EXPERTS JUDGEMENT: A BASIS FOR DEVELOPING INTEGRATED PROGRAMS FOR MITIGATING TRAFFIC PROBLEMS IN MEGA CITIES

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Abstract

This research starts by developing a comprehensive inventory and categorization of demand and supply-based policies and measures that are aimed at relieving traffic problems in metropolitan cities. A set of generic criteria that can be used as a basis for the judgmental assessment of such policies and measures is identified and selected. An attitudinal questionnaire is then designed to elicit the judgment of transport, traffic and highway experts regarding potentiality (efficiency and effectiveness), public acceptability, applicability, perceived cost and priority of implementation of these policies and measures. Appropriate nonparametric statistical tests and techniques are selected and applied to conduct an in depth statistical analysis of gathered expert information. The main purpose of such analysis is to obtain judgment patterns of experts and degree of consensus among them. Statistical analysis is complemented by a weighting procedure to establish the potential achievement rate of each policy and measure and hence to support in making decisions on whether to use and implement such policy or measure in relieving traffic problems. As a result of the analysis, three complementary traffic relief programs were developed. The research concludes with proposing an action program for the implementation of the suggested traffic relief package.

Keywords: Expert judgment; Integrated programs; Mitigating; Traffic problems
Topic Area: H10 Urban Transport Policy

1. Introduction

In many parts of the world, and particularly in developing countries, urban travel demand is growing at relatively fast rates. On the other hand, provision of transport networks and modes is constrained by limited funding and in many cases inefficiency in planning, design, construction, operation, maintenance and management. This growing demand accompanied by inadequacies in transport supply lead to several traffic related problems including traffic congestion and delays, increase in vehicle operating costs and energy consumption, traffic accidents and environmental pollution. Most traffic relieve programs can be described as piecemeal approaches, i.e. looking at separate solutions for single problems at single sites. These, when implemented alone, provide marginal relieve to traffic problems. Several studies were undertaken to assess such programs. Some of these used pre-specified criteria, questionnaires, and before and after studies. Others developed/expanded existing transportation models so as to assess the impacts of such programs.

The main objective of this research is to assist in establishing the priority of the various demand and supply based policies and measures that are directed towards relieving traffic problems. In addition, it aims at developing complementary traffic relief programs. The development of such programs is based on the analysis of experts' judgment. The paper starts by identifying a comprehensive inventory and categorization of demand and supply-based policies and measures that are aimed at relieving traffic problems in metropolitan cities. Such inventory constitutes 102 potential policies and measures. These were selected based on thorough discussions, and examination of relevant literature. These were grouped under four headings, namely, network and

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traffic management policies and measures, travel demand management policies and measures, land use management policies and measures and other policies and measures.

Generic criteria that can be used as basis for the judgmental assessment of such policies and measures were also selected. The core of the paper lies in designing an attitudinal questionnaire that is meant to elicit the judgment of transport, traffic and highway experts regarding potentiality (efficiency and effectiveness), public acceptability, applicability, perceived cost and priority of implementation of these policies and measures. The questionnaire went through several piloting stages, where it was discussed and piloted with a sample of experts. This helped in refining and improving the questionnaire. The questionnaire was designed, in such a way so as to allow experts to mark their responses in a simple manner. Questionnaire forms were then distributed among a number of highly qualified experts and 31 completed responses were received.

Appropriate nonparametric statistical tests and techniques were selected and applied to conduct in depth statistical analysis of the gathered expert information. The main purpose of such analysis is to obtain judgment patterns of experts and degree of consensus among them. The Kruskal-Wallis one-way analysis of variance test was considered to examine whether there is a difference among responses of independent groups of experts. The Wald-Wolfowitz runs test was used to establish randomness of sample sequence. The Kolmogrov-Smirnov one sample test was applied to establish the uniformity of judgments with respect to the five point judgmental rating scale provided in the experts' questionnaire. The Kendall coefficient of concordance test was also used in determining the judgmental consensus among all responding experts.

The statistical analysis was complemented by a weighting procedure to establish the potential achievement rate of each policy and measure and hence to support in making decisions on whether to use and implement such policy or measure in relieving traffic problems. As a result of the analysis, three complementary traffic relieve programs are developed. All of the policies and measures achieving a weighted score above or equal to 70% constituted the first proposed integrated traffic relieve package. This is described as the package with very high rates of achievement potentials. The research concludes with proposing an action program for the implementation of the suggested traffic relief package.

2. Design of an expert questionnaire: a tool for assessing traffic relief programs

Several studies were undertaken to assess the effectiveness of demand and supply based relief packages in different parts of the world. Some used pre-specified criteria, questionnaires and before and after comparisons in an effort to quantify effects of measures included in such packages. In this context, it is worth referring to an OECD report that depicts potential impacts of demand and supply based congestion management measures, see OECD (1994). Other studies developed or expanded existing transportation models to assess impacts of Travel Demand Management (TDM) measures, see Ingham (1992) for a study that used SATURN to quantify effect of congestion relief measures in Johannesburg CBD, see ARRB (1994) for a comprehensive workshop on models used to assess impact of TDM measures. One criterion, namely cost effectiveness of TDM measures, was thoroughly investigated by Jraiw (1992) and Mierzejewski (1991).

In many studies, behavioral responses of transport system users to traffic-related policies and measures were explored. Several examples were reported in the literature examining public attitudes towards demand management measures, see Thorpe et. al. (2000), Bhattacharjee et. al. (1997) as well as Al-Mosaind, (1998). Some studies dealt with the responding behavior to specific demand management measures, see Garling et. al. (2000) where the household choices of car use reduction measures in Sweden was examined, and see Jakobsson et. al. (2000) where determinants of private car users acceptance of road pricing in Sweden were explored. Other studies emphasized the importance of before and after evaluation, see Higgins and Johnson (1999). It is also interesting to note that in a recent study, attitudes to urban road pricing by the local authority and academics in the UK were investigated, see Ison (2000).

In this research, a structured questionnaire was specifically designed to elicit the judgment of experts with regards to a selected set of traffic relief policies and measures. Attitudinal surveys deal with perceptions towards reality. These are important for inferring and understanding behaviors, judgments and potential decisions. The questionnaire was designed, in such a way so as to allow experts to mark their responses in a simple manner. The questionnaire went through several piloting stages, where it was discussed with experts and most importantly tested on a pilot sample of experts. This helped in refining and improving the questionnaire. The questionnaire took a tabular format similar to the one depicted in table 4. The first column included a list of 102 policies and measures aimed at relieving traffic problems in general, and particularly in developing countries. Components of this list were selected based on thorough discussions, and examination of the above and other relevant literature, see Marshall and Banister (2000), Bonnel (1995), USDOT (1990). These components can be grouped under four headings, namely:

1. Network and Traffic Management policies and measures (25)
2. Travel Demand Management (TDM) policies and measures (35)
3. Land Use Management (LUM) policies and measures (12)
4. Other policies and measures (29)

It has to be noted that such categorization was not, however, presented to the experts. Experts were presented with eight evaluation criteria through which they were able to exercise their judgment for each of the 102 listed policies and measures. These criteria included:

1. Efficiency and effectiveness in relieving traffic congestion
2. Efficiency and effectiveness in reducing accidents
3. Efficiency and effectiveness in reducing environment pollutants
4. Efficiency and effectiveness in reducing energy consumption
5. Level of acceptability by the general public
6. Level (degree) of applicability
7. Estimation of costs of implementation
8. Priority of implementation

These criteria constituted the main headings of the next eight columns in the questionnaire, see table 4. Each of these criteria had a five-point ordinal scaling system. This ordinal scaling ranged from very low, low, medium, high and very high. These constituted the five sub-columns for each of the eight judgment criteria Such a scaling system was designed to assist the experts in expressing their different judgments through rating the evaluation criteria. In this context, the questionnaire can be described as a rating choice type questionnaire.

3. Survey details and sample representation

Using the designed questionnaire, a survey was conducted with a group of highly qualified experts in Egypt. In distributing questionnaire forms among experts, a stratified sampling was contemplated i.e. targeted sample was selected to represent variability in the following characteristics, see table 1:

a) Current position representing three classes of highly qualified academic experts i.e. professors, associate and assistant professors.
b) Affiliation representing the various academic universities/research centers in Egypt that specialize in transportation studies
c) Specialization representing four main specific specialization categories i.e. transport and traffic engineering, highway and traffic engineering, highway engineering and transport economics.
d) Countries where PhDs were pursued, thus representing the schools of thought forming the experts knowledge while pursuing their PhD degrees. Countries represented include: USA, Canada, UK, Germany, Japan, Belgium, Czechoslovakia and Egypt.
e) Finally, number of years representing length of experience since PhD award.

As shown in table 1, most respondents were professors or associate professors. Academics from Ain Shams university, the second largest university in Egypt, constituted the core of the

respondents. Transport and traffic engineering was also the most commonly represented specialization. The country where most respondents pursued their PhDs in was the USA. As for the years of experience since PhD award, this ranged from 1 to 40 years with an average of 12 years.

Table 1: Representation of experts characteristics as a basis for sample stratification

Characteristics of Experts	Classifications of Characteristics	Sample Size	Mode
Current Position	Professor	11	11
	Associate Professor	11	11
	Assistant Professor & Other	9	
Affiliation	Cairo University	5	9
	Ain Shams University	9	
	Al Azhar University	7	
	Egypt National Institute of Transport	2	
	Alexandria University	4	
	Zagazig University	-	
	Mansoura University	1	
	Suez Canal University	1	
	Other	2	
Specialization	Transport & Traffic Engineering	18	18
	Highway & Traffic Engineering	3	
	Highway Engineering	8	
	Transport Economics	2	
Countries PhD were pursued	USA	12	12
	UK	3	
	Germany	4	
	Japan	2	
	Canada	5	
	Belgium	1	
	Czechoslovakia	1	
	Egypt	3	
Experience Years since PhD Award: Mean =12 Standard Deviation = 9 Minimum = 1 Maximum = 40			

The population size of traffic, transport and highway academic experts in Egypt is thought to be in the range of 75 experts. Questionnaire forms were distributed to 55 experts representing the characteristics of the previously discussed stratified sample. A total of 31 forms were completed. As shown in table 2, the average response rate is around 56% representing a sample size of roughly 42%. Such number is reasonable, as the threshold for an acceptable sample size allowing manipulation and statistical inference of continuous data ought to be >30, see Richardson et al. (1995). Obviously for ordinal data such a number could be even less stringent.

Table 2: Details of survey response rate and sample size

Transport Academia in Egypt	Main Specialization	Approximate Population Size	Questionnaires Distributed	Questionnaires Received	Response Rate	Sample Size
Cairo University	Transport & Traffic Eng.	8	5	2	40%	25%
	Highway & Traffic Eng.	10	7	3	43%	30%
Ain Shams University	Transport & Traffic Eng.	8	6	6	100%	75%
	Highway Eng.	8	6	3	50	38%
Al-Azhar University	Transport & Traffic Eng.	4	4	4	100%	100%
	Highway Eng.	4	3	3	100%	75%
Egypt National Institute of Transport	Transport Planning & Traffic Eng.	4	3	1	33%	25%
	Transport Economics	3	3	1	33%	33%
Alexandria University	Transport Planning, Traffic & Railway Eng.	5	5	3	60%	60%
	Highway Eng.	2	1	1	100%	50%
Mansoura University	Transport & Traffic Eng.	3	3	1	33%	33%
	Highway Eng.		-	-	-	-
Suez Canal University	Transport & Traffic Eng.	1	1	-	0%	0%
	Highway & Airport Eng.	1	1	1	100%	100%
Fayoum University	Transport & Traffic Eng.	2	1	-	0%	0%
	Highway & Traffic Eng.	2	-	-	0%	0%
Zagazig University	Transport & Traffic Eng.	2	1	-	0	0%
	Highway & Traffic Eng.	2	-	-	0%	0%
Other	Transport &, Traffic Eng.	2	2	1	50%	50%
	Transport Economics	3	3	1	33%	33%
Total		74	55	31	56%	42%

4. Factors affecting judgement of experts

In this research, a strong emphasis is given to analyzing the judgment of transport, traffic and highway experts. The judgment of those experts is a representation of their traffic attitude. This in turn is formed as a result of experts' traffic related perceptual skills i.e. their perception of traffic problems, constraints and difficulties involved in relieving such problems, as well as their preferences and priorities on how to tackle these. A detailed explanation of factors affecting experts' traffic attitude and judgement is depicted in figure 1. The figure shows that traffic related perceptual skills can be perceived as a function of three elements:

a) Traffic knowledge of experts which in turn is a function of their education and accumulated information. Obviously their education is affected by their schools of thought, i.e. countries and universities where they pursued their PhDs as well as by their specific area of PhD research. On the other hand, their accumulated traffic information is a result of their exposure and access to available sources of transport and traffic information.
b) Traffic experience of experts, which is a representation of their cognitive skills i.e. how they would deal with traffic issues and problems. This in turn is a function of the amount, type and intensity of involvement in consultancy and research work that experts have pursued through their careers. Traffic experience is also a function of education.
c) Traffic environment in which experts have experienced most of their lives and obviously the one that they are attempting to judge through this questionnaire.

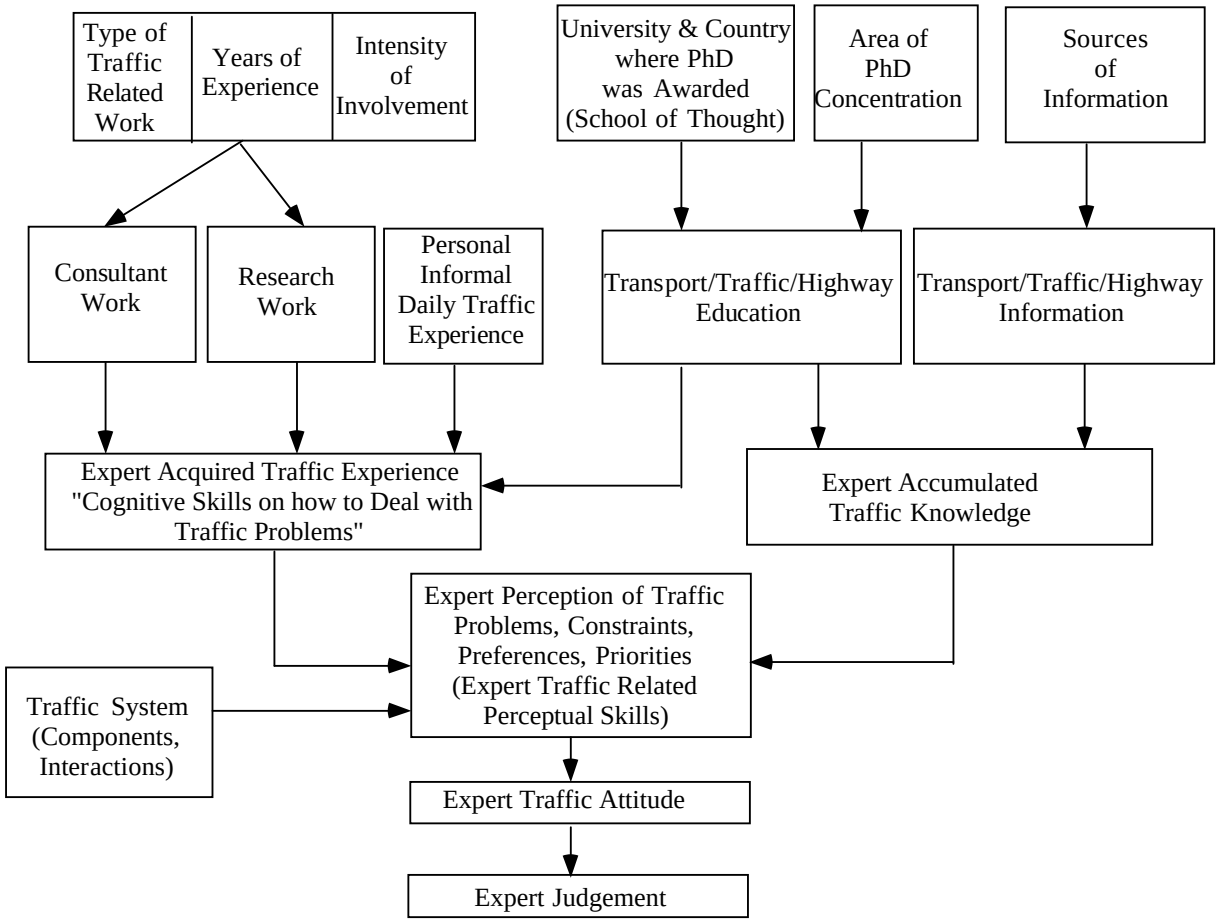

Figure 1: Factors affecting judgement of experts towards policies & measures suggested for relieve of traffic problems

5. Experts judgement: An in depth statistical analysis

Several nonparametric tests and techniques can be employed in order to statistically infer the responses of experts. Statistical inference is used to test hypothesis as well as to estimate population parameters. After a careful review, four non-parametric statistical tests were computed for each of the 816 (102 policy/measure * 8 evaluation criteria) obtained ordinal information, see table 3. These were selected based on the purpose of the analysis and the type of data. In addition, two descriptive statistics were computed. All of the tests and descriptive statistics displayed in table 3 were performed using the Statistical Packages For Social Sciences (SPSS) software. In the following subsections, a discussion of the results of this in depth statistical analysis is presented.

Table 3: Nonparametric tests and statistics used for conducting in depth statistical analysis of questionnaire responses

Level of Measurement of Questionnaire Responses	Test of Difference Among G Independent Groups	Randomness Test for One Sample Case	Goodness of Fit Test for One Sample Case	Measure of Agreement Test	Descriptive Statistics
Ordinal Information	Kruskal-Wallis one Way Analysis of Variance Test	Wald-Wolfowitz Runs Test	Kolmogrov-Smirnov One Sample Test	Kendall Coefficient of Concordance	Mode/ Median

5.1. Is there a difference among responses of independent groups of experts?

According to Siegel and Castellan (1988), sample values almost invariably differ somewhat, and the question is whether differences among samples signify genuine population differences, or whether they represent merely chance variations expected among random samples drawn from the same population. The aim of the analysis, presented in this sub-section, is to attempt to infer, whether there is any significant statistical difference in the patterns of experts' perceptual judgment with regards to listed traffic relief policies and measures. Such differences is thought to arise as a result of variations in positions and experiences of responding experts. The sample was divided into three independent groups of experts categorized in accordance with their positions i.e. professors (11) versus associate professors (11) versus assistant professors (9). Nonparametric statistical analysis can indicate whether differences in group samples are evident enough to conclude that circumstantial conditions of each of these groups are different. The Kruskal-Wallis (K-W) one-way analysis of variance test is considered to be the most appropriate test to establish whether there is a significant difference among G independent sample groups, where $G > 2$.

The rejection/confidence level, i.e. the significance level for this test, was set at $\alpha = 0.05$, where the null hypothesis H_0 suggests that there is no significant difference in the responses among the 3 control groups and that the samples are drawn from populations having the same distribution. On the other hand, the alternative hypothesis H_1 assumes the converse; i.e. there is a significant difference in the responses among the control groups and that the samples are drawn from stochastically different populations, i.e., having different statistical distributions explaining them. Results of applying this test for each of the 816 obtained ordinal information show that in approximately 95% of the judgments, H_0 is not rejected i.e. there is no significant difference among the judgments of the three groups. This is an important conclusion, demonstrating consensus among the three groups of experts with regards to their judgment of traffic relief policies and measures despite of their different positions and experiences. In this context, there would be no justification for separately analyzing the responses of the three groups of experts and further conclusions could be drawn from the joint analysis of the whole obtained sample of experts (31 responding experts).

5.2. Establishing randomness of sample sequence

It is vital to establish whether original sequence of collected information represents a random sample, i.e. successive observations are independent. If this proves to be the case, then it is plausible to generalize conclusions drawn from sample as being representative of the population of experts. The Wald-Wolfowitz (W-W) runs test was used to compute the significance level of the H_0 stating that the sequence of observations is independent i.e., the value of one observation does not influence those of later observations and hence the sequence is considered random. The rejection/confidence level, i.e. the level of significance for this test was also set at $\alpha = 0.05$.

The W-W test was conducted for each of the 816 obtained ordinal information. In almost 97% of the cases the probability of occurrence was more than 0.05, hence the H_0 was not rejected. Therefore, it is fair to draw a general statistical inference that the sample order is random, and that successive judgments of experts are independent of each other.

5.3. Uniformity of judgments with respect to judgmental rating scale

The Kolmogrov-Smirnov (K-S) one sample test was applied to establish whether there is any agreement between the distribution of the sample of responses and an assumed distribution. The test is appropriate to test the goodness of fit for variables measured on at least an ordinal scale. The H_0 specifies the theoretical distribution to which the distribution of the sample of responses is compared. In this context, a uniform distribution was assumed which merely means that for each evaluation criteria used to judge each of the traffic relief policies and measures, the expected proportions of responses of experts in each of the five judgmental rating scores are the same.

Results of applying this test for each of the 816 obtained ordinal information are shown in table 4. The table shows that in almost 87% of the responses the H_0 is rejected i.e. the assumption of uniformity of judgmental ratings is not accepted. This is an important conclusion as it justifies relying on computing central tendency statistics as the basis for establishing judgmental priority and hence in structuring components of suggested traffic relief programs.

5.4. Is there an agreement among responding experts?

It is important to establish whether there is judgmental consensus among all responding experts to the eight criteria applied for evaluating the 102 proposed traffic relief policies and measures. When responses are at least of an ordinal level of information, Kendall coefficient of concordance W test is useful in determining agreement among several respondents. Measures of agreement are specifically useful in obtaining an understanding and appreciation of inter-judgment reliability.

The W coefficient is a measure of the relation among several rankings or ratings given by respondents. The W coefficient represents an index of the degree of difference between the actual agreement shown in the data, and the total perfect agreement. Values of the W coefficient range between zero and one. The H_0 suggests that the N expert responses (N=31) are independent, i.e. respondents ratings are unrelated to each other. A high or a significant value of W could be understood as meaning that respondents are applying similar criteria in ranking questionnaire parameters. The W coefficients and their levels of significance were computed for each of the 102 traffic relief policies and measures, see table 4. The rejection level, i.e. the level of significance for this measure of agreement test, was set at $\alpha = 0.05$. In more than 99% of the cases, the H_0 was rejected. In all these cases, it is statistically inferred that the agreement among the 31 experts is higher than it would be due to mere random chance and that there is a relatively strong consensus among the experts. This is an important conclusion that supports the notion of computing central tendency statistics to be the basis for establishing judgmental priority and structuring components of suggested traffic relief packages.

5.5 Measuring central tendency

Descriptive statistics in the form of mode (most frequently occurring value) and median (value above and below which one half of the observations fall) were estimated to show the central tendency of each of the 816-judgment information obtained in the questionnaire, see table 4. The table shows those responses with a mode of 1 equivalent to very high or 2 equivalent to high as shaded, except for the criteria of cost of implementation, where responses with a mode of 5 standing for very low cost or 4 standing for low cost are shaded. As will be shown in the next section, these are utilized to structure the components of suggested traffic relief programs.

Table 4: Results of non-parametric statistical analysis of 816 obtained judgment information presented in a format similar to questionnaire design

Judgment Criteria	Efficiency & Effectiveness in Relieving Traffic Congestion		Efficiency & Effectiveness in Reducing Accidents		Efficiency & Effectiveness in Reducing Environment Pollutants		Efficiency & Effectiveness in Reducing Energy Consumption		Level of Acceptability By the General Public		Level of Applicability		Estimation of Costs of Implementation		Priority of Implementation		
	Mode/Median Descriptive Statistics, & Kolmogorov-Smirnov (K-S) Goodness of Fit Test																
I- Proposed Network and Traffic Management Policies & Measures	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Kendall Coefficient of Concordance W
1. Construction of new roads	1/2	R	3/3	R	3/3	R	2/2	R	2/2	R	3/3	R	1/1	R	2/2	NR	0.33, R
2. Reconstruction of roads	3/3	R	3/3	NR	3/3	R	2/3	NR	2/2	R	2/2	R	3/3	R	1/2	R	0.29, R
3. Widening of existing roads	3/2	R	3/3	R	3/3	R	3/3	R	2/2	R	3/3	R	2/2	R	3/3	NR	0.13, R
4. Grade Separation	2/2	R	2/2	R	3/3	R	2/2	R	2/2	R	2/2	R	1/1	R	2/2	NR	0.31, R
5. Railroad Grade Separation	3/2	R	1/2	R	3/3	NR	3/3	R	1/1	R	2/2	R	1/2	R	2/2	R	0.28, R
6. Improving Road Alignment	3/3	R	3/3	R	3/3	NR	3/3	R	2/3	R	2/3	R	3/3	R	3/3	R	0.12, R
7. Improving Intersection Geometry	2/2	R	2/2	R	2/3	NR	2/2	R	3/2	R	2/2	R	3/3	R	1/2	R	0.31, R
8. Improving Kerb Geometry (intersections & side-streets)	3/3	R	2/3	R	4/4	R	4/4	R	2/2	R	2/2	R	4/4	R	2/2	R	0.29, R
9. Proper selection, design & erection of traffic signs	4/3	NR	2/3	NR	4/4	R	4/4	R	2/3	R	2/2	R	3/3	R	2/2	R	0.32, R
10. Proper design, & planning of road markings	3/3	NR	2/3	NR	4/4	R	4/4	R	3/3	R	2/2	R	3/4	R	3/3	R	0.38, R
11. Proper selection, design, & erection of road lighting poles	3/4	R	2/2	NR	4/4	R	4/4	R	2/2	R	2/2	R	3/3	R	3/3	R	0.51, R
12. Proper design, planning of Island/Marking Channelization	3/3	R	2/2	R	3/4	R	4/4	R	3/2	R	2/2	R	3/3	R	1/2	R	0.45, R
13. Proper positioning of Mass Transit Stations/Stops	2/2	R	3/2	R	3/3	NR	2/3	NR	2/2	R	1/2	R	3/3.5	NR	1/2	R	0.26, R
14. Kerb lowering at pedestrian crossing positions	4/4	R	3/3	NR	4/4	R	5/4	R	2/2	R	1/2	R	4/4	R	1/2	R	0.31, R
15. Proper selection, design & implementation of U turns	2/2	R	2/2	R	3/3	R	3/3	R	3/3	R	1/2	R	3/4	R	3/2	R	0.37, R
16. Proper Planning & Design for Parking Lots	1/2	R	3/3	R	3/3	R	2/3	R	2/2	R	2/2	R	3/3	NR	1/2	R	0.23, R

Table Key: 1 = Very High, 2 = High, 3 = Medium, 4 = Low 5 = Very Low, R = Null Hypothesis *R*ejected, NR = Null Hypothesis *N*ot *R*ejected

Table 4: Continued

17. Proper Design of Exits/ Entrances to Major Land Uses	2/2	R	3/2.5	NR	3/3	R	3/3	NR	1/2	R	2/2	R	3/3	R	2/2	R	0.3, R
18. Re-dividing Lanes to create Additional Lanes	3/3	R	4/4	R	3/4	R	3/3	R	3/3	R	2/2.5	R	4/4	R	3/3	NR	0.2, R
19. Improving Traffic Signals and Other Control Devices	2/2	R	2/2	R	2/3	NR	2/3	R	2/2	R	2/2	R	2/2	NR	2/2	R	0.11, R
20. One Way Street System	2/2	R	2/2	R	3/3	R	3/3	R	3/3	R	3/3	NR	3/4	R	3/3	R	0.31, R
21. Reversible Traffic Lanes	2/3	R	3/3	R	3/3	R	3/3	R	4/4	NR	4/3	R	4/4	NR	4/3.5	NR	0.13, R
22. Traffic Control & Safety at Road Construction/Maintenance	2/2	R	2/2	R	3/3	R	3/3	R	2/2	R	2/2	R	3/3	R	2/2	R	0.37, R
23. Ramp metering	2/2	R	3/2	R	3/3	R	3/3	R	2/2	R	2/2	R	4/4	R	2/2	R	0.35, R
24. Incident Detection, Management, Control System	2/2	R	2/2	NR	3/3	NR	3/3	R	2/2	R	2/2	R	3/3	R	2/2	R	0.19, R
25. Traffic Management from Central Control Terminals	2/2	R	2/2	R	2/2	R	2/2	R	2/2	R	2/2	R	2/2	R	2/2	R	0.11, R
26. In Vehicle Driver Information Systems	2/2	R	2/2	NR	3/3	R	3/3	R	3/3	R	3/3	NR	2/2	R	3/3	R	0.13, R

II- Proposed Travel Demand Management Policies & Measures	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Kendall Coefficient of Concordance W
1. Encouraging Carpooling	2/2	R	3/3	R	3/3	R	2/2	R	4/4	R	4/4	R	5/4	R	3/3	NR	0.49, R
2. Improving Levels of Service for Mass Transit Modes	1/2	R	2/2	R	2/2	R	2/2	R	1/2	R	2/2	R	2/2	R	1/2	R	0.19, R
3. Design, construction & operation of designated bicycle & pedestrian routes	2/2	R	2/2	R	1/2	R	2/2	R	3/3	R	3/3	NR	3/3	R	3/3	R	0.18, R
4. Designated Bus Lanes	1/2	R	3/3	R	2/2	R	2/2	R	2/2	R	3/3	R	3/3	NR	1/2	R	0.17, R
5. Reduced Tolling for Buses	3/3	R	4/3	NR	3/3	NR	3/3	NR	2/3	R	2/2	R	3/3	R	3/3	NR	0.09, R
6. Parking priority for buses	2/2	R	3/3	NR	2/3	R	3/3	R	3/3	R	2/2	R	4/3	R	1/2	R	0.13, R
7. Reduced bus parking fees	3/3	NR	3/3	R	3/3	NR	3/3	NR	3/3	NR	2/2	R	4/4	R	1/2	R	0.19, R
8. Signal preemption for buses	3/3	R	4/3	R	4/4	R	3/3	R	4/4	R	4/3	NR	4/4	R	4/4	R	0.11, R
9. Traffic Mazes	3/3	R	3/3	R	4/4	R	3/4	R	3/3	R	3/3	R	3/3	R	3/3	R	0.28, R
10. Traffic Calming measures	4/4	R	2/2	R	4/4	R	4/4	R	3/3	R	2/2	R	3/3	NR	2/3	NR	0.5, R
11. Odd/Even License Plate System	2/2	R	3/3	R	2/2	R	2/2	R	5/4	R	2/4	R	4/4	R	4/3	NR	0.48, R
12. HGV Access Restriction	2/2	R	2/2	NR	2/2	R	4/3	R	2/3	NR	2/2	R	4/4	R	2/2	R	0.27, R

Table 4: Continued

13. Variable tolling w.r.t. type, occupancy & time of passing vehicles	2/2	R	3/3	R	2/2	R	3/3	R	4/4	R	3/3	NR	4/4	R	4/3	R	0.31, R
14. Strict Enforcement of Parking Violations	2/2	R	3/3	R	2/3	NR	3/3	NR	3/3	R	3/3	R	3/3	NR	2/2	R	0.2, R
15. Determining parking rates & specifications in accordance with land use types	1/2	R	3/3	NR	2/2	R	2/3	R	3/3	NR	2/2	R	3/3	R	1/2	R	0.23, R
16. Parking restrictions according to vehicle types	3/3	R	3/3	R	3/3	R	3/3	R	4/4	R	3/3	R	4/4	R	3/3	NR	0.24, R
17. Parking restrictions according to parking time	2/2	R	3/3	R	3/3	R	3/3	R	4/3.5	R	3/2.5	R	4/4	R	3/3	R	0.26, R
18. Parking restrictions in terms of parking periods	2/3	R	3/3	R	3/3	R	4/3	R	4/4	R	3/3	NR	4/4	R	2/2	R	0.22, R
19. Variable parking fees w.r.t. type of vehicle/parking time	3/3	R	3/3	R	3/3	R	4/3	R	3/3	R	2/2	R	4/4	R	2/2	R	0.22, R
20. Increase Fuel Prices	3/3	NR	4/3	R	3/3	NR	2/2	NR	5/5	R	3/3	NR	4/4	R	3/3	NR	0.44, R
21. Increase Vehicle Ownership Taxes	3/3	NR	3/3	R	3/3	NR	3/3	NR	4/4	R	2/2	NR	4/4	R	3/3	R	0.36, R
22. Increase Licensing Fees	3/3	R	3/3	R	3/3	R	3/3	R	4/4	R	2/2	NR	5/4	R	3/3	NR	0.37, R
23. Vehicle Licensing conditioned by availability of permanent parking space	2/2.5	R	3/3	R	4/3	NR	3/3	NR	5/4	R	3/4	R	4/4	R	3/4	R	0.18, R
24. Flextime in arrival & departure to/from work	2/2	NR	3/3	R	3/3	NR	3/3	R	2/2	R	3/3	R	3/4	R	2/2	R	0.18, R
25. Staggered start & end of Work and School times	2/2	R	3/3	R	3/3	R	3/3	R	2/3	R	2/2	R	4/4	R	2/2	R	0.25, R
26. HGV ban from using urban network during peak periods	2/2	R	1/2	R	2/2	R	3/3	R	2/2	R	2/2	R	4/4	R	2/2	R	0.27, R
27. Distribution centers outside cities	2/2	R	2/2	R	2/2	R	3/3	NR	3/3	R	2/2	R	2/2	R	2/2	R	0.07, R
28. Promote Teleworking	1/2	R	2/3	R	2/2	NR	2/2	NR	3/3	R	3/3	R	3/3	R	3/3	R	0.1, R
29. Promote Teleshopping	1/2	R	2/3	R	2/2	NR	2/2	NR	4/3	R	3/3	NR	3/3	R	3/3	NR	0.13, R
30. Promote Telelearning	2/2	R	3/3	NR	2/2	R	2/3	R	3/3	R	3/3	R	3/3	R	3/3	NR	0.15, R
31. Promote Teleconfrencing	3/3	NR	3/3	NR	3/3	R	3/3	NR	3/3	R	3/3	R	3/3	R	3/3	R	0.04, NR
32. Promote Telebanking	3/3	NR	3/3	NR	3/3	NR	2/3	NR	2/3	R	3/3	NR	3/3	R	3/3	NR	0.03, NR
33. Reduce working days	3/3	NR	3/3	R	3/3	R	2/3	NR	2/2	R	2/2	R	4/3.5	NR	2/2	R	0.19, R
34. Promote school bus transport	2/2	R	3/2	NR	2/2	R	2/2	R	2/2	R	3/3	R	3/3	R	2/2	R	0.06, NR
35. Encourage Home Delivery	3/3	R	3/3	R	3/3	R	3/3	R	3/3	NR	3/3	R	3/3	R	3/3	NR	0.06, NR

Table 4: Continued

III- Proposed Land Use Management Policies & Measures	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Kendall Coefficient of Concordance W
1. Promote commercial centers at cities peripheries	2/2	R	3/3	R	2/2	R	2/3	NR	3/3	R	3/3	R	2/2.5	NR	3/3	R	0.1, R
2. Mandatory traffic impact assessment for new developments	2/2	R	2/2	R	2/2	R	2/2	NR	2/3	NR	2/2	R	4/4	R	1/2	R	0.23, R
3. Promote land use mixing	2/2	R	2/2	R	2/2	R	2/2	R	2/2	R	3/3	R	3/3	R	2/2	R	0.22, R
4. Plan residential development to be near working sites	2/2	R	2/2	R	2/2	R	2/2	R	2/2	R	3/3	R	3/3	R	2/2	R	0.27, R
5. High density & variable land use mixing around and along transit stations/routes	2/2	R	3/3	NR	2/2	R	2/2	R	2/2	R	3/3	R	3/3	R	2/2	R	0.18, R
6. Proper planning & design of transit facilities & amenities	2/2	R	3/2	NR	3/2	R	3/2	R	2/2	R	2/2	R	3/3	R	2/2	R	0.1, R
7. Open space between buildings to encourage walking & cycling	2/3	R	3/3	R	2/2	R	2/2	R	2/2	R	3/3	R	2/3	R	2/2.5	R	0.07, R
8. Variable adjacent land mix encouraging walking/cycling	3/2	NR	3/3	R	2/2	R	2/2	R	3/2	R	3/3	R	3/3	R	2/2	R	0.12, R
9. Transit stations/stops located centrally within acceptable walking distances	2/2	R	3/3	R	2/2	R	2/2	R	2/2	R	2/2	R	3/3	R	2/2	R	0.13, R
10. Maintain continuity of buildings material/style to encourage walking/cycling	4/4	R	3/3	R	3/3	R	3/3	NR	1/2	R	2/3	R	2/2	R	3/3	R	0.31, R
11. Rear Parking areas & attractive activities in front of buildings	3/3	R	3/3	NR	4/3	R	4/3	NR	2/2	NR	3/3	NR	2/3	R	3/3	R	0.09, R
12. Develop integrated new urban communities away from existing cities	1/2	R	1/2	R	1/2	R	3/2	R	2/2	R	2/2	R	1/1	R	1/2	R	0.12, R

Table 4: Continued

IV- Other Policies & Measures	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Mode/ Med.	K-S Test	Kendall Coefficient of Concordance W
1. Develop standard vehicle specifications	3/3	NR	2/2	R	2/2	R	2/2	R	3/3	R	2/3	R	2/3	NR	2/2	R	0.38, R
2. Develop scheduled program for vehicle inspection	3/3	R	3/3	R	2/2	R	2/2	R	3/3	R	2/2	NR	2/3	R	2/2	R	0.25, R
3. Develop mandatory traffic education/training material for school children	3/3	NR	2/2	R	3/3	R	2/3	NR	2/2	R	2/2	R	3/3	R	2/2	R	0.21, R
4. Train teachers to be able to teach traffic related syllabus	3/3	NR	2/2	R	3/3	NR	3/3	NR	2/2	R	2/2	R	3/3	R	2/2	R	0.26, R
5. Develop traffic training programs for rural migrants	2/3	NR	2/2	R	2/3	NR	3/3	NR	3/2	R	2/2	R	3/3	R	3/2.5	R	0.18, R
6. Develop a driving handbook	2/3	R	3/2	R	3/3	NR	3/3	NR	2/2	R	2/2	R	3/3	R	2/2	R	0.28, R
7. Licensing driving instructors based on standard/stringent tests	2/2	R	2/2	R	3/3	R	3/3	R	3/2	R	2/2	R	3/3	R	1/2	R	0.41, R
8. Intensify traffic related mass media campaigns	2/2	R	2/2	R	3/3	NR	3/3	NR	2/2	R	2/2	R	3/3	R	2/2	R	0.39, R
9. Develop & update traffic legislation, rules, regulations	2/2	R	2/2	R	3/3	R	3/3	NR	2/2	R	2/2	R	3/3	R	2/2	R	0.23, R
10. Traffic legislation to ensure strict & competent driving tests	2/2	R	2/2	R	3/3	NR	3/3	NR	2/3	NR	2/2	R	3/3	R	1/2	R	0.33, R
11. Clear public explanation of traffic violations	2/2	R	2/2	R	3/3	R	3/3	R	3/2	R	2/2	R	3/3	R	2/2	R	0.38, R
12. Support for strict traffic violations penalty system	2/2	R	2/2	R	3/3	NR	3/3	R	2/3	NR	2/2	R	3/3	NR	2/2	R	0.34, R
13. Establish standards & monitoring for driving schools	2/3	R	2/2	R	3/3	R	3/3	R	2/2	R	2/2	R	3/3	R	2/2	R	0.37, R
14. Establish standards for driving/rest times for bus & HGV drivers	3/3	R	2/2	R	3/3	R	3/3	R	2/2	R	2/2	R	3/3	R	2/2	R	0.35, R
15. Develop speedy traffic court system	3/3	R	2/2	R	3/3	R	3/3	R	2/2	R	2/2	R	3/3	R	2/2	R	0.35, R
16. Issue laws aiming to limit rural migration to cities	2/2	R	3/3	NR	3/3	NR	3/3	NR	3/3	NR	4/3	NR	4/4	R	1/2	R	0.18, R

Table 4: Continued

17. More empowerment to traffic police to enforce certain traffic violations	2/2	R	2/2	R	3/3	R	3/3	R	4/3	NR	2/2	R	3/3	R	2/2	R	0.33, R
18. Enforce traffic laws on all road users with no exceptions	1/2	R	2/2	R	4/3	NR	3/3	R	1/2	R	2/2	R	4/4	R	1/1	R	0.42, R
19. Support reliance on traffic control devices to allow traffic police to enforce traffic law	2/2	R	2/2	R	3/3	NR	4/3	NR	2/2	R	2/2	R	2/2	R	2/2	R	0.26, R
20. Presence of traffic police in front of schools	2/2	R	1/2	R	3/3	R	3/3	R	2/2	R	2/2	R	3/3	R	1/2	R	0.28, R
21. Develop a proper institutional framework to deal with traffic issues	2/2	R	2/2	R	2/2	R	3/3	R	2/2	R	2/2	R	3/3	R	1/2	R	0.2, R
22. Develop personnel technical capabilities to handle traffic problems	2/2	R	2/2	R	3/3	R	3/3	R	2/2	R	2/2	R	2/2	R	2/2	R	0.18, R
23. Develop a continuous traffic data collection system	3/2	R	2/2	R	2/3	NR	3/3	NR	3/3	R	2/2	R	2/2	R	1/2	R	0.13, R
24. Utilize traffic packages to develop traffic models simulating traffic conditions	2/2	R	2/2	R	2/2	R	2/2	R	3/3	R	2/2	NR	2/2	R	1/2	R	0.21, R
25. Support role of research centers in traffic & highway	2/2	R	2/2	R	2/2	R	2/2	R	3/3	R	2/2	R	2/2	R	1/1	R	0.18, R
26. Planning for integration of transit modes	2/2	R	2/2	R	2/2	R	2/2	R	2/2	R	2/2	R	2/2.5	R	1/1	R	0.22, R
27. Metro routes selected to pass areas with high car ownership	1/2	R	2/2	R	1/2	R	1/2	R	2/2	R	2/2	R	2/2	R	1/2	R	0.03, NR
28. Integrate metro, road and intercity rail networks	2/2	R	1/2	R	2/2	R	1/2	R	2/2	R	2/2	R	3/2	R	2/2	R	0.08, R
29. Continuously conduct traffic studies	1/2	R	2/2	R	2/2	R	3/2	R	2/2	R	2/2	R	3/3	R	1/1	R	0.16, R

6. Integrated programs to relieve traffic problems

This research, as others, see UoW (1995), May and Roberts (1995) advocates the development of integrated programs aimed at relieving traffic problems. Such programs cannot, however, include a random combination of policies and measures. Which components are selected for the package will depend on the type and intensity of the traffic problem in hand as well as on the environment and constraints in which these will be implemented. In this research, prioritization and choice of traffic relief policies and measures were primarily based on the judgments of transport, traffic and highway experts with regards to the following criteria:

- Efficiency and effectiveness in relieving traffic problems
- Acceptability by the general public
- Applicability i.e. ease of implementation and maintenance;
- Estimation of costs of implementation
- Priority of implementation

The following procedure was used to develop three integrated traffic relief programs, see table 5.

1. All policies and measures that were not considered by the experts to have a high or very high efficiency and effectiveness in relieving one of the four generic traffic problems were excluded. These came to be 15 out of the considered 102 policies and measures, i.e. ≅ 15%
2. For each of the remaining 87 policies and measures, only the high to very high judgments with regard to efficiency and effectiveness in relieving the four generic traffic problems were considered. Other judgments were excluded. The underlying assumption is that the four traffic related problems, namely congestion, accidents, environmental pollutants and energy consumption, have equal importance. A very high efficiency and effectiveness in relieving a traffic problem was given a weight of five points, while a high efficiency and effectiveness in relieving a traffic problem was given a weight of four points.
3. The three criteria of acceptability, applicability and cost are considered as representative of the society and traffic environment in which the suggested policies and measures are to be implemented. For these criteria, all the five points scaling were considered. With regards to acceptability and applicability, the weighting scale went from very high acceptability or applicability given 5 points to very low acceptability or applicability given 1 point. As for cost, the weighting scale went from very high cost given a weight of 1 point to very low cost given a weight of 5 points. In this context, the underlying assumption is that the three environment related indicators have equal importance.
4. As for the last criterion representing the judgment of experts with regards to overall priority of the considered policy or measure, all of five points scaling were considered. For this criterion, the weighting scale also went from very high priority as 5 points to very low priority as 1 point.
5. In this context, the maximum aggregate weighting points that could be achieved across the eight judgment criteria would be equal to 40 points, (i.e. 8 criteria * 5 points). This can be interpreted as representing the best achievement in terms of very high efficiency and effectiveness in relieving the four generic traffic problems accompanied by very high public acceptability, very high applicability, very low cost and very high priority of implementation.
6. For each of the 87 policies and measures, the weighting points across the eight judgment criteria were summed. The resultant values were compared to the maximum value of 40 points so as to compute the expected percentage achievement of each policy or measure.
7. All of the policies and measures achieving a weighted score above or equal to 70% constituted the first proposed integrated traffic relief package. This is described as the package with very high rates of potential achievements. All of the policies and measures achieving a weighted score in the range of 50 to 69% constituted the second proposed traffic relief program. This is described as the program with high rates of potential achievements. All of the policies and measures achieving a weighted score below 50% constituted the third proposed traffic relief package. This is described as the package with low to medium rates of potential achievements.

8. As shown in table 5, each of these packages is composed of policies and measures categorized in accordance to the following four classifications:

a) Network and traffic management policies and measures (3 in package 1, 12 in package 2, 7 in package 3)
b) Travel demand management policies and measures (8 in package 1, 9 in package 2, 9 in package 3)
c) Land use management policies & measures (4 in package 1, 5 in package 2, 1 in package 3)
d) Other proposed policies and measures (7 in package 1, 17 in package 2, 5 in package 3)

9. In addition, the policies and measures within each classification are listed in an order reflecting their rate of potential achievement, see table 5.

It has to be noted that if the objective was to relieve one particular traffic problem or any combination of two or three of the four generic traffic problems, then a similar procedure could be followed in which the judgments of the efficiency and effectiveness of reducing the excluded traffic problem(s) would not be considered. On reviewing the suggested packages, the research presents in figure 2 a procedure to be followed as a cornerstone basis for allowing the implementation of components of such packages in Egypt as well as in other cities of the developing world.

7. Conclusion

In addition to the desirable outcomes of the transport system in terms of providing accessibility and mobility, traffic congestion and other negative outcomes also result of this complex system. This research started by developing a comprehensive inventory and categorization of demand and supply-based policies and measures that are aimed at relieving traffic problems in metropolitan cities. Generic criteria that can be used as basis for the judgmental assessment of such policies and measures were identified and selected. An attitudinal questionnaire was designed to elicit the judgment of highly qualified transport, traffic and highway experts regarding potentiality (efficiency and effectiveness), public acceptability, applicability, perceived cost and priority of implementation of these policies and measure.

Appropriate nonparametric statistical tests and techniques were selected and applied to conduct an in depth statistical analysis of the gathered expert information. The main purpose of such analysis was to obtain judgment patterns of experts and degree of consensus among them. The statistical analysis was complemented by a weighting procedure to establish the potential achievement rate of each policy and measure and hence to support in making decisions on whether to use and implement such policy or measure in relieving traffic problems. As a result of the analysis, three complementary traffic relief programs were developed.

An action program for the implementation of the suggested integrated traffic relief package ought to be developed. This entails splitting the implementation of the package into parallel and sequential stages and time framing these stages. It also requires establishing the necessary contacts and preparations with the various agents and organizations at the different levels through which the integrated package would be implemented. All in all, this is meant to coordinate, harmonize and guarantee the smooth implementation of these stages of the developed integrated traffic relief package through the various organizations.

On reviewing the suggested packages, the research presented a procedure to be followed as a cornerstone basis for allowing the implementation of components of such packages in mega cities and especially those of the developing world.

Table 5: Ingredients of integrated packages for relieving traffic problems in cities of the developing world

Package Ingredients Suggested Packages	Proposed Network and Traffic Management Policies & Measures	Proposed Travel Demand Management Policies & Measures	Proposed Land Use Management Policies & Measures	Other Proposed Policies &, Measures
Integrated Package (1): Very High Rates of Potential Achievement (Range 70% to 85%)	1. Improving Intersection Geometry (78%) 2. Improving Traffic Signals and Other Control Devices (75%) 3. Traffic Management from Central Control Terminals (75%)	1. Improving Levels of Service for Mass Transit Modes (83%) 2. Design, construction & operation of designated bicycle & pedestrian routes (73%) 3. HGV ban from using urban network during peak periods (73%) 4. Promote Teleworking (73%) 5. Designated Bus Lanes (70%) 6. HGV Access Restriction (70%) 7. Determining parking rates & specifications in accordance with land use types (70%) 8. Promote Teleshopping (70%)	1. Mandatory traffic impact assessment for new developments (83%) 2. Promote land use mixing (75%) 3. Plan residential development to be near working sites (75%) 4. Develop integrated new urban communities away from existing cities (73%)	1. Metro routes selected to pass areas with high car ownership (85%) 2. Integrate metro, road and intercity rail networks (83%) 3. Planning for integration of transit modes (78%) 4. Utilize traffic packages to develop traffic models simulating traffic conditions (75%) 5. Support role of research centers in traffic & highway (75%) 6. Continuously conduct traffic studies (73%) 7. Develop a proper institutional framework to deal with traffic issues (70%)
Integrated Package (2): High Rates of Potential Achievement (Range 50% to 69%)	1. Proper positioning of Mass Transit Stations/Stops (63%) 2. Proper Planning & Design for Parking Lots (63%) 3. Grade Separation (63%) 4. Incident Detection, Management, Control System (58%) 5. Traffic Control & Safety at Road Construction/Maintenance (58%) 6. Proper selection, design & implementation of U turns (55%)	1. Encourage school bus transport for children (65%) 2. Distribution centers outside cities (63%) 3. Promote Telelearning (60%) 4. Parking priority for buses (60%) 5. Odd/Even License Plate System (58%) 6. Strict Enforcement of Parking Violations (53%) 7. Encouraging Carpooling (50%)	1. Transit stations/stops located centrally within acceptable walking distances (68%) 2. High density & variable land use mixing around and along transit stations/routes (65%) 3. Open space between buildings to encourage walking & cycling (63%) 4. Promote commercial centers at cities peripheries (58%) 5. Variable adjacent land mix encouraging walking & cycling (53%)	1. Enforce traffic laws on all road users with no exceptions (68%) 2. Develop standard vehicle specifications (63%) 3. Develop traffic-training programs for rural migrants (63%) 4. Presence of traffic police in front of schools (63%) 5. Traffic legislation to ensure strict & competent driving tests (60%) 6. Develop mandatory traffic education/ training material for school children (58%) 7. Licensing driving instructors based on standard/stringent tests (58%) 8. Intensify traffic related mass media campaigns (58%)

Table 5: Continued

Package Ingredients Suggested Packages	Proposed Network and Traffic Management Policies & Measures	Proposed Travel Demand Management Policies & Measures	Proposed Land Use Management Policies & Measures	Other Proposed Policies &, Measures
Integrated Package (2): High Rates of Potential Achievement (Range 50% to 69%) (Continued)	7. Construction of new roads (53%) 8. Reconstruction of roads (50%) 9. Improving Kerb Geometry (intersections & side-streets) (50%) 10. Proper Design of Entrances & Exits to Major Land Uses (50%) 11. One Way Street System (50%) 12. Ramp metering (50%)	8. Staggered start & end of Work and School times (50%) 9. Reduce Working Days (50%)		9. Develop & update traffic legislation, rules, regulations (58%) 10. Support for strict traffic violations penalty system (58%) 11. Establish standards & monitoring for driving schools (58%) 12. Clear public explanation of traffic violations (55%) 13. Support reliance on traffic control devices to allow traffic police to enforce traffic law (55%) 14. Develop personnel technical capabilities to handle traffic problems (55%) 15. Develop a continuous traffic data collection system (55%) 16. Develop time schedule programs for vehicle inspection (53%) 17. More empowerment to traffic police to enforce certain traffic violations (53%)
Integrated Package (3): Low to Medium Rates of Potential Achievement (Range 35% to 49%)	1. Railroad Grade Separation (48%) 2. Proper selection, design, & erection of traffic signs (48%) 3. Proper design, planning of Island/Marking Channelization (48%) 4. In Vehicle Driver Information Systems (48%) 5. Proper selection, design, & erection of road lighting poles (45%) 6. Proper design, & planning of road markings (43%) 7. Reversible Traffic Lanes (35%)	1. Variable tolling w.r.t. type, occupancy, & time of passing of vehicles (48%) 2. Traffic Calming measures (45%) 3. Flextime in arrival & departure to/from work (45%) 4. Promote Telebanking (43%) 5. Parking restrictions in terms of maximum allowable parking period (43%) 6. Parking restrictions according to parking time (40%) 7. Increase Fuel Prices (38%) 8. Vehicle Licensing conditioned by availability of permanent parking space (38%) 9. Traffic Mazes (30%)	1. Proper planning & design of transit facilities & amenities (48%)	1. Train teachers to be able to teach traffic related syllabus (48%) 2. Develop a standard driving handbook (48%) 3. Establish standards for driving/rest times for bus & HGV drivers (48%) 4. Develop speedy traffic court system (48%) 5. Issue laws aiming to limit rural migration to cities (45%)

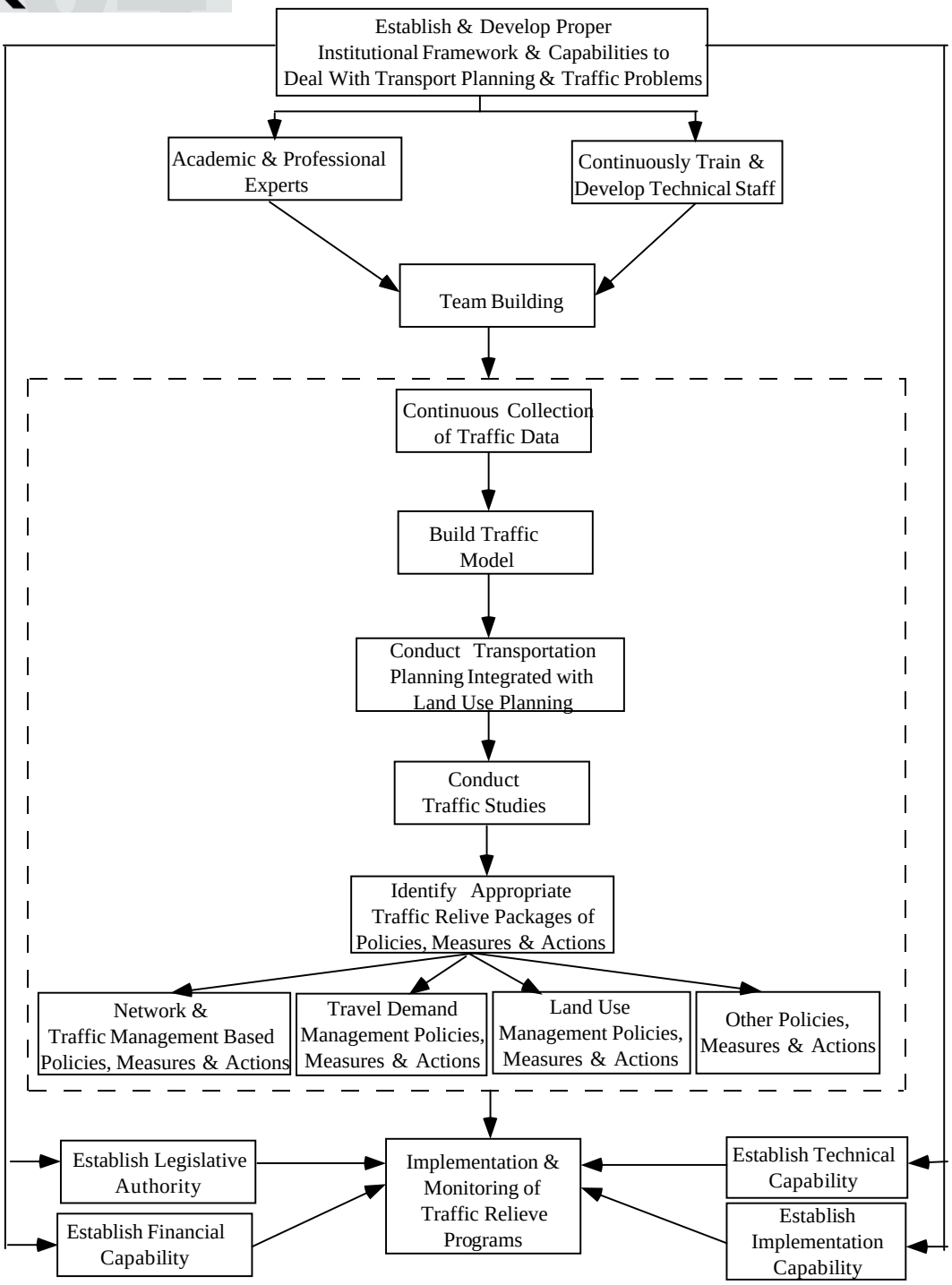

Figure 2: Suggested Cornerstone Procedure for Allowing Implementation of Traffic Relieve Packages in Cities of the Developing World

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