Toward Better Urban Transport Planning in Developing Countries

J. Michael Thomson

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Toward Better Urban Transport Planning in Developing Countries

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ABSTRACT

This paper describes the defects in transport planning and the various approaches that have been adopted in order to find solutions, but which have had limited success. It includes a discussion on the deficiencies and problems of the "Big Plan" approach to transport planning with specific reference to developing countries and the causes of planning failure.

For satisfactory planning the paper puts forward an approach that makes a clear distinction between directional and design planning. Direction planning aims to signpost the direction in which the land-use and transport structure of a city is intended to develop with no detailed time scale. It recognizes the need for flexibility in case the socio-economic growth of the city proceeds very differently from the forecast. Design planning is confined to the short and medium term and is greatly constrained by the directional plan. The purpose of the design plan is to give a complete list of projects in sufficient detail for inclusion in a 5-10 year rolling program.
Preface

One of the most daunting problems faced by the cities of the developing world is that of urban transport. Congestion is generally as intense or worse than in the cities of developed countries of comparable size, despite levels of automobile ownership still only a fraction of those in the developed world. The future seems bound to aggravate existing trends. Many of the cities in developing countries are doubling in population and area in a decade or little more and automobile ownership is advancing even more rapidly. The cost of providing roads and other transport infrastructure and public transport vehicles to meet this expansion is rising more than proportionately and represents a considerable proportion of total public investment, sometimes significantly more than a quarter.

Failure to provide adequate transport facilities greatly increases trip durations and costs both for passenger and goods traffic, lowering productive efficiency and placing a particularly heavy burden on poorer groups of the population living in peripheral and other areas of very limited access. The difference between suitable low cost solutions and the costly conventional approaches used in developed countries can be a factor of several times—but the more expensive approaches may be preferred for lack of adequate analysis and political reasons.

Unfortunately, the detailed methodologies best suited to the conditions of developing-country cities are far from clear. Conventional approaches require more data, technical staff and regulatory capacity than exist in all but a few of the developing-country cities. Moreover, experience in the developed countries with the models generally used has been far from satisfactory. In developing countries with much more uncertainty concerning future growth, incomes and land uses, these models seem even less appropriate. On the other hand, the design of the transport network expansion can have a profound effect on the physical directions of urban growth, land use, and general urban efficiency as well as on modal choice in the conditions of developing countries where access is a much scarcer phenomenon than in the developed world.

One general approach is to concentrate first on making better use of the existing transport infrastructure and other facilities. Traffic management, minor engineering, road widening, limited paving in squatter areas, construction of short link roads and the improvement of public transport enterprises can produce high returns and delay the time when major new highways or rail facilities are required. The Bank has been actively engaged in promoting this type of approach during the last few years with considerable success.

However, it is evident that with the continuing rapid growth of city populations, incomes and areas, the day must come when such an approach needs to be complemented by major new transport investments. Moreover, there is always a risk that some elements of the short-term approach may prove not to be as consistent with the longer-term expansion as could be desired.
In these circumstances, the Bank is exploring new approaches to the longer-term planning and programming of urban transport investments specifically related to the low income characteristics of developing countries. These approaches range from the adaption of well-tried techniques already in use to the development of radically new ideas. This paper by one of the most experienced of urban transport planners falls into the former category of how existing techniques might best be adapted to the conditions of developing countries. As a basis for the ensuing suggestions, the paper first presents a "state of the art" perspective of existing techniques familiar to most urban transport practitioners. Trends already evident towards a two-level analysis of strategic planning and of a shorter-term design planning are then presented and carried to a further stage of consideration of what in practice would be involved in the context of developing countries.

We do not expect this paper to find uniform acceptance. In the very varied conditions of developing countries probably no single approach will be relevant to all of their major cities. The paper, moreover, does not purport to cover all the manifold aspects of the urban planning process. The assessment of the long-term impact of provision of transport facilities on land use in combination with provision of other necessary services remains elusive. Stimulus of multiple-activity centers by public transport modes needs further exploration both for the effect on transport requirements and for savings in time and energy. The balance between primary and secondary roads in conditions of very constrained resources and rapid expansion of urban area also poses many problems of evaluation. Realistic assessment of the current and longer-term scope for traffic and parking restraints remains much of an art as does the value to be given to flexibility of systems in such dynamic conditions and the role of monitoring in adapting programs to actual experience. And then there is the usual problem of how to evaluate urban transport proposals in the absence of an agreed transport/land-use strategic plan—a common situation. How far and in what conditions a corridor analysis presents a reasonable second-best approach after testing alternative strategic plans is a further issue.

Within this general context, we regard this paper as an important addition to the current debate. We are therefore circulating it in the wider forum of the Bank's "Working Paper" series, hopefully to elicit further responses and ideas. At the same time, a series of other papers with narrower focus including Institution Building for Traffic Management, Traffic Management Operations, Transit Pre-feasibility Guidelines, and Bus Components in Urban Transport Projects are being prepared for circulation in the "Technical Paper" series of the Urban Development Department.

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SUMMARY

It is about 25 years since the introduction of modern methods of urban transport planning based on computerized network models. These methods, while undergoing continual improvement, cost a lot of money and often gave disappointing results. The author, having been associated for a long time with this planning technology, is frankly critical of its deficiencies and the way it is sometimes applied. The first part of the paper describes the weaknesses of the methods and the difficulties that planners face when trying to use them, particularly in developing countries. The intention is not destructive, however, but rather to show where the methods need to be improved. The second part of the paper is an attempt to suggest a way forward towards a better planning technology.

The urban transport problem is fundamentally similar in all large cities. The basic causes are the same and so are many of the consequences, although there are some differences of degree between developed and developing cities. Despite the much greater level of vehicle ownership and higher rate of trip generation in developed cities, it is the developing cities that in general suffer most from traffic congestion, road accidents, environmental pollution (except smog), overcrowding of public transport and poor conditions for pedestrians and cyclists. On the other hand, developed cities tend to suffer more from parking difficulties and infrequent public transport. But while the problems are similar, the solutions are not. Rich cities can afford motorways, multistory car parks, rapid transit and sophisticated control systems, and can fund lavish subsidies if they so wish. Whether these things constitute real solutions is another question, but it is irrelevant to developing countries since they cannot afford them anyway. The only possible solution for them—apart from cities in a few oil-rich countries—is a low-cost solution, which in practice means extensive bus priorities, traffic management and traffic restraint, together with selective road improvements. Only rarely can motorways or rapid transit lines be justified. The task of transport planning is to determine cost-effective solutions of this sort.

In the 1960s, transport planning went through the "big plan" phase in which massive studies aimed to produce comprehensive, long-term plans for land use and transport in considerable detail. The models failed to reflect realistically the interactions between land use and transport, ignored traffic generation and could not reproduce adequately the phenomenon of congestion. The "big plan" took a long time to produce, tended to ignore budget constraints and neglected the role of demand management as an alternative to investment, thus ending with grandiose solutions that were often not feasible. In developing countries, these deficiencies were compounded by lack of data, rapid and uncontrolled growth, mixed bus systems and other problems, which tended to reduce confidence in the results. Many people concluded that these studies were a waste of time and money and attempted the impossible without achieving the possible, which was to make some modest improvement in the existing chaos.
The critical reaction against the "big plan" led to the "incremental improvement" phase in which planning was confined to immediate action and short-term improvements with strong emphasis on low-cost measures. Eyes were closed to the longer term and to the need sooner or later to make strategic decisions about the development of the city. The limitations of this approach were bound to be recognized before long.

A further criticism of both phases of planning was that the emerging plans were all too often not implemented because the power or the will to do so was lacking. Even if feasible from a technical and financial viewpoint, they were politically or administratively unrealistic.

It is tempting to look for a completely fresh approach to transport planning, but this path is rejected. In the author's view, transport planning is basically on the right path and does not need to be radically changed. One difficulty is that quite small technical errors, or faulty assumptions, can lead to disastrous results. Rather than abandon the whole approach, more care and experience are needed in planning the study process and the structure of the models to be used.

Before considering these technical matters, however, it is essential to recognize that planning is a continuous process and cannot be effective and efficient unless it is carried out by an organization with the capability and authority to do what is needed and the power of implementation. Responsibility must cover the whole metropolitan area and all strategic aspects of land use and transport. The planners must be able to coordinate their activities with those of the transport operators and agencies. They must be in close touch with the political authorities and administrators, have access to available data and information, and have means of collecting specific data and monitoring trends. Most important, their work must be based realistically on such powers as do and do not exist to control the development of land use.

It is perhaps more important to set up an organization with the political, financial and administrative capability to plan than to give instruction in the technique of planning. But both are important. The technical approach recommended here is based on a two-plan process—a directional plan and a design plan—with separate models, for which specifications are suggested. Directional planning points the way for major changes in land use, transport networks and policy and ensures that decisions made today will not prove inconsistent and irreconcilable with long-term goals. The directional plan should indicate the main elements in the transport system in approximately 20-25 years time, which include the standard of line-haul roads and intersections, the required bus fleet, the supply of parking in the central and other critical areas, tariff policies for public transport, traffic management policies, including traffic restraint policies. The purpose of the design plan is to give a list of projects in sufficient detail for inclusion in a 5-10 year rolling program. The projects included in the design plan should be designed to the point necessary to establish their feasibility; that is, they should be ready, after approval, to go to detailed engineering design without further study.
Many past failures are attributable to the attempt to combine strategic and design planning in the same model. The models have become too big and costly to perform all the runs needed for strategic planning and not sufficiently accurate for design planning. Separate models designed for the very different requirements of strategic (directional) and design planning are considered an essential feature of the recommended approach.

The model for directional planning should be designed to make broad comparisons of alternative land-use and transport strategies, studied at two points in time in order to facilitate economic and other evaluations. In developing countries, where population is rising fast, the geographical expansion is bound to be very wide. There are, therefore, likely to be several alternative land-use patterns, each of which may require studying with two or three transport strategies, at least. Hence it is important that the model be small and fast but it must give results that are reliable enough for the purpose.

In design planning, the purpose of modeling is to provide reliable traffic data for feasibility studies of projects and, in particular, to compare the performance of alternative road designs and management schemes with the constraints of a predetermined strategy and a fixed land-use pattern derived from the directional plan.

Agencies, such as the World Bank, are interested to know that plans have been produced that help justify the financing of projects and that the plans make sense. Both directional and design plans must therefore stand up to a number of feasibility tests. These tests include an examination of consistency between: predicted numbers of vehicles and estimates of population and income; peak-hour trip destinations and employment data; traffic volumes and road capacities and available modal choice. Also it is necessary to determine that the capital expenditure required by the plans is realistic, and that the plans are likely to be satisfactory to political authorities.

The Bank also is interested in the details of the planning methodology itself, and a recommended method is therefore set out at the end of the paper.

A sample Terms of Reference for an urban transportation study is attached as an appendix. Other appendices deal with questions of plan evaluation.
PART 1: A CRITIQUE OF URBAN TRANSPORT PLANNING

Introduction

The World Bank is frequently involved with urban projects which are related, in one way or another, to transport planning. Some deal with the system as a whole, while others are concerned with just one aspect, for example, a major new road or railway that could affect the entire system in a significant way. Still other projects involve major housing or industrial schemes, which subsequently create large new demands on the transport system.

Thus it is important that all projects having a major impact on the demand for or supply of transport be consistent with the city's transport plans and policies, since development should not proceed in a haphazard manner. In this respect, the Bank is encouraging long-term planning of transport systems and the use of sound methods.

It is also recognized that a transport plan cannot be sensibly conceived without a land-use plan, and vice versa, the planning of land use and transport must go hand in hand. Thus long-term planning of cities with regard to their broad physical characteristics is a field in which the Bank is necessarily interested.

The purpose of this paper is to consider what sort of planning is desirable in the large cities of the developing countries and to suggest an acceptable way of doing it. There has been a good deal of experience in the last 20 years, some of it has been disappointing and frustrating, yet many lessons have been learned.
This paper is, to some extent a product of that experience. It briefly reviews the transport problem in large urban areas and looks critically at recent planning experience. Next, it describes the cities' basic planning needs and suggests guidelines for meeting them. While it is presumptuous to imply that there is only one way to produce a transport plan (and naive to imagine that all cities will adopt the same method), there are probably certain basic principles which should be generally observed. Therefore, the following guidelines are intended to present a planning method which is acceptable and which avoids a number of mistakes that have spoiled earlier efforts.

The Transport Problem in Large Cities

A transport plan is intended to tackle the transport "problem" as it presently exists and is expected to develop in the future. It is not likely to be a full solution to the problems, but should constitute the most effective way of using scarce resources that are also urgently needed for housing, sewerage, drainage, health and education.

The transport dilemma, although it has many facets, can be seen as a single complex problem of matching demand and supply. It is a problem that afflicts all large cities, in both developing and developed countries, and produces broadly similar results: congestion, parking difficulties, accidents, crowded public transport, environmental damage and bad conditions for pedestrians.
Superficially, the problem involves the large number of ways in which the transport system imposes difficulty or inconvenience on either the user or non-user. Of the various types of difficulties, the most conspicuous (though not necessarily the most important) is congestion, which, as measured by traffic speeds, is worse in cities in the developing world despite the fact that there are less vehicles per capita. As cities grow, congestion spreads, becomes more unpredictable, and the cost is alarmingly high in terms of time, energy and efficiency.

Closely associated with the growth of traffic is the shortage of parking space. Again, the parking difficulty is often worse than in cities in the developed world, because the streets are narrow and little off-street parking space has been provided. As a result, cars are parked on footpaths and in any available corner, causing danger, damage and inconvenience.

Third, because of bad roads, inadequate traffic management, poor driving standards and undisciplined behavior by other road users, accident rates per vehicle-kilometer are much higher in developing countries.¹/

The next two problems involve public transport. During peak hours, overcrowding is normal in cities in both developed and developing countries, but tends to be worse in the latter, causing passengers considerable delays and physical hardship. During off-peak periods, service is infrequent, but this is a greater problem in the developed world where car ownership is higher and residential densities are lower.

¹/ Accident rates per head are not always higher, since traffic volumes are much lower.
Next there is the problem of movement by pedestrians and cyclists. Here again the position tends to be much worse in the developing world. The needs of pedestrians are largely ignored, as footpaths are inadequate and badly maintained. Conditions for cyclists are often extremely dangerous and unpleasant.

Finally, there are the environmental aspects. While smog is generally not a problem (since there are not so many vehicles), there is a great deal of exposure to traffic noise, and the visual impact of traffic is at least as bad as it is in developed countries.

Besides these problems, it is important to determine if the right journeys are made, and in the right way, since the real test of the system is whether people can obtain access to their activities without undue expenditure of time, money and effort. Accessibility, not mobility, is what matters.

Accessibility is a function of three factors: the pattern of land use, the distribution of people in relation to the land use, and the transport system. Each of these factors is influenced by the other two and together they form a triangle of forces that must be balanced if people in a large city are to obtain efficiently the many amenities and opportunities it offers.

One of the differences between cities in the developing and developed world is this balance of land use, land users and transport facilities. In some of the former, there are people who spend hours travelling to and from work, who sleep at their workplace and only go home at weekends, or who, for lack of transport, cannot obtain work at all. Further, it is particularly
difficult for the elderly who become largely confined to their homes as they have no suitable means of transport and the congested streets are unsafe for them to walk.

Causes

Before attempting to resolve the problems, it is useful to consider why they have arisen, virtually in all large cities. The essence of the urban transport problem is that cities have been unable to supply some quite simple amenities which are easily provided in small towns but become progressively more costly to offer as the towns are transformed into cities and the cities into metropolises. In a small town, motorists can drive to work easily and park without trouble, bus services are provided effectively along the main roads, pedestrians and cyclists have little cause for complaint, and there is no real environmental problem. In a big city, people want the same simple things, but cannot get them.

In fact, it is not impossible to provide these same amenities in a large city, but it would be so costly that none has yet done so. As cities grow, journeys become longer and densities higher, so that traffic flows increase disproportionately, particularly in the inner city, and complicated engineering methods are needed to provide sufficient road, rail and parking capacity, while the quality of the environment and good conditions for pedestrians and cyclists are preserved. This could be accomplished, by elaborate use of tunnels, multi-level structures, underground car parks, subsidized bus services and strict enforcement of emission controls and noise regulations, but the expense would be enormous.
The transport problem could thus be eliminated, or very nearly, if cities were able and willing to commit the resources. It is thus an economic problem, one of matching demand and supply in a situation where, as the city grows, demand for transport services and associated amenities grows rapidly, and the cost of supplying the demand grows more rapidly still.

In other sectors of the economy, the normal solution is the price mechanism. Higher prices stimulate supply and restrain demand until the two are in balance. However, in urban transport, for a variety of reasons the price mechanism is not used effectively to deal with the problem. No direct price is charged for using the roads, nor for destroying other people's environment. Economic pricing policies are seldom adopted for parking or for public transport. As a result, people often cannot get the services they want at any price.

The problem is thus due to the structure of transport costs and demand, together with a number of practical pricing difficulties, all of which are common to all large cities. The causes are embedded in the nature and technology of our cities, and this fundamental fact explains why the transport problem is found with little variation in metropolitan areas in all parts of the world.

In developing countries, the problem has arisen more rapidly and officials have been less able to deal with it. They have been unable to afford much in the way of major roads and the networks are generally small and of low standard. Hardly any extensive rail systems exist and most cities have
no rail facilities at all. Thus, in general, the whole burden of transport falls upon an inadequate road network. In the developed countries, on the other hand, apart from the United States where some cities have been built to accommodate practically universal car ownership, all cities of over two million people possess urban rail systems, and most possess fairly highly developed road networks, as well.

Beyond the failure to match supply and demand, the problem is exacerbated by a failure to use the available roads efficiently. Recently, a great deal has been done to introduce traffic engineering and improve the operation of bus enterprises, but it is still true that, in almost every respect, the management and maintenance of the total transport system is poor. Driving standards are generally low, and quite often, road junctions are poorly designed, road surfaces and edges are in bad condition, pedestrians are undisciplined, vehicles are not roadworthy, parking practices are chaotic, and traffic signals are inefficiently used. In addition, police control is sometimes weak.

In developed countries, there seems to be little more that can be done to get better performance from existing facilities: rather, the problem has clarified into a choice between expanding the facilities or controlling the demand. In developing countries, however, there is still room for improved performance, and this possibility has appeared as a solution to the overall problem. But increased efficiency is no more than a short-term palliative. In many cities where traffic engineers have already introduced the basic elements of their trade (though much could still be done to improve safety,
convenience and the environment), there is probably not a great deal more capacity to be won from the network because it usually depends on a few key junctions which are naturally attended to first.

Hence, while it is undoubtedly right to concentrate initially on improving the existing system, it is impossible to avoid the fundamental problem and the need for longer-term solutions.

**Solutions**

It follows from the above discussion that a solution to the transport problem must consist of a land-use pattern, a transport system and a set of management policies that together bring demand and supply into balance, both for transport services and for those other amenities affected by transport or which compete with transport for space. In western cities, three broad approaches can be identified. One is the American response—"the fully motorized city"—which depends on a high level of car ownership, a relatively homogeneous distribution of land use at low density, and no large centers. The transport system is entirely based on roads and consists of a grid network of very large capacity with correspondingly large areas of surface land devoted to parking. The essence of management policy is to keep the price of cars as low as possible and similarly the cost of using and parking them. For those without cars, it is difficult to provide adequate bus services without huge subsidies.
Second, there is the "strong center" approach which tends to be followed in Europe, Japan and New York. The city retains the traditional concentration of "central" functions, although other quite large centers are built in suburban areas and accommodate "district" or "suburban" functions. The transport system, both road and rail, is strongly radial, maintaining the city center as the most accessible area and thus supporting the land-use structure. Management policies must maintain an efficient distribution of traffic between public and private transport, by means of parking restraints and subsidies for public transport. An essential feature is that a high proportion of longer-distance travel is by rail, and the whole structure of the city and its transport system is designed to make this possible.

The third approach is the "weak center" solution, which is suitable for non-capital cities. Here, the city center contains only the more crucial central functions and is supported by a few commuter railway lines. Sub-centers play an important role and are supported by a high-capacity ring-radial road network. And as the city center must strongly compete with the sub-centers, officials avoid imposing traffic restraints and attempt to attract commuters to the railway through heavy subsidies.

These three approaches have one thing in common: they are expensive. They all require large investment in highways or railways, or both. Two of them (the first and third) require a high level of car ownership and a lot of parking space. By definition, cities in developing countries do not have the resources to copy them, nor do they have the time—since the problems are so pressing and require more immediate responses.
New York possesses more urban railway and highways than all the developing cities of the world together. Mexico City's urban railway, which is well-publicized, measures only one-tenth that of London and serves almost twice the population, and neither London nor New York has fully solved its transport problem. The unavoidable truth is that the solutions which have proved too costly even for the developed countries are beyond the reach of the developing countries, apart, possibly, from some that are rich in oil.

It might be thought that the process of urbanization in developing countries is only a repetition of what occurred earlier in the developed world and could, if desired, follow a similar course. But this is not true. The process is occurring much faster and under different economic and technological conditions. In particular, since the cost of buying and running motor vehicles is relatively much lower, the demand for infrastructure of all kinds, including transport, is much greater than was the case in Europe or North America, relative to the resources of the city. Moreover, some of the developing cities are expected to grow rapidly to a size that has no parallel in the industrialized countries, except quite recently in Tokyo and New York.

It follows, therefore, that any transport solution within the foreseeable future must be cheap. Thus, it cannot include large networks of high-speed roads or railways. It must achieve the following aims:

1. **Avoidance of needless and needlessly-long journeys.** Land use must be arranged so that residential areas are mixed (in income and type) and are provided with nearby opportunities for employment, shopping,
education and entertainment, inasmuch as these things can be efficiently provided on a local scale. Many services, however, are more efficiently provided centrally, like those in head offices, government buildings, financial institutions, law courts and specialist operations of many kinds, and these "central services" should remain in the center with access provided from all parts of the city. Other services which can readily be localized, like supermarkets, district utilities' offices, general hospitals, branch banks, fire stations, and the like should be located in sub-centers or suburban centers.

(2) **Segregation of buses.** If buses and cars share the roads on equal terms, cars will always give superior service, no matter what the traffic conditions, provided there is a parking space near the destination. To compete effectively, buses must be segregated from car traffic on the parts of the route that are likely to become congested. While there are various ways to accomplish this, the principle is clear: buses must be able to perform their job without serious interruptions from private traffic.

(3) **Restraint of private traffic.** It has been shown repeatedly that car owners cannot be effectively persuaded to travel by bus unless they are both enticed to do so and penalized if they do not. In developing countries, successful enticement is more likely to consist of a superior quality of service, albeit at a higher fare; this may be provided by a minibus service. But whatever the enticement, a penalty on the use of the car is also necessary. High parking
charges, or some other form of tax or restriction, are essential to an effective solution.

Recent Planning Experience in Developing Countries

In the last three decades, planning of urban transport has changed dramatically. Until the mid-1950s, it consisted of estimating future traffic demand by means of simple growth rates. In the late 1950s, however, scientific planning, through which traffic demands were related to land use and modal choice, was introduced. The methods were pioneered in Detroit and Chicago, where the object was almost exclusively to provide roads for private transport, with very little attention to public transport. This approach soon crossed the Atlantic, first to London, Leicester, Copenhagen and Athens, where it was subsequently refined to meet the needs of cities in which public transport was more important. Later, in the late 1960s, the new methods began to be applied in developing countries, in cities like Bogota, Hong Kong, Caracas and Bombay.

Prior to 1960, except in a few more advanced cities like Buenos Aires, Rio de Janerio and Singapore, the urban transport problem in its modern form was hardly recognized in the developing world. This was largely because the cities were much smaller than they are now and contained very few motor vehicles. Traffic, however, moved slowly, but not for lack of road space; rather, because most of the traffic consisted of slow-moving non-motorized

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1/ In 1960 there were only about 7.5 million motor vehicles in the entire developing world—about six vehicles per thousand population (excluding China).
vehicles, e.g. carts, bicycles and rickshaws, together with large numbers of animals and pedestrians. Transport planning amounted to little more than widening the main radial arteries, laying out new side streets and gradually converting surfaces from earth to paved roads.

In the 1960s, with the rapid growth in the numbers of people and vehicles, the transport problem began to hit the developing cities with sudden and dramatic force. As there was little expertise in those countries, advisers and consultants started to flow in from more experienced countries, particularly Britain and the US. But although the transport problem had a much longer history in the latter countries, the methods of transport planning were more recent and were still in an early stage of development. Methods designed for Europe and North America were applied in developing countries before they had been adequately proved in their places of origin. Adaptation to the different conditions of the developing countries had to be made by consultants as best they could within the time and budget limits of their contracts.

The result was not always satisfactory. Even in the home cities of many of the consultants and academics, like London, San Francisco, Toronto and Paris, the methodology of some elaborate transportation studies was severely criticized and the conclusions were rejected. It is not surprising, therefore, that similar planning studies in developing countries also came under fire. As a result, two phases of transport planning in developing cities emerged: the "big plan" phase and the "incremental improvements" phase.
The "big plan" phase

The new planning era of the 1960s reflected a reaction in the developed countries against the piecemeal, short-sighted approaches that preceded it. The essence of the new method lay, first, in the recognition of the interaction between land use and transport and between different parts of the transport system, and second, in the need to plan major transport structures well into the future. This led to the big, all-embracing plan, preceded by a correspondingly large and comprehensive planning study of land use and all parts of the transport system throughout the whole metropolitan area for 25-30 years into the future.

The logic of the approach was indisputable: its practicality rested on the recently developed power of the computer. A large amount of data on travel patterns and their determinants had to be collected through traffic surveys and household interviews, and these required a lot of manual work; but the processing and analysis of the data, and projections for the future, could be largely mechanized.

The methods became rapidly more complex and need not be described here in detail. Basically the approach was to divide the metropolitan area into a large number of small zones and determine how many trips, both for passengers and goods, were made between each pair of zones on a typical day. The trips were classified according to motivation, mode of transport, land use and household characteristics of the places of origin and destination. The spatial and modal distributions of the trips were then analyzed as functions

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1/ Some earlier plans, like Abercrombie's for London in 1944 and the Boston Master Plan in 1948, were not piecemeal, but their authors failed to understand the nature of the transport problem in the long term.
of the land-use patterns and transport costs (including travel time) and the choice of route was simulated as a function of travel distance and/or time. The purpose of the analysis was to produce a model which, given a knowledge of land use, household characteristics and the available transport facilities, could estimate accurately the intricate movements of traffic on the system, by mode and, where necessary, in peak and off-peak hours separately. The model could then be used to show what would happen if the transport facilities were changed and if, over time, the land-use and household characteristics were altered.

In theory, the model was an excellent tool for investigating the complex changes to be expected as a result of future changes in population, employment, income and car ownership, and for comparing the impact of alternative transport systems and land-use arrangements. It did not actually design the alternatives, however, nor did it automatically solve the problem of choosing between them. It provided a lot of information about them but the final choice of "what to do" still posed some difficult questions. The application of the model had to be preceded by a design stage to determine what could be done, and followed by an evaluation stage to decide what should be done.

The "big plan" approach in developing countries produced some useful results. For example, it yielded a lot of data and led to a better understanding of the problem, but it also produced defective or inadequate results, some of which were inherent in the method itself. Particularly, these involved (1) the interaction between transport and land use, (2) public transport, (3) congestion (4) trip generation, (5) traffic composition, (6) budget, (7) size of model and (8) other problems.
The interaction between transport and land use. Although the approach emphasized the impact of land use on the demand for transport, it failed to deal satisfactorily with the impact of transport on land use as the latter was normally formulated and held independent of changes in the transport system. In the British situation, where land use was largely static and tightly controlled, this procedure might have been acceptable. In the American situation, where land use was generally free (apart from zoning limits) to follow market forces, the above approach was not feasible and, therefore, attempts were made to predict land-use development as a function of transport facilities, among other things. But in the developing countries, where a great deal of new development was certain to occur, the problem of identifying the interrelationship between land use and transport was much greater and was really insoluble. Many new roads failed to achieve their purpose (as defined in the plans) as efficient traffic arteries because they rapidly attracted to their sides unforeseen land-use patterns which unloaded all manner of slow-moving traffic onto the roads.

Public transport. The approach was initially developed for private vehicle traffic, such as cars, taxis and goods vehicles. Public transport was considered irrelevant in the particular American context in which the methods were first used. The subsequent introduction into the models of public transport, with the complications of interchange, walking and waiting, service frequency and comfort, took time. Moreover, the response of public transport passengers to changes in services, and, in particular, their choice between alternative modes, proved difficult to model. This
was serious in developing countries where most passengers were public transport passengers.

**Congestion.** It was assumed that the object of the plan was to provide free-flow conditions and that roads and intersections would be built to whatever standards were necessary to achieve this result. This extravagant approach has, of course, been abandoned in large cities, in the United States and elsewhere. Today, transport models must be able to reproduce speeds under congested conditions. This is more difficult but even more necessary in developing countries if realistic results are to be obtained.

**Trip generation.** Modelling techniques have always been weak on measuring and predicting (motorized) trip generation, i.e. the number of motorized trips as a function of the quality/cost of the transport facilities. This relates to the number of motorized trips and the quality/cost of the transport facilities. This has led to a general tendency to underestimate the growth of traffic on new roads and to overestimate the growth of traffic on existing congested roads.

**Traffic composition.** The analytical methods were designed for roads on which virtually all traffic was motorized. A great deal of research was undertaken on the capacity of such roads and on their speed-flow characteristics. This body of knowledge, which was essential for scientific highway planning, was not applicable to roads on which the traffic composition was quite different. The presence of bullock carts, camels, rick-shaws, etc. invalidated the conventional rules established in western cities.
Budget. One of the key questions in transport planning is: how much should be spent on improving the system? At first, the answer was given in engineering terms, namely that demand should be met in full to standards of construction and performance as considered safe and adequate by engineers. The principle proved too costly in the larger cities and was soon replaced by the criterion of the economic rate of return.

Size of model. Despite the power of the computer, it was found in study after study that the model was so large that it could be "run" only a few times, simply because of the amount of time and labor spent preparing, checking, processing and interpreting the data. Most studies fell behind schedule because of modelling delays and invariably little time was left to interpret results; also, most were unable to examine a sufficient number of options because of the cost and time involved in using the model. Many became so dominated by the demands of the model that other important work was neglected.

Other problems. A great deal of work has gone into the improvement of transport planning techniques, but the whole process is essentially based on long-term predictions which are critically dependent on factors that cannot be accurately determined. The most crucial is income growth: for example, the difference between 2% and 3%, or 4% and 6%, is critical over 20 years, and past forecasts have often failed to achieve greater accuracy than this. Population growth is also crucial and demographers have a poor record as forecasters. Predictions of car ownership have been reasonably accurate, but calculations of the numbers of goods vehicles, motorcycles
and bicycles have gone badly astray. Also, it is difficult to predict travel behavior which is related to the value of time, which itself is partly dependent on income.

These were the main defects in the planning methods that emerged in the developed countries during the 1960s and were rapidly introduced to developing countries. In general, the defects were less important in the countries for which the methods were originally designed and where all the associated research was done. The methods, when adapted and refined, were probably quite acceptable for a stable, mature city like Manchester, with a fairly well developed transport system, but not for a city like, say, Bangkok, in an early phase of industrialization, expecting rapid growth in both population and area, and with only a rudimentary transport system.

To the shortcomings already listed, others, which were specific to the developing countries, emerged, when planners attempted to deal with the following questions: prediction, data, value of time, shadow prices, secondary forms of transport, fares, inflation, and poverty.

**Prediction.** This problem was greater in the developing cities because growth rates of population, income and vehicle ownership were all much higher. Developed cities were planning mainly for an established population in an established urban area; developing cities were planning mainly for a population that did not yet exist, in empty spaces outside the present city. Errors in the growth rates could have devastating effects on the plan.
Data. By and large, the supply of data of all kinds was less plentiful and less reliable in the developing countries. Data on vehicle ownership and incomes were poor or non-existent. Sometimes even population figures were not available.

Value of time. The urban transport problem is largely about people's time and comfort, the value of which is important, both for the simulation of travel behavior and for the evaluation of transport improvements. In the developing countries, however, there was no research in this field, and results from Britain and the United States were hardly relevant.

Shadow prices. In the developed countries, labor was always costed at its market value or wage rate, and the impact of a transport plan on the balance of payments was never considered. In the developing countries it was common (though questionable) to value labor at less than its wage rate, that is, to shadow-price it, on the grounds that the opportunity cost of labor was less, because of high unemployment. Foreign exchange, on the other hand, was often considered to be worth more than the official exchange rate; therefore all expenditure requiring foreign exchange was calculated at the "real", rather than the official, exchange rate. In both cases, however, there were difficulties in deciding what shadow prices to use.

Secondary forms of transport. Another distinctive feature of developing cities is the use of small communal vehicles, or para-transit, operating as either small buses or shared taxis. Practically unknown in developed
countries, they often comprise a major part of the traffic, but planners knew little about them until quite recently.

**Fares.** Earlier studies ignored fares altogether, implicitly assuming that they would remain constant, in real terms, or could change without affecting the traffic. This approach was not acceptable in developing countries, where the level of fares was invariably a politically explosive issue and where it was not easy to obtain—or to justify—subsidies from government.

**Inflation.** Inflation affects planning in a number of ways which, to this day, have not been thoroughly analyzed. In the 1960s, inflation in Europe and North America was low and was not considered relevant to physical planning. Prices, apart from wages, were generally assumed to stay constant. After 1973, however, this approach had to be changed. In the developing countries, it was never valid because inflation rates were generally quite high (even before 1973) and were much higher thereafter.

**Poverty.** Modern methods of transport planning were evolved mainly in the interests of the car-owning classes and tended (unintentionally) to neglect the interests of the poorer classes. In the developing countries, of course, the poor comprise the large majority. Thus, the transport problem is dominated by the poverty of the majority and the gross insufficiency of resources with which to tackle the problem. The transfer of planning technology to the developing world must be accompanied by a drastic change of values. Accepted standards must be shelved, objectives re-thought and a much stricter emphasis placed on cost-effectiveness.
The many weaknesses in the planning methods and exercises of the 1960s, and the difficulties of applying them in developing cities in the early 1970s, led quickly to dissatisfaction with the results. Some planners were obviously more competent than others, but none could avoid the fact that they were trying to apply new and not fully developed methods in extremely complex situations for which the methods were not designed in the first place.

The big plans produced tended to contain grandiose schemes which could not be afforded, favored the rich minority and were probably not realistic; they planted Western solutions, such as urban motorways, underground railways, computerized traffic signals and metropolitan bus corporations in cities where these solutions would be too high in cost and too low in effectiveness. Not only was the underlying analysis riddled with weaknesses, but the solutions were so long-term that they offered no improvement in the transport situation for many years to come.

For these reasons, therefore, there was a reaction against the big plan and an attempt to replace it by a new approach, which may be called "incremental improvement."

The "incremental improvement" phase

In 1974, faith in forecasting was shattered and attitudes towards transport planning changed. The oil crisis and the world recession that followed it, together with high inflation, colossal disruption in the international balance of payments and fluctuations in exchange rates, made nonsense of most previous forecasts, especially in transport. At the same
time, it was gradually dawning that most demographic forecasts in the industrial countries were also inaccurate.

There was an understandable feeling that the big plans were a waste of time and money, attempting the impossible by being too ambitious, without doing what might be possible, making some modest, but real, improvements in the existing situation, which usually bordered on chaos.

The incremental improvement approach was based on the following:

- there were many pressing problems in the existing situation; it was not necessary to look 25 years ahead to find them;
- there was very little money to spend on solutions;
- a great deal could be done without heavy investment, mainly by using existing facilities more efficiently;
- governments were invariably anxious, in their own self-interest, to produce tangible improvements quickly.

All these facts spoke in favor of "immediate action" or "short term improvements" programs, with the emphasis on low-cost measures, which necessarily meant management improvements or minor structural changes. The theory behind this approach is that it is unnecessary to make forecasts for next year, since one can see what would be an improvement next year. If the focus is thus shifted to making small, but sure, improvements, rather than trying to make a quantum leap through 25 years, progress will be made.
It was noted earlier that the situation in developing cities is complicated by the fact that the underlying transport problem, which is inherent in the growth of large cities, is overlaid and partly obscured by a great deal of straightforward inefficiency.

This inefficiency offers a natural target for immediate action plans. More white paint to encourage better driving discipline, more traffic signals and warning signs, pedestrian crossings, one-way systems, lay-bys for buses, and parking controls to prevent obstruction are elementary, cheap ways of getting better service out of existing roads. Minor construction may be recommended to improve the design of junctions and bridges, or to eliminate key bottlenecks, and again, such work can be done quickly and cheaply. Bus services can be improved by provision of new vehicles, spare parts and repair facilities. Above all, there is a need for simple maintenance, since in many developing cities the care of the roads, footpaths, traffic signals, street lighting, other road furniture, and buses is often quite inadequate.

Some short-term plans of this kind have recently attached unusual importance to safety. There are innumerable simple—and often, obvious—ways in which the risk of accident can be reduced including regular maintenance of infrastructure and equipment (since safety and good maintenance go together).

Where large bus companies exist, it is usually possible to improve the quality of organization and management, with the object of reducing costs and
raising the level of bus utilization and reliability. Ex-patriate managers and consultants have been employed to try to introduce better management practices into bus companies.

The planning of incremental improvements is a process of looking for problems that already exist and finding quick solutions. It does not necessarily eliminate the use of computerized models (which have become unpopular in some quarters), because a network model can certainly be of assistance in planning traffic management schemes, bus routes or the location of markets and other big traffic generators. But the sort of model needed for this purpose is different from the big plan model. It is confined to the existing network with current land uses and trip generations and may be required only as an assignment model. For example, it may be used to study different ways of routing a fixed pattern of trips and modes or it may be required to incorporate changes in trip distribution and modal split as well. The problems of land use and long-term forecasting are avoided but, on the other hand, a higher level of detail and accuracy is needed.

The advantages of this approach are obvious. It leads rapidly to results which can be seen to be good, at least for a time, but the shortcomings are also fairly clear. The basic principle, that the sum of a series of incremental improvements must add up to progress, is not necessarily true and is certainly not sufficient. History has shown repeatedly that transport improvements which appeared obviously desirable at the time may be ultimately counter-productive. In fact, it is precisely because the results of earlier piecemeal planning were so chaotic and unsatisfactory, that comprehensive, long-term planning was introduced.
Moreover, short-term plans are, by their nature, short-sighted and fail to give due weight to long-term investments which, by virtue of their long life or high capacity, will give benefits over a long period. They also penalize projects such as railways, fly-overs and multi-level car parks, in that they are accorded insufficient weight. As a result, an approach that ignores the future beyond five or ten years in a field like transport, where capital structures are typically long-lived and offer large economies of scale, is bound to bias investment choices in favor of inefficient stop-gap measures.

The longer that incremental planning continues, the more obvious will become the need for something more comprehensive and far-sighted (although not the "big plan" described earlier).

**Implementation**

In general, transport planning has a poor "track record" for effectiveness, as plans for this sector are more often rejected or ignored than implemented. This is perhaps even more true in developed than developing countries, and especially in large cities. London, Paris, Stockholm, Zurich, San Francisco, New York, Toronto and many others have seen major transport plans reversed, often as a result of popular protest. In developing countries, many plans have been ignored because governments were lacking in money or interest. One can cite Singapore, Kuala Lumpur, Lagos, Calcutta and Bogota as cases where major proposals came to nothing.
Implementation requires three essential conditions: acceptance, finance and capability. In developing countries, acceptance often means approval by the cabinet, president or monarch, as well as ministry and/or city council or mayor. Many plans, or their important parts, have failed to obtain acceptance, not for sound, technical reasons, but for political or personal reasons, sometimes resulting from a change of government. Moreover, there is usually little or no communication between the planners and the people whose agreement is ultimately needed.

Even when accepted, plans are often either not implemented or only after a long delay, because of lack of funds. Thus, it may be argued that plans should be financially realistic, but this is not easy. In some instances, planners and the departments involved may wish to press for more money by putting forward ambitious plans.

Given the political will and the money, there remains the problem of actually carrying out the plan. Usually there is no difficulty in obtaining the necessary engineering capability, but there are obstacles, especially in developing countries, to enforcing land-use proposals. Few developing countries have any reliable means of controlling the way in which land is developed or redeveloped. Restrictions on land use lower its value, in the short-run at least, and therefore, open up the possibility of corruption. Hence, even if legal powers are available, they are often ineffective.

Acquiring land for construction poses another set of problems, apart from its monetary value. For example, the acquisition of land for road construction may involve the disruption of traditional land tenure
arrangements. Even if legal powers exist, or can be obtained, to permit compulsory purchase, these arrangements may deter or delay governments from acquiring the land.

Also, there are difficulties in implementing management measures, which may be essential parts of the plan. For example, a financial policy for public transport is obviously necessary but, whatever means are proposed to pay the cost of the service, if they involve higher fares or higher taxes of any kind, they are difficult to enforce. Further, the police in many developing countries are unwilling to enforce vehicle and traffic regulations.

Causes of planning failure

Planning is a difficult and controversial task. Even with the best intentions and the greatest skill, planners will never satisfy everyone and will almost inevitably antagonize some. Also, in many cases they have failed to influence development in the way they intended, and where the plans have been accepted and implemented, these have often failed to achieve the results expected.

The main reasons for such failures may be summarized as follows.

1. poor planning techniques - These, however, have steadily improved and are better today than 15 years ago when scientific planning began to be applied in developing countries

2. inadequate terms of reference - Some planning studies have been doomed from the start by terms of reference that excessively limited the area and aspects to be covered,
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. poor data;

. lack of political realism - Some plans have contained proposals that stood no chance of acceptance. The planning authorities either had no familiarity with political realities, or wished to ignore them;

. lack of budgetary realism - Again, the planning authorities may have had no feeling for what was financially feasible, or else they wished to push their case regardless. Either way, many plans have been shelved for lack of money;

. lack of qualified staff;

. lack of planning controls;

. inadequate means of enforcement - Police, inspectors, traffic wardens may be unable or unwilling to enforce regulations;

. lack of feasibility - It is not enough to blame failure on the lack of planning controls and enforcement. One should not sow seed in unsuitable soil. Plans should be designed for the practical conditions which are going to be encountered. Too many plans err on the side of an ideal and lose sight of what is achievable.
Introduction

Part I of this paper explained the difficulties of transport planning in both developing and developed countries. In this second part, a modified approach is proposed, which attempts to overcome the problems. As noted earlier, the problems are not just methodological; rather, they are also organizational. If good plans are to be produced, there must be more than a sound method of approach; there must be people capable of applying the method, and they must be employed by an organization with both the will and the power to adopt and implement a reasonable plan.

Planning is not an occasional task; it is a continuing activity, calling for regular data collection, monitoring of programs and predictions, updating and modification of plans, and implementation. As such it involves a few essential components. The first two are organizational: adequate planning capability and means of implementation (of the plans). Also, there must be two plans: a long-range directional plan and a short-range design plan. These four requirements will be described and will be followed by a final section proposing a method for producing plans.

A sample Terms of Reference for an urban transport study is included as Appendix A.
Planning Capability

There are three levels of transport planning in cities: operational, tactical and strategic planning.

Operational planning

This involves layout of junctions, pedestrian crossings and parking areas, siting of bus stops, establishing ticketing methods and road safety schemes and so on. These are the elements which are most noticeable to the ordinary user of transport and which often lead to complaints.

Tactical planning

This level of planning must deal with traffic management schemes, local road construction, parking control, organization of public transport, co-ordination of fares, creation of pedestrian areas, and the like. All of these aspects present complex problems because of their interactive and side effects and require the skills of trained professionals.

Strategic planning

This involves the structure and capacity of the main road network and public transport system, the relationship between transport and land use, the balancing of demand and supply, the reconciliation of transport objectives with the economic, environmental and social objectives of the city—all difficult questions not well understood, even by professional transport planners, and largely misunderstood by most others, including the politicians who make the vital decisions.
Operational planning should be consistent with the tactical plan for the area affected, and tactical plans should correspond to the strategic plan for the whole city. At all levels, planning is an on-going function that calls for continual evolution, monitoring and revision.

A basic requirement in every city, therefore, is an "organization" capable of undertaking these planning functions. The organization need not consist of only one body; indeed, it would be unusual for all three levels of planning to be found in a single unit. Rather, there must be coordination between separate bodies to ensure that operational planning reinforces tactical planning which, in turn, reinforces strategic planning. The latter must be carried out by a single body, which may be a ministry, metropolitan council or planning agency, and which may or may not engage in tactical planning, but is unlikely to be concerned with the details involved in operational planning. Operational planning, and sometimes tactical planning, are the responsibility of a lower level of administration.

Whatever the form of the organization, the essential conditions are:

An adequate scope of responsibilities - The whole metropolitan area (even those areas in which the city might expand in the foreseeable future) must be included. The scope must cover land use and all modes of transport, and must enable the planners to take account of economic, financial, social, environmental and administrative aspects. Planners should be empowered and required to coordinate their activities with those
of other agencies (both public and private) concerned with transport planning, including bus companies, paratransit associations and major land developers.

A sufficient number of qualified staff - At the strategic level, a team of at least 12 professional staff\(^1\) is needed, with a director capable of acting as a bridge between technicians and politicians. The team, which must be multi-disciplinary in operation, would of course be small compared with some of the planning teams or organizations in developed countries, and it must be regarded as a minimum; but it would be unrealistic to expect more than this in many cities in the developing world.

Where fewer staff are available, as in many cities, they can follow the same general practices but less rigorously and with less attention to individual projects.

At the tactical and operational levels, the need is largely for traffic engineers, public transport planners and highway engineers. The numbers required depend on the size of the city.

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\(^{1}\) This includes two land-use planners, one transport planner, two analysts, one transport economist, one public transport specialist, one traffic engineer, one general economist, one statistician, one highway engineer and one environmental planner.
To upgrade the technical expertise at the local level, there has been a tendency recently to bring in consultants to work with local planning teams. This can be a useful way of strengthening the planning effort and at the same time imparting higher standards, provided that the consultants are full members of the team, with clear responsibilities and functions, and are not simply advisors.

The quality of the planning obviously depends on the quality of the planners; and at present, there is a gap between the difficulty of the job and the capability of those who do it. Thus, attempts should be made to narrow the gap by simplifying the job and raising the quality of the planners; realistically, however, the gap will not be closed easily or quickly.

**Data collection.** Planning, and especially transport planning, is largely concerned with numbers—of people, jobs, vehicles, trips, minutes, miles, etc. Thus, planners must have good data with which to produce and monitor their plans. Regardless of who or which agency collects the data, it is essential that the information is readily available to the planners. Data on population, households, employment and vehicle ownership by zones, should normally be collected by different government departments: data on accidents, traffic flows and composition, may be collected by the police; data on public transport movements should be collected by the public transport authorities; more specialized information, such as speeds, junction and pedestrian movements, vehicle loads, origins and destinations, and other matters, will have to be
collected by the planners themselves and resources must be available for this. Also, the need for time series to monitor forecasts and progress should be stressed and regular data collection organized for this purpose.

At the same time, data collection must be restricted to what is really necessary, and planners must be aware that very accurate data are often costly to obtain and not really crucial. Conversely, very inaccurate data can be highly misleading and harmful. Therefore, in developing countries it is particularly important to obtain data that are adequate for their purpose, without being needlessly expensive.

It is important that when permanent planning teams exist, they should become involved not only in the use of data but also in the decision about what is to be collected so it meets their needs as far as possible.

In summary, the first planning need of a city is the capability to plan—and at all three levels. A minimum number of permanent staff with a variety of professional skills is required and they must be given suitable terms of reference and adequate arrangements for obtaining data.

**Means of Implementation**

One need look no further than the United States to find cities where an excellent planning capability is continually frustrated by a lack of implementation. However, if planning is to be of any significance, there must be a reasonable chance that it will be implemented. While planning must be
done by professional teams, implementation of their work must be the responsibility, first of politicians, and subsequently of the executive. It is as undesirable to give the planners the power to implement their plans as it is to leave the task of planning to the politicians and the executive. There are three important steps between the planners' drawing board and actual implementation:

Political approval - All transport plans must be approved by senior officials and political authorities before they can be executed. This involves approval in principle, and as a long-term goal or policy. Plans must be included in a program, must have a budget allocated and finally, must have orders to proceed with contracts.

There is no system of government in which political acceptance can be guaranteed. However, there are two vital conditions that greatly improve the chances of acceptance. First, the number of bodies whose concurrence is necessary should be as small as possible: if several local authorities must agree, there is little hope of getting any plan approved and no hope of getting a good plan approved. If separate authorities for roads, railways, transport, police, local government and the Ministry of Finance must all agree, again the final result is not likely to satisfy sound planning principles.

The best arrangement—from the point of view of good planning—is where political decision-making is vested in one authority responsible for the whole metropolitan area. As this has become increasingly apparent,
many cities have moved in this direction. A "greater" authority of some kind has been created, with powers to develop and manage the principal roads and urban railways, to control the buses and taxis, and to administer planning regulations on the use of land, throughout the whole urbanized area and beyond. In practice, most metropolitan authorities do not enjoy all these powers without restriction, including the budgetary freedom that they would like. Usually, where such authorities exist, there are historical or political reasons why particular powers have been retained by the central city, the central government, the Ministry of Finance, the Ministry of the Interior, the railways, the police, or a neighboring administrative district.

Clearly, though, there are some cities (for example, Singapore and Hong Kong) where political acceptance is much easier to achieve than in others, simply because of the way in which power is allocated.

The second condition is that the planners should work closely with the political authorities. To this end, the institutional arrangements should ensure that the planners can learn and understand the attitudes of those who ultimately make the decisions.

Obtaining legal power - A transport plan must be based on assumptions about future land use. The planning of land use—which is the essence of city planning—is critically dependent on the power to control or influence it. Even where governments enjoy strong planning powers, these powers are largely negative: the government may be able to prohibit development in certain locales, but it cannot often require development to
proceed. In fact, the only way to force private development to a particular location is to deny permission in any other area. Further, comprehensive powers to prevent changes of land use require legal authority and administrative machinery. In England it took 100 years and many acts of parliament to achieve this, culminating in the Town and Country Planning Act of 1947. In many developing countries, such powers do not exist.

If effective control of land use does not exist and cannot be obtained, land-use planning must be limited to what can be achieved by other means. The public sector may still be controllable, and the private sector may be enticed into particular areas by physical and financial incentives. The provision of infrastructure, and transport in particular, may be designed to promote the development of some areas and, by default, to discourage development elsewhere.

The problem of planning without land-use controls will be discussed below. The point to note here is that the process of transport planning is vitally affected by the existence or absence of land-use controls. For example, where these are lacking, transport networks will themselves become powerful determinants of land use and must therefore be planned with an understanding of their likely impact. This is especially true in developing countries, where growth is rapid and less inhibited than in developed nations by the lack of other public services. In many such countries, new roads have attracted dense borders of low-grade commercial
and residential building within a few years, generating volumes of pedestrians and cyclists, parked vehicles and animals that soon prevent the streets from performing the function for which they were intended.

Further, the lack of controls seriously limits the land-use options that are achievable and the transport options worth considering. This issue will underly much of the later discussion of planning method.

Whatever assumptions are made about land use, a transport plan will propose the construction of structures like roads, bridges and car parks, and the adoption of certain management policies regarding, for instance, fares, parking controls and traffic restrictions. Legal powers are needed if the plan is to move forward and in many developing countries, officials lack the authority to acquire land for road construction, to charge for street parking, to prohibit some types of traffic from individual streets or to control the operating practices of private car parks.

Enforcement - Even when political approval is won and the legal mechanisms exist, plans may still be unenforceable. For example, planning controls are notoriously vulnerable to bribery and improper influence. Also, decisions to increase fares and acquire land sometimes arouse violent public opposition and are subsequently blocked. And in the same vein, parking controls and traffic restrictions can only be enforced if a sufficient number of police are involved and if they apply themselves conscientiously to the task, which is often not the case.
Planning without land-use controls

If land use cannot be controlled by law enforcement, planning for it must develop from a position somewhere between what is desirable and what is liable to happen without any planning. Given a free land market, the development of land use can be predicted and hence planned as a process of cost minimization (although such forecasting is not easy to do). The costs (including those for transport) of developing sites for different types of activities, and of using them thereafter can be estimated to form the basis for a predictive model of land use. If the costs are changed to reflect policy measures, a different pattern of land use will emerge which can be predicted by the model.

The policy measures that may be employed to influence land-use development include:

1. financial incentives to employers establishing new jobs in specified areas, by means of grants per employee, or reduced taxes;
2. higher taxes on employers establishing jobs in other areas;
3. adjusted public utilities charges—for electricity, gas, water and telephones—reduced in development areas and raised in protected areas;
4. subsidized construction and leasing of factory buildings, office blocks and shops in development areas;
5. road improvements and better transport services to favor development areas;
6. careful design of access arrangements.
Some other measures lie outside the scope of this paper and will not be discussed in detail; however, all are designed to lower the costs of using certain locations—especially for the purposes of employment—relative to others. For their part, transport measures can profoundly affect the relative accessibility\(^1\) of different locations.

It is easy to talk theoretically about using transport to guide development into locations selected by planners but it is much more difficult to achieve in practice. One difficulty, which is often insurmountable, is that an improvement in the accessibility of zone A to zone B normally means an improvement in that of zone B to zone A, which explains why transport projects sometimes fail to stimulate development in the places intended. A study of relative accessibility should help the planner to avoid predictive errors of this sort.

Second, because urban transport facilities are continuous, they often provide access to areas where development is not desired (by the planner) and this can only be prevented through strict control of access to the transport system. If a new road passes—as frequently it must—through an area where development is not approved, the only way to prevent development may be physically to deny access to the road, that is, to design the road with limited access, on land-use grounds, regardless of whether this is required to

\(^1\) Accessibility is a concept that embraces the costs of transport in the widest sense, including the costs of time, convenience and reliability as well as conventional operating costs. It also relates to the transport costs attached to links within a specific type of land use: the most important links are home-workplace, home-school, workplace-input supplier, workplace-customer, home-shop.
improve traffic conditions. If the road is to serve its purpose, however, there must be some access points, and in a metropolitan area these could spawn unwanted development over a wide area. Therefore it is necessary to control the access roads themselves, again by means of physical barriers.

Although some ways to influence or guide land use without direct controls exist, their effectiveness should not be overstated. Much depends on the extent of development that has already occurred (especially highway development), and also on the degree to which planners want to divert future development from its natural course. Where a fair amount of development has indeed taken place, it may be impossible, without direct controls, to plan effectively for future densities or to prevent undesirable changes of land use.

In cities where no effectual land-use controls exist, the question that must be raised is, why not? And, should not they be established for long-term planning? No large city inherited from ancient times a system of land-use control other than for relatively small areas of government-owned land; thus modern planning controls have had to be created. If this has been possible in some cities, it should not be impossible, given time, in others. Until now, many have concluded that, because most developing countries do not have effective land-use controls, they never will. Perhaps, with greater effort, they could, and more energy should be devoted to this goal.
Directional Planning

Given the capability to plan and the means of enforcement, how should the planners proceed? In the past, planners have mixed together strategic and tactical planning, and, as we have seen, the results have been unsatisfactory. More recently planners have used a computer model to analyze strategic options and to produce quite detailed network recommendations with phased construction programs. However, such a study may require 20 model runs in order to test a reasonable number of alternative strategies at two future years in peak and off-peak conditions. The models have been made so large and detailed, in order to satisfy the tactical requirements, that such a large number of runs becomes impractical. As a result, such studies were dominated by the model and failed to fulfill their objectives in a number of ways.

The proposed solution to this problem is to divide planning studies into two clear stages: directional and design planning. In the first, the future structure of the city should be determined in broad terms: that is, the strategic choices should be analyzed and the preferred one determined. Precise dates are not necessary. For example, when looking 20-30 years ahead, there will always be considerable uncertainty about the levels of population, car ownership and travel demand, but all three parameters will invariably rise and are closely related; consequently, each of the forecasts for the year 2005, say, is likely to be reached some time during the decade 2000-2010, though probably not all in the same year. If the population and/or the economy grow faster than expected, the investment budget will probably also rise faster than anticipated, and vice versa. Thus the important point about
the long-term forecast is that the predicted situation is very likely to occur, though not on the predicted date. The probability of a trend reaching a given level in year X may be only 20%, whereas in the decade "X plus or minus 5 years" it may be over 90%. For planning purposes, it makes little difference in which year the prediction materializes, within the range mentioned. Even if the exact levels of future travel demand could be calculated, it would be impossible to say with certainty in which year new transport facilities should be provided, because the timing of the investment program would still be subject to imponderable factors.

One objective of all transport modeling must be to minimize data requirements. In developing countries, good data are usually scarce, difficult to collect and often cost more than the modeling itself. As mentioned earlier, every effort must therefore be made to eliminate data requirements that are not really necessary, unless the data already exist. Thus, the sophistication of the model should be tailored to the data that are available or can be easily obtained.

It can be argued that the population and income forecasts may be quite inaccurate, because there is uncertainty about the future growth of these basic variables. Therefore, predictions are derived from professional judgment and as a result, planning should be carefully tailored to the confidence that can be placed in the forecasts. In most planning studies, "best", "preferred" or "most likely" estimates are adopted as forecasts for population, income and other variables. However, once they are adopted, in many cases little consideration is given to alternative forecasts apart
possibly from some sensitivity testing of the final results. This is reasonable if there is confidence that the forecasts will not be badly out; but lacking such conviction, a new approach is needed.

For instance, if the population is forecast to rise from 5 million to 12.5 million in the year 2005, the alternative assessments (of the statistical probabilities of this result) may be the following: (in percentages)

<table>
<thead>
<tr>
<th>Population in 2005 (in millions)</th>
<th>Case A</th>
<th>Case B</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5-6</td>
<td>-</td>
<td>-</td>
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<td>6-7</td>
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<td>7-8</td>
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<td>9-10</td>
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<td>10</td>
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<tr>
<td>10-11</td>
<td>5</td>
<td>10</td>
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<tr>
<td>11-12</td>
<td>20</td>
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<tr>
<td>12-13</td>
<td>35</td>
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<td>13-14</td>
<td>25</td>
<td>10</td>
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<td>14-15</td>
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<tr>
<td>15-16</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>16+</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

In both cases the preferred forecast lies in the 12-13 million range, but the probability of the population falling in this range is 35% in case A and only 15% in case B. The probability of it falling within the range of 11-14 million is 80% in case A and only 35% in case B. It might be reasonable in case A to plan for a population between 11-14 million but not in case B.
Where the degree of uncertainty is very high as in case 8, the normal method
of planning for a single forecast situation (expressed precisely or in narrow
ranges) is not valid. Another method will be discussed in the section, Method
of Planning.

The value of the long-term strategic plan is that it shows the direction
in which development should proceed. It is called directional planning
because it points the way for major changes in land use, transport networks
and policy and ensures that decisions made today will not prove inconsistent
and irreconcilable with long-term goals.

The directional plan should contain those elements that will be
significantly affected by decisions taken in the near future. Other elements
which are interesting but inessential should not be allowed to divert
resources from the vital aspects.

Coverage

For transport planning, the two essential elements of a directional plan
are land-use predictions and transport strategy. The land-use plan will be
influenced, of course, by factors other than transport.

To begin with, although the exact date is unimportant, a target year has
to be specified for forecasting purposes. The basic criterion for
forecasting, as indicated earlier, is that it should deal with matters and
periods relevant to decisions that have to be made now or in the near future,
though there is little doubt that roads and railways built today will still exist in 100 years. Forecasts for this far in the future are generally regarded as too unreliable to be worth making, the argument being that benefits so distant become insignificant when discounted to the present. Although this argument is applied to all forecasts of over 30 years, it is not entirely convincing. For the most part, it is really inconceivable that roads built today will reach the end of their useful life in 30 years, in fact, roads built in 1950 are often still thought of as quite new. As for discounting if the annual benefits are constant, and the discount rate is 10%, only 5% of the discounted benefits will occur after 30 years, but if the discount rate is 5%, the proportion will be 20%. In reality, annual benefits are not constant but steadily rising and real interest rates are often very low (in Hong Kong, a government discount rate of 4% has been adopted). Thus, the benefits occurring after 30 years can be quite important.

Moreover, it is not only a question of benefits. Many cities in developing countries will continue to grow for more than 30 years, unless strong counter-measures are taken. For this reason, it could be counter-productive to plan these cities as if they were to reach their ultimate size in this time period. In fact, a longer frame of reference might open up new options for land-use and transport systems. Thus, it is neither necessary nor desirable to plan on the pretence as it were, that development will end in a relatively short time span.
It is concluded, therefore, that a directional plan should pay some attention to a longer time period. Such an approach could have important implications for population densities, railway development and energy policy, among other things.

However, it must be recognized that the main work on directional planning is likely to focus on the short-term say, a date not beyond a 30-year period. And though the land-use plan or prediction is essential for transport planning, such long-term considerations are only relevant to major transport investments which should not be sensitive to small details. Moreover, it is not realistic to plan or predict fine details for beyond 30 years.

The land-use data should therefore be related to geographical sectors of a size just small enough to permit traffic movements between them to be reasonably well assigned to the main road network as defined in the transport strategy (which may include theoretical corridors consisting of two or more parallel roads). It is equally important that the number of sectors, whose boundaries will partly depend on existing statistical areas be as small as possible so that the processing of data is not too unwieldy.

The data required to plan for each sector should be limited to that which is absolutely essential, involving population, employment and gross income.

It is desirable, however, that these three areas be disaggregated in the following manner: population into households by size and type (including age structure), employment into classes, and income into income groups, by
household. Given such information, estimates can be made of car and commercial vehicle ownership and population density, by sector, which, in turn, will permit estimates of trips and travel behavior.

It can be seen that the land-use data are critically dependent on the expected growth of population and income (which together will largely determine employment demand), on the one hand, and the planned or predicted distribution of population and employment, on the other.

The transport strategy in the long-term plan should specify the approximate location of a future network of main roads and railways, including stations, and their speed and capacity characteristics.

Also, while it is unnecessary to specify exactly the public transport services that will be provided on the available roads and railways, it is desirable to include in general terms how the supply of public transport services will be organized, and how demand and supply for transport will be brought into balance. In a developing country, as mentioned earlier, this is likely to involve a combination of bus priority schemes and restraints on the use of private cars. But, it is important to know how the balance is to be achieved because, without it, the rest of the strategy will fail. For example, if the control of parking is to be an essential part of the strategy, the areas where parking will be limited should be shown. Other intended means of restraint should be specified. For this purpose, estimates are required of traffic volumes (in peak hours at least) on main roads.
Feasibility

If a directional plan has been produced (containing the elements described above), it must be demonstrably feasible. The plan itself must be internally consistent, and the following issues must be raised:

1. **vehicle ownership**
   Are the predicted numbers of cars and commercial vehicles consistent with estimates of population and income?

2. **peak-hour trips**
   Are estimates of peak-hour trip destinations consistent with employment data?

3. **peak-hour traffic**
   Are traffic volumes consistent with road capacities, on the one hand, and with the available modal choice, on the other? This is the key test; there must be convincing evidence that the strategy would result in the anticipated modal distribution and that this is compatible with road capacities. The conventional way to do this is to estimate trip generation, sectoral distribution and modal distribution, on the basis of the sectoral planning data and transport costs reflecting the management policies included in the strategy; but other, simpler methods may be possible and might be acceptable.
4. **Land use**

Is the assumed land-use plan consistent with the accessibility provided by the transport system? This is a difficult problem. It might seem impossible that certain land-use patterns would materialize unless better accessibility were provided, but it is a difficult thing to prove. An accessibility analysis will give some guidance, by showing the distribution of travel times and costs for trips expected to take place between each sector and all other sectors. If the accessibility of a sector is relatively poor, it may be doubtful that the planned activities in that sector will actually materialize; but the conclusion must depend on the details of the case and on the strength of planning instruments used in the city.

In addition to these tests of consistency, which are exercises in logic, there are a number of tests of realism, which depend on practical and political judgment.

5. **Budget**

Is the capital expenditure required by the plan realistic? Historical trends should be produced for transport investment in the city, at constant prices, and as a percentage both of total public investment and expenditure. The planned extension of these trends should be calculated to show if any substantial increase on past trends is implied, and if so, its feasibility should be investigated.
6. **land acquisition**

Is the land designated for roads "obtainable?" Road construction in cities usually requires land either in long narrow strips, which are difficult to obtain, or in prime situations at busy junctions. The acquisition of such land may raise legal or political problems. In developing countries, traditional systems of land tenure often make it difficult or impossible, or simply politically unacceptable, for the authorities to turn people out of their homes, no matter how squalid they may be. Even where tenure is not established—as with squatters—authorities may be unwilling to clear an area.

7. **planning incentives and controls**

Is the land-use plan realistic in its assumptions and expectations regarding the use of incentives, controls and the response of private developers and property owners? The transport strategy depends vitally on the land-use pattern that it is designed to serve and support; and the latter will emerge only as a result of market forces and government incentives modified (or not) by planning controls. If market forces are to be relied upon, the plan must be logically related to a knowledge of the market and will be largely based on a prediction of market behavior. Government incentives, in the form of new infrastructure, including transport, may be used to attract private development, but even so, the future pattern of development will not be easy to predict. If, on the other hand,
planning controls are to be relied upon to force property owners and developers to conform with the plan, the need for prediction is reduced, but the effectiveness of the planning controls must be assured. In either case, the role of planning incentives is vital, in the form of streets, drains, water and electrical supply, local schools and other services, all suitable for the type and scale of development intended in the area.

8. Politics

Does the plan satisfy the political authorities? The need for close communication between planners and their political masters has been noted. In the last resort, a plan will only be implemented if the political authorities wish it to be.

Design Planning

The second stage in the proposed two-stage approach to transport planning is the design plan, since the strategic issues have already been settled and a transport strategy has been established. The purpose of the design plan is to give a complete list of projects in sufficient detail for inclusion in a 5-10 year rolling program. Projects should be designed to the point necessary to establish their feasibility; that is, they should be ready, after approval, to go to detailed engineering design without further study.

The design plan should contain all projects on which irreversible action will need to be taken within the near future, that is, before the next
updating of the plan, since these will determine its target date. For example, if the lead time (the expected time between firm approval and completion) on major roadworks is seven years, and if the design plan is updated every two years, the target date should be nine years ahead.

The required level of detail and the acceptable margins of error are clearly more demanding for projects proposed for immediate implementation than for those which need to be approved only in principle as long-term goals. This is one reason why it is necessary to separate transport planning into two stages.

A good deal of operational improvements can be achieved with a minimum of network planning. Developing local circulation schemes, secondary roads, and schemes to help pedestrians and cyclists, as well as upgrading bus operations, and many other aspects of a non-strategic character, are not dependent on a city-wide or even local transport plan. A great deal of action can proceed without any strategic or tactical planning. On the other hand, major, but local, projects like a dock expansion or the relocation of a wholesale market, do have transport implications that should be studied from both a tactical and a strategic point of view.

Coverage

The design plan should again consist of two parts: a land-use plan and a transport plan. The land-use plan will be derived from the directional plan, representing a step towards the former, but it should be specified by zones, with several zones to each sector. The same types of planning data are
required, but at the zonal level, and the breakdown into household type, income group and employment category is even more important.

The transport plan is also a step towards the directional plan. The road network, however, should include major distributor roads, and all main roads should be specified separately (not only in corridors). The definition of zones should be determined by the need to assign zone-to-zone trips to the more detailed network. Parking space should be shown by zone, according to whether it is public or private, and on-street or off-street, except in zones where the supply is abundant. Public transport routes should be shown, with fares and service frequencies.

In the design plan, the importance of system management should be reflected in a detailed specification of traffic restrictions, including bus priorities and parking regulations. Also, the expected structure of organization and control of public transport should be described. It may also be desirable to include proposals for the training and education of drivers, police and traffic wardens, and for vehicle inspection.

If the design plan is targeted nine or ten years ahead (because of the considerable time needed for construction projects to be approved and executed), the long time frame may be too distant for management plans, if these are to be realistic and detailed. It may also be too long a time span for administrators, who generally want plans to be realized within the expected life of their administration.
There is a case for dividing the plan into two phases. The first would contain a short-term interim plan, to be implemented in three to five years, depending on local requirements. The second phase would extend to about nine years ahead, as already explained, in order to complete investments authorized during the first two or three years. This dividing of the design plan into two parts is due to the fact that, in any city, there are always some improvements that can be implemented fairly quickly while others, planned at the same time, take much longer.

Feasibility

The design plan needs to be tested for feasibility in much the same way as the directional plan, but there are differences of emphasis. Predictions of population, employment, vehicle ownership and trip demand must be more precise. Also, the time schedule for implementation should be more detailed because there is less time to achieve it.

Since the design plan is strongly concerned with management, the feasibility of the management proposals should be carefully investigated. For example, the implementation of traffic schemes and parking controls is heavily dependent on the effectiveness of police and wardens. Thus, if the latter are ineffective at the present time, it would be unrealistic to expect a rapid improvement. Hence, short-term proposals that depend on such enforcement should not be promoted, unless good reasons are advanced to suggest that the enforcement agencies will be strengthened and improved. Indeed, proposals and assistance for the improvement of enforcement agencies could well form an
important part of many plans; for example, the establishment of traffic control may be as important as the construction of new roads. In the same way, it should be demonstrable that land needed for construction purposes will be obtainable, and at the right time.

An additional aspect of feasibility is financial viability. Within directional plans, it is fruitless to try to predict the financial viability of, say, transport operators because there are too many unknowns; but in the design plan, it is desirable, if not essential, to ensure that the cost of the proposed public transport services is linked to expected revenues. If the assumed level of fares implies a need for subsidy, this must be squarely recognized and shown to be feasible; otherwise the level of fares and standard of service will be in doubt, and with it, the whole modal balance.

Method of Planning

As mentioned earlier, the difficulties encountered in planning urban transport in both developed and developing countries have stemmed from numerous sources, one of the most important being the planning methods used. Because techniques have evolved continuously and rapidly, many areas have served as testing grounds for new ideas. The northeast corridor of the US, London, Caracas, Bogota, Detroit and Manila, are among those in which innovative techniques have been pioneered. Where failures have occurred, these have often resulted from comparatively small defects in the methods used; but as in surgical operations, a small slip may lead to disastrous consequences.
It is not possible to say, after all the work that has been done, that there is a "best" way of producing a transport plan, or that a consensus exists within the profession on what that way is, although it would be just as wrong to suggest that there are major conflicts of opinion. The method recommended in the following pages, however, reflects the judgment of the writer.

Planning framework

The earliest of the modern transport studies consisted of four stages: they surveyed existing traffic movements, analyzed the socio-economic factors giving rise to them, projected future traffic demand and designed new and wider roads to accommodate the demand.

Since then, the approach followed in all major studies has become more sophisticated and has contained more stages, but is basically similar. It can be expressed in various, slightly different ways, one of which is the following nine-stage framework: (see Figure on page 60)

1. goals

A clear statement of the goals and objectives of the plan, with possibly some indication of priorities, is presented;

2. performance

The manner in which the present system performs and ways in which it fails to satisfy the goals listed in (1) are described;
3. analysis

The transport system and the factors responsible for the demand are analyzed, in order to explain deficiencies noted in (2) and to serve as a base for future projections in (4) and (8);

4. projection

Demand for transport and future deficiencies are projected;

5. constraints

Constraints to improving the transport situation, especially within the budget, are identified;

6. options

All possible ways to overcome deficiencies in (2) and (4) are identified;

7. plans

Alternative packages of options identified in (6), within constraints listed in (5), are formulated;

8. testing

Predictions, based on (3) and (4), of effects of plans formulated in (7) to overcome deficiencies, are tested;

9. evaluation

Effects predicted in (8) are compared against the goals listed (1) in order to select best plan;
This framework provides a logical procedure to help planners decide clearly what they are trying to achieve and overcome, what resources are at their disposal, and how these can best be used to achieve certain goals. The framework fits with both directional and design planning, but is applied very differently. The various stages are described below, with the differences between directional and design planning emphasized.

**Goals**

Transport plans tend to have similar goals, such as reducing congestion, improving bus services, reducing accidents and providing better parking facilities, although they are all expressed more precisely in the context of a given city. Transport planning can also be used as an instrument to reduce economic inequalities, to ease ethnic problems, to encourage tourism, to increase a city's prestige, to improve the environment, to assist exports, to facilitate military movements, to lower residential densities, and so on.
The overall goals are obviously the same for both directional and design planning—except that the real goal of the design plan is to move concretely towards the directional plan.

**Performance**

Data are required to show the present state of the transport system. These take the form of inventories (to describe the physical components of the system), and operating statistics (to describe how it works).

The following elements must be included in the inventories:

1. a map of all roads, with engineering description for all main roads and junctions, plus (for design planning) main distributor roads. It should include the length, width and surface measurement of gradient and curvature and, sometimes, details of construction, services and lighting;

2. a map of all railway lines (including tramlines), stations and depots, with data by links giving length, measurements of gradient and curvature, junctions, level crossings and sections in tunnel;

3. a map of off-street parking space open to the public, with data giving capacity, regulations and prices at each park, and ownership. In the central area and other congested areas, data should also be available on the number of private parking spaces in each zone and of permitted on-street parking spaces;
4. the number of buses (by size), trams, taxis and other public transport vehicles, with details of ownership, management and location and capacity of bus depots; also railway rolling stock available for urban passenger transport;

5. the number of private cars, commercial vehicles and motorcycles.

The operating data required includes the following:

1. a map showing one-way and turning restrictions, also vehicle restrictions (e.g. bus lanes), signalized junctions (with list of signal phases); if relevant, a map showing speed limits; and one showing parking restrictions;

2. average traffic flows, by vehicle type, on main roads, in peak and off-peak hours; average traffic speeds during the same periods on a sample of routes on the main road network. The network should be divided into several homogeneous areas (in terms of traffic conditions) including the central area, and the measurements of flows and speeds should be made so that the data can be separated to give average flows and speeds in each area. A speed-flow relation should be calculated for each area;

3. sample data of parking occupancy rates at off-street and on-street locations, with the sample selected so as to uncover any significant areas of excess demand. Data on parking durations may sometimes be required;
4. the collection of accident data, unlike other data, cannot be done in one short, special survey; it requires continuous recording and an extensive, efficient organization to do it. It is unrealistic to expect such an organization in developing countries. Records can be collected, of course, but they will normally be incomplete. Nevertheless, an attempt should be made to collect statistics of accidents in which injuries or fatalities occurred, within one month of the accidents, showing precise locations;

5. train flows (giving seating capacity) and speeds by route;

6. service frequencies, passengers carried and revenue taken, peak and off-peak hours, on each bus, tram and rail route; total number of passengers carried by taxis; sample data on passenger load factors and waiting time;

7. conditions for pedestrians and cyclists depend on a large number of elements which are not easily treated statistically. These include surface conditions on carriageways and footpaths, curb conditions, provision of pedestrian refuges and crossings, channelization of traffic streams and control of traffic speeds, driver behavior, signal settings and the like. Thus, qualitative surveys are necessary, particularly to pinpoint bad streets and junctions;

8. in developing countries, the environment normally takes low priority. While air pollution is rarely a problem, because traffic volumes are not high enough (Mexico City and Sao Paulo are
exceptions), the main difficulties are probably the general levels of noise, danger, dirt and inconvenience in streets where people live and work in the midst of continual traffic. However, data on these elements are non-existent and difficult to collect.

In most cities, some of the data—particularly on traffic speeds and parking inventories—will not be available unless surveys are commissioned as part of a planning study. If it can be collected, it will show where the main deficiencies lie, in terms of congestion, poor conditions for passengers and pedestrians, and accidents.

Analysis

The purpose of the analytical stage is to develop tools for predicting how the transport situation will develop in the future under alternative assumptions about the factors determining transport demand, on the one hand, and changes in transport facilities, on the other. This work is typically done with the aid of models, and the difficulties arising from their use have generated a certain amount of hostility towards models in general. This is unjustified, because a model is no more than a device to ensure that the analysis is logical, internally consistent and comprehensive. Some of the hostility is really generated by the computer, rather than the model, but models are not always dependent on a computer. Again, though, it is not right to blame the computer, which also is no more than a tool to help the analyst.  

1/ In the last two years microcomputers have been introduced into transport planning. They are cheap (between $6,000 and $50,000, depending on facilities required), have sufficient capacity for most purposes and are readily transportable. These machines could enable planners to use small strategic models to much greater effect than before, because a machine can be made permanently available in the planner's office and costs little to use. This has been recently demonstrated in Baghdad where a 70-zone model was developed and run on an Apple computer over a five-month period.
The fault with models, where there is fault, lies either in their design, which may be unsuitable for the task of hand, or in the competence of the user. Urban transport is an ideal subject for mathematical modeling, but the design of the model has to be carefully judged if it is to give the desired results within the available budget of time and money. In this section some guidance on the design of the model is provided, with the assumption that the basic elements of transport models are understood.

The main reason for distinguishing between directional planning and design planning is that the modeling needs are different. A model that attempts to satisfy both requirements will normally fail because, if it is sufficiently large and detailed for design planning, it will be too slow and costly to run often enough for directional planning; if it is sufficiently small and simple for the latter purpose, it will not give reliable results for the former.

Model for directional planning. In directional planning, the main purpose of modeling is to make broad comparisons of alternative land-use and transport strategies, which should be studied at two points in time in order to facilitate economic and other evaluations. In developing countries, where population is rising fast, the geographical expansion during the next 20 to 30 years is bound to be very wide, bringing into development new areas larger than the existing city. There are, therefore, likely to be several alternative land-use patterns, each of which may require studying with two or three transport strategies, at least. The minimum number of model tests
required is quite large and, in practice, additional tests are usually found to be desirable.

It is therefore essential that the model be small and fast but it must give results that are reliable enough for the purpose. The main features of the model will probably be as follows:

1. a road network restricted to main roads and junctions, with roads amalgamated into corridors where possible, including one-way and turning restrictions; and a public transport network incorporating rail links, buses (including minibuses) and all forms of public transport other than private taxis, giving only one method of making each sector-to-sector movement;

2. the study area should be divided into sectors, small enough to permit a reasonable assignment of trips to the networks. It is desirable that the number of sectors, including external sectors, should not exceed 100 and if possible should be less than 80. This would imply an average of at least 50,000 people per sector in a city of five million, which is five times higher than conventional practice in developed countries. But cities in developing countries have far higher population densities and coarser networks than do those in developed nations;

Relatively large sectors mean that intrasectoral traffic will form a relatively large proportion of total traffic. Careful attention needs to be given therefore to intrasectoral traffic volumes;
3. As stated earlier, the required planning parameters from which vehicle ownership will be estimated, should be (by sector) population, number of households in at least three income groups by age structure, and employment in three groups (manufacturing, central service and other service).

The parameters should be chosen in the light of the data that is, or could be made, available without great cost. Careful attention to control totals—of populations, fleets, incomes, employments, etc.—can reduce the need for accuracy in the zonal distribution of the totals;

4. 24-hour demand model. Trip generations should distinguish business, work and other trips for passengers, and goods trips. Trip distribution may be by time-based gravity model using population and employment by type. Trip assignment should be based on diversion curves. Modal split is simply a two-way choice between private and public transport and the problem is to determine who in car-owing households has access to the car—a point on which survey data would be useful. It is important in developing countries where the quality of public transport is sometimes very low, and passengers are highly sensitive to fares, that the demand for public transport be related in some way to changes in quality and price;

5. Operating costs, including time costs and parking costs, are needed for both networks, using 24-hour averages. Speeds and flows should be calculated in individual areas and speeds adjusted until each area conforms with the speed-flow relation for the area;
6. the model estimates daily flows of vehicles and passengers on each network link, with speeds and costs; similarly, if required, on each sector-to-sector O/D (origin/destination) link; accessibility indices can also be produced.

It may be observed that the proposed model accepts great simplification of the networks and of the estimates of demand. It does not require a separate peak model, because this would add enormously to the work, but it does require that traffic speeds be consistent with flows on a 24-hour basis. Careful attention is needed to the construction of 24-hour speed-flow curves. Given a fixed hourly distribution, which is normally assumed in 24-hour models, the 24-hour speed-flow curve is easily reduced from an hourly speed-flow curve, but as the flow rises and the speed falls, the hourly distribution will in fact change and the peak-hour factor will decline as people take measures to avoid congestion. It should be noted that the simulation of this phenomenon is too complex for a strategic model. However, there are several arbitrary solutions, all of which need to be understood and interpreted by users of the model.

The proposed model is conventional in form. However, other types of models have also been developed. Of particular relevance as a strategic tool to analyze policy is the UMOT (Unified Mechanism of Travel) model sponsored by the US Department of Transportation. But while this model was intended for the kind of use envisaged here, it has not yet been adapted to the conditions in developing countries. It depends upon time and money "budgets", is designed for a car-owning community and therefore it does not seem appropriate.
Other unconventional models have been developed by Echenique et al for strategic purposes, with variable land use, but the data requirements are excessive for cities in developing countries. Disaggregate models have been advocated for a long time now, with questionable results, and, as the problem stated above, the quality of data required is difficult to obtain in developing cities.

**Model for design planning.** In design planning, the purpose of modeling is to provide reliable traffic data for feasibility studies of projects and, in particular, to compare the performance of alternative road designs and management schemes within the constraints of a predetermined strategy and a fixed land-use pattern.

A large-scale model is needed in order to give the necessary detail but few runs should be required. In fact, numerous projects can be tested together on the same run because, by definition, the alternatives under consideration are not of strategic significance and the land-use pattern is fixed. Sometimes, depending on the projects to be tested, it may not be necessary to model the whole urban network in detail; rather, the relevant part or parts may be treated in detail and the rest of the network treated in a more aggregate way. For very detailed work, for example, with traffic management schemes, this approach is usually necessary. Special models such as CONTRAM, developed by the Transport & Road Research Laboratory, or Giannopoulos's models, are designed for these purposes and incorporate dynamic features which greatly increase the size of the model.
One of the advantages of having already produced a directional plan is that it reduces the requirements for detailed design planning and demonstrates that the latter can be limited to, or at least concentrated upon, a few areas or corridors.

The main features of the model are likely to be as follows:

1. the road network will include main roads and important distributors, with one-way and turning restrictions. The number of public transport networks will depend on the city, but there could be a total of three: bus, rail and paratransit. However, these are only necessary if there is significant competition between the systems and if the modal split between them is relevant to the objectives of the study;

2. the study area should be divided into the same sectors as for the directional plan but most sectors should be subdivided into zones upon which the analysis is based. Definition of zones should be designated to facilitate accurate assignment of interzonal trips to the networks;

3. the parameters are the same as for the directional plan, but recorded at zonal level. It is useful to divide households into categories and more detailed categorization on employment and school locations may be included;
4. it is essential to have a peak-hour model since peak-hour performance is the most important factor to be studied. If resources are insufficient for two demand models, it is probably better to confine the analysis to a peak-hour model than to a 24-hour model. The form of the model is the same as for directional planning but trip purposes may separate school (or education) and shopping trips, and modal split may distinguish different forms of public transport;

5. transport services are the same as for the directional plan, but speeds and flows should be separately calculated for peak and off-peak periods.

6. the same items (output) will be estimated (as for directional plan), but for peak and off-peak hours separately.

It should be pointed out that there are many detailed differences in the modeling techniques now used by practitioners. The broad modeling designs suggested above leave ample scope for alternative methods of detailed execution.

In addition, it should be mentioned that there is still inadequate understanding of transport behavior in developing countries. The factors that generate trips and which determine modal choice among the low-income groups are not well understood and cannot be deduced from experience in developed countries. Thus, more research is needed in general and specifically, into the conditions of particular cities.
Projection

The planning parameters used in the model—the aggregated statistics of population, household size, employment by category, and average income (or GDP per head)—are projected to the target years. The distribution of the aggregates between sectors varies according to the land-use plan, but in the design plan there is only one land-use plan and therefore one set of zonal data. Projections of car ownership and the commercial vehicle fleet follow from the basic parameters.

Projected demand for transport can be applied in the model to the existing networks in order to uncover deficiencies (with respect to meeting future demand); but in a developing city, this is not likely to be useful since the networks will be grossly inadequate to accommodate the demand and the land-use pattern can not realistically occur without some expansion of the networks.

As mentioned in Chapter 5, the use of "preferred" or "most likely" forecasts is not valid when they are subject to a high degree of uncertainty. To take an extreme example, if there is an almost equal chance that the population will be four million, six million, eight million or ten million in the target year, there is no justification in selecting any one of these figures and ignoring the others. Nor is the problem overcome by working with one figure and later substituting the others as sensitivity tests. While this procedure may help to avoid gross errors, it is not likely to lead to an optimal solution.

The problem is normally only likely to occur in directional planning, where the time period is long, but it could occur in design planning in cities where political uncertainty makes even short-term forecasting hazardous, (for
example in Amman, Beirut, Salisbury and Hong Kong). Thus, the only practical solution is to adopt alternative forecasts covering the range of probabilities worth considering. Since the major variables (population, income, employment and car ownership) are generally related to each other, it is desirable to select sets of these variables that are consistent and relatively "probable" and which may be regarded as statistical scenarios; that is, to forecast combinations of variables that seem to represent fairly probable futures. (Full scenarios require a statement of the political and economic causes that lead to the statistics).

The adoption of several scenarios in place of a single one will clearly complicate the rest of the planning process. It will affect the constraints, especially with respect to the budget, and may widen the range of options that merit study. Further, each plan will have to be selected in the light of the relative probabilities of each scenario occurring and will need to be flexible (modifiable), so that it can be altered to suit the reality that ultimately emerges.

Constraints

All practical limitations to any transport solution must be recognized and fully respected thereafter. For example, there are normally a host of constraints on land-use development, usually due to existing ownership and use. Also, there are strict limits to what can be enforced, in both planning control and traffic regulation. Political taboos operate as well, and, of course, there is always the budget constraint. These problems affect both the directional and the design plan. The transport planner is faced not only with a budget constraint but also with the problem of determining exactly what the constraint may be. At best, transport planners are given a budget ceiling or
a rate of return within which to plan. At the worst, they receive no guidance and very little information about past expenditures. When operating within such a vacuum, the best they can do is postulate, say, three possible levels of expenditure and to produce plans corresponding to each.

Options

The kinds of options to be considered in the directional plan are quite different from those in the design plan. The former are structural and policy choices of strategic significance—choices that would have important and wide-ranging repercussions on the pattern of activity and movement in the city—while the latter are choices between alternative ways of satisfying a largely predetermined pattern of movement.

1. strategic options
   - land-use alternatives substantially affecting the distribution of population and/or employment (especially service employment) between sectors;
   - new roads and junctions having the effect of substantially raising free speeds between sectors, i.e. grade separated junctions;
   - new railways;
   - new tramways;
   - management schemes expected to have major influence on the split between public and private transport.

2. design options
   - alternative alignments for new main roads;
   - new distributor roads;
   - road widening schemes (provided that free speeds are not much increased);
   - alternative alignments and station siting of railways and tramways;
   - bus routes;
- traffic management schemes affecting one-way rules, turning restrictions and speed limits;
- variants on parking control.

Plans

The next stage consists of combining various options into alternative, comprehensive plans. Clearly the purpose of directional planning is to produce contrasting alternatives in the broad land-use structure and its associated transport system, whereas that of design planning is to find alternative ways of interpreting the chosen directional plan and designing the first steps in its implementation.

The reason why it is necessary to produce alternative plans is that no way has been found of deducing logically from the earlier analysis of the city's needs and problems the best way of meeting them. Imagination and experience are essential, but even with these qualities, the best solution is not often obvious, and in any case it needs to be demonstrated as the best. Consequently all alternative solutions that show a reasonable possibility of being the best should be included for testing and evaluation.

In principle, it is possible that the best solution will not be considered, or will be rejected as obviously inferior. In the same fashion, in the not too distant past, many plans that technicians today would regard as disastrous have been approved and implemented. Thus, one cannot be complacent that today's planners are always capable of conceiving and recognizing the best solution.

Generally, a "do-minimum" plan is included, containing only projects already committed or obviously justified, in order to demonstrate the impact of additional projects.
Testing

The main purpose of the model developed in the earlier stages is to test the alternative plans in order to predict the number of movements on all parts of the networks, and the journey speeds and costs, under each.

Directional plans need to be tested at two target dates, the latter being, say, 20 or 25 years ahead. Design plans should also be tested, as suggested earlier, at two target dates, three to five years and ten years ahead. It would, therefore, be convenient if the earlier target date for the directional plan were the same as the latter target date for the design plan.

- Design Plan
  - Short-term plan 3-5 years
  - Medium-term plan 9-10 years

- Directional Plan
  - Intermediate plan 9-10 years
  - Final plan 20-25 years

Since the model does not produce all the information required about the future performance of the plan, the following must be generated separately:

- capital cost of plan
- differential maintenance costs (differences between plans)
- accidents
- environmental effects
Estimates of accidents and environmental effects will be based on the output of the model.

The computer is used to compare the results of different tests in order to estimate the benefits of one plan relative to another on each O/D link. Other comparative information can also be obtained, as required, concerning traffic volumes, journey times and lengths, trip volumes, modal split, accessibility indices, and so on. Computer models produce a great many numbers but, for ease of comprehension and future monitoring, they should be aggregated to a few area-wide totals and averages.

Evaluation

The final stage in the planning framework is the comparison of test results with the initial goals in order to decide which of the alternative plans is preferable. Evaluation techniques have evolved gradually, and need not be described here. The first big transport studies "evaluated" their results in purely engineering terms, seeking the cheapest way to do a specific job, which was basically to eliminate congestion by building roads to accepted engineering standards. Later studies attempted to place monetary values on all relevant factors in order to calculate rates of return on capital costs, or net present values, as single catch-all measurements which enabled alternative plans to be compared. But as the goals of transport policy have become ever more diverse, the use of monetary values has become more difficult and less acceptable.

Today it is clear that the final evaluation of plans must be carried out in non-monetary terms. Instead, a scoring system is required which aims to reflect faithfully the values placed by the decision-makers on the various
differential effects of alternative plans. Such a system must enable all relevant effects to be measured, to be methodically and objectively weighed, in whatever units are most suitable, and to be given scores.

A number of scoring systems have been used. A full discussion of this stage (or any other stage) of the planning process would not be appropriate in this paper. However general aspects of evaluating both directional and design plans are briefly discussed below:

1. **Evaluation of design plans.** Land-use assumptions are fixed and are the same, practically speaking, for each design plan. Economic evaluation of the plans is then relatively simple, can be carried out by conventional, well-known techniques, and can be incorporated into a scoring system (of evaluation) if there are important non-economic factors to be considered. However, whether or not a scoring system is used, governments normally want to know the net present values and internal rates of return for the investments included in the plan.

2. **Evaluation of directional plans.** If land-use assumptions are fixed for directional planning, the evaluation of alternative plans again can be carried out by well-known methods. But if the land-use assumptions differ substantially, these methods are not valid. An alternative method is described in Appendix C. It must be noted, however, that if alternative plans have very different land-use patterns, they may offer different life-styles, whose evaluation is bound to be difficult and controversial. Nevertheless, if the
differences can be identified and the numbers of affected people quantified, the proposed scoring system is probably the best way of dealing rationally with this problem.

Conclusion

Part I of this paper described the many difficulties and inadequacies of transport planning in large cities in order to clarify the problems that need to be solved. Scientific, as distinct from visionary, transport planning is still a new subject and is being continually and rapidly improved.

Progress in this field is likely to be evolutionary. Attempts have been made to develop radically new approaches but the view taken here is that, despite all the difficulties, the best way to proceed is probably to develop further the existing methods that are basically sound (even if they have sometimes been poorly employed) because no better approach has yet been found. The second part of this paper puts forward an approach which incorporates numerous ideas and conclusions gained by transport planners as a result of experience in many cities in both developed and developing countries. None of the features of this approach is new, but the whole combination has not been applied in any city.

One important feature of this approach is the clear distinction between what are called directional and design planning. Directional planning aims to signal the direction in which the land-use and transport structure of the city is intended to develop. It specifies the main structural elements but says little about their timing. It recognizes the need for flexibility in the event that the socio-economic growth of the city proceeds very differently from forecast.
Design planning, on the other hand, is confined to the short and medium term and is greatly constrained by the directional plan. Separate models are used for the two planning stages.

Another feature is the emphasis on policy. Although long and medium-term planning is necessary mainly for infrastructural decisions, these require major assumptions about policy, particularly regarding the restraint of private transport and the financing of public transport. The success of a transport plan in a large city is critically dependent on the management of the system. Policy assumptions, therefore, need to be clearly specified as part of the plan.

The approach also tries to allow for the treatment of uncertainty where this is important and a method of comprehensive evaluation is proposed.

Finally, it is not to be imagined that the suggestions made here will solve the many problems of transport planning in cities in developing countries. Not all the problems are technical; indeed, some are insoluble within the foreseeable future. Further, it is important to remember that planning is inevitably a reflection of prediction, either explicit or implicit. Thus, the best one can hope to do is to reduce the possibility of making erroneous predictions and increase the probability of making decisions that in the fullness of time will be seen to be sound.
APPENDIX A

SAMPLE TERMS OF REFERENCE
FOR AN URBAN TRANSPORT STUDY

The following is an example of the terms of reference needed for a comprehensive urban transport study. In order to make it realistic, and to focus on an actual situation, it has been produced for a specific city, namely Lima, Peru, but this is purely by way of illustration. These terms of reference have not been adopted nor proposed for use in Lima.

Background

The population of Lima grew from about 4.0 million in 1975 to 5.0 million in 1980 and is forecast to reach between 9.6 million and 13.8 million by the year 2000, depending on assumptions about migration and fertility. Geographically the city has expanded steadily into the surrounding desert and now measures some 30-40 kilometers across. A large proportion of the population is poor and depends on public transport. This situation can only intensify as the city continues to grow.

Public transport is entirely by road and mainly by bus. Buses are of two general sizes: omnibuses which carry 60-80 passengers, and microbuses, which carry 20-25 passengers. Although there are only 1600 omnibuses, as against 7500 microbuses, the former carry three-quarters of the passenger traffic.
Due to restrictions on the import of vehicles, the bus fleet is very old and its condition very poor. Fares are quite low. The only public alternative to the bus is the taxi.

The number of buses in Lima is clearly inadequate to meet the demand in a satisfactory way. Waiting times are excessive, buses are overcrowded, many journeys require interchange and buses are increasingly held up in traffic congestion. Thus many people have long, arduous journeys to work every day.

Car ownership, although still at a very low level, is growing rapidly and is leading to problems of congestion on the edge of the central area, through which most bus routes pass. Unless effective action is taken at once, the situation is liable to deteriorate sharply in the next few years. In view of the continuing immense growth of the city, there is clearly a need both for immediate action to establish and maintain a tolerable level of service in the coming years and for strategic planning to ensure that the transport system is expanded and improved in the longer term in order to cope with the needs arising from future growth.

General

Nature and purpose of study. The study will be a continuation and development of previous planning studies in Lima, to be carried out jointly by external consultants and local staff, with the intention of strengthening the planning capability of the latter while producing new plans for the city. The study will collect and analyze information about the transport system as a basis for the preparation of two transport plans: a directional plan, which
will establish the strategic elements to be pursued over the next 20-30 years, and a design plan which will set out a program of action for the next ten years, consistent with the longer-term directional plan.

Area and scope of study. The study should relate to the entire metropolitan area, including outlying areas in which urbanization may occur within commuting distance of Lima during the next 30 years. The study should cover the main roads, i.e. all line-haul routes and important distributor roads, and any potential rail or other fixed-track routes, in particular the routes proposed by the German study of 1972 and the routes recently studied between Comas and Villa El Salvador. It should cover urban buses, taxis, freight traffic, cars and motorcycles. It should deal in a general way with the supply of parking space and facilities for pedestrians.

Land use. The study of the transport system should be closely related to the land-use pattern which it serves and which it influences. It is not a general planning study but, in its long-term aspect, it will need to consider the possibility of alternative land-use patterns and how they might be served and influenced by the transport system. In the shorter term, for design planning, fixed land-use assumptions should be available from the Planning Office.

Main features. The expected results of the study are as follows:

1. up-to-date information about the transport system, as specified below;
2. a directional plan indicating the main elements in the transport system in approximately 20-25 years time, which include the standard of line-haul roads and intersections and other fixed-track systems (if any), the required bus fleet, the supply of parking in the central and other critical areas, tariff policies for public transport and parking, traffic management policies, including traffic restraint policies, if any. Details of tariffs and traffic management are not required. Flexible components of the plan should be indicated, in two categories: first, links and standards of construction that should be held dependent on the developments that justify them, and second, additional links and standards not included in the plan but for which reservation should be made in case of need;

3. a design plan indicating the main elements of the transport system in 9-10 years time, as stated in (2) above, but including main distributor roads and details of traffic management, bus routes and parking supply. Proposed structures and levels (in real terms) of public transport tariffs, parking charges and other relevant transport charges should be specified;

4. a ten-year investment program indicating the achievement of the structural elements in the design plan;

5. a five-year management program indicating the introduction of traffic management schemes, parking schemes, changes in the organization of bus services and other relevant managerial changes;
6. a design model suitable for updating by local staff for purposes of monitoring future developments and planning traffic management schemes and minor road improvements.

Requirements

The study shall comprise three phases: (1) an analysis of the present transport situation in the study area; (2) preparation of the directional plan; and (3) preparation of the design plan. As regards timing, the three phases may overlap.

Phase I

This phase should be devoted to the collection of information and its analysis. The purpose is to identify and quantify the defects and deficiencies in the transport system at present and to analyze the operational characteristics of the system in such a way as to facilitate forecasting of future performance under different demand conditions and subject to changes in the system itself.

Information will be required on the following: traffic flows and speeds during peak and off-peak periods; traffic composition; performance of public transport (in terms of waiting times, journey times, number of interchanges, overcrowding, fares, condition of vehicles); availability and utilization of parking spaces; parking charges; sample data on origin-destination movements of passengers and goods, with details of trip purpose, household characteristics and modal choice; road accidents; pedestrian flows on main pedestrian routes, with quality grading of pedestrian facilities.
Phase 2

The second phase will be devoted to the structure of land uses and transport in the longer term, which is to say, about the period 2000 - 2005. The purpose will be to determine the main elements of land-use and transport structure towards which planning and policy should be directed. The following steps will be required:

1. forecasting of exogenous variables: the growth of population income, car ownership and employment should be forecast within likely ranges of variation. A preferred scenario and two alternative scenarios should be specified;

2. determination of goals: an attempt should be made to clarify the political, social and economic goals of the Peruvian Government inasmuch as these may be relevant to the planning of land use and transport, and to establish the relative importance attached to them;

3. identification of constraints: planning constraints, such as investment budget, areas not suitable or available for development, committed projects, political or social factors limiting the possible scope of land-use or transport policy, should be identified;

4. formulation of strategies: land-use and transport strategies should be designed for the three scenarios, observing the goals and constraints identified. Where there are realistic choices to be made, alternative strategies should be designed so that these choices
can be tested. Each strategy should be specified as at the target
date, which is a date not precisely determined in the period 2000-
2005, and also as at the year 1992. Strategies should specify the
main physical features, the management policies necessary to achieve
efficient operation of the system, and also the means of
implementation;

5. development of strategic model: a small, versatile model is needed
for the analysis of strategies. Its purpose is to show the main
differences in cost and performances between alternative strategies
under different conditions of demand, and to test the impact of major
modifications of strategy. The model will be used mainly for the
target period, 2000-2005, for which accurate, detailed predictions
are not possible; it should therefore be designed and used as an
analytical tool, intended to help the team acquire a better
quantitative understanding of the complex behavior of the transport
system, rather than as a means of obtaining reliable predictions;

6. testing of strategies: with the use of the model the alternative
strategies should be tested at the final target period. Transport
strategies should be tested under alternative scenarios. Tests will
produce data of traffic movement and costs needed for the evaluation
of strategies;
7. evaluation of strategies: the purpose of the evaluation is to determine a directional plan. To the results of the model tests must be added the capital costs, environmental, social and political factors. A comprehensive evaluation system should be used to bring together in a systematic way the final consideration of all relevant factors. The evaluation should include a conventional evaluation of the economic factors, with results expressed as net present values and internal rates of return. For this purpose, model tests will be confined to those strategies that appear to merit this degree of examination; in other words, some strategies may be rejected on the basis of the earlier tests;

8. selection of directional plan: the plan will contain three categories of infrastructure: first, those elements which are regarded firmly as desirable before the year 2005; second, those which are expected to be desirable by that date but which should be dependent on certain specified demands arising; and third, those which, although not expected to be, could be desirable by that date in certain specified circumstances and for which the possible need should therefore be allowed. The plan will specify the assumed land-use developments and all major transport structures. It will specify the management policies that would be needed in order to obtain the expected performance from the transport system, in particular, the means whereby the use of private transport is to be limited to the efficient capacity of the road network and the means whereby the costs of public transport are to be financed.
Phase 3

The final phase will be devoted to the preparation of a design plan for the metropolitan area of Lima. The starting point will be the directional plan determined in Phase 2. Design planning consists of revising the 1992 version of the directional plan and filling in structural and managerial details. The following steps are necessary:

1. preparation of design model: the strategic model should form the basis of the design model but the latter will include the subdivision of zones and the addition of secondary links and modes. It will be designed for separate use as a peak-hour and an off-peak model. Depending on the schemes to be studied, it may be decided to elaborate selected parts of the network, leaving other parts in less detail, in order to concentrate study where it is most needed;

2. formulation of projects: the strategic features of land-use structure and the transport system in 1992 will be taken from the directional plan. It will then be necessary to consider alternative forms (and possibly alternative timing) of the new elements of infrastructure required by the plan; where relevant, alternative alignments, capacities and design standards should be formulated for testing and evaluation. If relevant, the possibility of reordering the investment program before and after 1992 should be examined. Minor projections for implementation before 1992 should be formulated;
3. selection of test networks: given the projects to be studied (as per the previous paragraph), a small number of networks—possibly three—should be prepared for model testing. These should not necessarily be conceived as alternative networks but simply as vehicles for the simultaneous modeling of numerous alternative projects;

4. design of management options: whatever infrastructure is provided by 1992, the efficient operation of the transport system will depend on the management policies adopted, in particular, the supply and price of parking space, bus priorities, bus fares and traffic restraints. Realistic options should be defined and specified in quantitative terms for detailed study;

5. evaluation of projects and policies: a number of model runs should be made to test the effects of various combinations of networks and management policies as defined in the preceding steps. The results should be used to evaluate the component projects and policies in terms of costs and benefits;

6. selection of design plan: the design plan should specify the projects and policies recommended for implementation up to 1992, as described earlier;
preparation of investment program: the timing and phasing of the investment needed to achieve the design plan should be studied in order to produce an annual program for investment up to and including 1992. The latter years of the program should include tentative proposals for the start of new projects not due for completion until after 1992. The program should obviously be consistent with the budgetary forecasts made in Phase 2.

preparation of management program: detailed proposals should be made for the introduction of the management policies embodied in the design plan, insofar as this is deemed necessary before the end of 1987. An annual program should be produced for management action during this five-year period;

recommendations regarding implementation: the successful implementation of the above programs will require an appropriate organization and power structure. Proposals should be made, if necessary, to ensure that an adequate organization exists to carry forward the programs, to monitor future transport developments and to continue the planning process. These proposals should concern, among other things, the number of staff and their qualifications, their positions and powers within the transport establishment, and their principal functions.
APPENDIX B

COMPREHENSIVE METHOD OF EVALUATION

The final decision or recommendation in favor of a particular solution requires that all pros and cons be taken into account. Whoever makes the decision, or recommends it, cannot escape the need to weigh a variety of disparate considerations, to judge how much importance to attach to each of them and to arrive at a conviction that, on balance, one solution is better, i.e. it offers greater net value to the community, than the alternatives. Somehow or other, quantities of items as diverse as fuel consumption, passengers' leisure time, construction costs, noise nuisance and the beauty of parkland have got to be compared, assessed, taken into account, in short, evaluated, if there is to be a reasonable and responsible decision.

Various methods have been suggested, all involving a scoring system of some sort. The one recommended here is relatively comprehensive. It forces the user to express certain values, both objective and subjective, in numerical terms on paper. This may seem difficult but in practice, people do form conclusions when faced with complex choices like road projects in which they claim to take account of various disparate factors. Somehow they give a measure of importance to each factor, or at least a limiting range, sufficiently precise to enable them to decide that the sum of one set of such factors is greater than that of another. Otherwise they could not come to a conclusion.
The purpose of the method is to clarify these hidden processes of the mind and set them explicitly on paper in order to ensure that they are (1) comprehensive, i.e. nothing has been forgotten; (2) logical, i.e. that the numbers are consistent and add up correctly; and (3) valid, i.e. that in the opinion of the decision-makers, the numbers truly reflect their value judgments.

The method contains five steps: identification of factors, choice of units, measurement, scaling and weighting.

1. **Identification of Factors**

This is simply the definition of the various cost/benefit factors to be included in the evaluation. They should be clearly defined so that they can be unambiguously measured. As an example, let us take a choice of four road projects. The relevant factors in the evaluation might be as follows:

a. capital cost of project  
b. operating cost of common traffic  
c. time costs of common traffic  
d. benefits to redistributed and generated traffic (operating costs)  
e. benefits to redistributed and generated traffic (time costs)  
f. number of fatalities predicted  
g. number of serious injuries predicted  
h. number of slight injuries predicted  
i. material costs of accidents  
j. road maintenance costs
k. number of residents displaced by road construction
1. number of residents seriously affected by noise
m. loss of public open space
n. visual intrusion in parkland
o. severance of communities
p. related tax receipts to Government

It is, of course, important that the factors should not duplicate each other. Many of the benefits from road construction are captured by the items of operating costs and time costs. Transmitted and transferred benefits must not be included.

2. Choice of units

Each evaluation factor must be measured, for which purpose a suitable unit of measurement is needed. Six of the factors listed above can be measured in terms of money (a, b, c, i, j, and p). Two are in manhours (c and d), five in numbers of people (f, g, h, k, and l), and one in square meters (m). Visual intrusion (n), and severance of communities (o), call for special measures, of which several are possible, and it will be assumed that they are in square meters. Clearly the object is to select a measure that fairly reflects the magnitude of the phenomenon in question. Note that 1, concerning noise guidance, requires a definition of "seriously affected by noise". Given a definition which would involve a measure of decibels (or it might be simply a combination of traffic volumes and distance between house and road), the unit of measurement becomes simply the number of residents falling within that definition.
3. Measurement

The third step is the actual measurement, or prediction of such, of the various factors. It is, of course, the task of the planning study to produce this information.

All measurements must apply to the same period. There are two possibilities:

a. measurements may be made for specific years. All capital items must be annualized to give a fraction that can be reasonably attributed to the year in question. Capital costs should be represented by the annual cost of capital, which is the annual real interest foregone plus depreciation. On transport infrastructure, the depreciation will be zero if annual maintenance costs are designed to maintain the structure in perpetuity. Other once-and-for-all items may be spread evenly over the life of the project (or 30 years if this is the evaluation period) in order to give them due weight in a single-year evaluation;

b. Alternatively, the measurements may cover the life of the project, or, say, 30 years, in which case all measurements may be discounted sums as at a particular year.

It is possible that a factor may be unmeasurable but that enough is known about it to permit the judgment that the effect on it of option A would be better than that of option B. In other words, the
options can be ranked with respect to this factor but not measured more exactly. In this case they must be simply placed in order of preference. This is known as an ordinal measurement.

4. Scaling

Each factor yields a range of measurements, one for each of the alternative solutions being evaluated. These are placed on such a scale that the worst value is set equal to 0 and the best to 10. Thus the scale is related only to the difference between best and worst. (It is not essential to do the scaling in this way. As will be seen, the validity of the scaling process depends on the weighting process that follows.) If the scale is taken to be a simple linear one, this implies that each successive equal increment in the factor is valued equally. This is usually true. For instance, a factor measured in money units might give the following measurements for four road options:

<table>
<thead>
<tr>
<th>$000</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>0</td>
</tr>
<tr>
<td>180</td>
<td>3.16</td>
</tr>
<tr>
<td>230</td>
<td>8.42</td>
</tr>
<tr>
<td>245</td>
<td>10</td>
</tr>
</tbody>
</table>

This produces a score of one for each successive increment of $9500 and implies that each such increment is of equal value, which is not open to doubt in a case of money units. But sometimes it is not so, e.g. in a case of decibel units. Logarithmic, or some other non-linear, scale might then be better. The loss of parkland, for instance, becomes progressively more serious as the magnitude of loss increases because the dwindling amount of parkland becomes more valuable; this is a clear application of the law of
diminishing marginal utility. The analyst must therefore be careful to choose an appropriate scale for each factor. This requirement is depicted in the figure below. The actual measurement of a factor is given on one axis and the perceived relative value of the factor for the other. A scale is needed which converts the measurements into relative values, and this scale is not necessarily linear.

If the evaluation factor is expressed as a cost rather than as a benefit, it follows that the highest value is equated to 0 and the lowest to 10.

If there are any non-measurable factors, which have been ranked, the best and worst options naturally take the pole positions at 10 and 0 on their scale, but there is no immediate means of placing the intermediate options. It is desirable to try to do so. If it is possible to place the options in order between the two limiting cases, it should also be possible to place them at appropriate intervals. If this is not possible, the only acceptance solution is to place them at equal intervals, i.e. if the ranking is A, B, C, D, then A:B = C:C:D.

In the following table some fictitious figures have been produced to illustrate the measurement and scaling of the 16 factors listed above for four road options.
<table>
<thead>
<tr>
<th>i</th>
<th>ii</th>
<th>iii</th>
<th>iv</th>
<th>v</th>
<th>vi</th>
<th>vii</th>
<th>viii</th>
<th>ix</th>
<th>x</th>
<th>xi</th>
<th>xii</th>
<th>xiii</th>
<th>xiv</th>
<th>xv</th>
<th>xvi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units</td>
<td>$m^*$</td>
<td>$m$</td>
<td>m/h</td>
<td>$m</td>
<td>m/h</td>
<td>no.</td>
<td>no.</td>
<td>no.</td>
<td>$m</td>
<td>$m</td>
<td>no.*</td>
<td>no.</td>
<td>sq.m</td>
<td>sq.m</td>
<td>index</td>
</tr>
<tr>
<td>Options</td>
<td>Measurements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>10.0</td>
<td>90</td>
<td>26</td>
<td>0</td>
<td>0</td>
<td>57.2</td>
<td>412</td>
<td>11240</td>
<td>20.6</td>
<td>0</td>
<td>100</td>
<td>5000</td>
<td>0</td>
<td>4000</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>24.4</td>
<td>63</td>
<td>21.7</td>
<td>12.9</td>
<td>1.6</td>
<td>55</td>
<td>370</td>
<td>9600</td>
<td>18.0</td>
<td>2.73</td>
<td>4455</td>
<td>20000</td>
<td>8000</td>
<td>17650</td>
<td>2.8</td>
</tr>
<tr>
<td>C</td>
<td>48.7</td>
<td>67.7</td>
<td>21.9</td>
<td>12.7</td>
<td>1.6</td>
<td>61</td>
<td>460</td>
<td>13600</td>
<td>24.6</td>
<td>6.19</td>
<td>6800</td>
<td>0</td>
<td>4560</td>
<td>25000</td>
<td>5.0</td>
</tr>
<tr>
<td>D</td>
<td>100.0</td>
<td>54</td>
<td>20</td>
<td>24</td>
<td>2.7</td>
<td>59.7</td>
<td>432</td>
<td>11880</td>
<td>22.1</td>
<td>10.50</td>
<td>1440</td>
<td>7200</td>
<td>4000</td>
<td>6940</td>
<td>2.15</td>
</tr>
<tr>
<td>Measurement of the increment</td>
<td>9.0</td>
<td>3.6</td>
<td>0.6</td>
<td>2.4</td>
<td>0.27</td>
<td>0.6</td>
<td>9</td>
<td>400</td>
<td>0.66</td>
<td>1.05</td>
<td>670</td>
<td>2000</td>
<td>800</td>
<td>2100</td>
<td>0.5</td>
</tr>
<tr>
<td>Scaling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6.4</td>
<td>5.3</td>
<td>5.9</td>
<td>6.0</td>
<td>10</td>
<td>10</td>
<td>7.5</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>8.4</td>
<td>7.5</td>
<td>7.2</td>
<td>5.4</td>
<td>6.0</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>7.4</td>
<td>3.5</td>
<td>0</td>
<td>0</td>
<td>3.5</td>
<td>4.4</td>
</tr>
<tr>
<td>C</td>
<td>5.7</td>
<td>6.2</td>
<td>6.8</td>
<td>5.3</td>
<td>5.9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.1</td>
<td>0</td>
<td>10</td>
<td>4.3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>D</td>
<td>0</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>2.2</td>
<td>3.1</td>
<td>4.3</td>
<td>3.8</td>
<td>0</td>
<td>8.0</td>
<td>6.4</td>
<td>5.0</td>
<td>8.6</td>
<td>5.7</td>
</tr>
</tbody>
</table>

* Annualized
5. **Weighting**

At this point, each factor has been arranged on a scale measuring from 0 to 10, but clearly a score of 5, say, on the scale, is not necessarily to be equated with the same score on another scale. A weight must be applied to each factor, and this is the part of the method that depends unavoidably on subjective judgment. The easiest way to proceed is to consider an increment in the middle of each scale, say between 4 and 5, and to allocate 100 points between them in proportion to their importance. (Of course, the increment between 4 and 5 was designed in the scaling process to be equal in value to other unit increments on the same scale, but it may be a little easier to work with a central increment than one at either extremity of the scale). In the example this means that the following increments have to be compared and weighted:

**Investment (per year)**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Unit/Amount</th>
<th>Suggested Weight</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Cost of capital, $</td>
<td>9.0mn*</td>
<td></td>
<td>30.0</td>
</tr>
<tr>
<td>b. Vehicle operating cost, $</td>
<td>3.6 mn</td>
<td></td>
<td>12.0</td>
</tr>
<tr>
<td>c. Passenger time, man-hours</td>
<td>0.6 mn</td>
<td></td>
<td>10.0</td>
</tr>
<tr>
<td>d. Vehicle operating cost, $</td>
<td>2.4 mn</td>
<td></td>
<td>8.0</td>
</tr>
<tr>
<td>e. Passenger time, man-hours</td>
<td>0.27 mn</td>
<td></td>
<td>6.2</td>
</tr>
<tr>
<td>f. Fatalities</td>
<td>0.6</td>
<td></td>
<td>2.0</td>
</tr>
<tr>
<td>g. Serious injuries</td>
<td>9</td>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td>h. Slight injuries</td>
<td>400</td>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td>i. Accident costs, $</td>
<td>0.66 mn</td>
<td></td>
<td>2.2</td>
</tr>
<tr>
<td>j. Road maintenance, $</td>
<td>1.05 mn</td>
<td></td>
<td>3.5</td>
</tr>
<tr>
<td>k. Residents displaced</td>
<td>670*</td>
<td></td>
<td>4.5</td>
</tr>
<tr>
<td>l. Residents affected by noise</td>
<td>2000</td>
<td></td>
<td>6.5</td>
</tr>
<tr>
<td>m. Loss of open space, sq. m.</td>
<td>800</td>
<td></td>
<td>2.6</td>
</tr>
<tr>
<td>n. Visual intrusion, sq. m.</td>
<td>2100</td>
<td></td>
<td>3.5</td>
</tr>
<tr>
<td>o. Severance of communities, index</td>
<td>0.5</td>
<td></td>
<td>2.0</td>
</tr>
<tr>
<td>p. Tax receipts, $</td>
<td>1.2 mn</td>
<td></td>
<td>4.0</td>
</tr>
</tbody>
</table>

* Annualized amounts
It will be appreciated that the weights are not related to any concept of absolute importance. One factor is not absolutely more important than another, but a given amount of one factor is more important than a given amount of another factor. Hence, if the options all have little impact on, say, accidents, the incremental value for accidents will be small and will attract a low weighting. Similarly if the options do not have an impact on accidents but there is little difference between them, again the incremental value will be small and will attract a low weighting.

Factors measured in money units may be weighted so as to give the same value of money throughout, although this need not be always the case. Monetary benefits to different sections of the community, or to foreign communities, might be valued differently.

The allocation of weighting points is intended to reflect value of importance to the community. This is not an easy concept to understand or interpret, but the same problem arises with any method of making decisions. Obviously the allocation of points should not represent the personal values of the allocators, but rather their views of what would be valued by the community.

When the weighting is complete, there is no more to do but add up the points. It can be seen that the maximum score is 1000 and the minimum is 0. If one option is best on every factor, it automatically scores 1000; if it is worst on every factor, it automatically scores 0. To show better the effects of the weighting, the unweighted totals should be multiplied by 100/(no. of factors). The final table appears as follows:
### Cost-Benefit Factors

<table>
<thead>
<tr>
<th>Alternative Options</th>
<th>i</th>
<th>ii</th>
<th>iii</th>
<th>iv</th>
<th>v</th>
<th>vi</th>
<th>vii</th>
<th>viii</th>
<th>ix</th>
<th>x</th>
<th>xi</th>
<th>xii</th>
<th>xiii</th>
<th>xiv</th>
<th>xv</th>
<th>xvi</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6.4</td>
<td>5.3</td>
<td>5.9</td>
<td>6.0</td>
<td>10</td>
<td>10</td>
<td>7.5</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>8.4</td>
<td>7.5</td>
<td>7.2</td>
<td>5.4</td>
<td>6.0</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>7.4</td>
<td>3.5</td>
<td>0</td>
<td>0</td>
<td>3.5</td>
<td>4.3</td>
<td>3.8</td>
</tr>
<tr>
<td>C</td>
<td>5.7</td>
<td>6.2</td>
<td>6.8</td>
<td>5.3</td>
<td>5.9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.1</td>
<td>0</td>
<td>10</td>
<td>4.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>D</td>
<td>0</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>2.2</td>
<td>3.1</td>
<td>4.3</td>
<td>3.8</td>
<td>0</td>
<td>8.0</td>
<td>6.4</td>
<td>5.0</td>
<td>8.6</td>
<td>5.7</td>
<td>10</td>
</tr>
<tr>
<td>Weights</td>
<td>30</td>
<td>12</td>
<td>10</td>
<td>8.0</td>
<td>6.2</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
<td>2.2</td>
<td>3.5</td>
<td>4.5</td>
<td>6.5</td>
<td>2.6</td>
<td>3.5</td>
<td>2.0</td>
<td>4.0</td>
</tr>
</tbody>
</table>

**Unweighted Total**: 569.4  
**Weighted Total**: 552.6  
**Unweighted Total**: 606.2  
**Weighted Total**: 644.1  
**Unweighted Total**: 341.9  
**Weighted Total**: 508.5  
**Unweighted Total**: 606.9  
**Weighted Total**: 558.0
In this fictitious example, Alternative A costs least and therefore scores 10 on capital cost (Item a) while Alternative D is the most costly. The other numbers show that Alternative A, not surprisingly, produces least traffic benefits (b-e), shows up well on accidents (f-i) and scores best on road maintenance (j) and on all the environmental factors except noise (k-o); it produces least in tax gain to Government (p). Alternative D naturally produces greatest traffic benefits and tax receipts, but shows up poorly on accidents and road maintenance costs; it scores well on environmental factors. Overall, Alternative B appears clearly the best with a weighted score of 644.1 and Alternative C is clearly the worst.

One of the attractive features of the method is that the first four steps are practically uncontroversial and can be carried out as a technical exercise, while the final step, the selection of weights, is a simple process that can be performed by anyone. Different people will choose different weights and the effect on the final result can be calculated in a few minutes. The differences of judgement can be clearly seen, as can their influence on the final result, and discussion can thus focus on the important issues. A committee can apply the method, if it so wishes, by averaging the individual weights selected by its members.
The evaluation of transport projects is normally based on the assumption that land uses remain unchanged, i.e. the situations "with project" and "without project" have the same land uses. The assumption affects only the evaluation of generated or spatially redistributed trips. If the "with project" situation induces people to change their trip ends or to make new trips, these changes can only be attributed to the transport improvement, if nothing else changes at the same time. Obviously, if there is also a change in land use, this might be the cause of the change in trip pattern.

Strictly speaking, it is seldom possible to introduce a major transport project without also changing some land uses in the vicinity of the project. If these changes are trivial, they can be ignored.

Free market changes

A transport improvement will add to the accessibility of certain areas and thus attract development there. If the constraints on development remain the same, with and without the project, the decision to develop can be ascribed to the transport improvement and the benefits can be approximately estimated in the conventional way.
Controlled changes

If, on the other hand, the transport improvement is part of a plan which involves major changes in land-use controls or policies, the method of evaluation as described is no longer valid. The changes in land use cannot be ascribed to the transport improvement, but rather to a change in land-use planning. For instance, a government decision to build a housing estate in a certain area, and therefore to improve the roads in the area, may generate a lot of traffic which cannot be ascribed solely to the road improvements.

In this situation where changes in traffic volumes result from two sources, i.e. the transport improvement and the land-use changes, three evaluations are possible:

1. evaluation of the joint plan, i.e. the housing development plus the road improvement;
2. evaluation of the housing development, assuming that the road improvements have been made;
3. evaluation of the road improvements, assuming that the housing development has been built;

Thus the three evaluations require the following comparisons:

```
Existing Situation + Housing Estate + Road Improvements
1. Existing Situation vs. ( + Road Improvements
2. Existing Situation
3. Existing Situation + Housing Estate
```
Evaluation 3 is the conventional transport evaluation. Evaluations 1 and 2 both include an evaluation of land use. A change of land use affects capital costs, current costs, including transport costs, and benefits. The cost-benefit analysis of land-use plans is not easy.

Some transport plans are part and parcel of land-use plans and cannot sensibly be evaluated on their own. If the objective is to evaluate the plan as a whole (i.e. evaluation 1), the difficulties of evaluating land use cannot be avoided. Only if the objective is to evaluate the transport component on the assumption that the land-use plan will be implemented anyway (i.e. evaluation 3) is it possible to avoid the difficulties.

The procedure for dealing with the problem is as follows:

1. separate the zones where controlled land-use changes are made; movements between other zones can be evaluated in the normal way;
2. evaluate traffic with unchanged trip ends in the normal way (i.e. common and modally redistributed traffic);
3. calculate total transport costs of remaining trips (i.e. generated and spatially redistributed traffic);
4. calculate differences in land-use costs, capital and current, to which add the transport costs from (3);
5. assess differences in land-use benefits;
6. compute cost-benefit indicators from (4) and (5).
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J. Stuart Yerrell editor
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This report presents the findings of a five-year evaluation of the First Lusaka Upgrading and Sites and Services Project made possible through a cooperative research project supported jointly by the World Bank and the International Development Research Centre of Canada.


Saad Yahya

A manual for professionals and administrators working in urban uncontrolled settlements in the third world. Examines the problem of registering houses and plots in unplanned settlements in the large urban centers of the developing countries.


Housing

Reviews the importance of housing within the framework of urban development problems, and makes recommendations for World Bank assistance in integrated urban planning.


Housing for Low-Income Urban Families: Economics and Policy in the Developing World

Orville E. Grimes, Jr.

Analyzes the operation of urban housing markets in developing countries to determine the kinds of dwellings affordable by the urban poor.


National Urbanization Policy in Developing Countries

Bertrand M. Renaud

National urbanization policies in developing countries often attempt, without a full understanding of the forces at work, to block the growth of the largest cities and to induce decentralization. This book takes a critical look at such policies and their weak conceptual foundations and describes problems inherent in implementation. The coverage is comprehensive, and both global and national trends are analyzed.

Oxford University Press, 1982. 192 pages (including index, appendices).

Also available in Korean from the Korea Research Institute for Human Settlements.

Ownership and Efficiency in Urban Buses

Charles Feibel and A. A. Walters

Stock No. WP-0371. $3.00.
The People of Bogota: Who They Are, What They Earn, Where They Live
Rakesh Mohan

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Pirate Subdivisions and the Market for Residential Lots in Bogota
Alan Carroll

Stock Nos. PP-7401-E, PP-7401-P, PP-7401-S. $5.00.

Sites and Services Projects

LC 81-48176. ISBN 0-8018-2805-8, $22.50 hardcover. Spanish. Subscriptions at $20 a year (plus $4 for overseas postage) can be obtained from CIUL, 818 18th Street, N.W., Washington, D.C. 20006. U.S.A.

Urban and Spatial Development in Mexico
Ian Scott

Examines urbanization in a country in which that process has been particularly rapid and in which such issues as provision of jobs, shelter, public services, and mass transit are urgent. Also considers issues that arise because of the size and form of the system of large cities and the linkages between them: centralization, rural-urban integration, and patterns of interregional development. The study is relevant to other countries in which similar problems will undoubtedly become increasingly urgent.

The Johns Hopkins University Press, 1982. 344 pages (including maps, appendices, bibliography, index).

Urban Economic and Planning Models: Assessing the Potential for Cities in Developing Countries
Rakesh Mohan

Applies current urban modeling techniques to cities in developing countries. Problems intrinsic to the modeling of all urban areas are considered along with those particular to cities in poor countries.


The Transformation of Urban Housing: The Experience of Upgrading in Cartagena
W. Paul Strassmann

In urban development, it is now often considered more practical and efficient to upgrade the existing housing stock than to replace it with new construction. Housing transformation should not only be expected and tolerated, but should even be fostered as a means to increase production in an important field, to generate employment, and to improve equity in the distribution of housing. This study shows how the housing stock in Cartagena was upgraded during the 1970s by owner-occupants and, to a lesser extent, by landlords. The principal conclusions are supported by extensive econometric tests and by interviews with local experts and authorities.


Urban Land Policy: Issues and Opportunities
Harold B. Dunkerley, coordinating editor, with the assistance of Christine M.E. Whitehead

Various authors with experience in their respective fields discuss major problems of urban land: the rising cost, the relation of different types of land tenure to equity and efficiency, the rationale for government intervention and the forms it may take—taxation, acquisition and development of land, regulation of land use, and other forms of control. The analyses refine and illuminate many of the urban problems that confront developing countries and provide practical guidelines for dealing with them. Chapter authors are John M. Courtney, William A. Doebele, Harold B. Dunkerley, Malcolm D. Rivkin, Donald C. Shoup, Alan A. Walters, and Christine M.E. Whitehead.


The Economics of Self-Help Housing: Theory and Some Evidence from a Developing Country
Emmanuel Jimenez


The Costs of Urbanization in Developing Countries
Johannes Linn


The Spatial Structure of Latin American Cities
Gregory K. Ingram and Alan Carroll


The Urban Edge
Herbert H. Werlin (Editor) and George G. Wynne (Publications Director)

This six-page newsletter is published for the World Bank by the Council for International Urban Liaison. It is concerned with practical approaches to urban problems in developing countries.

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