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## Transportation and Land Use Planning to Achieve National Goals: the Netherlands

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The Netherlands is one of the most densely populated countries in the world. The Dutch people have a long history of rigid land use controls; urban sprawl is unknown there. High-rise apartment complexes generally mark the boundary between urban and agricultural land uses. Urban expansion and some decentralization of urban activities since World War II have placed a difficult burden on transportation. The number of pas-

senger automobiles has increased fivefold between 1960 and 1970. Transportation policy goals for the Amsterdam region call for public transportation in the future to accommodate about 60 percent of the journey to work traffic (it now accommodates about 25 percent), bicycle and pedestrian trips will be 30 percent, and the private automobile will account for the remaining 10 percent. To help achieve the

latter goal, parking will be provided for no more than 10 percent of central city employees. The key to land use control in the Netherlands is municipal expropriation of land ripe for development. The three-tiered land use planning process (national, provincial, municipal) is described in some detail, as well as the process of land acquisition, the provision of funding, and the installation of public facilities prior to private development. The manner in which highway planning is incorporated into and becomes an integral part of the overall planning process is described. The nature and degree of public participation in highway planning and the method of resolving disputes is discussed. The moderate effectiveness in coordinating highway development and land use activities to minimize adverse effects and enhance beneficial effects of highways is more an indirect result of the intensive overall land use planning process than the result of specific controls for such purposes. The Netherlands system of land use controls might not be as effective if not for the extremely high financial costs involved in preparing sites for construction (draining, removing peat and top soil, sand layering, and installing piles). Moreover, their land use control system does not appear to be politically or institutionally acceptable in the United States at this time. The remarkable success of the Netherlands in controlling a very scarce and valuable resource, land, has probably led to a more stable economic and social system for the country as a whole, but it has not been without some trade-off costs—restrictions of freedom of private land ownership and an almost total constraint on private gains from land value appreciation.

### TRANSPORTATION PERSPECTIVES

One of the most striking features of the Netherlands' landscape, besides its flatness, is the very intensive use of land. The Netherlands is one of the most densely populated countries in the world; consequently, idle use of land simply is not economically feasible. The usual pattern of single family home development that marks the urban fringes of American cities is almost totally lacking around the major urban complexes in the Netherlands. Multistory apartment buildings usually provide the demarcation between urban and rural uses of land. Live-stock are commonly seen grazing, crops are planted in the shadows of apartment buildings, and goats and sheep are seen tethered and grazing on railroad and limited access highway embankments. Urban sprawl, as we know it in this country, is nonexistent in the Netherlands.

Modern cities could not have developed in the southwestern portion of the Netherlands without the construction of seawalls and subsequent draining of the land, yet this is where most urban development has occurred. Over the centuries, about 607 000 hectares (1.5 million acres) have been recovered from the sea or from tidal marshlands. In 1970, about 8 percent of the land area in the country was in urban use. By the year 2000, this is expected to increase to 16 percent, mostly because of a declining density in housing. Within the Amsterdam region, there are now about 2.5 million people. By the year 2000, the total population in the Netherlands is expected to reach 13.5 million.

Although residential density is decreasing, it is still extremely high by our standards. Land has always been a scarce resource in Western Europe, particularly in the Netherlands, and so residential density in the older portions of the cities was, and still is, extremely high. However, the rapid rise in personal incomes and the adoption of modern technologies have resulted in a decentralization of the cities and a movement of both people and industry to urban fringe areas.

Such decentralization has placed a particularly difficult burden on transportation. Between 1960 and 1970 the number of passenger cars increased fivefold, from 0.5 million to 2.5 million. By the year 2000, 6 to 7 million passenger cars are anticipated. Public transport during the 1960s showed a strong relative decline in terms of passenger kilometers. Its share of total passenger transportation in 1960 was 47 percent; by 1970, it dropped to 18 percent.

In Amsterdam, as in the other major cities, traffic problems are severe. Older streets are very narrow, and during rush hours congestion is extremely heavy, even though 60 percent of all journeys to and from the central area are made by bicycle. Heavy bicycle traffic, in fact, accounts for part of the congestion. City streets are marked with well-defined bike lanes on which automobiles must not intrude.

Urban expansion in the last few decades has resulted in some dispersion of work places. Both industrial and service establishments are appearing in city extensions. Such spatial changes in activity have altered traffic flows. In addition to more radial traffic, there are now tangential flows. Increased distances to the city center because of suburban expansion have discouraged the use of bicycles, contributing to increased congestion.

From an intensive study of the expected development of the city and future transportation needs, specific policies have been formulated (1, 2, 3). The automobile will be unable to absorb a larger share of the journey to work, despite a national road-building effort to provide more radial and secondary roads. Reliance on public transportation appears to be the key to the future transportation policy of the Netherlands; transportation planning and physical planning are very closely related.

At the present time, public transportation by bus and tram carries about 25 percent of the rush hour traffic and private cars about 10 percent (bicycles and pedestrians account for the remaining 65 percent). Future policy goals call for public transportation to accommodate about 60 percent of the rush hour traffic and for the private automobile's share to remain at 10 percent. To help achieve this latter goal, parking will be provided for no more than 10 percent of those employed in the central city. Little has been written about the relations between transportation and environmental quality and the means by which adverse effects might be mitigated or beneficial effects enhanced. However, both implicitly and explicitly, social, economic, and environmental effects as related to highways are recognized by officials and the public.

### LAND USE PLANNING AND CONTROLS

Land use and land development are strictly controlled in the Netherlands. Every hectare in the country is under some land use plan. The key to public control of land use is the right of expropriation, as formalized in the Expropriation Act, which gives the municipality the power to designate land for future development and subsequently provides for compulsory purchase of such lands.

There are three levels of government in the Netherlands, and all play a role in the planning process. An overall national plan recognizes and mandates specific uses of land. Communities are responsible for providing the planning details and plan implementation, but such plans must conform to the overall national plan. Plans formulated by the communities must first be approved at the provincial level and then approved at the national level. The provinces, however, have no legislative power in land use; they only provide an advisory and review function. The first national plan was formulated about 50 years ago. In 1965 a new law, separate for housing and community planning, emphasized the role of municipalities in the planning process, although the national development plans still are overriding.

In its local expansion plan to meet the demands for new growth, a municipality will designate certain adjoining undeveloped land (in almost all cases, land now in agricultural use) as tracts suitable for development.

It may acquire those lands once the plan has been approved by the provincial authority and by the Crown (through the Minister of Housing and Physical Planning in the federal government). When the lands cannot be purchased by mutual agreement between the landowner and the municipality, a judge issues an expropriative order and decides what compensation shall be paid by the municipality to the landowner. In this way, land is acquired for new development for any purpose (housing, commercial or industrial uses, highways, recreation areas) and development can take place only on such appropriated lands. Once the land has been acquired, it is then made ripe for development by the municipality. The relatively heavy layers of top soil and peat must be removed and the site covered by a layer of sand. A sand and water slurry is pumped to the site. Often the sand has been recovered from the North Sea. This is a very expensive operation, so only comparatively large tracts are prepared. Usually, only the government can afford such undertakings. After the sand has drained of excess water, it is leveled and streets, sewers, waterworks, canals, bridges, roads, and other utilities are constructed by the municipality.

Because of the swampy nature of the soil, virtually all buildings have to be constructed on piles. Also, throughout much of the southwestern portion of the country, bedrock is 3000 m (9800 ft) below the surface. Piles are usually 6 to 12 m (20 to 40 ft) in length, all within the sand layer. Thus, the cost of site preparation, even for single-family houses, is extremely high. This is why about  $\frac{2}{3}$  of the cost of most housing, which is high-rise apartments or row condominiums, is subsidized by public funds.

Building sites prepared by municipalities are not sold to developers or private landowners, but are rented under long-term lease arrangements. The long-term lease system was introduced in Amsterdam in 1896. A system of perpetual leaseholds was introduced for private residences in 1915. A system of moving leasehold terms for industrial sites was introduced in 1937, but in 1966 this was changed to a system of perpetual leaseholds.

The costs of making the land ripe for development are shared among the individual building sites according to the use assigned each of these sites in the development plan. A ground rent on a particular site is then levied by the municipality; this rent is fixed at from 4 to 6 percent of the cost of site preparation. Ground rents are adjusted every 5 years to correct for changes in land values, and at the end of each term of the long lease agreement (50 years) adjustments in ground rent are made to reflect changes in the real value of land.

Under the procedures outlined above, the government exercises very close control over the kind and location of various land use activities. Because municipalities purchase and prepare all tracts for future developmental needs, there is virtually no land speculation in the Netherlands. Speculative interest in land is further discouraged by the fact that the municipality, when purchasing land previously designated on the approval extension plan as land for future development, pays to the landowner a price only slightly higher than the present value of agricultural land.

Municipal capital funds for land acquisition and site preparation come largely from bank loans, which are guaranteed by the federal government. Such loans are generally made at normal market interest rates. The municipality recoups the principal of the loan over time and is able to meet interest charges through the ground rents it subsequently collects and through taxes. Ground rents are determined by the costs the municipality has absorbed in land acquisition and preparation, giving the

municipality the flexibility to establish ground rents sufficient to meet its loan obligations. Moreover, increases in the value of land resulting from both inflationary forces and the interaction of supply and demand determine, over the long run, future ground rents. Thus, over time, the municipality, not the private landowner, captures the benefits of public improvements capitalized into land values.

Most of the Dutch do not consider the procedure of state-mandated and approved planning, expropriation of land and subsequent site development, and lack of private land ownership to be socialistic. There are perhaps two reasons for this. First, the process is not strongly tied to politics. Seldom is it a political issue at the national or provincial level. At the local or municipal level, some long range plans may have political overtones and thus indirectly contribute to the election or defeat of present or aspiring council members. But the usual ongoing planning decisions of housing, commercial, or industrial expansion seldom become political issues.

Second, the Dutch have a long history of government intervention in land development. In fact, without government involvement in seawall and canal construction and subsequent draining and preparation of polder lands, the country could not have been developed. Moreover, a large population, dependent for survival over a long time upon a very limited land resource base, could not have maintained itself in the absence of strong public authority and intervention in land use decisions.

#### LAND USE AND HIGHWAYS

Highway planning in the Netherlands is incorporated into and becomes an integral part of the overall planning process. At the national level, the Ministry of Transport provides two basic kinds of plans: a structure plan, which covers 30 to 40 years into the future, and a national plan. The second national plan was formulated in 1966; the third came out in 1977. Each national plan, which resembles more a program of development efforts, contains a structure plan. Until the last national plan, highways were included in a structure plan.

The Ministry of Transport may designate a highway between two cities in a national plan. Such a future highway must then be incorporated into the plans of each municipality and province, and together with the other community needs and extensions comprise the comprehensive plans for the communities. Thus national highway planning gets integrated into urban and regional planning at an early stage and there are no surprises at the local level. The corridors for primary national highways are designated by the Ministry of Transport at the national level, but more precise alignments are left to the discretion of the municipalities, subject to final approval by the province and the state. There is no legal basis for public participation in the highway planning process, nor are environmental impact statements required.

Although the public has no legal way to stop highway planning or construction, such as recourse to the courts as used in this country, conflicts and disagreements do arise and must be resolved. For example, residents in a municipality may object to a certain highway corridor as suggested in the national plan. Since municipal plans must be approved by the municipal council, members of which are locally elected, and since most council members are aware of the opinions and desires of their constituents, voting at the local level is not disassociated from local issues, of which highway planning is one. If the council will not accept a highway plan formulated by the local planning agency in conformance with the plans as handed down from the national level, then a locally



acceptable plan is prepared. But the new, locally acceptable plan, in turn, must be approved by the provincial and national governments. The new municipal plan, however, may not conform to other national goals, such as containment of growth, saving agricultural land, or location and provision of public utilities, and so the national government may reject the municipal plans. In this case, then, an appeal is made to the Crown to settle the dispute.

The hearing or adjudicating body that handles such appeals is the State Council, which is really an administrative court. Their decisions are generally binding. At the present time there are about 4000 plans awaiting decision by the State Council, only some of which involve highway planning disputes.

Once highways are opened for use, the same planning process and land use constraints exist for abutting or nearby lands as exist for all other lands. It does not appear, however, that very much explicit attention has been directed toward ameliorating adverse highway effects through controlling land use, or enhancing the positive effects. The long existing strict controls on development and its spatial dimension would in and of itself prevent the patterns of roadside development we so commonly find in the United States. In the Netherlands there is no strip development as we know it. There are very strict access controls to all roads and highways, although at times political pressure does get some changes and exceptions made. But one finds virtually no motels, quick food service establishments, or other businesses catering to motorists' needs along the Dutch highways. Service stations are far less numerous than in the United States (preponderance of small cars and lower commuting and travel distances required would contribute to this). At major highway interchanges, one is as apt to see cows as high-rise apartments. Large shopping centers or malls are just now becoming popular.

One of the principal beneficial effects of highways in the United States is the increase in land value caused by improved accessibility. In the Netherlands, land value appreciates from improved accessibility, but the private sector does not benefit, because all development land is expropriated by the municipality. The shifting of such economic incentives from the private to the public sector has removed much of the pressure, both speculative and real, for unplanned and uncoordinated development of a multitude of land use activities near highways.

For some time, a law has been in effect preventing building within 100 m (328 ft) of the edge of expropriation lands, although in certain circumstances exceptions are granted. A gentleman's agreement prevents the construction of structures closer than 200 m (656 ft) to the center of the highway. There are no billboards in the Netherlands. The government purchases land adjacent to the highway for landscaping purposes.

There is no noise legislation in the Netherlands at present, although such a law is now under consideration. This law, if adopted as now written, would establish norms for different land uses. The noise level within a residential structure could be no greater than 35 dB(A), and noise outdoors in residential areas should be no more than 55 dB(A). The indoor norm would have to be satisfied, but the outdoor noise level norm is only suggested, but one must have good reasons not to satisfy it. Structures to alleviate highway noise within heavily developed areas are being planned, but none have been installed to date.

#### PLANNING EFFECTIVENESS AND GOAL ACHIEVEMENT

The moderate effectiveness in coordinating highway de-

velopment and land use activities to minimize adverse effects and enhance beneficial effects of highways has come about more as an indirect result of the intensive overall land use planning process than through specific controls designed for such purposes. For example, residential land uses are not excluded from sites adjoining the highway, and in redevelopment of downtown areas can be right next to the right-of-way. The 100-m restrictions in new expansion lands on the urban periphery are more for aesthetic purposes than to ameliorate the effects of air and noise pollutants. The rigid access controls and land development controls, however, have been highly effective in preventing unsightly strip development and preventing a gradual reduction in traffic flows and capacity. Public expropriation of land, however, has effectively denied one major beneficial effect from highways, that of the capture of land value appreciation by the private sector, but at the same time has probably enabled a wider segment of the populace to benefit from improved accessibility.

The Dutch approach to controlling land use does not appear to be applicable to the United States at this time. The extremely strong and long-held beliefs of the American people in the desirability and right of private land ownership would make the current land use planning and control techniques of the Netherlands unacceptable. Most American landowners cherish their rights in land and adamantly oppose strong governmental intervention. The ability of the Netherlands' municipalities to expropriate land from private ownership, make it ripe for development, retain ownership into perpetuity, and insist that all new development can only take place on such expropriated lands seems far beyond fiscal, social, political, and legal reality in the United States. Fiscally, over the long run, such a program is probably self-amortizing, but Americans lack the legislative or institutional framework to launch such programs.

Although a direct cause and effect relationship between the spatial distribution of land use activity and the strict approach to land use planning and control in the Netherlands seems to be apparent, it is interesting to speculate whether such a pattern of land use is caused by strict land use controls or whether it might also be due in part to economic factors. When one considers that agricultural land, because of its high productivity, is worth about \$1600/hectare (\$4000/acre), the high cost of land preparation through removal of topsoil and replacement with sand, and the cost of piling, which alone represents about  $\frac{1}{3}$  the cost of a house, high density becomes necessary in order to recover costs. The cost of a single family home on an individual lot becomes prohibitive for all but the very wealthy. In the absence of the economic constraints surrounding new development, the Netherlands system of land use controls might not be as effective as it now appears to be.

Overall, the Dutch have achieved remarkable success in controlling the use of a very scarce and valuable resource—land. There is no idle land, no waste land, and no urban sprawl such as we know. The Dutch realize that if they are to survive and prosper in a modern age they must exercise strict control over how their land resource is to be used. The land must be used in a manner most beneficial to the community and to society, and not necessarily in a manner most rewarding to the interest of a private landowner. Over time a system has evolved that achieves this goal to a remarkable degree, a system based on integrated multijurisdictional planning, strong municipal authority, and economic realities.

This achievement, however, has had some trade-off costs to the individual. Full land ownership rights are

not possible for most Dutch citizens. Consequently, the gains to wealth originating from appreciation of land values are largely constricted in the Netherlands. Only the very wealthy can own a home on an individual lot. One must balance such restriction of freedom in private land ownership against the situation that might have evolved over the years had there been no such restrictions. Basically, what is involved is the trade-off of one kind of freedom for another kind of freedom. The loss of freedom of land ownership for the majority has probably meant a more stable economic and social system for the nation as a whole—hence higher national output and total personal income, a higher standard of living for the majority, and freedom from economic want.

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# The Effects of Urban Structure on Automobile Ownership and Journey to Work Mode Choices

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This study documents an investigation of the effects on automobile ownership and use of intermetropolitan differences in transit and highway service levels and overall urban development patterns. Specifically, we present models of the determinants of automobile ownership and mode choice for 163 488 white, single-worker households from the largest 125 standard metropolitan statistical areas in 1970. Indexes of highway capacity, transit service levels, and overall residential density for each area as well as each household's socioeconomic characteristics, workplace location, and residence choice, are used to explain the number of automobiles owned by each household, and, given that, each household's work trip mode (automobile driver; automobile, bus, or rail passenger; or walking). The models offer a framework for considering the effect of alternative urban development scenarios on automobile ownership and use, and for comparing alternative development and infrastructure policy options. Because the models were estimated using households from different areas, they are particularly appropriate for investigating changes in spatial structure.

Forecasts of automobile ownership and use are crucial inputs to the transportation planning process. Attempts to model these decisions based on disaggregate probabilistic techniques have recently received much interest. Typically, these studies focus on a particular metropolitan area, take each individual's workplace and residence zone as fixed, and characterize the ownership or use decision as dependent on various socioeconomic factors and the costs of alternative modes of travel.

This study has a similar approach in its disaggregate probabilistic framework and in its selection of variables that influence the ownership and use decisions. The analysis, however, addresses a range of questions that studies of a single metropolitan area are not designed to answer, such as how the overall arrangement of land uses (the density, location, and juxtaposition of workplaces and residences, in combination with the transit

and highway systems serving them) affect the level of automobile ownership and mode choices of urban households.

Statistical studies of a single metropolitan area cannot capture or quantify the effects of the overall spatial structure and transportation systems on automobile ownership and travel behavior. However, these aggregate effects are required to evaluate the effects of major transportation investments or of extensive changes in land use patterns. A household whose sole or primary wage earner works in Manhattan must choose from a different set of housing and mobility choices than an otherwise identical household whose primary wage earner is employed in the suburban New York area, in the Phoenix central business district (CBD), or at a suburban workplace in Phoenix.

## MODEL OVERVIEW

The analyses presented in this report consider the determinants of two interrelated decisions: (a) the number of automobiles each household owns and (b) the modes of travel employed members of the household use to commute to work. The statistical model employs a three-stage method of estimation that analyzes automobile ownership and modal choice decisions of urban households within a recursive model structure. The procedure first estimates the expected probabilities of owning zero, one, or more than one automobile based on the socioeconomic demographic characteristics of the sample households. Similarly, we obtain estimates of the expected probability that households in each automobile ownership class use each mode, again based solely on socioeconomic demographic characteristics.

The second stage of the analysis incorporates the