A Methodology for Delveloping Transport System Improvements Plans for Middle Cities of The Developing Countries

by

Ali S.HUZAYYIN
Prof. of Transport Planning,
Faculty of Engineering, Cairo University.

3111

Correspondence Address: A.S.HUZAYYIN
Apt. # 42, Libon Building,
19 Gabalaya Street, Zamalek,
Cairo, Egypt.

Synopsis

Abstract

Many of the developing countries middle cities have been suffering from rapid growth over the last decade. The existing transport infrastructure and supply were not originally planned to cope with the increasing demand on urban travel. In order to methodologically approach these problems the planners are often confronted with the challenge of how to develop a well structured transport improvement plan. This is particularly when they are faced with the lack of data base, trained staff and appropriate fund. This paper suggests a methodology that can effectively be used in that respect. The methodology uses a minimum of field surveys on demand and supply. It also uses information on existing policies and the views of the local councils. With this input the methodology suggests formulation of an appropriate policy and then the development of an applicable transport system improvements plan. The methodology was applied in a middle city in Egypt and proved to be successful. After discussing the philosophy behind the methodology and describing the methodology in detail, the paper highlights the application exercise and ends with conclusions.

A Methodology for Delveloping Transport System Improvements Plans for Middle Cities of The Developing Countries

by

Ali S.HUZAYYIN

Prof. of Transport Planning,

Faculty of Engineering, Cairo University

Abstract

Many of the developing countries middle cities have been suffering from rapid growth over the last decade. The existing transport infrastructure and supply were not originally planned to cope with the increasing demand on urban travel. In order to methodologically approach these problems, rather than to depend on intuitive judgement recommendations, the planners are often confronted with the challenge of how to develop a well structured transport improvement plan. This is particularly when they are faced with the lack of sufficient data base, trained staff and appropriate fund. This paper suggests a methodology that can effectively be used in that respect. The methodology uses a minimum of field surveys on demand and supply. It also uses information on existing policies and the views of the local councils. With this input the methodology suggests formulation of an appropriate policy and then the development of an applicable transport system improvements plan. The methodology was applied in a middle city in Egypt and proved to be successful. After discussing the philosophy behind the methodology and describing the methodology in detail, the paper highlights the application exercise and ends with conclusions.

1- Introduction

Most of the developing countries major cities have been subject to massive increase in population, car ownership and concentration of activities since the 1960's. Accordingly, travel needs and demand have increased with greater rates and so are the related problems of urban travel. With the lack of fund to expand the transport supply and the developed area such cities suffer from severe traffic congestion, insufficient transit, air and noise pollution, accidents and delays (HUZAYYIN and EL HAWARY 1984, HUZAYYIN and El HAWARY Oct. 1984). Naturally, many of the rural migrants have considered settling in the middle size cities of less problems. Furthermore, governments are trying to encourage this trend and even to try to tempt metropolitan dwellers to think of moving to these cities. This has been translated in creating new job, education and cultural opportunities to be offered in the middle size city. For instance, agro/industrial and light industry plants are encouraged to operate in these cities in Egypt. Besides the creation of new regional Universities to absorb the demand on education preventing it from being satisfied in Cairo, Alexandria and Assuit (the major city of Upper Egypt) as used to be in the 1960's. Furthermore, the government of Egypt is also encouraging cultural and sports events to take place in such cities so as to make them more attractive for living.

As a natural result many of the provincial middle cities have been subject to increased growth over the last decade. Therefore, they started to suffer from the consequences of increased travel demand. This is expected to cause some concern especially where the existing transport infrastructure was not originally designed to cope with the newly increased demand (BANJO, 1986). With the lack of necessary fund and the location of such cities in the heart of the highly cultivated rich soil that the country cannot afford to urbanize, it has been very difficult to expand neither the urban street system nor the city limits.

The least that can, and should, be done is to improve the existing transport supply, to reorganize it and upgrade it. This would certainly lead to making full use of the present infrastructure and can in fact exert rapid impact in easing the problems of urban transport in such cities.

The question that is now faced is how the transport planner can meet such a challenge of developing a well structured transport improvements plan? This research work puts forward a new transport planning methodology that can be effectively used in that respect. It avoids the need for the traditional and expensive urban transport planning process that is difficult to undertake in many instances.

In section 2 the underlaying philosophy and the basic requirements of the new methodology are discussed. Then, the paper gives in detail the methodology in its third section. Section 4 is devoted to a brief description of the application of the suggested methodology in one of the important middle size cities in Egypt. The paper finally ends with conclusions and recommendations.

2- Basic Requirements and Underlaying Philosophy

It is believed that the development of the transport improvements plan should be based on a well defined methodological approach which suits the existing context. In other words, one should always remember that he is working in the framework of developing countries and is dealing with a middle city. Accordingly, the cost limitation of undertaking the planning methodology and the nature of travel behaviour identify the main features of the scope of work. Such scope is not only different from that when we are dealing with a middle size city of a developed nation but it is also different from the situation of a major city in a developing country.

Thus, the transport planner is facing here a two-way challenge; the need to arrive to an optimal transport improvements plan and the obligation of following a simple but sound and realistic approach. This leads to the need to answer the following 2 questions,

- what the optimum plan should generally achieve?
- why a simple and realistic planning approach is required?

The optimum transport improvements plan besides achieving the usual urban transport objectives should be able to fulfil certain requirements. For instance, it should be based on a well defined transport policy which is approved by the local authority. It should also include projects which can be easily implemented (GAKENHEIMER 1986). Thirdly, the plan should make full use of the existing transport infrastructure and supply (BANJO 1986, HUZAYYIN 1986); to improve and to upgrade rather than to neglect their existence and start from scratch. Furthermore, the plan should be possible to implement (HUZAYYIN 1988), and should not exceed the cost capabilities of the local authority.

In answering the second question about the need to follow a simple approach, it should be noted that besides the obvious motives behind simplicity other reasons exist. These are dictated by two facts that should always be born in mined as mentioned earlier; namely dealing with a middle city and working in the context of developing countries. Accordingly, for instance, no large scale surveys are to be undertaken such as home interviews. Also no sophisticated modelling techniques are to be adopted. Sophisticated modelling would need a sound and comprehensive data base that is both non-existing and very expensive to collect. Furthermore, the assumptions of urban travel behaviour and the basic underlaying factors on which modelling techniques are based may in many cases not be justified. For example, in most cases in Egyptian provential cities the majority of urban daily peak trips are made on foot and by the bicycle. Such type of trip is very difficult to model and to project (UNTERMANN 1984). Another example is mode captivity (HUZAYYIN and EL HAWARY 1986) where there would be no sense in calibrating a modal split model (EL HAWARY et. al. 1983). There is also no guarantee of the accuracy of the results of sophisticated models and hence their applicability would be questioned. Another reason is the difficulty for local authorities to follow up the results of the plan and to update it using such models because of the serious lack in well trained staff of transport planners (GAKENHEIMER 1986). Therefore, it is believed that there would be no justification neither of the time, effort and cost needed for calibration and suing sophisticated models, nor of the accuracy of the expected output.

The developed planning methodology is based on 2 phases. In the first phase a transport policy is to be formulated and, then, the second phase comprises identification of the transport improvements plan. The transport policy should reflect the basic travel needs and meet the habits of the urban dweller. Whereas based on such policy the improvements plan should identify the required actions to upgrade the different elements of the existing transport system. Accordingly, the plan should also satisfy the travellers basic needs. To ensure implementation, the developed policy, and hence the plan, should take into account the views of the local (elected) council and any urban development policies of the local government if they exist (GAKENHEIMER 1986).

Therefore, a clear picture of the "existing travel needs and habits" and "the existing transport system" should be available. In order to know the existing supply an inventory can be carried out identifying the major characteristics of the transport system. Then, it remains to investigate how the basic travel needs and habits can be detected with the minimum of field surveys. Here, it is suggested that mode choice (modal split) ratios can to a great extent reflect such needs and habits, for three main reasons. Firstly, mode choice depends mainly on the trip maker characteristics. These include income level, age, sex and cultural background. Secondly, modal split ratios give a clear picture of the usage of the transport subsystems (modes) for the trip type being analysed. Hence, when considering peak travel, mode choice ratios would for instance, reflect the general travel habits of the urban dwellers for the work and education trips. Thirdly, in developing countries (and particularly in middle cities) modal split is very much likely to remain stable for some time to come. This is mainly due to the fact that urban travellers are mode captives (HUZAYYIN and EL HAWARY 1986, EL HAWARY et. al. 1983). Those who walk simply cannot afford motorized travel, and those who use transit cannot afford running a private car. Thus walking and/or using transit are made out of necessity rather than out of choice. In addition, many people in provential cities have developed the walking travel habit over the years and it is very much unlikely that they would easily change it. Furthermore, those who own private cars do not walk or use transit because the walking routes and transit level of service are deteriorated.

In order to obtain modal split ratios an O/D survey is needed. The survey, however, needs not to be a comprehensive one for the sake of economy. It is also not needed to expand the O/D matrix from sample to population. This is mainly because it is suggested to use modal split ratios rather than actual enlarged values of modal usage. Such ratios can be obtained from the sample matrix. This will also eliminate the need of sophisticated methodology and additional traffic cordon and screenline counts for enlarging purposes.

The use of the modal split ratios and the transport system inventory to formulate the transport policy and then to set out the transport improvements plan are discussed in the following section.

3- Description of the Methodology

Figure 1 gives a flow chart of the steps of the suggested methodology for developing transport system improvements plans in middle cities of the developing countries. It comprises three sequential stages; collection of basic information and performance of field surveys, policy formulation and developing the transport improvements plan.

3.1 Basic Information and Surveys (stage-1)

In stage-1, two background information are needed about the local authority urban development policies, if any, and the views of the local (elected) council on transport needs. These are necessary for policy formulation and later for the development of the transport improvements plan, if implementation is to be considerd. Obviously, endorsement of transport policies and the improvements plan need to be granted by the local authority and council. Hence they should stem from the general ideas and requirements expressed by such institutions.

Stage-1 also comprises two field surveys, an O/D survey and a transport system inventory. As mentioned earlier the O/D survey is needed to establish modal split ratios. The survey need not to be a comprehensive expensive one, and there is no need to enlarge from sample to population as mentioned earlier. A questionnaire form to be distributed at major work places and education institutions is enough. The form is to include the minimum of questions about the morning peak hour trips, travel mode and the destination zone. The origin zone is of course identified by the address of the establishment at which the survey is undertaken.

The second survey is a transport system inventory that will give a picture of the level of service and deficiencies of the existing supply. The inventory should cover the street system, transit system and the terminals of the different modes. The general features of the above systems are to be documented considering physical elements and operation conditions.

It should be noted that the O/D results (modal split ratios) and the system inventory output must be established at two levels. The city level for use in policy formulation and the interzonal level for use in developing the transport system improvements plan. These are discussed in the following sections.

3.2 Transport Policy Formulation (stage-2)

The city level modal split ratios give a general picture of the travellers needs and modal usage. Whereas the global assessment of the city transport system gives an account of the existing supply. Using the above pieces of input data together with the background information on the local authority urban policies and the local council views on transportation needs, the transport policy can be formulated. For instance, if city level modal split ratios show that 70% of the trips are made by the transit bus, then the policy should be formulated in favour of this mode. Then it could be enhanced using the other information on the existing transport system condition, urban policies and local council views. Such enhancement may, for example, add the importance of not neglecting walk and cycling even if the policy is to concentrate mainly on the bus. In section 4 a real world example is given on policy formulation.

3.3 Developing the Transport System Improvements Plan (Stage-3)

At this stage two inputs are essential besides the formulated policy. These inputs are at the interzonal level, namely the "O/D matrix of modal split ratios" and the "O/D matrix of the interzonal linkage condition". The two inputs stem, respectively, from the O/D survey and the transport system inventory described earlier in stage-1. Formulation of these 2 matrices is described in section 3.3.1 and there usage to develop the system improvements plan is given in section 3.3.2.

3.3.1 Formulation of the O/D matrices

Figure 2 illustrates an example of the modal split ratios O/D matrix. The matrix is very simple. It presents the percentages of modal shares of all the peak hour trips between each O/D pair. It is clear from the given example in Figure 2 that 40% of the peak trips between i and j occurs on foot, with 25% by bus, 20% by paratranist, 10% cycling and only 5% by car.

Figure 3 then, gives an illustrative example of the O/D matrix of the interzonal transport linkage condition. Though the matrix may appear complicated from a first glance, yet it is in fact a very simple visual presentation of the general conditions of the transport subsystems linking each O/D pair. Of course when developing such a matrix one should always refere to the detailed transport system inventory sheets and the transport system map of the city under consideration. It should be noted that the transport subsystems given in the TSS column in Figure 3 should of course refer to the relevant modes given in Figure 2 matrix. For instance, the SW (side walks) are relevant to the walk, CT (cycle track) to the bicycle and so on. Furthermore, the St. (street) is applicable to the cases of bus, paratransit and car. Standard evaluation creteria can be easily set out by the transport engineer for evaluation of each subsystem condition as poor, average, good ans so on.

3.3.2 Using the O/D matrices for developing the transport system improvements plan

Based on the O/D matrices given in Figures 2 and 3 and on other input information such as the formulated transport policy, the existing urban policies and the local council requirements, the planner can directly develop the transport system improvements plan. To illustrate the methodology it should be noted first that the plan is to identify and recommend certain actions for improving the transport system to cope with the prevailing mode (subsystem) usage. This is to be developed at two subsequent levels. First is the interzonal linkage level and second is the overall level.

3.3.2.1 The interzonal linkage improvements level

At the interzonal level the planner is to consider each pair of zones at a time. To illustrate assume that the i-j pair is considered as given by Figures 2 and 3. Examination of the i-j modal split ratios of Figure 2 shows that the major mode used is the walk. However, from Figure 3 the corresponding subsystem (given by the side walks and lighting of streets) linking the two zones seems to be in poor condition. The side walks widths are not sufficient, their surface condition is poor and so is the corresponding street lighting. This immediately signals to the planner that something aught to be done for upgrading the system.

It is important to note that having reached the above conclusion, it will be important to go back to the original, detailed, street inventory files. This would make it possible to illustrate on a map the major pedestrian corridors that would be subject to improvement between the said O/D pair (i-j in our example). Furthermore, field visits to the identified corridors would also support the planner in identifying the needed improvements. Then, a preliminary proposal had to be worked out, naming the streets concerned and the actions needed for improvements.

Next, the planner would turn to examine other modes and the relevant subsystems between the same O/D pair. In our case (i-j) the bus system appears as the second important mode with a share of 25% of the peak trips as seen from Figure 2. Examination of Figure 3 then shows that the geometric features of the bus routes between zones i and j are good. However, the surface condition of paving along the route is poor. The service coverage and frequency are average. Hence, it seems logical to consider in the improvements plan to undertake pavement maintenance along the streets forming the bus routes between zones i and j. Furthermore, enhancement of bus service coverage and frequencies are needed. The same procedure would then, follow for other important modes, if any, as they appear from the O/D modal split ratios matrix of Figure 2.

As for the modes that are not highly used (with low percentages of usage) they would be given low priority. The only exception is in the case if the formulated policy encourages their use. For example, in our case the interzonal (i-j) usage of the bicycle is only 10% of total trips. If the formulated policy calls for boosting non-motorized trips, then the planner is obliged to suggest improvements (or creation) of cycling routes between the two zones under consideration.

The above procedure would, then, continue till all zonal pairs are investigated and relevant improvements are suggested.

3.3.2.2 <u>The overall level of transport improvements</u>

It is clear that the suggested improvements at the interzonal level cannot be finalized before they are examined once more at the overall city level. For instance, if a subsystem link connects 4 adjacent zones (e.g. zones 1,2,3 & 4) and examination of the relevant modal usage suggests improvements of the parts of that link between zones 1 & 2 and 2 & 4 only, yet it would be more useful to suggest also improving the intermediate part between zones 2 and 3. This ensures overall coherence of the improvements plan.

To simplify this procedure, it may be useful to indicate all the interzonal level recommendations on a city map. Careful examination would make it easy to spot the needed extra recommendations for ensuring the overall coherence of the improvements plan. Then the plan can be finalized and documented for approval of the decision makers.

4- Application

This section gives a brief account of the application of the developed methodology in this research work. This is demonstrated with the case of the city of Shebin El-Kom in Egypt through its Urban Development Study (PLANNING STUDIES ... 1987). It is a middle size provincial city with a population of some 120,000. Part of the study was developing of a transport system improvements plan. The above mentioned methodology was applied. Obviously an O/D survey and a transport system inventory were carried out, a transport policy was formulated and a transport system improvements plan was developed.

The study area was divided into 6 traffic zones coincided with the administrative districts and 11 external zone of the province. The O/D survey was performed at all major work and education institutions premises in the city. The survey form included 4 main questions about the origin zone of the trip, the used mode(s), trip length (min.) and hour of travel. During the analysis all information on the urban parts of the external (rural/urban) trips were added to the internal (urban/urban) trips. Hence, the resulting O/D modal split ratios matrix reflected all types of the trips which took place during the morning peak within the city boundaries.

The transport system inventory included physical and operation conditions of the existing street system, side walks, lighting, bus system, shared taxi system and terminals.

It is not intended to go further in the details of the above mentioned standard field work. The details are given in the subsequent reports of the above mentioned study (PLANNING STUDIES ... 1987). The aim of this section, however, is to give highlights of some relevant results, that would demonstrate the application of the developed methodology; the main concern of this paper.

Table 1 gives the city level modal split ratios as the major input for the formulation of the transport policy. It is clear from this table that non-motorized (walk and cycling) trips are dominating with 60% share of the daily peak hour trips.

Based on this result it was possible to formulate 2 alternative policies. The first was "give attention to non-motrized transport", the second was "give attention to both non-motorized and public (bus & shared taxi) transport". This is more comprehensive as both bus and shared taxi transport accounted for 32% of all peak travel. Hence, the second policy formulation pays attention to 62% of peak travel. However, with other inputs from the general urban policy of saving energy and the views of local council it was decided to settle on the following enhanced formulation: "encourage non-motorized transport and give attention to public transport". The latter formulation is felt more appropriate than the previous one. Here encouraging non-motorized transport means boosting such "energy-consumption-free" transportation and it includes in the same time the meaning of giving attention to it. However, it is enough to give attention to public transport rather than to encourage increasing its usage as for the case of non-motorized trips.

Based on the above mentioned field work, two matrices were obtained similar to those of Figures 2 and 3. Examination of each O/D pair modal split ratios and transport linkage conditions made it possible to recommend the needed system improvements at the interzonal level. These were then supported by several field visits to enhance the recommendations and make sure of their applicability. Finally, the transport system improvements plan was set out after examination of the interzonal recommendations at the overall city level. The plan give detailed description of the needed actions which were also platted on a set of city maps.

5- Conclusions and Recommendations

As mentioned before, this paper presents a methodology for the development of transport system improvements plans for middle size cities in the developing countries. It is clear from the above presentation and the application exercise that the suggested methodology has many advantages for use in the context for which it is developed. Firstly, it is based on a clear and logical philosophy of formulating a transport policy as a first phase and, then, developing an applicable transport improvements plan. Secondly, it considers basic needs of the travellers, the condition of the existing transport system, existing urban development policies and the views of the local council. In addition, the cost of undertaking the methodology is very reasonable and by all means can be afforded by the local authority. With the recommended continuous field visits the plan can be always enhanced to make sure of its coherence and overall effectiveness before being finalized. The needed field surveys are simple and inexpensive. Finally, there is no need for using sophisticated methods or models that may, in many cases, be neither applicable nor easy to use with the lake of well trained staff and large data base.

A fringe recommendation, but believed to be of vital importance to developing countries, can finally be drown out. It is very important that transport planners and transport planning research in the third world be directed towards developing new methods and procedures. Such methods and procedures should be based on logical philosophy, well defined steps, simplistic approach and minimum of input data. Furthermore, they should be easy to perform with the existing technical and financial capabilities and should produce applicable results that could be easily implemented (HUZAYYIN 1988). The present work is hoped to be a step in that direction.

References

BANJO, G.A., 1986, "Toward a new framework for urban transport planning in the third world", the 4th World Conference on Transport Research, WCTR, Vancouver.

GAKENHEIMER, R., 1986, "Urban transport training for the third world", the 4th World Conference on Transport Research, WCTR, Vancouver.

EL HAWARY, M., ABDEL BARRY, F., HUZAYYIN, A.S., et al, 1983, Transport Planning Aids & Methods", Cairo Urban Transport Project-Final Report, Vol. III, Part 1, TPA Report 83-6A, Cairo University/MIT.

HUZAYYIN, A.S. & EL HAWARY, M., 1984, "Man & his transport behaviour, Part 3b, Urban Travel Characteristics in Greater Cairo", Transport Reviews, Vol. 4, No. 3, 287-198.

HUZAYYIN, A.S. & EL HAWARY, M., Oct. 1984, "Technical, economic & social actions and urban transport problems, with special reference to Greater Cairo", METROPOLIS-84 symposium International, Paris Ile-de-France.

HUZAYYIN, A.S., 1986, "Managerial staff and changes in intercity bus transport management in Egypt: a case study", the 4th World Conference on Transport Research, WCTR, Vancouver.

HUZAYYIN, A.S. & EL HAWARY, M., 1986, "Car captivity & the new metro service in Greater Cairo", the 4th World Conference on Transport Research, WCTR, Vancouver.

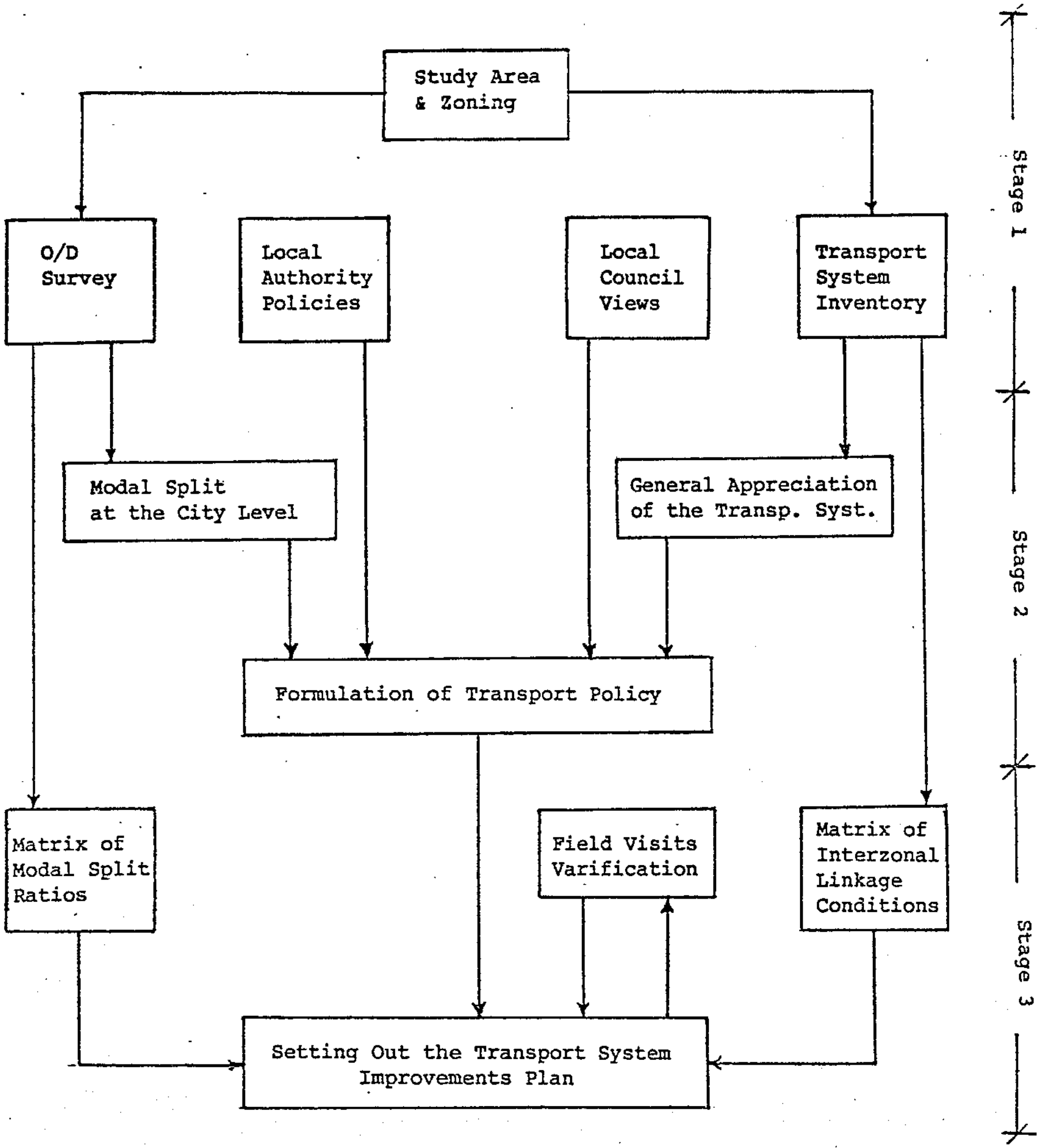
HUZAYYIN, A.S., 1988, "The need for low cost transport improvements in the developing countries metropolis: a new framework for implementation", Approaches to Regional Transport Problems: Middle East Requirements, International Symposium, Istanbul Technical University, Istanbul.

"PLANNING STUDIES OF SHEBIN EL KOM", 1987, Vol. 3, Integrated Studies Group (ETTONY & ABDELKADER), GOPP, Cairo.

UNTERMANN, R.K., 1984, "Accommodating the Pedestrian: Adapting Towns and Neighbourhoods for Walking & Bicycling", Van Nostrand Reinhold Co., New York.

T-ble 1: Modal split ratios at the city level, Shebin El Kom Study (PLANNING STUDIES ... 1987).

Mode	Walk	Cycle	Bus	Shared Taxi	Car	Other
Modal Split%	50	10	16	16	2	6



Stage 1: Basic information & field surveys.
Stage 2: Policy formulation.
Stage 3: Developing the transport system improvements plan.

Fig. 1: Flow Chart of the suggested methodology for developing transport system improvements plans in middle cities of the developing countries.

O \ D	Mode	1	2	......	j	......	n
1							
2							
⋮							
i	Walk Cycle Bus P.T. Car				40% 10% 25% 20% 5%		
⋮							
n							

Fig. 2: An illustrative example of the O/D matrix of modal split ratios during the morning peak hour.

O \ D	GC \ TSS	1	2	......	j: Geo.	j: Surf.	j: L	j: Ser.	j: F	...	n
1											
2											
. . .											
i	SW				P	P	P	NA	NA		
	CT				NE	NE	NE	NA	NA		
	B				G	P	P	A	A		
	P.T.				G	P	P	G	VG		
	ST.				G	P	P	NA	NA		
. . .											
n											

O= Origin , D= Destination , Zone No.= 1,2,..,i,j,...,n

* <u>TSS Transport Subsystem linking a pair of zones</u>:

SW Side walks for pedestrians
CT Cycle track
B Bus
P.T. Paratransit

* <u>GC General condition of the subsystem linking a pair of zones</u>:

Geo. geometric features (width, radii, etc.).
Surf. surface (pavement condition).
L street lighting.
Ser. B or P.T. service coverage.
F B or P.T. service frequency.

* <u>Condition ratio</u>:

P = poor , A = average , G = good and V.G = very good

* NE not existing , NA not applicable.

Fig. 3: An illustrative example of the O/D matrix of the interzonal transport linkage condition.