withdrawn by 1980. The focus has shifted from planning and technology to the promotion of existing services and endeavoring to find politically acceptable ways to maintain high subsidies. Clearly the design of Milton Keynes has produced extremely hostile operating conditions for public transport and those dependent on it are finding travel unnecessarily difficult.

Additionally the low density of development means that the population served by local facilities is small and only basic services such as a shop or two, a school for children under 12, playing fields, and a community hall, are within walking distance of the home. A good system of cycleways has been provided; but, nevertheless, such an urban structure means that a high proportion of journeys are required to be by motorized forms of travel.

An alternative approach, adopted in only a few new towns, has been to try to design an urban structure that is capable of resolving, or at least minimizing, the operational conflict between the private

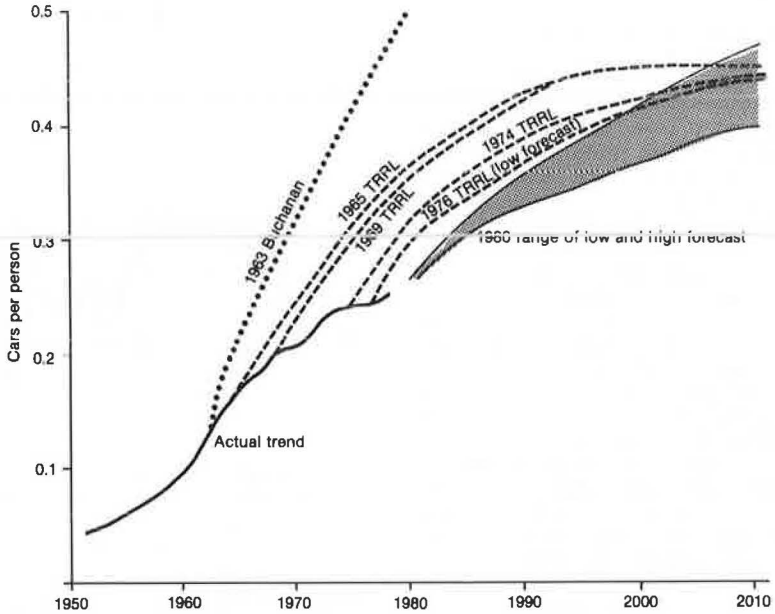


FIGURE 2 British car ownership levels and forecasts, 1950 to 2010.

FIGURE 3 The Milton Keynes Plan. Travel generating land uses are dispersed over the development area and traffic loads are spread evenly over a grid of dual carriageway roads.

car, public transport, and nonmotorized travel. In Milton Keynes the belief that there would be a massive rise in car ownership led to this factor dominating the design of the town. In another new town, Runcorn, the growth of car ownership was seen as a factor that required a design that emphasized public transport. What produced this seemingly opposite reaction to the same problem? Although the designer of Runcorn (Arthur Ling) accepted the car ownership forecasts, he recognized that this was potentially socially and economically divisive (4):

> To design the town dominantly for the motor car would require the maximum expenditure on highways to cater for peak-period traffic and a more extensive provision of car parking spaces at the Town Centre and in the industrial areas. In addition, public transport . . . would be little used and therefore it would be uneconomic to operate a frequent service. This would cause a sense of social isolation for those without the use of a car, such as children and old people, and also members of the family to whom the car is not available at a particular time.

It is interesting to compare this with the more recent writings of the French Marxist urban sociologist Castells (7):

> This extreme dependence on the automobile creates new sources of discrimination--all nondrivers are seen as virtually handicapped. Such is the case for the aged, for adolescents, for housewives when the husband has gone to work in the car, for the sick, but also for the great segment of the population not equipped with a car . . . so many immobile people destined to consume little else but television. So many "living dead."

Both authors, one from a traditional, the other from a Marxist planning viewpoint, express the same concern--that consumer demand for cars cannot be universally met, but the demand is sufficiently great to erode the operational environment of other travel methods and cause serious problems for a major sector of the population. Therefore the greater concern is not ways of accommodating high car ownership, for this is really quite easy, but addressing its social and economic consequences.

The Runcorn plan and those of some other new towns (Redditch, 1966; Peterborough, 1970; Irvine, 1967; and Stonehouse, 1974) are the only significant attempts at addressing the conflict between land use and transport by planning design (see Figures 4 and 5). The basic design principles of these plans were

1. Public transport and car flows are on separate networks, making it possible to concentrate

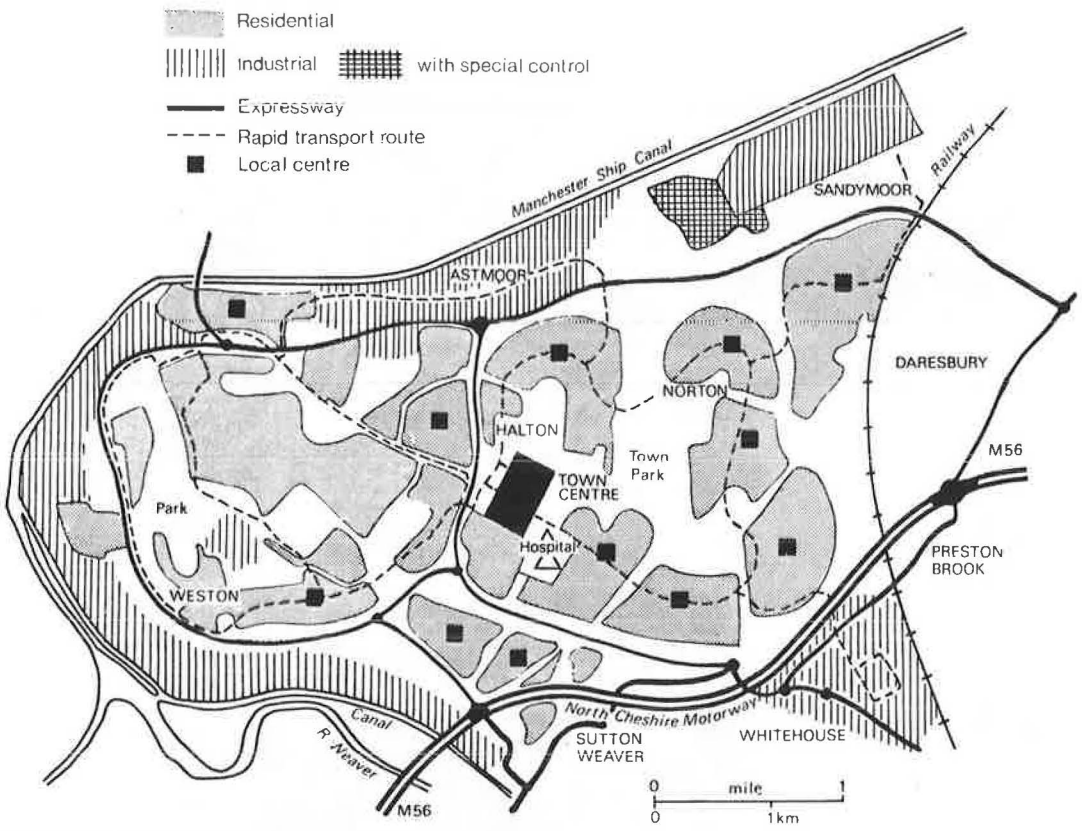


FIGURE 4 Runcorn land use and transportation plan.

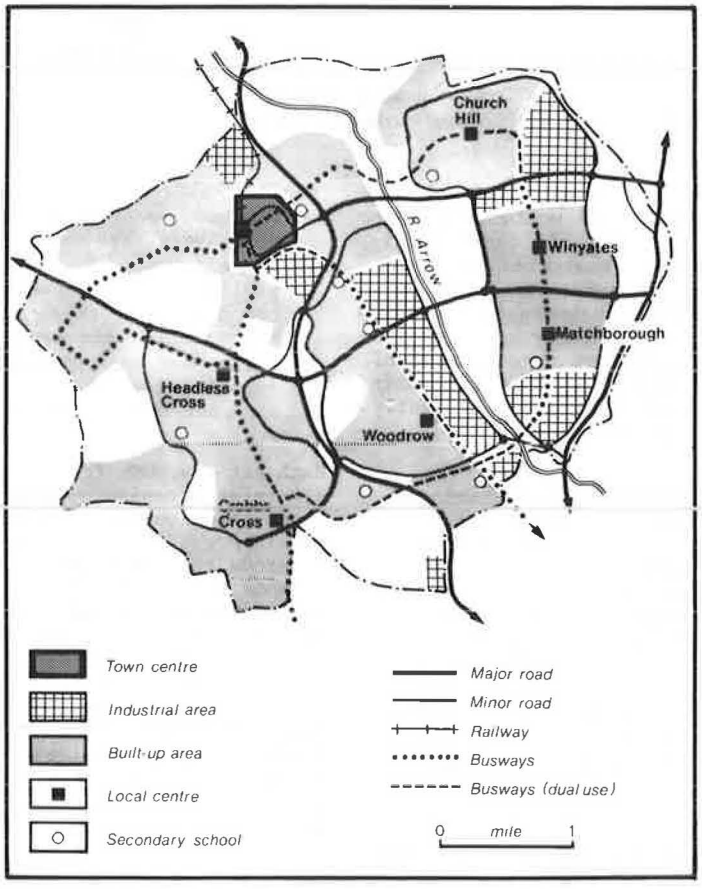


FIGURE 5 Redditch land use and transportation plan.

travel flows for public transport while dispersing car traffic.

2. The size of residential areas is determined by the population needed to maintain a frequent public transport service.

3. Residential densities are zoned so that they increase toward public transport routes.

4. Low-density uses (e.g., open space, warehousing, major roads, and parks) are zoned away from public transport routes so as not to increase walking distances to the routes.

5. Residential areas, employment, shopping, and other major travel-generating land uses are arranged so that they provide corridors of public transport movement conducive to high service frequencies.

6. The overall density of development is changed little, but land uses are rearranged to provide a pattern of development that is conducive to public transport operations.

The construction of Runcorn and Redditch is now essentially complete and in practice these towns have shown that a considerable amount can be done to address the inherent conflicts between land use and private and public transport, especially considering that these are relatively small towns where public transport operations are usually less viable than in cities.

In Runcorn a service frequency of 5 to 10 min is in operation and in Redditch a 10 min frequency has been achieved. However, what is of particular note is that these public transport systems require very little subsidy. In Redditch 6 percent of operating costs are subsidies and in Runcorn about 5 percent. These are considerably lower than the 42 percent subsidy in Milton Keynes for a 30 min frequency bus service (see Table 2).

In addition, the capacity of the highway networks of Redditch and Runcorn have proved to be ample with no restrictions on car use. The distance-minimizing techniques used to promote public transport viability have also enhanced pedestrian accessibility. To a large extent, urban structures that are conducive to a good quality public transport service enhance pedestrian and cycle access too, so long as local physical conflicts with traffic are recognized in the provision of highway crossings and separate foot and cycle paths. Indeed, in terms of energy conservation, this aspect is more important than the provision of good public transport services. A slight modification of the deign for Runcorn and Redditch to provide a larger population center for local facilities can make upwards of 60 percent of the journeys within walking distance of the home, compared with only 30 percent in a dispersed Milton Keynes-type urban structure. This elimination of the need for motorized travel could cut energy use by up to one-third. Further research is continuing on this aspect at the Open University (see Figure 6).

It seems that such urban structures are capable of providing good transport services under widely differing modal split assumptions; and with transport and energy availability presenting a very uncertain future, this flexibility is to be valued.

APPRAISING ALTERNATIVE URBAN DESIGNS

From the above empirical examples, it seems possible to address the inherent conflicts between the operational requirements of the private car and public transport. However, transport is only one aspect of the urban environment. The different designs have implications for development and servicing costs, the types of housing that can be provided, and so forth.

The development costs of the more structured, public-transport-oriented designs are lower, even allowing for the infrastructure costs of busways and the occasional need for grade-separated highway interchanges (see Table 2). When development is concentrated along public transport routes and unserviced areas (e.g., parkland) are to the periphery, these unserviced areas do not have to be crossed by water pipes, electricity cables, and so forth. The more dispersed urban structures require a greater quantity of piping and cables per person, as well as a larger provision of local roads. Costs of providing and maintaining urban services can be 10 to 25 percent lower than in a dispersed, car-oriented town. The amount of land used is 20 percent less and overall development costs can be almost 50 percent lower per person accommodated (10-12).

The main advantage of a fragmented and dispersed urban structure is that it can adapt to a wide range of changes in land use. It is essentially a nonplan that allows market forces to express themselves freely. These advantages are rather vague and the degree to which this flexibility is actually of significance over alternative urban structures is a matter of conjecture. It does not seem that this ultraflexibility is worth the additional transport, development, and servicing costs that such structures impose on their population and the taxpayer.

To be fair, plans such as that for Milton Keynes were conceived in an era when the main design problem was viewed as providing for extreme prosperity and that general affluence would eliminate any of the arising problems; that is, it would not matter that low-density, dispersed urban structures cost more to build and service as there would be ample funds to subsidize buses. In the context of an anticipated economic boom, the ultraflexible plan for Milton Keynes can be understood.

TABLE 2 Key Characteristics of the New Towns Under Study *(8,9)*

	Milton Keynes	Washington	Redditch	Runcorn	Peterborough
Population	107,000	55,000	68,000	65,000	124,000
Current gross density (ppha)[a]	12	24	23	32	19
Planned gross density (ppha)[a]	20	27	25	34	23
Development costs to state per person housed (£)	10,200	11,000	4,100	7,000	5,300
Average bus frequency (min)	30	20	10	5	15
Cost of bus season ticket per week (£)	2.40	1.65	3.50	2.50	3.50
Subsidy as percent of bus running costs	42	NA	6	5	14
Average number of shops at local center	5	9	15	7	23

Note: This table includes two new towns in addition to those considered in the text. Washington (in northeast England) is of comparable size to Redditch and Runcorn but was designed similarly to Milton Keynes. Peterborough is comparable in size to Milton Keynes but was designed to promote public transport.

[a]Persons per hectare.

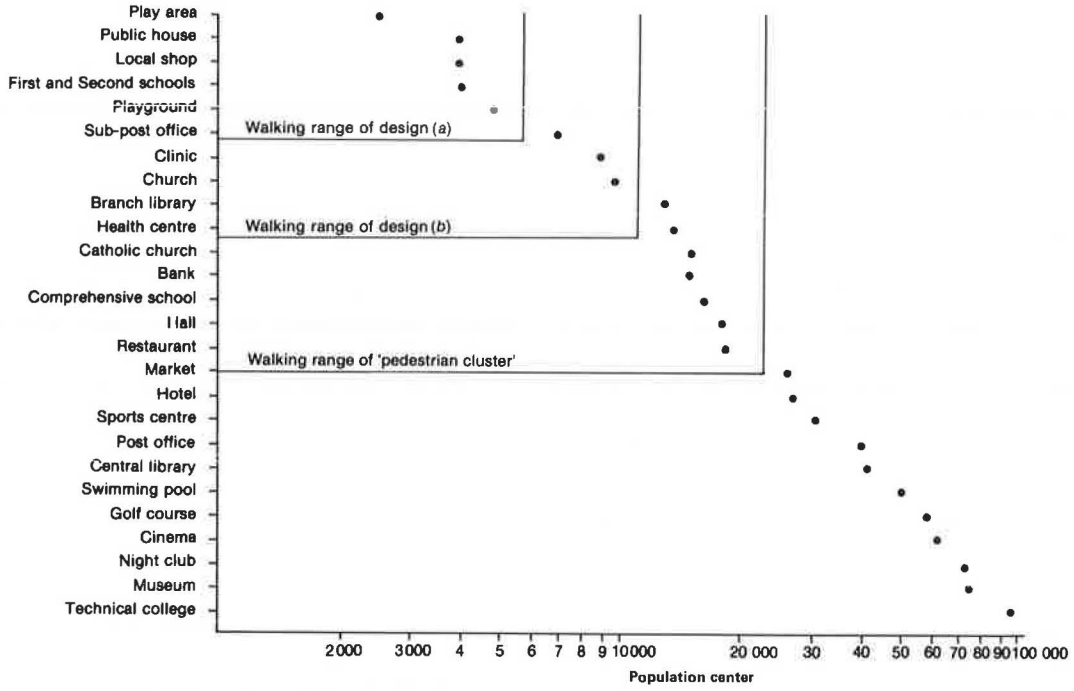


FIGURE 6 Facilities and population centers.

Today such an optimistic and confident view of the future is recognized to be naive and simplistic. Future trends in transport and economic growth are very unsure and increasingly planners have to recognize that their plans need to accommodate an uncertain future. Although low-density, fragmented urban structures are physically flexible under conditions of economic prosperity, they are inflexible to factors such as energy shortages, requirements to reduce travel needs, recession, and so forth.

General Application

This paper has used examples from the new towns because they provide the best examples of the conflicts between transport and land use. But this, of course, is also present in existing settlements. How the conflict expresses itself may vary according to the nature of the area, its culture, wealth, and political factors. It may be expressed by protests over high public transport fares, the closure of rail lines or the current political controversy in Britain over the use of subsidies to maintain public transport operations. At the extreme this transport conflict results in social segregation, as poorer groups are forced to move away from areas where they find travel difficult. This can only contribute to the severe social and economic problems found, for example, in most inner city areas where the poor are concentrated. The conflict between the operational requirements for different forms of travel can, therefore, be seen as a contributory factor to the social unrest and disturbance present in so many inner city areas.

Adapting the planning and state investment principles contained in this paper to existing towns and cities would, of course, be a long-term measure. A mixture of physical and fiscal measures would be needed: public transport subsidies to compensate for hostile operational conditions and to reduce the externalities of accidents, energy use, social costs, and so forth while the physical measures are implemented. But above all such a blend of measures would have to be firmly rooted in an understanding by planners and politicians of the complexities of the transport crisis faced by our society.

INHERENT POLITICAL CONFLICTS

It seems possible at least to lessen the conflicts between the private car and other travel methods and to aspire toward an urban form that may seem better suited to the uncertainties of the 21st century than the direction in which cities presently seem to be moving. Yet, despite this knowledge, rising energy costs, and the recession, there seems to be no particularly strong move in this direction. Why is this?

There seem to be several underlying causes. First, although transportation and land use planning are often regarded as a single process, it is carried out by a variety of government and state departments, each of which has its own professional and political stance to defend. For example, the combination of highway engineering, planning for other forms of transport, and land use planning has only occurred within the last decade in Britain. The integration of these three is often superficial. The degree of financial and political power held by these three groups is also markedly different.

Highway engineering is well established and benefits from considerable industrial support and lobbying, something that is not true of planning in general. Highway engineering represents a market-oriented approach, which is carried out by the state not because of a desire for planning (in the social and economic sense of the word) but because it is an essential activity that private enterprise cannot practically fulfill. The tradition of highway engineering is more closely akin to that of the private developer than the environmental planner. It is a tradition that is remote from the basic ideology of planning, which presumes that a market failure is as good an environment as one in which the same resources are properly coordinated.

The traditional highway engineering approach has been that of responding to the market demand for roadspace. Environmental planning and state intervention for other travel methods holds the contrasting philosophy of the comprehensive optimal approach, compensating for externalities, the inclusion of wider economic and social criteria, forward planning, and all that is associated with the concept of planning. The approach discussed in the first part of this paper is considered to be capable of reducing inherent transport conflicts.

Compared with the real political, industrial, and economic power of traditional highway planning, however, it matters little whether environmental planning is intellectually superior. Planning in Britain is a political weakling [and this is true even in Eastern Europe where environmental planning carries remarkably little influence (13)]. The two may technically be coordinated but in practice one carries a hundred times the influence of the other.

So one branch of state intervention (highway engineering) is creating externalities that another branch (planning) tries, but has neither the power nor the influence, to correct. It is an inefficient, unnecessarily costly process that creates avoidable problems, inconvenience, and often hardship for millions. The key to changing this situation is not to improve planning techniques, for they are adequate, but to improve the political status of the concept of planning. Without such a change integrated planning for transport and land use will always be an activity of marginal relevance.

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