SUSTAINABILITY ASSESSMENT OF TRANSPORTATION MEASURES – AN EVALUTION OF ODD EVEN SCHEME IN DELHI

A Project Dissertation Submitted in partial fulfillment of the requirements for The Award of the Degree of

MASTER OF TECHNOLOGY

IN

ENVIRONMENTAL ENGINEERING

Submitted by

ASIF HUSSAIN

ROLL NO 2K14-ENE-05

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DELHI TECHNOLOGICAL UNIVERSITY

(SHAHBAD DAULATPUR, BAWANA ROAD, DELHI – 110042)

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CERTIFICATE

This is to certify that the major project (II) report entitled "**Sustainability Assessment of Transportation Measures – An Evaluation of Odd-Even Scheme in Delhi"** submitted by **ASIF HUSSAIN** (ROLL NO.2K14-ENE-05) as a record of the work carried by him, is accepted as major project(II) work submission in partial fulfillment of the requirement for the award of degree of **Master of Technology in Environmental Engineering** in the **Department of Environmental Engineering,** Delhi Technological University Delhi-110042.

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DECLARATION

I hereby declare that the report of Major Project (II) entitled **"Sustainability Assessment of Transportation Measures – An Evaluation of Odd-Even Scheme in Delhi"** which is being submitted to **Department of Environmental Engineering, Delhi Technological University Delhi- 110042,** for the award of the degree of **Master of Technology in Environmental Engineering** in the **Department of Environmental Engineering**, is a bonafide report of the work carried out by me. The material contained in this report has not been submitted to any university or institution for the award of any degree.

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ABSTRACT

With ever-increasing urbanization many cities of developing countries suffer from the rapid increase in vehicle ownership despite the fact that the road network density and the road widths still remain inadequate. Moreover, the level of utilization of public transport system remains pathetically low in cities of most of the developing countries especially in Delhi the capital city of India where, urbanization is at fore-front with massive increase in private vehicle ownership. This tremendous increase in the number of vehicle has resulted in congestion in road network, increased air pollution, reduced speeds, and increase in road accidents. The lack of proper urban transport management strategies and neglect of roads, and safety to the cyclists, pedestrians and lack of policies to promote public transportation have complicated the urban transport scenario.

To cater above discussed problems, the government of NCT Delhi came up with a transportation measure named "Odd-Even Scheme" and implemented it temporarily as social experiment in two phases fifteen days each and completed its test period with mixed responses but for the actual evaluation, it is necessary to evaluate the above measure in term of sustainability that is to evaluate its impact on the sustainability of the transportation system. So for sustainability assessment of above mentioned transportation measure, this study presents a hybrid approach based on Analytic Hierarchy Process (AHP) and Dempster Shafer theory in which AHP is used to structure and rate the evaluation criteria and D-S theory is used to fuse the data coming from multiple information sources.

The proposed approach comprises of multiple steps. In the first step we identify the criteria for sustainability evaluation. AHP is used to structure and rate the criteria. In the second step we test the basic probability function of increase, decrease, and no change due to implementation of transportation measure for sustainability and collect data from multiple information sources like human expert, public opinion surveys, sensors/actual measurement, models, etc on the selected criteria for evaluation purposes. The information from multiple data sources is combined using Dempster-Shafer theory. In the third step, we estimate the state of sustainability of transportation system using a Transportation Sustainability Index (TSI). The transportation sustainability index is computed at two stages at the pre- and post-implementation stages of the transportation measure. In the fourth step, we assess the impact of transportation measure on the sustainability of transportation system by observing the difference between the values at pre- and post test stages. If an increase in the value of TSI is observed, then the impact of transportation measure on the sustainability of transportation system is judged as positive and is recommended for adoption.

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Chapter 1

INTRODUCTION

1.1. General

India is a developing nation and is going to be world's third largest car market by 2030 and population growth in coming future is going to pose a major challenge for planners in Transportation; thus implying the need for sustainable transportation system. This is an important new concept because only recently people have been burdened with uncertainty about society's long-term future. Although technological progress has improved our quality of life in many ways, it can also exacerbate many problems, including war, oppression, resource depletion, environmental damages, and social alienation, which threaten the quality and very existence of future generations. In the past, futurists debated whether the future would lead to utopia (an ideal world) or dystopia (a degraded world). Sustainable development reflects a more sophisticated understanding of our impacts: it recognizes that our future will result, in part, on our current decisions. We cannot simply predict the future, instead we create it. Sustainability includes more than just long-term planning. If we are concerned with the quality of life and environment in distant times, we must also be concerned the quality of life in distant places, even if only because we care about our own descendants, since they will be affected by, and possibly descended from, people in other parts of the world. Since economic, social and environmental activities interact in so many ways, most experts now agree that sustainability requires balancing these various realms. A basic principle of good planning is that individual, short-term decision should reflect strategic, long-term objectives. Sustainability planning provides guidance to insure that individual decisions balance economic, social and environmental objectives, taking into account indirect, distant, and long-term impacts. Sustainability and sustainable development are generally considered desirable, although some conditions should not be sustained, such as hate, poverty and ignorance, and these terms are sometimes used to promote a particular policy or project that may only vaguely reflect strategic planning objectives. As a result, there is potential for legitimate debate concerning what sustainability policies are truly desirable. None-the-less, sustainability principles properly applied can improve decision making, particularly for strategic policy making and planning (Amit Dahiya 2015). Under above condition my study aims at evaluating Delhi Government's implemented "Odd-Even Scheme". In future work more measures would be evaluated in combination.

1.2. Definition of sustainable transportation system

A sustainable transportation system is one that (CST 2005):

- Allows the basic access and development needs of people to be met safely and promotes equity within and between successive generations.
- Is affordable within the limits imposed by internalization of external costs, operates fairly and efficiently, and fosters a balanced regional development.

- Limits emissions of air pollution and GHGs as well as waste and minimizes the impact on the use of land and the generation of noise**.**
- Is designed in a participatory process, which involves relevant stakeholders in all parts of the society.

1.3. Urban Transport Problem Scenario in Delhi

Delhi has an extensive road network. The road network of 14316 km lane that existed in 1981 was expanded to 28508 km lane in 2001 and 31373 km lane in 2009. The total number of vehicles registered too demonstrated a significant increase from 562,000 in 1981 to 3,457,000 in March 2001 and 6,933,000 in March 2011 **(Website: Delhi Government 2012).** This immense increase in the number of vehicles has resulted in congestion on the road network, reduced speeds and increase in road accidents air pollution. The air pollution status in terms of pollutant concentration ranges reported by central pollution control board is tabulated below:

Table: 1.1 Delhi's pollution status

Pollutants	Concentration Range
PM10	142-454 μg/m3
PM2.5	52-298 μg/m3
SO2	4-31 μg/m3
Benzene	1-7 μg/m3
O3	18-48 μg/m3
NO2	5-116 μg/m3
CO	114 – 1244 μg/m3

As related to National Ambient Air Quality Standard (CPCB) the pollutant ranges are above the limiting standard which is great cause of concern.

To cater above discussed problem the government of NCT Delhi implemented a transportation measure called "Odd-Even Scheme" which at this stage of temporary and experimental nature and it has been implemented in two phases for fifteen days each. First in January and second is in the month of April (**Notification no F.3 (218)/MRTS/Tpt/2015/302 dated 28th December 2015).**

1.4. Odd-Even Scheme

The Government of NCT of Delhi had implemented odd-even scheme from 1st to 15th January, and 15th April to 30th April 2016 with the objective of reducing air pollution and congestion etc in Delhi. In this scheme the plying of privately owned cars were restricted on

alternate days on the basis of the last digit (odd/even) of the registration number. The odd-even scheme applied to four wheeler Passenger/Private Cars. The public transport buses, two wheelers, trucks, CNG operated Passenger/private cars, three-wheeler, were exempted from the scheme. In addition, cars driven by women were also exempted apart from a select number of VIP and emergency vehicles.

Since it is of experimental nature, hence the decision of its permanent adoption should be on the basis of its performance in its experimental stage. To evaluate its performance, in this study sustainability assessment is conducted.

1.5. Scope and objective of the study

Based on above discussed problem and its experimental solution the objective of this study or evaluation is:

- To identify a set of criteria for the evaluation of the solution or measure. The criteria here basically a set of indicators on which changes brought about by the transportation measure can be well reflected.
- To quantify the criteria by collecting information from four information sources viz experts opinion, surveys, models, and actual measurement/ sensors.
- To assess the impact on the basis of change in transportation sustainability index (TSI) calculated in pre- and post-implementation stage of the solution/measure

The evaluation approach is based on the Analytic Hierarchy process (AHP) and Dempster-Shafer theory. In which AHP is used to structure and weigh the criteria and the D-S theory is used for the fusion of information coming from different sources. The very strength of AHP is that it allows pair wise comparison of all the selected indicators so that its weight with respects to our objective is calculated, and the strength of D-S theory is its ability to treat incomplete, uncertain information in the form of probability assignments, thereby making it useful for further analysis.

Chapter 2

LITERATURE REVIEW

2.1. Introduction

The chapter provides a synopsis of various studies carried out on above mentioned topic and helps in identifying the need of further research requirements in the area of public transport evaluation. In this chapter presents an overview of literature survey related to assessment of public transportation and studies on indicators and methodology for measuring the environmental, social, and economic effects of transportation system.

- Sustainable development came into limelight with the publication of World Commission on Environment and Developments' the Our Common Future (1987) Report is also known by the name **'Brundtland Report'** after the chairman of commission "Gro Harlem Brundtland". Since then it serves as basis for all discussions connected to sustainable development, a concept it then introduced. **Hall Ralph (2002).**

- Sustainability came out as one of the principal planning concepts from its very beginnings in economics as well as ecological thinking, and is used for evaluating urban development. Different techniques, methods and instruments for urban sustainability calculation that aids in determination of how urban centres can become more sustainable have evolved over a period of time (**Zachariads 2005**). For assessing them we need to develop indicators that are not universal in nature.

2.2. Studies on indicators for measuring sustainability

Several set Indicators are available for developing Sustainability Indices the most prominent ones being given by **Propolis (2014)** with based on 35 parameters, other by **Dobranskyte-Nistoka et al (2004)** and **Konsult (2008).**

Table: 2.1Proposed indicator set by Propolis (2014)

Sustainability Dimension	Indicators	Parameters
Environmental Indicators	Global Climate Change	1. Greenhouse gases from transport.
	Air Pollution	2. Acidifying gases from transport.
		3.Volatile organic compound from transport
	Consumption of Natural Resources	4. Consumption of mineral oil products.
		5. Land coverage.
		6. Need for additional new construction.
	Environmental Quality	7. Fragmentation of open space

		8. Quality of open space.
Social Indicators	Health	9. Exposure to PM from transport in the living environment.
		10. Exposure to NO2 from transport in the living environment.
		11. Exposure to traffic noise.
		12. Traffic deaths.
		13. Traffic injuries.
		14. Justice of distribution of economic benefits.
		15. Justice of exposure to PM.
		16. Justice of exposure to NO2.
		17. Justice of exposure to noise.
		18. Segregation.
	Accessibility and Traffic	19. Housing standard.
		20. Vitality of city centre.
		21. Vitality of surrounding region.
		22. Productivity gain from land use.
		23. Total time spent in traffic.
		24. Level of service of public transport and slow modes.
		25. Accessibility to city centre.
		26. Accessibility to services.
		27. Accessibility to open space.
Economic Indicators	Total Net Benefit From Transport	28. Transport investment cost.
		29. Transport user's benefits.
		30. Transport operator benefits.
		31. Government benefits from transport.
		32. Transport external accident costs.
		33. Transport external emission costs.
		34. Transport external greenhouse gases costs.
		35. Transport external noise costs.

Table: 2.2 Indicators used by Dobranskyte-Niskota et al (2014)

Dimension	Theme	Indicators
Economic	Transport Demand and Intensity	1. Volume of transport related to GDP (tone-km; passenger-km).
		2. Road transport (passenger and freight; tone-km and passenger-km).
		3. Railway transport (passenger and freight; tone-km and passenger-km).
		4. Maritime transport for good and passengers (tone-km and passenger-km)

		5. Inland waterway transport (passenger and freight; tone-km and passenger-km).
		6. Air transport (passenger and freight; tone-km and passenger-km).
		7. Intermodal transport (tone-km and passenger-km).
	Transport Cost and Prices	8. Total per capita transport expenditure
		9. Motor vehicle fuel prices and taxes.
		10. Direct user cost by mode (passenger transport)
		11. External cost for transport activities.
		12. Internalization of costs (implementation of economic policy tools with a direct link with the marginal external cost of the use of different transport modes).
		13. Subsidies to transport.
		14. Taxation of vehicle and vehicle use.
		15. % of GDP contributed by transport.
		16. Investment in transport infrastructure (per capita by model as share of GDP)
Social	Infrastructure	17. Road quality – paved road, fair /good condition.
		18. Total length of road in km by mode.
		19. Density of infrastructure (km-km^2).
	Accessibility and Mobility	20. Average passenger journey time.
		21. Average passenger journey length per mode.
		22. Quality of transport for disadvantaged people (disabled, low incomes, children).
		23. Personal mobility (daily or annual person-miles and trip by income group).
		24. Volume of passengers.
	Risk and Safety	25. Persons killed in traffic accidents
		26. Traffic accidents involving personal injury.
	Health Impacts	27. Population exposed to and annoyed by traffic noise, by noise category and by mode associated with health and other effects.
		28. Case of chronic respiratory diseases, cancer, headaches, respiratory restricted activity days and premature death due to motor vehicle pollution.
	Affordability	29. Private car ownerships
		30. Affordability (income for transport)

	Employment	31. Contribution of transport sector (by mode) to employment.
Environmental	Transport Emissions	32. NO2 emission (per capita).
		33. VOCs emissions (per capita).
		34. PM10 and PM2.5 emission (per capita).
		35. SOX emissions (per capita).
		36. O3 emissions (per capita).
		37. CO2 emissions (per capita).
		38. N2O emissions (per capita).
		39. CH4 emissions (per capita).
	Energy Efficiency	40. Energy consumption by transport mode (tone-oil equivalent per vehicle km).
		41. Fuel consumption (vehicle-km by mode)
	Impacts on Environmental Resources	42. Habitat and ecosystem disruption.
		43. Land taken by transport infrastructure.
	Environmental Risks and Damages	44. Polluting accidents (land, air, water).
		45. Hazardous materials transported by mode.
Technical and Operational	Occupancy of Transportation	46. Occupancy rate of passenger vehicles.
		47. Load factors for freight transport.
	Technology Status	48. Average age of vehicle fleet.
		49. Size of vehicle fleet(vehicle/inhabitants)
		50. Proportion of vehicle fleet meeting.
	Measure to Improve Transport Sustainability	51. R & D expenditure on "eco vehicles" and clean transport fuels.
		52. Total expenditure on pollution prevention and clean up.
		53. Measures taken to improve public transport.
Institutional	Institutional Development	54. Uptake of strategic environmental assessment in transport sector.

Table: 2.3 Indicators used by Konsult (2008)

Sustainability Dimension	Indicators	Parameters
Environmental Indicators	Environmental Protection	1.Vibration
		2. Level of different air quality (local) pollutants.
		3. Visual intrusion.
		4. Townscape quality (subjective)
		5. Fear and intimidation
		6. Severance.
		7. CO2 emission of the area as a whole.
		8. Fuel consumption for the area as a whole.

Social Indicators	Safety and Security	9. Personal injury, accidents by user type per unit exposure (for links, intersections and networks).
	Equity	10. Activities (by type) within given time and money cost for specified origin and mode.
		11. weighted average time and money cost to all activities of a given type from a specified origin by a specified mode.
		12. Indicators as above, considered separately for different impact groups.
	Accessibility	13. Delays for vehicles (by type) at intersections.
		14. Delays for pedestrians at road crossings.
Economic Indicators	Economic Efficiency	15. Time and money costs of journey actually undertaken.
		16. Variability in journey time (by type of journey)
		17. Cost of operating different transport services.
	Economic Regeneration	18. Environmental and accessibility indicators as above, by area and economic sector.

Table: 2.4 Indicators used in Melbourne case study (2013)

Sustainability Dimension	Indicators	Parameters
Environmental	Depletion of Non-renewable Resources	1. Liters of crude oil per household annually.
	GHG Emissions (CO2)	2. Kg per household annually.
	Other Air Pollutants (CO, NO2,PM10)	3. Kg per household annually.
	Land Consumption for transport	4. m^2 per household.
Social	Accessibility	5. Score between 0 and 1.
	Fatalities and Injuries Related to Traffic Accidents	6. Persons per household annually.
	Mortality Effect of Air Pollutants	7. Persons per household annually.
Economic	Car Ownership Cost	8. $ per household annually.
	Vehicle and General cost of accidents	9. $ per household annually.

India is going to be the world's third largest car market by 2030 (**Dargay et al 2007**). Within India, Delhi is the largest market for cars followed by Mumbai, Kolkata and Chennai respectively, according to a survey conducted by an advertising agency (**Swamy 2004**), the growth of car ownership imposes pressure not only on transport infrastructure but also on energy consumption and air pollution in the country. In addition to these, the cities are also confronting severe problem of traffic congestion and shortage of parking space due to uncontrolled growth of car ownership.

According to **Census of India (2011)**, the absolute increase in urban population was found to be 9.1% and that of rural population was found to be 9%. The urban population in India was found out to be 377.1 million constituting 31.6% of the population, while in 2001, it stood at 27.81%.

Wibur Smith Associates (2007) carried out study of Public Transport system in 30 Indian cities by developing several indices to assess transport performance. Weightage was given to each index to achieve a transport performance index for each city which gives the overall efficiency of transportation system prevalent in the city.

The three backbones suggested in sustainability by **Verma and Dixit et al (2014)** namely include environmental, economic and social. Various MCD techniques have been to estimate and grade the sustainability indices. Andrea Souza Santos (2013 use indicators that are 20 in number to evaluate sustainable transportation system and used as an illustration to assess their applicability for monitoring the lines of action concerning transportation in the Rio de Janeiro State Climate Plan. The result of the study reveal that certain objectives cannot be monitored from the view of the sustainability criteria, and indicate the significance of initiating monitoring criteria formerly of public policy elaboration process. The utilization of the suggested indicators could aid the public managers to monitor progress in the direction of the goals mentioned in climate change policy for lowering greenhouse gas emissions and determine whether there is any progress toward sustainable development in Rio de Janeiro.

Wei Wei (2013) has used PriEst that is based on methodology of AHP for group decision making. A technique that is combination of Dempster-e-Shafer theory and AHP for assessing city sustainability has been used by **Awasthi and Chauhan (2011)**. **Satty (1990)** proposed a multi criteria decision making approach named Analytic Hierarchy Process in which factors are organized in a hierarchical structure. The characteristics and the philosophy of the theory are put in a nutshell giving general backward detail of the kind of measurement used, its properties and implementation.

2.3. Studies on Impact Assessment of Transportation Projects

Verma and Dixit et al (2014) carried out a study which proposes a model for assessing the impact of various transportation policies and projects based on the variation in three pillars of sustainability environmental, economic and social. The methodology consists of determination of different indicators of sustainability pillars as discussed earlier and thus the Composite Sustainability Index (CSI) before and after introduction of a transportation policy. Indicators include air pollution indicators, natural resource consumption indicators, health indicators, accessibility indicators

mobility indicators, commute indicators, and cost indicators. CSI is obtained by summing all these indicators after weighing them using an Analytical Hierarchy Process (AHP). Basically the aim of the study was to propose a model for testing the transportation policies and projects against sustainability. This study is done for evaluation of transport project against sustainability, but to treat the incomplete information which is normally the case in transport decision making situations with limited heterogeneous data.

Santos and Ribeiro (2013) evaluate sustainable transportation system using indicators which are 20 in numbers and used as an example to evaluate their applicability to monitoring the lines of action regarding transportation in the Rio de Janeiro State Climate Plan. And the result obtained through study indicate that certain objectives cannot be monitored from the perspective of the sustainability criteria, and signal the importance of establishing monitoring criteria previously of public policy elaboration process. The use of the proposed indicators could help the public managers to monitor progress toward the goals presented in climate change policy for reducing greenhouse gas emissions and identify whether Rio de Janeiro is progressing toward sustainable development. This study used long list of indicators to evaluate the sustainability which is very complex and tedious as indicated in "Melbourne Case Study 2013).

Reisi and Rajabifard (2013) reviewed through their studies the challenge of measuring transport sustainability using long lists of indicators. To overcome the issue of using too many indicators for evaluation, in their study they develop a method for obtaining a composite transport sustainability index for Melbourne statistical local areas (SLAs). Nine sustainability indicators relevant to urban transport which deal with environmental, social, economic aspects were selected by assessing and reviewing past research and based on available data for Melbourne. The indicators were integrated to environmental, social, and economic sub-indices and then to a composite index, in a way that overcomes the limitations on normalization, weighting and aggregation. This study presents the concept of composite index to evaluate the sustainability to avoid the complexity of measuring sustainability using long list of indicators. No work is done regarding evaluation of transportation solutions in terms of sustainability.

Haghshenas and Vaziri (2010) created a database from UITP databank: "Millennium cities database for sustainable mobility" or MCDST. They first select indicators regarding sustainable transportation by review of past researchers. Then they edited or redefined some indicators. Consequently 9 STI were developed, 3 indicators in each 3 groups of environmental, economic and social. Then composite index was also suggested by combination of 9 standardized indicators. According to composite index various cities were compared. Finally some important factors affecting urban transportation sustainability were determined by using correlation analyses between composite index and cities characterizes. This study aims at data base formation and indicator selection and composite index calculation for city comparison. No policy decision work is done.

Florianna and Figueroa (2014) carried out a study and the paper on their study examines and compares the processes, methodologies and resulting sets of indicators for urban sustainability carried out in three of Asia's developing countries; Malaysia, Taiwan and China. The paper analytically discusses the challenges of developing urban sustainability indicators among the developing countries. The comparison reveals the urban indicators development processes, contentsand outcomes. In this study, the focus is only on indicator development and comparison, no real evaluation is done.

Zachariadis (2005) had presented a transport simulation and forecast model, which was designed for the assessment of policy options aiming to achieve sustainability in transportation. Starting from a simulation of the economic behavior of consumers and producers within a microeconomic optimization framework and the resulting calculation of the modal split, the allocation of the vehicle stock into vintages and technological groups is modeled. In a third step, a technology-oriented algorithm, which incorporates the relevant state-of-the-art knowledge in Europe, calculates emissions of air pollutants and greenhouse gases as well as appropriate indicators for traffic congestion, noise and road accidents. The paper outlines the methodology and the basic data sources used in connection with work done so far in Europe at that time. This study is based on forecast model no actual measurement is done, for testing the policy options.

Saaty (1990) introduce a multi-criteria decision making approach called Analytic Hierarchy Process in which factors are arranged in a hierarchic structure. The principles and the philosophy of the theory are summarized giving general backward information of the type of measurement utilized, its properties and applications.

2.4. Summary

Based on literature review performed, it is observed that most of the study is done using indicator based approach for both quantification of sustainability and impact assessment in term of sustainability, but no study has been done in Indian condition for the enhancement of sustainability of transportation system using various transport measures. So study in this course in Indian condition would be very fruitful for policy maker to device policies and schemes to enhance the quality of transportation system

Chapter 3

METHODOLOGY

3.1. Introduction

To evaluate the sustainability of transportation system a number of methods available in numbers of literatures, almost all the methods are indicator based by quantifying which the final sustainability is estimated in term of transportation sustainability index (TSI). The methodology is used to evaluate the sustainability of transport measure "Odd-Even Scheme in Delhi" based on Analytic Hierarchy Process and Dempter-Shafer theory. These two techniques are chosen because of their ability to deal with multiple decision maker and heterogeneous data type. AHP is used for rating the evaluation criteria for transportation measure. The D-S theory is used because of its ability to deal with ignorance and missing information which is very likely the case in realistic transport solutions.

3.2. Problem definition

The major problem in this study is to find a common framework in order to aggregate information/data coming from multiple information sources for evaluating the sustainability of transportation measure under consideration. The information sources selected here are people perception, expert opinion, actual measurement/sensors, and models.

3.3. Evaluation approach

The proposed approach for evaluating the sustainability of transportation measure under consideration involves two decision-making techniques namely Analytic Hierarchy Process (AHP) and Dempster-Shafer theory. AHP is used mainly to allocate weights or rate the selected criteria for the evaluation of transportation measure. The D-S theory is used for data fusion or aggregating information from multiple information sources. The main advantage of D-S theory is its ability to treat incomplete, uncertain information in the form of probability assignments, thereby, making it useful for further analysis. These two techniques are described in details as follows:

3.4. Analytic Hierarchy Process (AHP)

AHP is a multi-criteria decision making technique proposed by Saaty .The various step of AHP are as follows.

1. Defining the problem and determining its goal.
2. Structuring the hierarchy from the top (the objective) through the intermediate level (criteria) to the lowest level (alternatives).

3. Constructing a set of pair-wise comparison (size n x n), for each of the lower levels for one matrix for each elements in the level immediately above by using the relative scale measurement as shown in table 3.1. The pair-wise comparison is done in terms of preferences of one over the other.

4. There are n (n-1)/2 judgments per matrix to develop a set of matrices in step 3. The reciprocals are automatically assigned in each pair-wise comparison.

5. Having made all pair-wise comparison the consistency is determined by using the eigenvalue λ_{max} to calculate the consistency index CI where CI=(λ_{max}-n)/(n-1) where n is the matrix size. Judgment consistency can be checked by seeing the value of consistency ratio CR for the appropriate matrix value in the table. If the CR≤.1 the judgment matrix is acceptable otherwise it is considered inconsistent. To obtain the consistent matrix the options should be reviewed and improved.

6. Hierarchical synthesis is now use to weight the normalized eigenvector by the weights of criteria and then sum is taken over all weighted eigenvector entries corresponding to those in the next lower level of the hierarchy. A non zero vector "C" is called an eigenvector of any matrix say "A" if and only if there exists a number (real or complex) λ such that AC = λC . if such a number λ exists it is called eigenvalue of "A" and the vector "C" is called eigenvector associated to eigenvalue λ.

The strength of AHP is that it allows the verification of transitivity property of criteria weight that is if criteria "a" has higher criteria weight than criteria "b" which has higher weight than criteria "c", then criteria a will always have higher weight than criteria "c". This is the reason why it is chosen over other simple methods of weight allocation.

Table 3.1:Pair-wise comparison scale for AHP (Saaty 1990)

Numerical Rating	Scale of Importance
1	Equal Importance
3	Moderate Importance
5	Strong Importance
7	Very Strong Importance
9	Extreme Importance
2, 4, 6, 8	Intermediate values in between the adjacent judgments
Reciprocals	When activity *i* compared to *j* is assigned one of the above numbers, then activity *j* compared to *i* is assigned its reciprocal.

Table 3.2: Average random consistency ratio (RI).

Size of matrix	1	2	3	4	5	6	7	8	9	10
Random consistency	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

3.5. Dempster –Shafer (D-S) theory

The Dempster-Shafer theory was first developed by Dempster (1968) and later extended and formalized by Shafer (1976). The Dempster-Shafer theory is related to Bayesian probability theory in the sense that both deals with subjective belief. According to Shafer, the D-S theory includes the Bayesian probability theory as a special case with later not being able to deal with the ignorance. D-S theory have been widely applied artificial intelligence, expert systems, pattern recognitions, information fusion, risk assessment and multiple attribute decision analysis, etc.

The main strengths of this approach lie in its ability to treat heterogeneous, uncertain and incomplete data coming from multiple information sources. This approach is very useful for transport decision-making situations with limited, heterogeneous data.

Let (H) = {H_1, H_2……..H_N) be a collectively exhaustive and mutually exclusive set of hypothesis or propositions, which is called the frame discernment. A basic probability assignment (Bpa) is a function m: $2^{(H)} \rightarrow$ [0, 1], which called mass function, satisfying

$m(\phi) = 0$

and

$\sum_{A \subseteq (H)} m(A) = 1$ ……..Eq. 3.1

Where ϕ is an empty set A is any subset of (H) and $2^{(H)}$ is the power set of (H) which consists of all the subsets of (H) i.e

$2^{(H)}$ = { ϕ, {H_1}, …. {H_N}, { H_1, H_2 }, { H_1, H_N},……, (H) }…….. Eq. 3.2

The assigned probability (also called probability mass) m(A) measure the belief exactly assigned to A and represent how strongly evidences support A. all assigned probability sum to unity and there is no belief in empty set ϕ. The assigned probability to (H), i.e m((H)), is called degree of ignorance. Each subset A⊆ (H) such that m(A) > 0 is called a focal of m. all the related focal element are collectively called body of evidence.

Associated with each bpa is the belief function Bel, and the plausibility measure, PI which are both function: $2^{(H)} \rightarrow [0,1]$ and given by Bel(A) = $\sum_{B \subseteq A} m(B)$ and PI(A) = $\sum_{A \cap B \neq \phi} m(B)$ where A and B are subset of (H), Bel(A) represents the exact support to A i.e the belief of hypothesis A being true; PI(A) represents the possible support to A, i.e total amount of belief that could be potentially placed in A, [Bel(A), PI(A)] constitute the interval of support to A and can be seen as the lower and upper bound of the probability to which A is supported. The two functions are related to each other by PI(A) = 1 – Bel($\bar{A}$) where $\bar{A}$ denotes the complement of A. the difference between the believe and plausibility of set A describes the ignorance the assessment for the set A.

Since m(A), Bel(A), and PI(A) are in one to one correspondence they can be seen as three facet of same information. There are other several such as commonality function , doubt fuction, and so on, which can be used to represent evidence. they all represent same information ad provide flexibility to match a variety of reasoning applications.

The evidence from different sources is combined using the dempster's rule of combination. The rule assumes that the information sources are independent and uses the orthogonal sum to combine multiple belief structures:

$m = m_1 \oplus m_2 \oplus m_3 \oplus \ldots\ldots \oplus m_k$ .....Eq. 3.3

where $\oplus$ represent the operator of combination, for two belief structure m_1 and m_2, the Dempster's rule of combination is given by:

$$[m_1 \oplus m_2]\, C = \begin{cases} 0 & C = \emptyset \\ \dfrac{\sum_{A \cap B = C} m1(A)m2(B)}{1 - \sum_{A \cap B = \emptyset} m1(A)m2(B)} & C \neq \emptyset \end{cases} \quad \text{.....Eq. 3.4}$$

Where A and B are focal elements and $[m_1 \oplus m_2]$ (C) is a bpa. The denominator 1- $\sum_{A \cap B = \phi} m1(A)m2(B)$ is called normalization factor and $\sum_{A \cap B = \phi} m1(A)m2(B)$ is denoted by k is called degree of conflict, which measure the conflict between pieces of evidence. The larger the k , the more the sources are conflicting and lesser in sense in their combination. If k = 0 this shows complete compatibility, and if 0< k < 1, it shows partial compatibility. Finally, the orthogonal sum does not exist when k = 1. In this case the sources are completely contradictory.

The Dempsters rule of combination is proved to be both commutative and associative i.e $m_1 \oplus m_2 = m_2 \oplus m_1$ commutatively and $(m_1 \oplus m_2) \oplus m_3 = m_1 \oplus (m_2 \oplus m_3)$ associatively. These two property shows that evidence can be combined in any order. Therefore in case of multiple belief structure, the combination of evidence can be carried out in a pair-wise way.

3.6. Sustainability evaluation steps

The sustainability evaluation of transportation measures involves the following steps.

1. **Selection of criteria**: The criteria for sustainability evaluation of transportation measure are identified through literature review and discussion with the transportation experts. Analytic Hierarchy Process (AHP) is used to structure and weight the criteria.

2. **Data collection:** the information sources used to collect the data are people opinion, expert opinion, results from sensors, results from models and surveys during the testing of proposed transportation measure. D-S theory is used for data fusion.

3. **Assessment of state of sustainability of the city:** A transport sustainability index (TSI) is computed using the criteria weights and the transport measure data. The city state is measured at two stages, pre- and post-test phase of the transportation measure.

4. **Impact assessment of the transport measure:** Difference in the TSI values for the transportation measure at the pre- and the post-stages of testing are computed to observe the change. If an increase is observed, then the impact of the transportation measure is judged as positive and it is recommended for adoption.

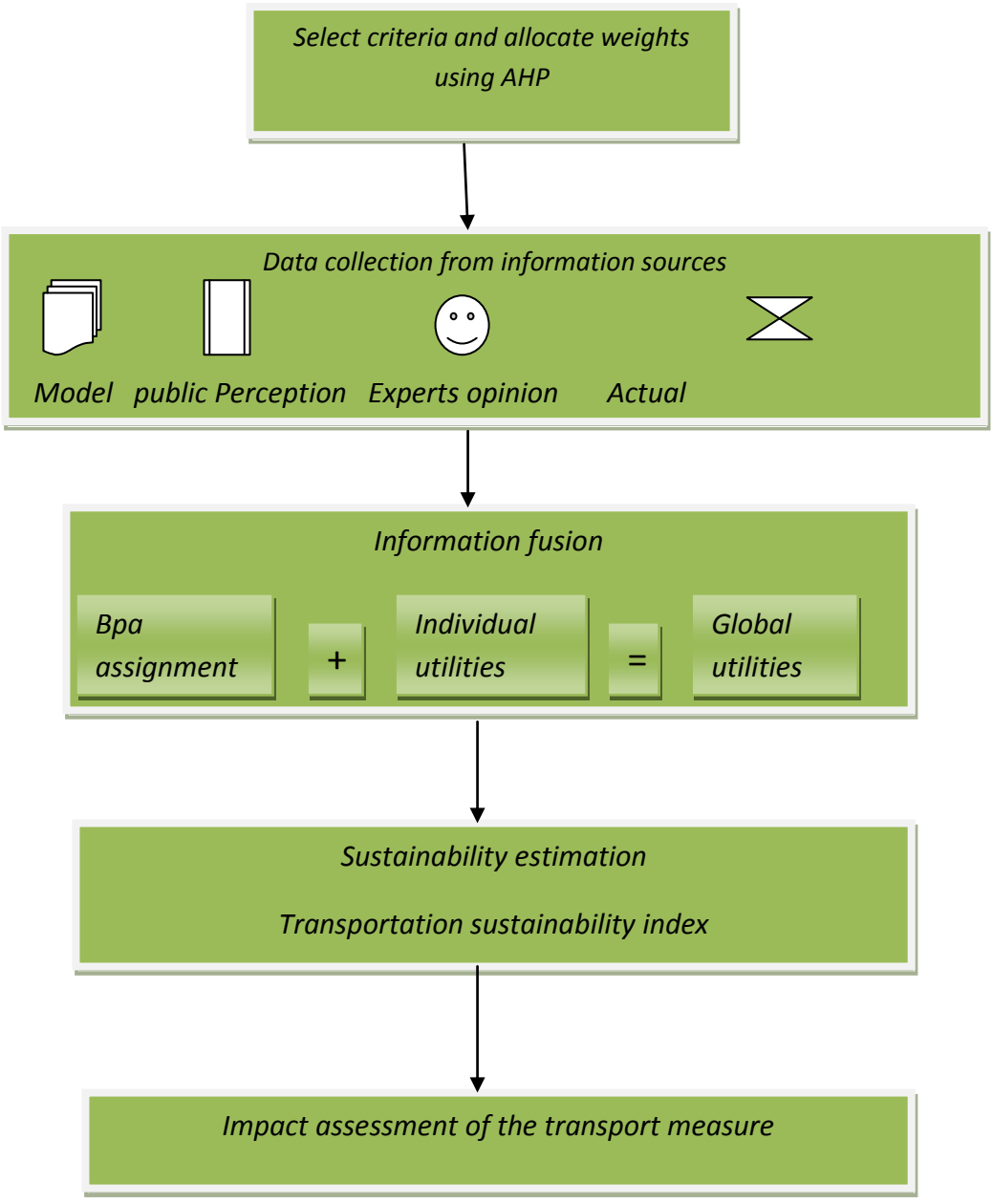

Figure 3.1: Multi- source evaluation of transportation measure

3.7. Methodological steps:

A multi-step methodology is used for sustainability assessment of the transportation measure. The various steps are explained as follows.

3.7.1. Step 1: Criteria selection

To evaluate the transportation measure, a list of criteria is generated as listed below through literature review, discussion with transportation scientists, and taking in to account the transport problem scenario of Delhi e.g congestion, air pollution (CPCB) etc. The city transportation experts structure and rate the criteria using the AHP. The various steps of AHP are applied using the procedure explained earlier.

Table 3.3: Selected criteria

Sustainability Assessment	Criteria
Economic	Trip Cost
Social	Safety and Security Accidents Users Satisfaction
Transport	Trip Time Congestion Level Parking Demand Para –Transit Demand
Environment	Air Quality Noise Level Fuel Consumption

3.7.2. Step 2: Data collection and information fusion from multiple sources

Data (bpa or mass functions) for the eleven criteria was collected from the four information sources namely human experts, traffic sensors, questionnaire surveys, models, etc. The experts provided the bpa values directly on expert opinion survey (Appendix A). Since these experts were the city transportation group people having several years of experience with the city, they are deemed reliable. Surveys were conducted with the city residents and the responses aggregated to obtain their bpa assignments (Appendix B). The models are used to quantify the indicators after analyzing the change the bpa is estimated.The sensors use measurement technique to allocate bpa values to the different criteria for the transportation measure under study. The bpa from different information sources were aggregated using the Dempster-Shafer (D-S) theory.

3.7.3. Step 3: Utility estimation

After discussion with transport scientists, the utilities are allocated to the evaluation levels used for various criteria. Three sets of evaluation levels are used: (I), (N) and (D) where I represents increase, N represents no change and D represents decrease. The vector of utility related to the evaluation levels is given by{u (I), u (N), u (D)}. Certain criteria are either positively or negatively oriented with the utilities. For example, a higher air quality gets a higher utility but a higher noise level gets a lower utility. Taking this into account, the utility values for the eleven criteria were computed. The results are shown in the table given below. Note that 1 represents the highest utility value, 0 represents the lowest utility and 0.3 represents an intermediate value chosen between 0 and 1.

Using the individual utility for the evaluation levels H_k e {I,N,D} and the bpa for each information source, we compute the global utility (u_i) for a criterion i as follows:

$u_i = \sum_{k=1}^{p} u(Hk) \times bpa(Hk)$ ……..Eq. 3.5 (Anjali Awasthi et al 2013)

where Hk represents the evaluation level, Hk € {I,N,D}, u(Hk) represents the individual utility of an evaluation level Hk, bpa(Hk) represents the basic probability assignment or mass function related to each evaluation level Hk, and p represents the number of evaluation levels. p = 3 for Hk € {I,N,D}.

As from the above discussion the utilities for different evaluation level is tabulates below

Table 3.4: Criteria utilities

Evaluation criteria	**Utility values**		
	u(I)	**u(N)**	**u(D)**
Trip Cost(C1)	0	0.3	1
Trip Time(C2)	0	0.3	1
Safety and Security(C3)	1	0.3	0
Accidents(C4)	0	0.3	1
Users Satisfaction(C5)	1	0.3	0
Congestion Level(C6)	0	0.3	1
Parking Demand(C7)	0	0.3	1
Para-Transit Demand(C8)	0	0.3	1
Fuel Consumption(C9)	0	0.3	1
Noise Level(C10)	0	0.3	1
Air Quality(C11)	1	0.3	0

3.7.4. Step 4: Estimation of city sustainability

Global utilities are used to determine the city sustainability at any given time t using a transportation sustainability index (TSI). Let us denote the global utilities for the criteria C_1, C_2……, C_N at time t_n by $u_1(t_n)$, $u_2(t_n)$,……., $u_N(t_n)$, then the transportation sustainability index is given by:

$TSI\ (t_n) = u_1(t_n) \times W_1 + u_2(t_n) \times W_2 + \ldots\ldots\ldots\ldots\ldots u_N(t_n) \times W_N$ ……..Eq.3.6

Where $W_1, W_2, \ldots\ldots W_N$ represent the weight of criteria $C_1, C_2\ldots\ldots, C_N$ obtained from AHP.

3.7.5. Step 5: Impact assessment

The impact of the transportation measure on the city sustainability is assessed by the observing the change in the transportation sustainability index (TSI) with respect to pre-implementation and post-implementation stages. Let t_{n-1} represent a time instant in pre-implementation test stage and t_n represents a time instant in the post–implementation stage, then the change in transport sustainability index over time interval $[t_{n-1}, t_n]$ is given by:

$\Delta TSI\ (t_n, t_{n-1}) = TSI\ (t_n) - TSI\ (t_{n-1})$ …….Eq. 3.7

If $\Delta TSI\ (t_n, t_{n-1}) > 0$ then the impact of transportation measure on the city is said to be positive and the measure is recommended for adoption. If $\Delta TSI\ (t_n, t_{n-1}) \leq 0$ then the measure is rejected.

3.8. Evaluation of "Odd-Even" scheme in Delhi

Air pollution is a big concern in a city like Delhi where more than 16 million people are exposed to severely high pollutant concentrations on an annual average basis. It is in this regard that the Government of Delhi introduced Odd-Even scheme in which plying of privately owned cars was restricted on alternate days based on the last digit (odd/even) of the registration number. However, there were exemptions to the cars under certain categories. The first phase of the scheme was launched in January 2016 and thereafter it was re-introduced from 15–30 April 2016.(TERI Report 2016)

The evaluation of above mentioned transportation measure is done in following steps:

3.8.1. Step 1: Selection of study corridors for data collection

For the sake of convenience in data collection and to enhance the sustainability result of previous study in Indian condition following study corridor is selected:

1. Captain Gaur Marg (From Lajpat Nagar Xing to Modi Mill)

2. Outer Ring Road (Modi Mill to Nehru Place Flyover)

3. Lalalajpat Rai Marg (Nehru Place Flyover to Moolchand Flyover)

Table 3.5: Length of study corridor

Study corridor	Length (km)
. Captain Gaur Marg	2.14
Outer Ring Road	1.95
Lalalajpat Rai Marg	2.56

Study Area Map- Delhi City (South Delhi Region)

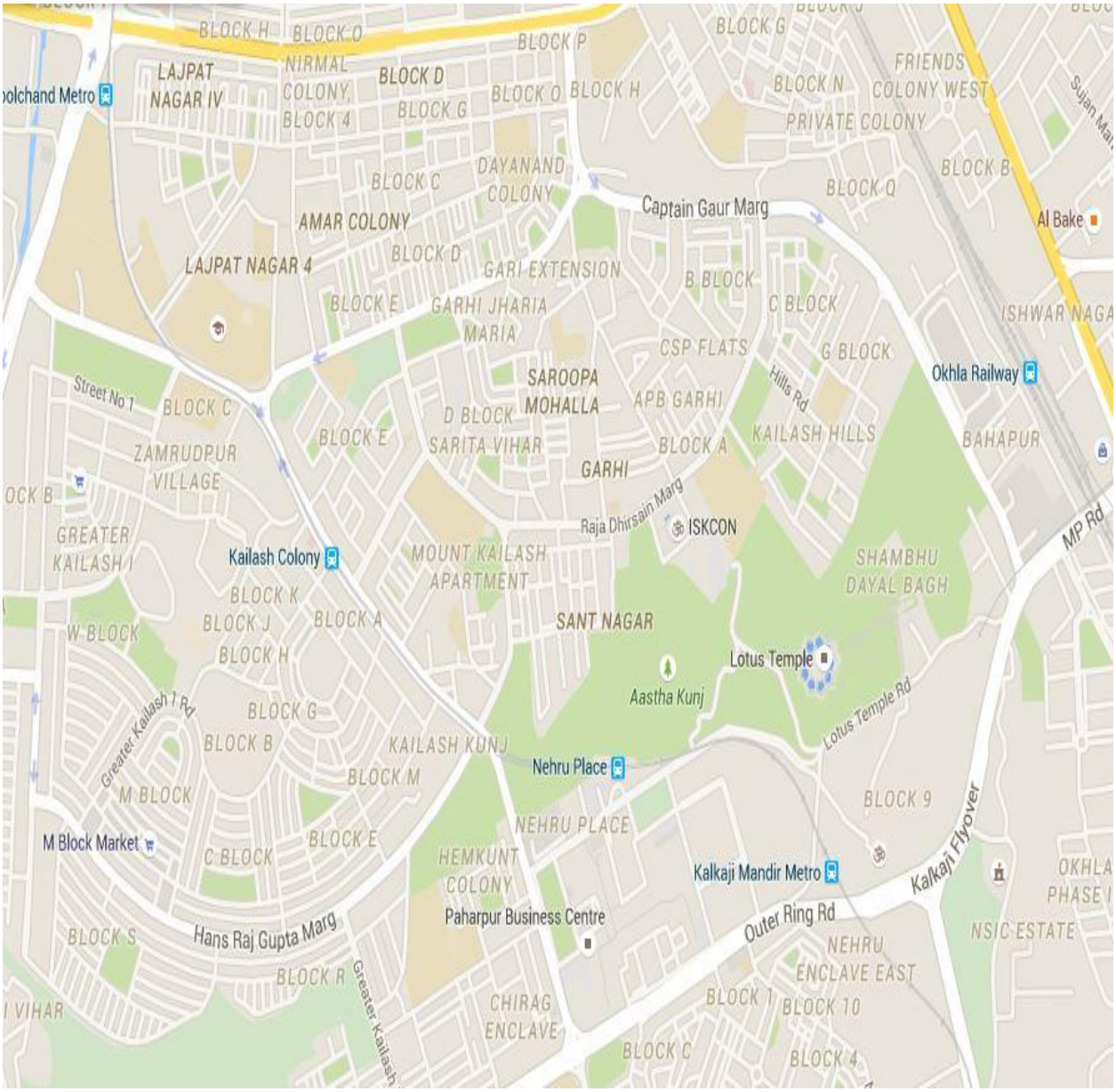

Figure 3.2: Map of the selected study area

Figure 3.3: Scaled images of the study corridors

3.8.2. Step 2: Selection of criteria

Eleven criteria namely Trip Cost (C_1), Trip Time (C_2), Safety and Security (C3), Accidents (C4), Users Satisfaction (C5), Congestion Level (C6), Parking Demand (C7), Para-Transit Demand (C8), Fuel Consumption (C9), Noise Level (C10), Air Quality (C11) are chosen for evaluating the "Odd-Even Scheme" of Delhi through literature review, discussion with transportation scientists, and taking in to account the transport problem scenario of Delhi e.g congestion, air pollution etc.

3.8.3 Step 3: Weight allocation

Using AHPs pair-wise comparison methodology, weights of different selected criteria is computed using BPMSG AHP calculator.(http://bpmsg.com/academic/ahp.php). For that thirty expert opinion survey on the formats of AHP is done, using that, weights of indicators using above calculator are calculated. The mean value of all thirty samples are tabulated below

Table 3.6: Criteria weights

S. No	Criteria	Mean
1	Trip Cost	0.064
2	Trip Time	0.104
3	Safety and Security	0.117
4	Accidents	0.141
5	Users Satisfaction	0.089
6	Congestion Level	0.116
7	Parking Demand	0.036
8	Para-Transit Demand	0.042
9	Fuel Consumption	0.076
10	Noise Level	0.099
11	Air Quality	0.144

3.8.4. Step 4: Criteria quantification for basic probability assignment (Bpa) allocation for model and actual measurement/sensor information sources.

Since for other two sources that is expert and survey, the bpa is allocated directly by doing rating survey among the study corridor commuters and expert opinion survey among transport and environmental experts. The quantification of criteria are as follows:

- **Trip Cost**

  Model

  Since the models are the indirect way to quantify the criteria hence the change in trip cost in pre- and post-implementation stage can be calculated by observing the change in "car occupancy and daily car usage"

For car occupancy 50 cars in pre- and post-implementation stage is observed and surveyed (Appendix C) and change in car occupancy is calculated as follows:

Pre-implementation stage

Occupancy = $\frac{77}{50}$ = 1.54…….. (Appendix C)

Post- implementation stage

Occupancy = $\frac{113}{50}$ = 2.26…… (Appendix C)

% change in occupancy = 46.73 ⊐ 47 (decrease)

Daily car usage:

Pre- implementation stage

No of cars possessed= 125 …….. (Appendix C)

No of cars daily used= 124

% change = .80 ⊐ 1

Post- implementation stage

No of cars possessed =140…….. (Appendix C)

No of cars used = 83

% change = 41

Actual change = 41-1 = 40 %

Since car usage and car occupancy can be, somehow indirectly related to trip cost, hence here it is assumed that change in occupancy and car usage will be the change in trip cost.

So decreases in trip cost (considering change in occupancy) = 47 %, and

Decrease in trip cost (considering change in car usage) = 40 %

So average change in trip cost = $\frac{47+40}{2}$ = 43.5 ⊐ 44 % (decrease)

Actual measurement

In actual measurement change in trip cost is calculated by observing the change in fuel wastage in time spent in traffic jams

10 min idle costs .14 litre of fuel wastage (K.P Tiwari et al 2013)

So time spent in traffic jams

Pre = 1190 minutes (sum of time of surveyed vehicle)……. (Appendix C)

Fuel wastage = $\frac{.14}{10} \times 1190 = 16.66 \backsimeq 17$ litres

Post = 700 minutes

Fuel wastage = $\frac{.14}{10} \times 700 = 9.8 \backsimeq 10$ litres

% change in fuel wastage = $41.17 \backsimeq 42$

Here it is assumed that fuel wastage is related to cost

Hence decrease in trip cost = 42 %

- ## Trip Time

Model

It can be quantified by observing the change in speed and time spent in traffic jams

Speed

Increase in speed = 16 % (TERI report on odd even scheme 2016)

Time spent in traffic jams

Pre = 1190 minutes (sum of the times of vehicle surveyed)

Post = 700 minutes

Since, more the time spent in traffic jams more would be the trip time

So change in trip time = $41.17 \backsimeq 42$ % (decrease)

Average change = $\frac{16+42}{2} = 29$ % (decrease)

Actual Measurement

Actual time

Pre = 7460 minutes (sum of the time of surveyed vehicles)…….. (Appendix C)

Post = 6715 minutes

Change in trip time = 9.9 ≅ 10 % (decrease)

- ## Safety and Security

Subjective surveyed data from public opinion rating survey is used. (Appendix B)

- ## Users Satisfaction

Since the satisfaction of the user depends on the positive changes in various other criterions hence for both model and actual measurement the average positive change in other criterions for pre and post implementation scenario has been used for the quantification of above criteria

Model

Average value = $\frac{44+29+7+29+16+27+16+2+19}{9} = 21$ % (increase) (Table 3.9: average of the changes in other criteria on which user's satisfaction depends)

Actual measurement

Average value = $\frac{42+10+7+16+33+18+16+3+6}{9}$ = 17 % (increase)

- ## Accidents

Model

Netherland urban accident model is used (Sixth framework programme 2005)

The formula used is given below:

$ACC = .55 \times AADT^{.32} \times length$ ……Eq. 3.8

Where

ACC - Accident Unit

AADT – Average Daily traffic (vehicle per day)

Length – length of the selected corridor.

Table: 3.7 Accident criteria calculation

Road	Vehicle Per Day		Length (km)
	Pre	Post	
Lalalajpat Rai Marg	1102 x 24 = 26448	914 x 24 = 21936	2.56
ACC (No)	.55 x $26448^{.32}$ x2.56 = 37	.55 x $21936^{.32}$ x 2.56 = 35	
% Change	5.4 ~ 6 % (decrease)		
Captain Gaur Marg	1351 x 24 = 32424	1188 x 24 = 28512	2.14
ACC (No)	33	32	
% Change	3 % (decrease)		
Outer Ring Road	1436 x 24 = 34464	1164 x 24 = 27936	1.95
ACC (No)	31	28	
% Change	10 % (decrease)		

Average change = $\frac{10+3+6}{3}$ = 6.33 ≃ 7 % (decrease)

Actual measurement

For lack of accidental data especially for odd- even scheme, so in actual measurement the model data is used.

- ## Congestion Level

Model

Change in speed = 16 % (decrease) (TERI Report 2016)

Time spent in traffic jams (% change) = 42 % (decrease) (previously calculated)

Here congestion level is assumed to be related to change in speed and traffic jam time

So average % change in congestion level = $\frac{42+16}{2}$ = 29 % (decrease)

Actual measurement …… (Appendix E)

Decrease in traffic volume

Lalalajpat Rai Marg = 17 % (percent decrease in number of cars in pre-and post stage)

Captain Gaur Marg = 12 %

Outer Ring Road = 19 %

Average Decrease = $\frac{17+12+19}{3}$ = 16 %

- ## Parking Demand

Model

It is quantified very loosely on the basis of traffic volume.

As above calculated the average change in traffic volume = 16 %

So % change in parking demand = 16 % (decrease)

Actual measurement

For actual measurement parking data has been collected from two parking lot in the form of percentage decrease of the selected study corridors which are as listed below

Nehru Place Market (% change) = 35 % (decrease)

Nehru Place Metro Station (% change) = 30 % (decrease)

Average change = $\frac{35+30}{2}$ = 33 % (decrease)

- ## Para-Transit Demand

Model

The change in Para-transit demand is calculated by taking in to account the change in trip and occupancy of autos, taxis, and E-vehicles

From survey data following changes in trip and occupancy of above mentioned transportation mode is calculated in pre- and post stage which are listed below

Pre-implementation stage

Auto

Occupancy = $\frac{59}{26}$ =2.26 ≅ 2.3 No …….. (Appendix C)

Where 59 is number of occupant and 26 is number of cars, in the same way both the parameters for other modes is calculated

Trip = $\frac{197}{26}$ = 7.57 ≅ 8 No (sum of trips of 26 autos)

Taxi

Occupancy = $\frac{45}{20}$ = 2.25 ≅ 2.3 No …… (Appendix C)

Trip = $\frac{132}{20}$ = 6.6 ≅ 7 No

E-vehicle

Occupancy = $\frac{23}{5}$ = 4.6 No ……. …. (Appendix C)

Trip = $\frac{52}{2}$ = 10.4 ≅ 11 No

Post-implementation stage

Auto

Trip = $\frac{234}{21}$ = 11.14 ≅ 11 No …… (Appendix C)

Occupancy = $\frac{59}{21}$ = 2.80 No

Taxi

Trip = $\frac{99}{10}$ = 9.9 ≅ 10 …….. (Appendix C)

Occupancy = $\frac{31}{10}$ = 3.1 ⊐ 3 No

E-vehicle

Trip = $\frac{99}{7}$ = 14.14 ⊐ 14 No ……. (Appendix C)

Occupancy = $\frac{35}{7}$ = 5 No

Percentage change

Auto

Trip = 37.5 % (increase)

Occupancy = 22 % (increase)

Taxi

Trip = 43 % (increase)

Occupancy = 22 % (increase)

E-vehicle

Trip = 22 % (increase)

Occupancy = 10 % (increase)

Average value

Trip = (37.5 + 43 + 22) /3 = 34.16 ⊐ 35 % (increase)

Occupancy = (22 + 22 + 10) / 3 = 18 % (increase)

So change in Para-transit demand = (35 + 18) /2 = 26.5 ⊐ 27 % (Increase)

Actual measurement

It is calculated by calculating the increase or decrease in the number of auto and taxi, etc in both pre- and post implementation stage of the above mentioned transportation measure for selected study corridors.

The number of above mentioned vehicles is counted by video-graphic survey done for pre- and post implementation condition (Appendix E)

Table: 3.8 Para-Transit vehicle count

Lalalajpat Rai Marg	**Pre**	**Post**	**Change**
Number of autos	514	596	16 % (increase)
Number of taxis	143	168	18 % (increase)
Captain Gaur Marg			
Number of autos	447	532	19 % (increase)
Number of taxis	205	232	12 % (increase)
Outer Ring Road			
Number of autos	497	602	21 % (increase)
Number of taxis	237	279	12 % (increase)

Average value

Change in number of autos = $\frac{16+19+21}{3}$ = 18.66 ≅ 19 % (increase)

Change in number of taxis = $\frac{18+12+18}{3}$ = 16 % (increase)

So actual average change in Para-transit demand = $\frac{19+16}{2}$ = 17.5 ≅ 18 % (increase)

- ## Fuel consumption

Model

The model used for the calculation of fuel is given below

Fuel consumption = VKT × average millage……..Eq. 3.9

Where VKT is vehicle kilometer travelled, here VKT is calculated by multiplying no of vehicles in video-graphic survey with length of selected study corridors, and average millage is taken from a study done by Dr. G Tiwari et al 2013.

Millage

Diesel cars =14.7 km/liter

Petrol cars = 15.8 km/liters

Average millage = $\frac{14.7+15.8}{2}$ = 16.25 ≃ 17 km/liter (since no of vehicle is not counted separately as petrol engine or diesel engine)

VKT Computation

VKT = No of vehicles × length of study corridor……Eq.3.10

Table: 3.9 VKT (Vehicle kilometer travelled) estimation

Road	Pre	Post	Length (km)
Lalalajpat Rai Marg			
Number of vehicles	1102	914	2.56
VKT	2821	2340	
Captain Gaur Marg			
Number of vehicles	1351	1188	2.14
VKT	2891	2542	
Outer Ring Road			
Number of vehicles	1436	1164	1.95
VKT	2800	2270	

Total VKT (pre) = 2821 + 2891 + 2800 = 8512 km

Total VKT (post) = 2340 + 2542 +2270 = 7152 km

Fuel consumption (pre) = 8512 × 17 =144704 liters

Fuel consumption (post) = 7152 × 17 = 121548 liters

% change = 16 % (decrease)

Actual measurement

Data in the form of percentage change has been collected from four fuel pumps from the selected study corridors which are tabulated as follows

Table 3.10: Fuel consumption data

Fuel consumption Data			
S.NO	**% decrease**		**average**
	1st phase	2nd phase	
1	17	9	13
2	25	15	20
3	15	12	14
4	18	10	14

Average value = $\frac{13+20+14+14}{4}$ = 15.25 ≅ 16

% change = 16 % (decrease)

- ## Noise Level

Model

For noise level calculation CRTN model (Lam and Tam 1998) is used, the equation is given by

L = 10 log Q + 33 log (V + 40 +$\frac{500}{V}$) + 10 log (1 + $\frac{5P}{V}$) – 26.6……..Eq.3.11

Where

L = Noise level in dBA, Q = Traffic flow in vehicle/hour

P = percentage of heavy vehicle, V = Average speed of vehicles in km/hour

Lalalajpat Rai Marg ……. (Appendix E)

Q (pre) = 1102

P = 4.68, V (pre) = 32 km/h

Hence

L (pre) = 10 log 1102 + 33 log (32+ 40 + $\frac{500}{32}$) + 10 log(1+ $\frac{5 \times 4.68}{32}$) – 26.6

= 70.31 ⊐ 71 dBA

Similarly

Q (post) = 914

V (post) = 33km/h

L (post) = 69.52 ⊐ 70 dBA

% change = 1.40 ⊐ 2 % (decrease)

Captain Gaur Marg

Q (pre) =1351veh/h

V (pre) = 32km/h

L (pre) = 71.19 ⊐ 72 dBA

Q (post) = 1188 veh/h

V (post) = 33km/h

L (post) = 70.66 ⊐ 71 dBA

% change = 1.3 ⊐ 2 % (decrease)

Outer Ring Road

Q (pre) = 1436 veh/h

V (pre) = 32 km/h

L (pre) = 71.46 ≅ 72 dBA

Q (post) = 1164 veh/h

V (post) = 33 veh/h

L (post) = 70.5 ≅ 71 dBA

% change = 1.38 ≅ 2 % (decrease)

Average value = $\frac{2+2+2}{3}$ = 2 % (decrease)

Actual measurement

Actual noise level is measured with the help of noise level meter for all three selected corridors which are as tabulated below:

Table 3.11: Noise level data

Date	**14-04-2016**		**18-04-2016**
Time	**Before Implementation**		**After Implementation**
	Sound Level (dBA)		**Sound Level (dBA)**
0-15	83.6	**Outer Ring Road**	78.5
15-30	85.6		78.8
30-45	77.3		80.1
45-60	87.6		77.3
Mean	**83.525**		**78.675**
0-15	74	**Lalalajpat Rai Marg**	79.7
15-30	74.7		75.1
30-45	76.6		76.8
45-60	87		78.2
Mean	**78.075**		**77.45**

0-15	88.5	**Captain Gaur Marg**	
15-30	75.9		82.2
30-45	75.2		78.2
45-60	78.4		79.9
Mean	**79.5**		**79.6**

Average value pre =(83.525 + 78.075 + 79.5) = 80.37 ≅ 81 dBA

Average value post = (78.675 + 77.45 + 79.6) = 78.575 ≅ 79 dBA

% change = 2.46 ≅ 3 % (decrease)

- ## Air Quality

Model

The change in air quality is quantified by observing the change in PM_{10} and $PM_{2.5}$ as these two pollutant has severest of the effect on the air quality of Delhi.

The model used here for the quantification is taken from "Melbourne case study Marzieh Reisi 2013" given by:

$PM_{Emission} = VKT \times EF$ ……Eq. 3.12

Where

VKT = Vehicle kilometer travelled

EF = Emission Factor

Since in this study vehicle are not categorized by its fuel type so average EF of petrol, diesel and CNG is used which is take from Emission factor study by Central Pollution Control Board (CPCB 2007) which is given by

EF_{PM} for passenger cars

Petrol engine = 0.006 g/km

Diesel engine = 0.002 g/km

CNG engine =0 .001 g/km

So average value = $\frac{.006+.002+.001}{3}$ = 0.003 g/km (since vehicles are not counted according to its engine type so average value of emission factor is used)

So PM (particulate matters PM_{10}, $PM_{2.5}$) concentration for study corridors for pre- and post implementation are as follows

Lalalajpat Rai Marg

PM (pre) = VKT (pre) × EF = 2821 × .003 = 8.463 ⇉ 9 gm (VKT used from fuel consumption calculations)

Similarly

PM (post) = 2340 × .003 = 7.02 ⇉ 7 gm

% change = 22.22 ⇉ 22 % (decrease)

Captain Gaur Marg

PM (pre) = 2891 × .003 = 8.67 ⇉ 9 gm

PM (post) = 2542 × .003 = 7.62 ⇉ 8 gm

% change = 11.11 ⇉ 12 % (decrease)

Outer Ring Road

PM (pre) = 2800 × .003 = 8.4 ⇉ 9 gm

PM (post) = 2270 × .003 = 6.81 ⇉ 7 gm

% change = 22.22 ⇉ 22 % (decrease)

Average value = $\frac{22+12+22}{3}$ = 18.66 ⇉ 19 % (decrease)

Hence increase in air quality = 19 % (PM concentration major cause of concern)

Actual measurement

% change in PM (excluding Delhi's background pollution concentration) (TERI report 2016)

1st phase = 4 % (decrease)

2nd phase = 7 % (decrease)

Average change = $\frac{4+7}{2}$ = 5.5 ≃ 6 % (decrease)

Hence increase in air quality = 6%

3.8.5. Summary

The change in all above discussed criteria selected for evaluation of "Odd-Even scheme" of Delhi for model and actual measurement/sensors information sources are as tabulated below by using which Bpa(Basic probability assignment) would be allocated.

Table: 3.12 Summary of changes in criteria road-wise

Criteria	**Quantifying Parameters**	**Captain Gaur Marg**	**Outer Ring Road**	**Lalalajpa Rai Marg**
Trip Cost				
Model	Car occupancy Daily car usage	47 % (increase) 41 % (decrease)	47 % (increase) 41 % (decrease)	47 % (increase) 41 % (decrease)
Actual Measurement	Fuel wastage in traffic jams	42 % (decrease)	42 % (decrease)	42 % (decrease)
Trip Time				
Model	Speed Time spent in traffic jams	16 % (increase) 29 % (decrease)	16 % (increase) 29 % (decrease)	16 % (increase) 29 % (decrease)

Actual Measurement	Actual time	10 % (increase)	10 % (increase)	10 % (increase)
Safety and security	Subjective survey data (Data from public rating survey is used)			
Users Satisfaction				
Model	Change in satisfaction criteria	21 % (increase)	21 % (increase)	21 % (increase)
Actual measurement	-do-	17 % (increase)	17 % (increase)	17 % (increase)
Accidents				
Modal	Netherland Model	3 % (decrease)	10 % (decrease)	6 % (decrease)
Actual Measurement	-do-	3 % (decrease)	10 % (decrease)	6 % (decrease)
Congestion level				
Model	Speed Time Spent in Traffic Jams	16 % (increase) 42 % (decrease)	16 % (increase) 42 % (decrease)	16 % (increase) 42 % (decrease)
Actual Measurement	Traffic Volume	12 % (increase)	19 % (increase)	17 % (increase)
Parking Demand				

Model	Traffic Volume	12 % (increase)	19 % (increase)	17 % (increase)
Actual Measurement	Actual Data	33 % (decrease)	33 % (decrease)	33 % (decrease)
Para-Transit Demand				
Model	Trip and Occupancy (auto,taxi,E-vehicle)	27 % (increase)	27 % (increase)	27 % (increase)
Actual Measurement	Actual Vehicle Count	17 % (increase)	15.5 % (increase)	19.5 % (increase)
Fuel Consumption				
Model	G. Tiwari Model	12 % (decrease)	19 % (decrease)	17 % (decrease)
Actual Measurement	Pump Data	16 % (decrease)	16 % (decrease)	16 % (decrease)
Noise Level				
Model	Lam & Tam model	2 % (decrease)	2 % (decrease)	2 % (decrease)
Actual Measurement	Actual Data	3 % (decrease)	3 % (decrease)	3 % (decrease)
Air Quality				
Model	Emission Model	12 % (decrease)	22 % (decrease)	22 % (decrease)
Actual Measurement	TERI Report	6 % (decrease)	6 % (decrease)	6 % (decrease)

To assign Basic probability assignment (Bpa) the above changes are aggregated using simple average method which is tabulated below:

Aggregation example

Parking Demand

Model

It is calculated on basis of change in traffic volume in all three study corridors

Captain gaur marg = 12 % (decrese)

Outer ring Road = 19 % (decrease)

Lalalajpat rai marg = 17 % (decrease)

Aggregated average = $\frac{12+19+17}{3}$ = 16% (decrease)

For actual measurement same method is used for aggregation that is simple average method

Table 3.13: Aggregated change in criteria

S.No	Indicators	Percent Change	
		Model	**Actual**
1	Trip Cost	-44	-42
2	Trip Time	-29	-10
3	Safety and Security	Subjective Survey Data	
4	Accidents	-7	-7
5	Users Satisfaction	21	17
6	Congestion Level	-29	-16
7	Parking Demand	-16	-33
8	Para-Transit Demand	27	18
9	Fuel Consumption	-16	-16
10	Noise Level	-2	-3
11	Air Quality	19	6

Please note that for safety and security criteria Bpa value is directly taken from public rating survey that is why in above table subjective survey data is written.

Note that positive values represent increase and negative value represents decrease. The difference in quantified values of model and actual measurement information source is because in model to measure the criteria the study takes into account the indirectly related parameters. for example in case of trip time in model information source the criteria is quantified by considering the change in speed and time spent in traffic jams and in actual measurement only time is measured without considering the related parameters and in case of Air Quality criteria the difference is due to use of different model for the measurement of air pollution. The actual measurement data is borrowed from TERI (The Energy Resources Institute) Report in which they used "Black Box Model" for the measurement of pollution and in my calculation I have used "Emission model".

3.8.6. Step 4: Bpa allocation

On the basis of above calculated changes the Bpa is allocated using presume threshold scale given below that if change observed is 40 % the Bpa would be 0.4 for the change evaluation level and remaining 0.6 would be equally distributed to other two evaluation levels so that biasness is avoided in the allocation.

Table 3.14: Presumed threshold scale

Presumed threshold scale	
Percent change	**Bpa**
100	1
90	0.9
80	0.8
70	0.7
60	0.6
50	0.5
40	0.4
30	0.3
20	0.2
Up to 10	0.1

Bpa allocation example

Trip cost

Model

% change = 44 % (decrease) as we, with discussion with experts, and literature review selected three evaluation level that is increase (I) Decrease (D) and no change (N) so in this case of trip time change is in decrease evaluation level hence the change Bpa in decrease evaluation level, according to above scale D = 0.44 and the Bpa for other to evaluation level would be equally distributed in the ration of 1 : 1 and the summation of all the Bpa for all three evaluation level must not be greater than 100 as per the law of probability, so I = 0.28 and N = 0.28 . Here the Bpa allocation is done for both the pre and post implementation scenario, Bpa for post implementation is allocated on basis of calculated change as discussed above and the Bpa for the pre-implementation is allocated by using the reverse scenario of the post implementation Bpa, for the change is calculated by comparing pre and post implementation scenario.

For example:

For trip time, the Bpa for post implementation is

I = 0.28, N = 0.28, D = 0.44 (as calculated from change analysis)

From above discussion the Bpa for pre is

I = 0.44, N = 0.28, D = 0.28

In the same way all the Bpas is allocated which are as tabulated below:

Table 3.15: Bpa allocation for model and actual measurement for pre-implementation stage

S.No	Criteria	Bpa (Model)			Bpa (Actual)		
		I	N	D	I	N	D
1	Trip Cost	0.44	0.28	0.28	0.42	0.29	0.29
2	Trip Time	0.29	0.355	0.355	0.1	0.45	0.45
3	Safety and Security	0.34	0.22	0.44	0.34	0.22	0.44
4	Accidents	0.1	0.45	0.45	0.1	0.45	0.45
5	Users Satisfaction	0..395	0.395	0..21	0.415	0.415	0.17
6	Congestion Level	0.29	0.355	0..355	0..16	0.42	0.42
7	Parking Demand	0.16	0.42	0.42	0.33	0.355	0.355
8	Para-Transit Demand	0..365	0.365	0.27	0.365	0.365	0.18
9	Fuel Consumption	0.16	0.42	0.42	0.16	0.42	0.42
10	Noise Level	0.1	0.45	0.45	0.1	0.45	0.45
11	Air Quality	0.405	0.405	0.19	0.45	0.45	0.1

Table3.16: Bpa allocation for model and actual measurement for post-implementation stage

S.No	Criteria	Bpa (Model)			Bpa (Actual)		
		I	N	D	I	N	D
1	Trip Cost	0.28	0.28	0.44	0.29	0.29	0.42
2	Trip Time	0.355	0.355	0.29	0.45	0.45	0.1
3	Safety and Security	.61	0.21	0.18	0.61	0.21	0.18
4	Accidents	0.45	0.45	0.1	0.45	0.45	0.1

5	Users Satisfaction	0.21	0.395	0.395	0.17	0.415	0.415
6	Congestion Level	0.355	0.355	0.29	0.42	0.42	0.16
7	Parking Demand	0.42	0.42	0.16	0.355	0.355	0.33
8	Para-Transit Demand	0.27	0.365	0.365	0.18	0.365	0.365
9	Fuel Consumption	0.42	0.42	0.16	0.42	0.42	0.16
10	Noise Level	0.45	0.45	0.1	0.45	0.45	0.1
11	Air Quality	0.19	0.405	0.405	0.1	0.45	0.45

Since the Bpa for other two information sources that is expert and public opinion is taken from expert opinion and public opinion survey so the final Bpa for all four sources viz expert, public opinion, models, and actual measurement/ sensors for both pre and post scenario is tabulated below

Table 3.17: Bpa allocation for pre-implementation stage

Evaluation Criteria	**Experts**			**Model**			**Public Opinion**			**Actual Measurement**		
	I	**N**	**D**	**I**	**N**	**D**	**I**	**N**	**D**	**I**	**N**	**D**
Trip Cost(C1)	0.62	0.2	0.18	0.44	0.28	0.28	0.63	0.18	0.19	0.42	0.29	0.29
Trip Time(C2)	0.58	0.23	0.19	0.29	0.355	0.355	0.61	0.2	0.19	0.1	0.45	0.45
Safety and Security(C3)	0.32	0.25	0.43	0.34	0.22	0.44	0.34	0.22	0.44	0.34	0.22	0.44
Accidents(C4)	0.55	0.26	0.19	0.1	0.45	0.45	0.6	0.2	0.2	0.1	0.45	0.45
Users Satisfaction(C5)	0.28	0.27	0.45	0.395	0.395	0.21	0.29	0.22	0.49	0.415	0.42	0.17
Congestion Level(C6)	0.66	0.18	0.16	0.29	0.355	0.355	0.66	0.18	0.16	0.16	0.42	0.42
Parking Demand(C7)	0.62	0.21	0.17	0.16	0.42	0.42	0.7	0.14	0.16	0.33	0.36	0.36
Para-Transit Demand(C8)	0.36	0.25	0.39	0.365	0.365	0.27	0.32	0.23	0.45	0.365	0.37	0.18
Fuel Consumption(C9)	0.63	0.21	0.16	0.16	0.42	0.42	0.64	0.2	0.16	0.16	0.42	0.42
Noise Level(C10)	0.56	0.21	0.23	0.1	0.45	0.45	0.58	0.2	0.22	0.1	0.45	0.45
Air Quality(C11)	0.29	0.22	0.49	0.405	0.405	0.19	0.25	0.2	0.55	0.45	0.45	0.1

Table 3.18: Bpa allocation for post-implementation stage

Evaluation criteria	Experts			Model			Public Opinion			Actual Measurement		
	I	**N**	**D**	**I**	**N**	**D**	**I**	**N**	**D**	**I**	**N**	**D**
Trip Cost(C1)	0.24	0.22	0.54	0.28	0.28	0.44	0.27	0.19	0.54	0.29	0.29	0.42
Trip Time(C2)	0.24	0.2	0.56	0.355	0.355	0.29	0.27	0.2	0.53	0.45	0.45	0.1
Safety and Security(C3)	0.59	0.21	0.2	0.61	0.21	0.18	0.61	0.21	0.18	0.61	0.21	0.18
Accidents(C4)	0.26	0.23	0.51	0.45	0.45	0.1	0.25	0.23	0.52	0.45	0.45	0.1
Users Satisfaction(C5)	0.63	0.19	0.18	0.21	0.395	0.395	0.63	0.21	0.16	0.17	0.42	0.42
Congestion Level(C6)	0.2	0.22	0.58	0.355	0.355	0.29	0.23	0.21	0.56	0.42	0.42	0.16
Parking Demand(C7)	0.28	0.24	0.48	0.42	0.42	0.16	0.24	0.22	0.54	0.355	0.36	0.33
Para-Transit Demand(C8)	0.54	0.2	0.26	0.27	0.365	0.365	0.59	0.2	0.21	0.18	0.37	0.37
Fuel Consumption(C9)	0.26	0.24	0.5	0.42	0.42	0.16	0.25	0.21	0.54	0.42	0.42	0.16
Noise Level(C10)	0.3	0.22	0.48	0.45	0.45	0.1	0.27	0.2	0.53	0.45	0.45	0.1
Air Quality(C11)	0.54	0.23	0.23	0.19	0.405	0.405	0.59	0.21	0.2	0.1	0.45	0.45

3.8.7 Step 5: Information fusion

In this step the first Bpas from all the information sources would be combined by D-S rule of combination to find out final fused Bpa, then the final Bpa would be combined with assumed individual utilities to find out the global utilities of all the criteria to find out the TSI.

Information fusion example

For example for criteria "Trip Cost" and information sources "Expert", the probability of I = .62, N = .20, and D = .18.After Bpa assignments are done, the D-S theory is used to perform the data fusion. In the first stage, data from information source 1 and information source 2 is combined. In stage 2 the result of stage 1 are combined with data from information source 3. Finally in stage 3 we combine result of stage 2 with data from information source 4. Let us consider the criteria "Trip Cost" in table 3.18. Let us denote the Bpa from Expert by m_1^1, from model m_2^1, from survey by m_3^1, and from actual measurement/ sensors by m_4^1.

Table 3.19: Data fusion from information source 1 and 2 (expert and model)

C1	$m_1^1(I)=0.24$	$m_1^1(N)=0.22$	$m_1^1(D)=0.54$
$m_2^1(I)=.28$	0.07	0.06	0.15
$m_2^1(N)=.28$	0.07	0.06	0.15
$m_2^1(D)=.44$	0.11	0.10	0.24
normalization fator = 1-k			**0.36**

From table 3.19

m_1^1 (I) = 0.24 m_1^1 (N) = 0.22 m_1^1 (D) = 0.54

m_2^1 (I) =0.28 m_2^1 (N) = 0.28 m_2^1 (D) = 0.44

m_3^1 (I) = 0.27 m_3^1 (N) = 0.19 m_3^1 (D) = 0.54

m_4^1 (I) = 0.29 m_4^1 (N) = 0.29 m_4^1 (D) = 0.42

Table 3.19 presents the fusion results of information source 1 and information source 2 that is m_1^1 and m_2^1

K= 0.07 + 0.11 + 0.06 + 0.10 + 0.15 + 0.15 = 0.640

Since k> 0 hence normalization will be applied where normalization factor is given by:

1-k = 1- 0.64 = 0.36

The results obtained from fusion of information sources 1 (Expert) and 2 (model) are given by:

$m_1^1 \oplus m_2^1$ (I) = 0.067/0.36 = 0.18

$m_1^1 \oplus m_2^1$ (N) = 0.062/0.36 = 0.17

$m_1^1 \oplus m_2^1$ (D) = 0.238/0.36 = 0.65

Table 3.20:Data fusion from information source 1,2 and 3 (expert, model, and public opinion)

C1	$m_1^1 \oplus m_2^1$ (I) =0.18	$m_1^1 \oplus m_2^1$ (N) =0.17	$m_1^1 \oplus m_2^1$ (D) =0.65
m_3^1 (I) =0.27	0.05	0.05	0.18
m_3^1 (N) =0.19	0.03	0.03	0.12
m_3^1 (D) =0.54	0.10	0.09	0.35
		1-k	**0.43**

We now combine the result obtained from information sources 1 and 2 with information source 3 (survey) in table 3.20

k= 0.03 + 0.10 + 0.05 + 0.09 + 0.18 + 0.12 = 0.57

Since k > 0 hence normalization will be applied where normalization factor is given by:

1-k = 1- 0.57 = 0.43

The results obtained from fusion of information sources 1 (expert), 2 (model), and 3 (public opinion) are given by:

$m_1^1 \oplus m_2^1 \oplus m_3^1$ (I) = 0.049/0.43 = 0.11

$m_1^1 \oplus m_2^1 \oplus m_3^1$ (N) = 0.032/0.43 = 0.07

$m_1^1 \oplus m_2^1 \oplus m_3^1$ (D) = 0.351/0.43 = 0.81

Table3.21: Data fusion from information source 1, 2, 3, and 4 (expert, model, pulic opinion, actual measurement/sensors).

C1	$m_1^1 \oplus m_2^1 \oplus m_3^1$ (I) =0.11	$m_1^1 \oplus m_2^1 \oplus m_3^1$ (N) =0.07	$m_1^1 \oplus m_2^1 \oplus m_3^1$ (D) =0.81
m_4^1 (I) =0.275	0.03	0.02	0.24
m_4^1 (N) =0.275	0.03	0.02	0.24
m_4^1 (D) =0.42	0.05	0.03	0.34
		1-k	**0.39**

We now combine the result obtained from fusion of information source 1, 2, and 3 with information source 4 (actual measurement/sensors) in table 3.21.

k= 0.03 + 0.05 + 0.02 + 0.03 + 0.24 + 0.24 = 0.61

Since k > 0 normalization will be applied where normalization factor is given by:

1-k = 1- 0.61 = 0.39

The result obtained from fusion of information sources 1 (expert), 2 (model), 3 (survey), and 4 (actual measurement/sensors) are given by:

$m_1^1 \oplus m_2^1 \oplus m_3^1 \oplus m_4^1$ (I) = 0.030/0.39 = 0.08

$m_1^1 \oplus m_2^1 \oplus m_3^1 \oplus m_4^1$ (N) = 0.019/0.39 = 0.05

$m_1^1 \oplus m_2^1 \oplus m_3^1 \oplus m_4^1$ (D) = 0.340/0.39 = 0.87

Similarly the data fusion for all remaining criteria is done.

The data fusion with help of D-S theory of combination for pre-implementation stage is tabulated below:

1. Trip Cost

Table 3.22: Trip cost data fusion

Data fusion stage 1 (expert and model)					
C1	I=0.62	N=0.2	D=0.18	I	0.72
I=0.44	0.2728	0.088	0.0792	N	0.15
N=0.28	0.1736	0.056	0.0504	D	0.13
D=0.28	0.1736	0.056	0.0504		
normalization factor = 1-k			**0.3792**		
Data fusion stage 2 (stage1 and public opinion)					
C1	I=0.72	N=0.15	D=0.13	I	0.90
I=0.63	0.453	0.093	0.084	N	0.05
N=0.18	0.129	0.027	0.024	D	0.05
D=0.19	0.137	0.028	0.025		
		1-k	**0.51**		
Data fusion stage3 (stage2 and sensors)					
C1	I=.90	N=.05	D=.05	**I**	**0.93**
I=0.42	0.38	0.02	0.02	**N**	**0.04**
N=0.29	0.26	0.0153	0.01	**D**	**0.04**
D=0.29	0.26	0.0153	0.01		
		1-k	0.41		

2. Trip Time

Table 3.23 Trip time data fusion

C2	I=0.58	N=0.23	D=0.19	I	0.53
I=0.29	0.1682	0.0667	0.0551	N	0.26
N=0.355	0.2059	0.08165	0.06745	D	0.21
D=0.355	0.2059	0.08165	0.06745		
normalization factor = 1 – k			**0.3173**		
C2	I=.53	N=.26	D=.21	I	0.78
I=0.61	0.32	0.16	0.13	N	0.12
N=0.20	0.11	0.05	0.04	D	0.10
D=0.19	0.10	0.05	0.04		
		1-k	**0.42**		
C2	I=0.78	N=0.12	D=0.10	**I**	**0.44**
I=0.1	0.08	0.01	0.01	**N**	**0.31**
N=0.45	0.35	0.06	0.04	**D**	**0.25**
D=0.45	0.35	0.06	0.04		
		1-k	**0.18**		

3. Safety and Security

Table 3.24: Safety and security data fusion

C3	I=0.32	N=0.25	D=0.43	I	0.31
I=0.34	0.11	0.09	0.15	N	0.16
N=0.22	0.07	0.06	0.09	D	0.54
D=0.44	0.14	0.11	0.19		
normalization factor = 1 – k			**0.35**		
C3	I=0.31	N=0.16	D=0.54	I	0.28
I=0.34	0.10	0.05	0.18	N	0.09
N=0.22	0.07	0.03	0.12	D	0.63
D=0.44	0.14	0.07	0.24		
		1-k	**0.37**		
C3	I=.28	N=.09	D=.63	**I**	**0.242**
I=0.34	0.095	0.031	0.214	**N**	**0.051**
N=0.22	0.061	0.020	0.138	**D**	**0.706**
D=0.44	0.123	0.040	0.277		
		1-k	**0.39**		

4. Accidents

Table 3.25: Accidents data fusion

C4	I=0.55	N=0.26	D=0.19	I	0.21
I=0.1	0.06	0.03	0.02	N	0.45
N=0.45	0.25	0.12	0.09	D	0.33
D=0.45	0.25	0.12	0.09		
normalization factor = 1-k			**0.26**		
C4	I=0.21	N=0.45	D=0.33	I	0.45
I=0.6	0.13	0.27	0.20	N	0.32
N=0.2	0.04	0.09	0.07	D	0.23
D=0.2	0.04	0.09	0.07		
		1-k	**0.29**		
C4	I=0.45	N=0.32	D=0.23	**I**	**0.15**
I=0.1	0.045	0.032	0.023	**N**	**0.49**
N=0.45	0.202	0.143	0.105	**D**	**0.36**
D=0.45	0.202	0.143	0.105		
		1-k	**0.29**		

5. Users Satisfaction

Table 3.26: User's satisfaction data fusion

C5	I=0.28	N=0.27	D=0.45	I	0.35
I=0.395	0.111	0.107	0.178	N	0.34
N=0.395	0.111	0.107	0.178	D	0.30
D=0.21	0.059	0.057	0.095		
normalization factor = 1-k			**0.31175**		
C5	I=0.35	N=0.34	D=0.30	I	0.31
I=0.29	0.10	0.10	0.09	N	0.23
N=0.22	0.08	0.08	0.07	D	0.45
D=0.49	0.17	0.17	0.15		
		1-k	**0.33**		
C5	I=0.31	N=0.23	D=0.45	**I**	**0.430**
I=0.415	0.131	0.096	0.189	**N**	**0.315**
N=0.415	0.131	0.096	0.189	**D**	**0.255**
D=0.17	0.054	0.039	0.077		
		1-k	**0.30**		

6. Congestion Level

Table 3.27: Congestion level data fusion

C6	I=0.66	N=0.18	D=0.16	I	0.61
I=0.58	0.1914	0.0522	0.0464	N	0.20
N=0.21	0.2343	0.0639	0.0568	D	0.18
D=0.21	0.2343	0.0639	0.0568		
normalization factor = 1-k			**0.3121**		
C6	I=0.84	N=0.08	D=0.07	I	0.86
I=0.66	0.40	0.14	0.12	N	0.08
N=0.18	0.11	0.03	0.03	D	0.06
D=0.16	0.10	0.03	0.03		
		1-k	**0.47**		
C6	I=0.95	N=0.03	D=0.02	**I**	**0.78**
I=0.16	0.138	0.033	0.010	**N**	**0.19**
N=0.42	0.361	0.033	0.026	**D**	**0.15**
D=0.42	0.361	0.033	0.026		
		1-k	**0.18**		

7. Parking Demand

Table 3.28: Parking demand data fusion

C7	I=0.62	N=0.21	D=0.17	I	0.38
I=0.16	0.0992	0.0336	0.0272	N	0.34
N=0.42	0.2604	0.0882	0.0714	D	0.28
D=0.42	0.2604	0.0882	0.0714		
normalization factor = 1-k			**0.2588**		
C7	I=0.57	N=0.24	D=0.19	I	0.74
I=0.7	0.268	0.239	0.193	N	0.13
N=0.14	0.054	0.048	0.039	D	0.12
D=0.16	0.061	0.055	0.044		
		1-k	**0.36**		
C7	I=0.86	N=0.07	D=0.07	**I**	**0.829**
I=.033	0.2458	0.0437	0.0404	**N**	**0.159**
N=0.355	0.2645	0.0470	0.0435	**D**	**0.147**
D=0.355	0.2645	0.0470	0.0435		
		1-k	**0.30**		

8. Para-Transit Demand

Table 3.29: Para-transit demand data fusion

C8	I=0.36	N=0.25	D=0.39		
I=0.365	0.1314	0.09125	0.14235	I	0.40
N=0.365	0.1314	0.09125	0.14235	N	0.28
D=0.27	0.0972	0.0675	0.1053	D	0.32
normalization factor = 1-k			**0.32795**		
C8	I=0.40	N=0.28	D=0.32	I	0.38
I=0.32	0.13	0.09	0.10	N	0.19
N=0.23	0.09	0.06	0.07	D	0.43
D=0.45	0.18	0.13	0.14		
		1-k	**0.34**		
C8	I=0.38	N=0.19	D=0.43	**I**	**0.37**
I=0.365	0.14	0.07	0.16	**N**	**0.18**
N=0.365	0.14	0.07	0.16	**D**	**0.21**
D=0.18	0.07	0.03	0.08		
		1-k	**0.38**		

9. Fuel Consumption

Table 3.30: Fuel consumption data fusion

C9	I=0.63	N=0.21	D=0.16	I	0.39
I=0.16	0.1008	0.0336	0.0256	N	0.34
N=0.42	0.2646	0.0882	0.0672	D	0.26
D=0.42	0.2646	0.0882	0.0672		
normalization factor = 1-k			**0.2562**		
C9	I=0.38	N=0.35	D=0.27	I	0.69
I=0.64	0.25	0.22	0.17	N	0.19
N=0.2	0.08	0.07	0.05	D	0.12
D=0.16	0.06	0.06	0.04		
		1-k	**0.36**		
C9	I=0.68	N=0.20	D=0.12	**I**	**0.46**
I=0.16	0.11	0.03	0.02	**N**	**0.33**
N=0.42	0.29	0.08	0.05	**D**	**0.20**
D=0.42	0.29	0.08	0.05		
		1-k	**0.24**		

10. Noise Level

Table 3.31: Noise level data fusion

C10	I=0.56	N=0.21	D=0.23	I	0.22
I=0.1	0.135	0.021	0.023	N	0.37
N=0.45	0.252	0.0945	0.1035	D	0.40
D=0.45	0.252	0.022	0.1035		
normalization factor=1-k			**0.2562**		
C10	I=0.22	N=0.38	D=0.41	I	0.43
I=0.58	0.13	0.21	0.23	N	0.25
N=0.2	0.04	0.07	0.08	D	0.30
D=0.22	0.05	0.08	0.09		
		1-k	**0.30**		
C10	I=.45	N=.26	D=.32	**I**	**0.134**
I=.1	0.043	0.025	0.030	**N**	**0.351**
N=.45	0.191	0.111	0.134	**D**	**0.423**
D=.45	0.191	0.111	0.134		
		1-k	**0.32**		

11. Air Quality

Table 3.32: Air quality data fusion

C11	I=0.29	N=0.22	D=0.49	I	0.39
I=0.405	0.117	0.089	0.198	N	0.30
N=0.405	0.117	0.089	0.198	D	0.31
D=0.19	0.055	0.042	0.093		
normalization factor=1-k			**0.30**		
C11	I=0.40	N=0.30	D=0.30	I	0.30
I=0.25	0.098	0.074	0.078	N	0.18
N=0.2	0.078	0.059	0.062	D	0.52
D=0.55	0.216	0.164	0.171		
		1-k	**0.33**		
C11	I=0.31	N=0.19	D=0.50	**I**	**0.501**
I=0.45	0.134	0.082	0.234	**N**	**0.304**
N=0.45	0.134	0.082	0.234	**D**	**0.194**
D=0.1	0.030	0.018	0.052		
		1-k	**0.27**		

Data fusion for post implementation stage

1. Trip Cost

Table 3.33 Trip cost data fusion

Data fusion stage 1(expert and model)					
C1	I=0.24	N=0.22	D=0.54	I	0.18
I=0.28	0.0672	0.0616	0.1512	N	0.17
N=0.28	0.0672	0.0616	0.1512	D	0.65
D=0.44	0.1056	0.0968	0.2376		
normalization factor = 1-k			**0.3664**		
Data fusion stage 2 (stage1 and public opinion)					
C1	I=0.18	N=0.17	D=0.65	I	0.11
I=0.27	0.05	0.05	0.18	N	0.07
N=0.19	0.03	0.03	0.12	D	0.81
D=0.54	0.10	0.09	0.35		
		1-k	**0.43**		
Data fusion stage3 (stage2 and sensors)					
C1	I=0.11	N=0.07	D=0.81	**I**	**0.084**
I=0.29	0.033	0.021	0.235	**N**	**0.054**
N=0.29	0.033	0.021	0.235	**D**	**0.862**
D=0.42	0.048	0.031	0.341		
		1-k	**0.395**		

2. Trip Time

Table 3.34: Trip time data fusion

C2	I=0.24	N=0.2	D=0.56	I	0.27
I=0.355	0.0852	0.071	0.1988	N	0.22
N=0.355	0.0852	0.071	0.1988	D	0.51
D=0.29	0.0696	0.058	0.1624		
normalization factor = 1-k			**0.3186**		
C2	I=0.27	N=0.22	D=0.51	I	0.19
I=0.27	0.07	0.06	0.14	N	0.12
N=0.2	0.05	0.04	0.10	D	0.70
D=0.53	0.14	0.12	0.27		
		1-k	**0.39**		
C2	I=0.19	N=0.12	D=0.70	**I**	**0.41**
I=0.45	0.084	0.052	0.314	**N**	**0.25**
N=0.45	0.084	0.052	0.314	**D**	**0.34**
D=0.1	0.019	0.012	0.070		
		1-k	**0.21**		

3. Safety and Security

Table 3.35: Safety and security data fusion

C3	I=0.59	N=0.21	D=0.20	I	0.82
I=0.61	0.3599	0.1281	0.122	N	0.10
N=0.21	0.1239	0.0441	0.042	D	0.08
D=0.18	0.1062	0.0378	0.036		
normalization factor = 1-k			**0.44**		
C3	I=0.82	N=0.10	D=0.08	I	0.93
I=0.61	0.499	0.061	0.050	N	0.04
N=0.21	0.172	0.021	0.017	D	0.03
D=0.18	0.147	0.018	0.015		
		1-k	**0.53**		
C3	I=0.93	N=0.04	D=0.03	**I**	**0.977**
I=0.61	0.569	0.024	0.017	**N**	**0.014**
N=0.21	0.196	0.008	0.006	**D**	**0.009**
D=0.18	0.168	0.007	0.005		
		1-k	**0.58**		

4. Accidents

Table 3.36: Accidents data fusion

C4	I=0.26	N=0.23	D=0.51	I	0.43
I=0.45	0.117	0.1035	0.2295	N	0.38
N=0.45	0.117	0.1035	0.2295	D	0.19
H=0.1	0.026	0.023	0.051		
normalization factor = 1-k			**0.2715**		
C4	I=0.43	N=0.38	D=0.19	I	0.37
I=0.25	0.108	0.095	0.047	N	0.30
N=0.23	0.099	0.088	0.043	D	0.33
D=0.52	0.224	0.198	0.098		
		1-k	**0.29**		
C4	I=0.37	N=0.30	D=0.33	**I**	**0.496**
I=0.45	0.165	0.135	0.150	**N**	**0.404**
N=0.45	0.165	0.135	0.150	**D**	**0.100**
D=0.1	0.037	0.030	0.033		
		1-k	**0.33**		

5. Users Satisfaction

Table 3.37: User's satisfaction data fusion

C5	I=0.63	N=0.19	D=0.18	I	0.48
I=0.21	0.132	0.040	0.038	N	0.27
N=0.395	0.249	0.075	0.071	D	0.26
D=0.395	0.249	0.075	0.071		
normalization factor = 1-k			**0.28**		
C5	I=0.48	N=0.27	D=0.26	I	0.75
I=0.63	0.299	0.170	0.161	N	0.14
N=0.21	0.100	0.057	0.054	D	0.10
D=0.16	0.076	0.043	0.041		
		1-k	**0.40**		
C5	I=0.75	N=0.14	D=0.10	**I**	**0.557**
I=0.17	0.128	0.024	0.018	**N**	**0.257**
N=0.415	0.313	0.059	0.043	**D**	**0.186**
D=0.415	0.313	0.059	0.043		
		1-k	**0.23**		

6. Congestion Level

Table 3.38: Congestion level data fusion

C6	I=0.20	N=0.22	D=0.58		
I=0.355	0.071	0.0781	0.2059	I	0.22
N=0.355	0.071	0.0781	0.2059	N	0.25
D=0.29	0.058	0.0638	0.1682	D	0.53
normalization factor = 1-k			**0.3173**		
				I	0.13
C6	I=0.22	N=0.25	D=0.53	N	0.13
I=0.23	0.051	0.057	0.122	D	0.74
N=0.21	0.047	0.052	0.111		
D=0.56	0.125	0.138	0.297		
		1-k	**0.40**		
C6	I=0.13	N=0.13	D=0.74	**I**	**0.238**
I=0.42	0.054	0.054	0.312	**N**	**0.239**
N=0.42	0.054	0.054	0.312	**D**	**0.523**
D=0.16	0.021	0.021	0.119		
		1-k	**0.23**		

7. Parking Demand

Table 3.39: Parking demand data fusion

C7	I=0.28	N=0.24	D=0.48	I	0.40
I=0.42	0.1176	0.1008	0.2016	N	0.34
N=0.42	0.1176	0.1008	0.2016	D	0.26
D=0.16	0.0448	0.0384	0.0768		
normalization factor = 1-k			**0.2952**		
C7	I=0.40	N=0.34	D=0.26	I	0.31
I=0.24	0.096	0.082	0.062	N	0.24
N=0.22	0.088	0.075	0.057	D	0.45
D=0.54	0.215	0.184	0.140		
		1-k	**0.31**		
C7	I=0.31	N=0.24	D=0.45	**I**	**0.359**
I=0.355	0.109	0.086	0.160	**N**	**0.282**
N=0.355	0.109	0.086	0.160	**D**	**0.490**
D=0.33	0.101	0.080	0.149		
		1-k	**0.30**		

8. Para-Transit Demand

Table 3.40: Para-transit demand data fusion

C8	I=0.54	N=0.20	D=0.26	I	0.46
I=0.27	0.1458	0.054	0.0702	N	0.23
N=0.365	0.1971	0.073	0.0949	D	0.30
D=0.365	0.1971	0.073	0.0949		
normalization factor = 1-k			**0.31**		
C8	I=0.46	N=0.23	D=0.30	I	0.71
I=0.59	0.274	0.137	0.178	N	0.12
N=0.20	0.093	0.047	0.061	D	0.17
D=0.21	0.098	0.049	0.064		
		1-k	**0.38**		
C8	I=0.71	N=0.12	D=0.17	**I**	**0.398**
I=0.18	0.128	0.022	0.030	**N**	**0.137**
N=0.365	0.260	0.044	0.060	**D**	**0.187**
D=0.365	0.260	0.044	0.060		
		1-k	**0.32**		

9. Fuel Consumption

Table 3.41: Fuel consumption data fusion

C9	I=0.26	N=0.24	D=0.50	I	0.38
I=0.42	0.1092	0.1008	0.21	N	0.35
N=0.42	0.1092	0.1008	0.21	D	0.28
D=0.16	0.0416	0.0384	0.08		
normalization factor = 1-k			**0.29**		
C9	I=0.38	N=0.35	D=0.26	I	0.30
I=0.25	0.094	0.087	0.069	N	0.23
N=0.21	0.079	0.073	0.058	D	0.47
D=0.54	0.203	0.188	0.149		
		1-k	**0.32**		
C9	I=0.31	N=0.24	D=0.45	**I**	**0.420**
I=0.42	0.125	0.097	0.198	**N**	**0.326**
N=0.42	0.125	0.097	0.198	**D**	**0.253**
D=0.16	0.048	0.037	0.075		
		1-k	**0.30**		

10. Noise Level

Table 3.42: Noise level data fusion

C10	I=0.30	N=0.22	D=0.48	I	0.48
I=0.45	0.135	0.099	0.216	N	0.35
N=0.45	0.135	0.099	0.216	D	0.17
D=0.1	0.03	0.022	0.048		
normalization factor=1-k			**0.28**		
C10	I=0.48	N=0.35	D=0.17	I	0.45
I=0.27	0.129	0.095	0.046	N	0.24
N=0.20	0.096	0.070	0.034	D	0.31
D=0.53	0.254	0.186	0.090		
		1-K	**0.29**		
C10	I=0.45	N=0.24	D=0.31	**I**	**0.589**
I=0.45	0.201	0.109	0.140	**N**	**0.320**
N=0.45	0.201	0.109	0.140	**D**	**0.091**
D=0.1	0.045	0.024	0.031		
		1-K	**0.34**		

11. Air Quality

Table 3.43: Air quality data fusion

C11	I=0.54	N=0.23	D=0.23	I	0.36
I=0.19	0.103	0.044	0.044	N	0.32
N=0.405	0.219	0.093	0.093	D	0.32
D=0.405	0.219	0.093	0.093		
normalization factor=1-k			**0.29**		
C11	I=0.34	N=0.33	D=0.33	I	0.61
I=0.59	0.210	0.190	0.190	N	0.20
N=0.21	0.075	0.068	0.068	D	0.19
D=0.20	0.071	0.064	0.064		
		1-k	**0.34**		
C11	I=0.60	N=0.21	D=0.20	**I**	**0.260**
I=0.1	0.061	0.020	0.019	**N**	**0.379**
N=0.45	0.276	0.089	0.085	**D**	**0.361**
D=0.45	0.276	0.089	0.085		
		1-k	**0.24**		

Summary of information fusion

Table 3.44: Bpa's after data fusion

Evaluation Criteria	Pre-Implementation Stage			Post-Implementation Stage		
	I	N	D	I	N	D
Trip Cost(C1)	0.9268	0.0375	0.0357	0.0841	0.0543	0.8616
Trip Time(C2)	0.4389	0.3144	0.2467	0.4084	0.2521	0.3395
Safety and Security(C3)	0.2425	0.0513	0.7062	0.9773	0.0142	0.0085
Accidents(C4)	0.1533	0.4892	0.3575	0.4962	0.4038	0.1000
Users Satisfaction(C5)	0.4305	0.3149	0.2546	0.5572	0.2572	0.1856
Congestion Level(C6)	0.7813	0.1867	0.1475	0.2380	0.2390	0.5230
Parking Demand(C7)	0.8295	0.1587	0.1468	0.3591	0.2821	0.4905
Para-Transit Demand(C8)	0.3700	0.1847	0.2056	0.3977	0.1369	0.1868
Fuel Consumption(C9)	0.4640	0.3330	0.2030	0.4205	0.3260	0.2535
Noise Level(C10)	0.1342	0.3515	0.4234	0.5888	0.3199	0.0913
Air Quality(C11)	0.5014	0.3043	0.1943	0.2605	0.3788	0.3607

Calculation of global utilities

The global utilities of selected criteria are calculated by using given formulae

$u_i = \sum_{k=1}^{p} u(Hk) \times bpa(Hk)$ ……Eq. 3.13 (Anjali Awasthi et al 2009)

where Hk represents the evaluation level, Hk € {I,N,D}, u(Hk) represents the individual utility of an evaluation level Hk, bpa(Hk) represents the basic probability assignment or mass function related to each evaluation level Hk, and p represents the number of evaluation levels. p = 3 for Hk € {I, N, D}.The individual utilities are tabulated below

Table 3.45: Individual utilities of criteria

Evaluation criteria	Utility values		
	u(I)	u(N)	u(D)
Trip Cost(C1)	0	0.3	1
Trip Time(C2)	0	0.3	1
Safety and Security(C3)	1	0.3	0
Accidents(C4)	0	0.3	1
Users Satisfaction(C5)	1	0.3	0
Congestion Level(C6)	0	0.3	1
Parking Demand(C7)	0	0.3	1
Para-Transit Demand(C8)	0	0.3	1
Fuel Consumption(C9)	0	0.3	1
Noise Level(C10)	0	0.3	1
Air Quality(C11)	1	0.3	0

Calculation example

By using above formulae the global utilities are calculated as follows

Trip cost

Pre- implementation scheme stage

Final combined Bpa

I = 0.93 N = 0.04 D = 0.04 u(I) = 0 u(N) = 0.3 u(D) = 1

So global utility

u_i = u (I) × Bpa (I) + u (N) × Bpa (N) + u (D) × Bpa (D)

u_i = 0 × 0.93 + 0.3 × 0.04 + 1 × 0.04 = 0.047

Similarly all the global utilities is calculated for both stages which are tabulated below

Table 3.46: Global utilities

Evaluation criteria	Pre-test stage	Post-test stage
Trip Cost(C1)	0.047	0.878
Trip Time(C2)	0.341	0.415
Safety and Security(C3)	0.258	0.982
Accidents(C4)	0.504	0.221
Users Satisfaction(C5)	0.525	0.634
Congestion Level(C6)	0.204	0.595
Parking Demand(C7)	0.194	0.575
Para-Transit Demand(C8)	0.261	0.228
Fuel Consumption(C9)	0.303	0.351
Noise Level(C10)	0.529	0.187
Air Quality(C11)	0.593	0.374

3.8.8. Step 6: Calculation of transportation sustainability index (TSI)

Taking into account the lengthiness of information fusion as evident from tabular calculation of information fusion in previous section separate road wise calculation is not done instead a composite sustainability index is calculated which collectively reflects the change in sustainability of all selected corridors. The composite transportation sustainability index for both stages is calculated by using given formulae

$TSI\ (t_n) = u_1\ (t_n)\ x\ W_1 + u_2\ (t_n)\ x\ W_2 + \ldots\ldots\ldots\ldots\ldots\ldots\ u_N(t_n)\ x\ W_N$ ……Eq. 3.14

Where $W_1, W_2, \ldots\ldots W_N$ represent the weight of criteria $C_1, C_2\ldots\ldots, C_N$ obtained from AHP.

$$TSI\ (pre) = .047 \times .064 + 0.341 \times 0.104 + 0.258 \times 0.117 + 0.525 \times .089 + 0.204 \times 0.116 + 0.194 \times 0.036 + 0.261 \times 0.042 + 0.303 \times 0.076 + 0.529 \times 0.099 + 0.593 \times 0.144 = 0.389$$

TSI (pre) = 0.389

TSI (post) = 0.878 x 0.064 + 0.415 x 0.104 + 0.982 x 0.117 + 0.221 x 0.141 + 0.634 x 0.089 +0.595 x 0.116 + 0.575 x 0.036 + 0.228 x 0.042 + 0.351 x 0.076 + 0.187 x 0.099 + 0.374 x0 .144 = .500

TSI (post) = 0.500

3.8.9. Step 7: Impact assessment

In this step the change in the TSIs of both stages is observed in order to recommend for the adoption in the city.

From the above calculation it is observed that:

TSI (pre) = 0.389

TSI (post) = 0.500

Now the change in TSIs is

Δ TSI = 0.500 - .0389 = 0.111

As the Δ TSI > 0 it may be recommended for the adoption in the city but it also depends on the adoption authority that if the authority has set some threshold of change brought by the measure then adoption is totally based upon that threshold that if the change is greater or equal to that threshold then the measure is adopted otherwise rejected.

Chapter 4

RESULT AND DISCUSSION

4.1. Calculation of TSI and impact assessment

The objective of this study is to evaluate the transportation measure in terms of sustainability. The transportation measure opted here for the evaluation is "Odd-Even Scheme" in Delhi. By using evaluation criteria its evaluation is done with the help AHP and D-S theory.

For the collection of data following study corridors are selected

i. Captain Gaur Marg

ii. Outer Ring Road

iii. Lalalajpat Rai Marg

The above corridors are selected to collect data to observe change in criteria because of implementation of transportation measure Odd-Even Scheme for that purpose following criteria are selected which are listed as follows:

i. Trip Cost

ii. Trip Time

iii. Safety and Security

iv. Accidents

v. Users Satisfaction

vi. Congestion Level

vii. Parking Demand

viii. Para-Transit Demand

ix. Fuel consumption

x. Noise Level

xi. Air Quality

For observing the change in the criteria following types of data is collected from above listed study corridors

- Public Questionnaire Survey

  Size of samples

  Pre-implementation stage = 120

  Post-implementation stage = 120

- Public Rating Survey

  Size of samples

  Pre-implementation stage = 120

  Post implementation stage = 120

- Expert Opinion Survey for Bpa allocation

  Location: CRRI, DTU

  Size of samples

  Pre-implementation stage = 30

  Post implementation stage = 30

- Expert Opinion Survey for weightage allocation

  Size of sample = 30

- Video-graphic Vehicle Count Survey

  One hour each for all three selected corridors for both pre-and post implementation stage

- Noise level Measurement using “Noise level Meter”

  One hour each for all three selected corridors at an interval 15 minutes for both pre-and post implementation stage.

- The change in air quality on the basis of change in pollution concentration for actual measurement information sources is taken from TERI (The Energy and Resources Institute) report on “Odd-Even Scheme”.

Tables given below represents summation summary of quantifying parameters to quantify selected criteria calculated from public questionnaire survey Appendix C

Table: 4.1 Summation summary of quantifying parameters for pre-implementation stage

Quantifying parameters for criteria quantification	Summation
Distance(km) (sum of the distance travelled by surveyed vehicles) appendix C	3161
Time(min) (sum of the time taken by surveyed vehicles in origin destination journey	7460
Total number of cars possessed by surveyed vehicle owner	125
Total number of cars actually used daily by surveyed owner	124
Sum of times spent by vehicle in traffic jams	2925
Total number of cars surveyed or observed	50
Car occupancy (sum of the number of occupants of car surveyed or observed)	77
Total number of autos surveyed or observed	26
Total number of taxis surveyed or observed	20
Total number of E-Vehicle surveyed or observed	5
Autos occupancy (sum of the number of occupants of autos surveyed or observed)	59
Taxis occupancy (sum of the number of occupants of taxis surveyed or observed)	45
E-vehicle occupancy (sum of numbers of occupants of E-Vehicles surveyed or observed)	23
Autos trip (sum of trips of all autos surveyed or observed)	197
Taxis trip (sum of trips of all taxis surveyed or observed)	132
E-vehicles trip (sum of trips of all E-Vehicles surveyed or observed)	52

Table: 4.2 Summation summary of quantifying parameters for post-implementation stage

Quantifying parameters for criteria quantification	Summation
Distance(km) (sum of the distance travelled by surveyed vehicles) appendix C	2455
Time(min) (sum of the time taken by surveyed vehicles in origin destination journey	6715
Total number of cars possessed by surveyed vehicle owner	140
Total number of cars actually used daily by surveyed owner	83
Sum of times spent by vehicle in traffic jams	1695
Total number of cars surveyed or observed	50
Car occupancy (sum of the number of occupants of car surveyed or observed)	113
Total number of autos surveyed or observed	21
Total number of taxis surveyed or observed	10
Total number of E-Vehicle surveyed or observed	7
Autos occupancy (sum of the number of occupants of autos surveyed or observed)	59
Taxis occupancy (sum of the number of occupants of taxis surveyed or observed)	31
E-vehicle occupancy (sum of numbers of occupants of E-Vehicles surveyed or observed)	35
Autos trip (sum of trips of all autos surveyed or observed)	234
Taxis trip (sum of trips of all taxis surveyed or observed)	99
E-vehicles trip (sum of trips of all E-Vehicles surveyed or observed)	99

The table below shows the criteria-wise data used to quantify the change in criteria selected for evaluation of Odd-Even scheme

Table: 4.3 Criteria wise data for change evaluation

Criteria	Quantifying parameters
Trip Cost	
Model	Occupancy (pre) = $\frac{sum\ of\ the\ occupant\ \ of\ car\ surveyed\ \ in\ pre-test\ stage}{no\ of\ car\ surved\ \ in\ pre-test\ stage}$ Number of car surveyed = 50 Summation of occupants = 77 Occupancy (post)= $\frac{sum\ of\ the\ occupant\ \ of\ car\ surveyed\ \ in\ post-test\ stage}{no\ of\ car\ surved\ \ in\ post-test\ stage}$ Number of car surveyed = 50 Summation of occupants = 113 Daily car usage = number of car possessed – number of car used Daily car usage (pre) Number of car possessed = 125 Number of car daily used = 124 Daily car usage (post) Number of car possessed = 140 Number of car daily used = 83
Actual Measurement	Fuel wastage in traffic jams 10 min idle costs .14 litre of fuel wastage (K.P Tiwari et al 2013) Time spent in traffic jams (pre) = 1190 minutes Time spent in traffic jams (post) = 700 minutes The above time is the summation of time spent in traffic jams by surveyed vehicles as given above in summation table.

Trip Time	Quantifying parameters
Model	Speed Increase in speed = 16 % (TERI Report on Odd-Even 2016) Time spent in traffic jams Pre = 1190 minutes Post = 700 minutes
Actual Measurement	Actual time (sum of time for origin destination journey of vehicles surveyed) Pre = 7460 minutes Post = 6715 minutes
Safety and Security	Subjective survey data (Appendix B)
Accidents	
Model	Netherland accident model Data required Vehicle per day (video-graphic vehicle count) Lalalajpat rai marg Pre = 26448 Post = 21936 Captain gaur marg Pre = 32424 Post = 21936 Outer ring road Pre = 34464 Post = 28512 Length of corridors Listed in corridors selection section
Actual Measurement	same as model, as actual data is not available

Users Satisfaction	It depends on positive changes on other criteria hence average change in other criteria data is used
Congestion level	
Model	Speed Change in speed = 16 % (TERI Report 2016) Time spent in traffic jams Pre = 1190 minutes Post = 700 minutes
Actual Measurement	Decrease in traffic volume (percent decrease in cars) Lalaljpat rai marg Pre = 1102 post = 914 (video-graphic vehicle count) Captain gaur marg Pre = 1351 post = 1188 Outer ring raod Pre = 1436 post = 1164
Parking Demand	
Model	Decrease in traffic volume given above
Actual Measurement	Actual parking data Nehru place market = 35 % (decrease) Nehru place metro station = 30 % (decrease)

Para-Transit Demand	
Model	Occupancy and trip (auto, taxi, and E-vehicle) Pre-implementation stage Auto Sum of number of occupants = 59 Number of auto surveyed = 26 Trip = $\frac{sum\ of\ the\ trips\ of\ the\ auto\ surveyed}{number\ \ of\ auto\ surveyed}$ Sum of the trips of auto surveyed = 197 Number of auto surveyed = 26 Taxi Sum of number of occupants = 45 Number of taxis surveyed = 20 Trip Sum of the taxi surveyed = 132 Number of taxi surveyed = 20 E-Vehicle Sum of number of occupants = 23 Number of E-Vehicle surveyed = 5 Trip Sum of the trips of E-Vehicle surveyed = 23 Number of E-Vehicle surveyed = 5

	Post implementation stage Auto Occupancy Sum of the occupant of auto surveyed = 59 Number of auto surveyed = 21 Trips Sum of the number of trips of auto surveyed= 234 Number of auto surveyed = 21 Taxi Occupancy Sum of the numbers of occupant of taxi surveyed= 31 Number of taxi surveyed = 10 Trips Sum of the number of trips of taxi surveyed =99 Number of taxi surveyed = 10 E-Vehicle Occupancy Sum of the number of occupants of E-Vehicle surveyed= 35 Number of E-Vehicle surveyed = 7 Trips Sum of the number of trips of E-Vehicles surveyed= 99 Number of E-Vehicle surveyed = 7

Actual Measurement	Change in actual number of autos and taxis(video-graphic vehicle count) Lalalajpat rai marg pre post Number of autos = 514 596 Number of taxis = 143 168 Captain gaur marg Number of autos = 447 532 Number of taxis = 205 232 Outer ring road Number of autos = 497 602 Number of taxs = 237 279
Fuel Consumption	
Model	Dr.G Tiwari et al 2013 Fuel consumption = VKT × Average millage VKT = number of vehicles × length of corridors Data required Number of vehicles(cars) Lalalajpat rai marg pre post Number of vehicles 1102 914 Captain gaur marg 1351 1188 Outer ring road 1436 1164 Length of corridors Lalalajpat rai marg = 2.56 km Captain gaur marg = 2.14 km Outer ring road = 1.95 km

Actual Measurement	Actual measurement data from fuel pumps S.No % change (decrease) Pump 1 13 Pump 2 20 Pump 3 14 Pump 4 14
Noise level	
Model	CRTN model (Lam and Tam 1998) Data required Q -Traffic flow in vehicle/hour(video-graphic vehicle count Appendix E) P-Percentage of heavy vehicle (IIT Delhi study 2016) V-Average speed of vehicle in km/h Lalalajpat rai marg pre post Q = 1102 914 P = 4.68 4.68 V = 32 33 Captain gaur marg Q = 1351 1188 P = 4.68 4.68 V = 32 33 Outer ring road Q = 1436 1164 P = 4.68 4.68 V = 32 33

Actual Measurement	Actual measurement using Noise Level Meter Outer ring road (mean value) Pre = 83.525 dBA Post = 78.675 dBA Lalalajpat rai marg Pre = 78.075 dBA Post = 77.450 dBA Captain gaur marg Pre = 79.5 dBA Post = 79.6 dBA
Air Quality	Melbourne case study 2013
Model	Emission = VKT × EF Data required VKT – vehicle kilometer travelled Emission factor (CPCB 2007) Lalalajpat rai marg pre post VKT 2821 2340 Captain gaur marg VKT 2891 2542 Outer ring road VKT 2800 2270
Actual Measurement	TERI 2016 Report on odd even scheme Change = 6 % (decrease)

Using above data, calculation is done to observe the change in criteria which is shown in table 3.13. On the basis of change observed using presumed threshold scale Bpa is assigned which in tabulated in table 3.17 and table 3.18. After assigning Bpa fusion is done using D-S theory which summarized in table 3.44 for both pre-and post implementation stage. Using these fused Bpa and individual utilities tabulated in table 3.45 global utilities are calculated which are tabulated in table 3.46 for both pre-and post implementation stages. The TSIs of criteria is calculated by multiplying weights allocated by AHP and global utilities as shown in equation 3.14. The TSIs of all the selected criteria are as tabulated below:

Table: 4.4 TSI of individual criteria

Criteria	TSI (Pre-implementation stage)	TSI (Post-implementation stage)
Trip Cost(C1)	0.003	0.056
Trip Time(C2)	0.035	0.043
Safety and Security(C3)	0.030	0.115
Accidents(C4)	0.071	0.031
Users Satisfaction(C5)	0.047	0.056
Congestion Level(C6)	0.024	0.069
Parking Demand(C7)	0.007	0.021
Para-Transit Demand(C8)	0.011	0.010
Fuel Consumption(C9)	0.023	0.027
Noise Level(C10)	0.052	0.019
Air Quality(C11)	0.085	0.054

$$\text{Average TSI (pre-implementation stage)} = \frac{.003+.035+.030+.071+.047+.024+.007+.011+.023+.052+.085}{11}$$

$$= \frac{.389}{11} = .035$$

$$\text{Average TSI (post-implementation stage)} = \frac{.056+.043+.115+.031+.056+.069+.021+.010+.027+.019+.054}{11}$$

$$= \frac{.500}{11} = 0.045$$

Equation used for standard deviation calculation

$$\sigma = \sqrt{\frac{\sum(x - \overline{x})^2}{N}}$$

Where

σ = standard deviation

x = each value in population, $\bar{x}$ = mean of values

N = number of values

So

Standard deviation σ (pre-implementation stage) = 0.026

Standard deviation σ (pre-implementation stage) = 0.030

Discussion on TSIs of criteria

The criteria Trip Cost shows a substantial increase in TSI value this is because of increase in number of car sharing as evident from occupancy data and decrease in car usage on account of implementation of scheme.

The criteria Trip Time shows moderate increase TSI value as increase in speed and decrease in time spent in traffic jams is not substantial.

The criteria safety and security shows a very substantial increase in TSI value as it is totally calculated on the basis of subjective survey in which people acknowledge the scheme implementation a good way to increase safety and security.

The criteria accident shows a decrease in sustainability because the decrease in accidents is very low and Bpa for decrease is also low which in turn increase the Bpa of other two evaluation level that is decrease and no change.

The criteria Users Satisfaction shows small change in TSI value because the change brought about by scheme implementation is not very substantial.

The criteria congestion level shows moderate change in TSI value as the change observed in speed and time spent in traffic jams is moderate.

The criteria Parking Demand shows increase in TSI value because as from the parking demand data tabulated in Appendix there is a substantial decrease in parking demand is observed.

The criteria Para-transit demand shows decrease in sustainability as its demand increase in post-implementation stage and which has negative impact on sustainability.

The criteria fuel consumption shows increase in TSI values as it is evident from the fuel consumption data, it shows in fuel consumption.

The criteria noise level and air quality shows decrease in TSI values this is because of the fact that the decrease in these two criteria is very less and its Bpa is also very less for positive evaluation which in turn increases the Bpa values for negative evaluation levels.

Final TSI

TSI (pre) = sum of the TSIs of criteria for pre-implementation stage

= .030 + .035 + .030 + .071 + .047 + .024 + .007 + .011 + .023 + .052 + .085

= 0.389

TSI (post) = sum of the TSIs of criteria for post implementation stage

= .056 + .043 + .115 + .031 + .056 + .069 + .021 + .010 + .027 + .019 + .054

= 0.500

Transportation sustainability index of pre- implementation stage TSI (pre) = .389

Transportation sustainability index of post-implementation stage TSI (post) = .500

The change brought about by the testing of above mentioned transportation measure that is the change in transportation sustainability index

Δ TSI = TSI (post) – TSI (pre) …….Eq.3.15

Hence

Δ TSI = (.500- .389) = .111

The evaluation shows positive change hence it may consider for adoption in the city as per the theory but its adoption would also depends on the expected change it should bring.

Chapter 5

CONCLUSION AND RECOMENDATION

5.1 Conclusion

This study present an integrated decision-making approach based on Analytical Hierarchy Process (AHP) and Dempster-Shafer theory for evaluating the impact of transport measures on city sustainability. The approach comprises of selecting evaluation criteria, data collection and information fusion, evaluation of city sustainability using a Transport Sustainability Index (TSI) and impact assessment of proposed transportation measure.The evaluation of transportation measure which is done by above listed procedure in which the most important part is the selection of criteria which should reflect and manifest the change brought about by the implementation of the measure, in this course, through literature review and discussion with transportation and environmental experts eleven criteria is selected which fortunately very well reflected and manifested the changes brought about by the implementation of selected transportation measure.
The main strength of this approach lie in its ability to treat heterogeneous, uncertain and incomplete data coming from multiple information sources. This approach is very useful for transport decision-making situations with limited, heterogeneous data. Here in this study transportation measure "Odd-Even Scheme" is evaluated because government of Delhi implemented it as a social experiment and the decision of its permanent adoption is totally depends on its performance in its test phase. The types of data collected are expert opinion survey data, public opinion survey data, public rating survey data, and actual measurement data from various sensors. For example noise level using noise level meter etc.

In this study, apart from two information sources that is public opinion and expert opinion the other two sources are model and actual measurement. Models basically uses analytical equation, empirical equations and parameters which are indirectly related to the criteria for the quantification of criteria where as the actual measurement/sensors information source uses actual measurement techniques and sensors for criteria quantification. Here in this study it is observed that in some of the criteria there is a difference in quantified value between models and actual measurement, it is so because in model information source for the quantification many parameters which indirectly affect the criteria, is considered. For example, for trip time quantification speed and time spent in traffic jams is considered and its average value is used to calculate the change in criteria. The average value normally varies with actual time required for origin destination journey.

The final results of the evaluation yielded the transportation sustainability index for pre-implementation stage that is TSI (pre) = 0.389 which represents the sustainability of the transportation system without any measure or solution. In regard to the developing country like India the result is not very appreciating. The result of sustainability index calculated for post-implementation stage shows an increase in sustainability up to 0.500 that is TSI (post) = 0.500, and the change or increase in sustainability brought about by the measure is Δ TSI =0.111,which in terms of percentage only 11.1 % and is not enough to cater the transportation problem scenario of

Delhi. To address the problem scenario of Delhi government have to implement different scheme for diverse transportation problem in combination.

5.2. Recommendations

As the result suggests the enhancement in sustainability of transportation system brought about by "Odd-Even Scheme" of Delhi in terms of percentage is 11.1 % which is, not enough to improve the prevalent condition of Delhi's Transportation system and its detrimental effect on environment. Hence for improving the condition consequently sustainability following internationally acknowledged transportation measures is recommended for Delhi, which are categorized in following categories:

a) Immediate measures

- Congestion pricing
- Ensuring earliest possible introduction of BS-VI vehicle and fuel quality norms
- Real-time continuous monitoring and reporting of industrial stacks
- Enhanced LPG penetration in NCR
- Complete ban on refuse burning and use of technology for reporting of violations

b) Medium term measures

- Strengthening of existing I&M system, retrofitment (with tail-pipe diesel filters) of old vehicles and fleet modernization schemes
- Enhancement of public transportation systems and non-motorized options
- Enhancement of E-mobility and demand control measures
- Maintenance of stack emission control devices
- Exploring industrial emission trading schemes and fiscal measures
- Standards for NOx and other important pollutants for industrial establishments
- Ensuring 24x7 power supply in NCR to cut down the DG set use
- Business model for waste to energy conversion of agricultural wastes using biomass gasification technologies

c) Research and planning

- Regular source apportionment studies to ascertain the changing contribution of different sources in pollution to take specific actions
- Strengthen monitoring networks, reporting and development, and maintenance of database of emission inventories.
- Enhance capacities of air quality simulation and future predictions.
- Comprehensive air quality management plan for whole NCR consisting of strategies for air pollution control in different sectors. These plans should be based on scientific studies and will need to be updated every 3–5 years, in a rapidly changing scenario as in the NCR.
- Based on the plans, air quality targets needs to be defined for each year and strategies are to be enforced to achieve them.

5.3. Limitations of the study

- The current study involves the combination of perception and reality and perception normally varies expert to expert and person to person which ultimately affect the final result.
- In actual measurement information source the quantification of criteria “Accidents” is done by using data from model information source because of lack of availability of actual accident data.

5.4 Scope for future work

The current study evaluates one transport measure that is "Odd-Even Scheme”. Future work will involve the assessment of several transportation measures in combination that is combined sustainability evaluation of measures like congestion pricing, clean fuels etc.

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Appendix A

Expert opinion survey

CSIR-Central Road Research Institute, New Delhi -110020

SUSTAINABILITY ASSESSMENT OF TRANSPORT MEASURES AN EVALUATION OF ODD-EVEN SCHEME

Personal Details

Name:

Organization:

Designation:

Assign your probability of believe for Increase Decrease and No change of given specific sustainability indicators in terms of percentage probability for "NO ODD-EVEN SCHEME" and "ODD-EVEN SCHEME" scenario.

Distribute the percentage probability in such a way that summation of probability for increase decrease and no change should be hundred i.e P(I)+P(D)+P(N)=100 where P(I) P(D) and P(N) are probability of increase decrease and no change respectively.

Assign the probability by keeping in mind the effect of above two scenarios i.e "NO ODD-EVEN SCHEME" and "ODD-EVEN SCHEME" on given specific indicators. For example

	NO ODD-EVEN SCHEME			ODD-EVEN SCHEME		
Trip Cost	P(I)	P(D)	P(N)	P(I)	P(D)	P(N)
	60	10	30	25	50	25

SNO	INDICATORS	NO ODD-EVEN SCHEME			ODD-EVEN SCHEME		
		P(I)	P(D)	P(N)	P(I)	P(D)	P(N)
1	Trip Cost						
2	Trip Time						
3	Safety and Security						
4	Accidents						
5	Users Satisfaction						
6	Congestion Level						
7	Parking Demand						
8	Para-transit Demand						
9	Fuel Consumption						
10	Noise Level						
11	Air Quality						

INDICATOR HELP

INDICATORS	DESCRIPTION
Trip Cost	Cost of origin destination journey in rupee.
Trip Time	Time spent in origin destination journey in minutes.
Safety and Security	Safety and Security of car users.
Accident	No of traffic accidents.
Users Satisfaction	Satisfaction of car users.
Congestion Level	Variability in travel time due to increase in traffic volume beyond roadway capacity.
Parking Demand	Demand of parking space in parking areas.
Para-transit Demand	Demand of autos and taxis.
Noise Level	Noise level in dBA
Air Quality	Level of pollution in terms of air pollutants and Greenhouse gas emission from transport.

Expert opinion survey data

BPA function for expert opinion(PRE)			1	2	3	4	5	6
S.NO	INDICATORS							
1	**Trip cost**	I	0.55	0.5	0.4	0.5	0.6	0.4
		D	0.05	0.2	0.2	0.1	0.1	0.3
		N	0.45	0.3	0.4	0.4	0.2	0.3
2	**Trip time**	I	0.2	0.3	0.3	0.5	0.5	0.6
		D	0.2	0.4	0.3	0.1	0.1	0.1
		N	0.6	0.3	0.4	0.4	0.4	0.3
3	**Safety and security**	I	0.1	0.3	0.1	0.2	0.6	0.4
		D	0.05	0.4	0.1	0.7	0.2	0.2
		N	0.85	0.3	0.8	0.1	0.2	0.4
4	**Accident**	I	0.6	0.3	0.2	0.6	0.6	0.4
		D	0.2	0.4	0.05	0.1	0.2	0.2
		N	0.2	0.3	0.75	0.3	0.2	0.4
5	**Users satisfaction**	I	0.1	0.45	0.1	0.5	0.7	0.2
		D	0.1	0.25	0.1	0.1	0.2	0.6
		N	0.8	0.3	0.8	0.4	0.1	0.2
6	**Congestion level**	I	0.5	0.6	0.2	0.8	0.8	0.6
		D	0.1	0.2	0.1	0.1	0.1	0.2
		N	0.4	0.2	0.7	0.1	0.1	0.2
7	**Parking demand**	I	0.7	0.6	0.4	0.7	0.5	0.5
		D	0.1	0.1	0.1	0.1	0.3	0.2
		N	0.2	0.3	0.5	0.2	0.2	0.3
8	**Para-transit demand**	I	0.5	0.35	0.1	0.7	0.6	0.3
		D	0.05	0.35	0.1	0.1	0.2	0.6
		N	0.45	0.3	0.8	0.2	0.2	0.1
9	**Fuel comsumption**	I	0.3	0.45	0.3	0.8	0.4	0.6
		N	0	0.3	0.3	0.1	0.3	0.2
		D	0.7	0.25	0.4	0.1	0.3	0.2
10	**Noise level**	I	0.5	0.35	0.2	0.8	0.4	0.4
		N	0.1	0.35	0.2	0.1	0.4	0.4
		D	0.4	0.3	0.6	0.1	0.2	0.2
11	**Air quality**	I	0.7	0.35	0.2	0.7	0.5	0.2
		N	0	0.35	0.2	0.1	0.3	0.2
		D	0.3	0.3	0.6	0.2	0.2	0.6

7	8	9	10	11	12	13	14	15	16
0.6	0.7	0.8	0.6	0.6	0.8	0.7	0.7	0.7	0.7
0.2	0.2	0.1	0.2	0.3	0.1	0.2	0.1	0.2	0.2
0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.1
0.5	0.6	0.7	0.5	0.5	0.7	0.6	0.6	0.6	0.8
0.3	0.1	0.2	0.2	0.2	0.2	0.1	0.3	0.2	0.1
0.2	0.3	0.1	0.3	0.3	0.1	0.3	0.1	0.1	0.1
0.2	0.3	0.2	0.2	0.3	0.2	0.3	0.2	0.2	0.3
0.5	0.6	0.5	0.5	0.5	0.5	0.6	0.6	0.5	0.5
0.3	0.1	0.3	0.3	0.2	0.3	0.1	0.2	0.3	0.2
0.6	0.5	0.5	0.5	0.6	0.6	0.5	0.7	0.6	0.5
0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2
0.2	0.3	0.3	0.3	0.2	0.2	0.3	0.2	0.2	0.3
0.3	0.3	0.4	0.2	0.3	0.3	0.3	0.2	0.2	0.2
0.5	0.5	0.5	0.5	0.5	0.6	0.5	0.4	0.5	0.6
0.2	0.2	0.1	0.3	0.2	0.1	0.2	0.4	0.3	0.2
0.6	0.6	0.5	0.5	0.6	0.5	0.6	0.6	0.7	0.7
0.2	0.3	0.3	0.2	0.1	0.4	0.3	0.3	0.1	0.1
0.2	0.1	0.2	0.3	0.3	0.1	0.1	0.1	0.3	0.2
0.6	0.6	0.6	0.4	0.6	0.6	0.6	0.6	0.5	0.6
0.3	0.1	0.2	0.2	0.1	0.1	0.1	0.3	0.2	0.2
0.1	0.3	0.2	0.4	0.3	0.3	0.3	0.1	0.3	0.2
0.4	0.3	0.4	0.6	0.4	0.4	0.3	0.3	0.4	0.6
0.5	0.5	0.5	0.1	0.5	0.5	0.5	0.4	0.5	0.2
0.1	0.2	0.1	0.3	0.1	0.1	0.2	0.3	0.1	0.2
0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7
0.2	0.2	0.3	0.1	0.1	0.3	0.2	0.2	0.1	0.2
0.2	0.2	0.1	0.3	0.3	0.1	0.2	0.2	0.3	0.1
0.5	0.7	0.6	0.5	0.6	0.6	0.7	0.7	0.7	0.6
0.3	0.1	0.3	0.3	0.3	0.3	0.1	0.1	0.2	0.1
0.2	0.2	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.3
0.2	0.3	0.4	0.4	0.1	0.3	0.3	0.3	0.3	0.2
0.6	0.6	0.5	0.5	0.5	0.6	0.6	0.5	0.5	0.6
0.2	0.1	0.1	0.1	0.4	0.1	0.1	0.2	0.2	0.2

27	28	29	30	Mean
0.7	0.5	0.8	0.7	**0.63**
0.2	0.4	0.1	0.2	**0.18**
0.1	0.1	0.1	0.1	**0.20**
0.5	0.5	0.5	0.6	**0.58**
0.1	0.3	0.3	0.1	**0.19**
0.4	0.2	0.2	0.3	**0.23**
0.2	0.5	0.2	0.2	**0.32**
0.6	0.3	0.4	0.7	**0.43**
0.2	0.2	0.4	0.1	**0.25**
0.7	0.8	0.6	0.7	**0.55**
0.2	0.1	0.1	0.1	**0.19**
0.1	0.1	0.2	0.2	**0.26**
0.1	0.1	0.2	0.2	**0.28**
0.8	0.7	0.5	0.6	**0.45**
0.1	0.2	0.3	0.2	**0.26**
0.8	0.8	0.7	0.7	**0.66**
0.1	0.1	0.1	0.2	**0.16**
0.1	0.1	0.2	0.1	**0.18**
0.8	0.1	0.7	0.7	**0.62**
0.1	0.8	0.1	0.2	**0.17**
0.1	0.1	0.2	0.1	**0.21**
0.2	0.7	0.3	0.3	**0.36**
0.4	0.2	0.4	0.5	**0.39**
0.4	0.1	0.3	0.2	**0.25**
0.7	0.7	0.6	0.7	**0.63**
0.2	0.2	0.1	0.1	**0.17**
0.1	0.1	0.3	0.2	**0.21**
0.8	0.1	0.6	0.7	**0.56**
0.1	0.8	0.1	0.1	**0.23**
0.1	0.1	0.3	0.2	**0.21**
0.2	0.3	0.2	0.3	**0.29**
0.5	0.5	0.5	0.4	**0.49**
0.3	0.2	0.3	0.3	**0.23**

BPA function expert opinion (post)								
S.NO	INDICATORS		**1**	**2**	**3**	**4**	**5**	**6**
1	**Trip cost**	I	0.3	0.25	0.6	0.2	0.2	0.2
		D	0.6	0.5	0.3	0.7	0.4	0.6
		N	0.1	0.25	0.1	0.1	0.4	0.2
2	**Trip time**	I	0.1	0.6	0.1	0.2	0.3	0.3
		D	0.5	0.3	0.6	0.7	0.6	0.6
		N	0.4	0.1	0.3	0.1	0.1	0.1
3	**Safety and security**	I	0.4	0.55	0.2	0.7	0.5	0.5
		D	0	0.35	0.1	0.2	0.4	0.3
		N	0.6	0.1	0.7	0.1	0.1	0.2
4	**Accident**	I	0.3	0.55	0.05	0.2	0.3	0.3
		D	0.4	0.35	0.5	0.7	0.3	0.2
		N	0.3	0.1	0.45	0.1	0.4	0.5
5	**Users satisfaction**	I	0.25	0.5	0.5	0.7	0.6	0.5
		D	0.05	0.35	0.5	0.1	0.3	0.2
		N	0.7	0.15	0	0.2	0.1	0.3
6	**Congestion level**	I	0.35	0.3	0.5	0.2	0.2	0.1
		D	0.2	0.5	0.75	0.7	0.6	0.7
		N	0.45	0.2	0.2	0.1	0.2	0.2
7	**Parking demand**	I	0.4	0.2	0.5	0.5	0.3	0.2
		D	0.1	0.5	0.2	0.4	0.5	0.6
		N	0.5	0.3	0.3	0.1	0.2	0.2
8	**Para-transit demand**	I	0.7	0.35	0.6	0.5	0.5	0.6
		D	0.5	0.35	0.1	0.4	0.3	0.2
		N	0.25	0.3	0.3	0.1	0.2	0.2
9	**Fuel comsumption**	I	0.2	0.4	0.3	0.2	0.2	0.2
		N	0.4	0.5	0.5	0.7	0.6	0.2
		D	0.4	0.1	0.2	0.1	0.2	0.6
10	**Noise level**	I	0.1	0.35	0.1	0.2	0.4	0.3
		N	0.2	0.35	0.8	0.7	0.4	0.1
		D	0.7	0.3	0.1	0.1	0.2	0.6
11	**Air quality**	I	0.1	0.4	0.4	0.7	0.6	0.7
		N	0.2	0.3	0.1	0.2	0.3	0.2
		D	0.7	0.3	0.5	0.1	0.1	0.1

7	8	9	10	11	12	13	14	15	16
0.2	0.2	0.3	0.3	0.3	0.3	0.1	0.2	0.2	0.3
0.5	0.5	0.4	0.5	0.5	0.4	0.5	0.5	0.5	0.5
0.3	0.3	0.3	0.2	0.2	0.3	0.4	0.3	0.3	0.2
0.3	0.3	0.2	0.4	0.2	0.2	0.3	0.3	0.3	0.2
0.6	0.6	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.5
0.1	0.1	0.3	0.1	0.3	0.3	0.1	0.1	0.1	0.3
0.6	0.5	0.7	0.6	0.6	0.7	0.5	0.7	0.6	0.7
0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1
0.2	0.3	0.2	0.3	0.3	0.2	0.3	0.1	0.2	0.2
0.2	0.2	0.3	0.2	0.2	0.3	0.2	0.2	0.2	0.2
0.5	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.6	0.7
0.3	0.3	0.2	0.3	0.4	0.2	0.3	0.3	0.2	0.1
0.7	0.6	0.6	0.5	0.5	0.6	0.6	0.6	0.6	0.8
0.2	0.2	0.3	0.2	0.2	0.3	0.2	0.2	0.2	0.1
0.1	0.2	0.1	0.3	0.3	0.1	0.2	0.2	0.2	0.1
0.2	0.2	0.3	0.2	0.2	0.3	0.2	0.2	0.2	0.2
0.6	0.5	0.5	0.4	0.5	0.5	0.5	0.6	0.6	0.5
0.2	0.3	0.2	0.4	0.3	0.2	0.3	0.2	0.2	0.3
0.3	0.2	0.3	0.3	0.2	0.6	0.2	0.3	0.2	0.2
0.5	0.4	0.5	0.5	0.6	0.3	0.4	0.4	0.5	0.7
0.2	0.4	0.2	0.2	0.2	0.1	0.4	0.3	0.3	0.1
0.6	0.5	0.6	0.5	0.6	0.2	0.5	0.6	0.6	0.6
0.3	0.1	0.3	0.1	0.2	0.5	0.1	0.3	0.2	0.2
0.1	0.4	0.1	0.4	0.2	0.3	0.4	0.1	0.2	0.2
0.2	0.4	0.2	0.3	0.2	0.4	0.4	0.3	0.2	0.2
0.5	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.4	0.7
0.3	0.1	0.3	0.2	0.4	0.1	0.1	0.2	0.4	0.1
0.2	0.4	0.5	0.3	0.3	0.3	0.4	0.3	0.3	0.2
0.4	0.5	0.4	0.5	0.5	0.2	0.5	0.5	0.5	0.7
0.4	0.1	0.1	0.2	0.2	0.5	0.1	0.2	0.2	0.1
0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.7
0.2	0.3	0.3	0.2	0.2	0.2	0.3	0.3	0.1	0.2
0.2	0.2	0.2	0.3	0.3	0.3	0.2	0.1	0.3	0.1

17	18	19	20	21	22	23	24	25	26
0.2	0.3	0.2	0.2	0.1	0.2	0.1	0.2	0.2	0.1
0.5	0.5	0.7	0.7	0.6	0.6	0.7	0.6	0.6	0.7
0.3	0.2	0.1	0.1	0.3	0.2	0.2	0.2	0.2	0.2
0.3	0.2	0.3	0.1	0.1	0.1	0.3	0.6	0.1	0.2
0.4	0.4	0.5	0.6	0.7	0.7	0.6	0.1	0.8	0.6
0.3	0.4	0.2	0.3	0.2	0.2	0.1	0.3	0.1	0.2
0.7	0.6	0.5	0.5	0.6	0.6	0.5	0.6	0.7	0.8
0.1	0.2	0.3	0.2	0.2	0.3	0.3	0.3	0.2	0.1
0.2	0.2	0.2	0.3	0.2	0.1	0.2	0.1	0.1	0.1
0.5	0.2	0.2	0.3	0.2	0.3	0.3	0.2	0.2	0.4
0.3	0.5	0.6	0.6	0.7	0.6	0.6	0.6	0.6	0.5
0.2	0.3	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.1
0.6	0.6	0.8	0.6	0.8	0.7	0.7	0.7	0.8	0.6
0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.2
0.2	0.3	0.1	0.2	0.1	0.2	0.2	0.2	0.1	0.2
0.1	0.2	0.2	0.2	0.3	0.2	0.1	0.2	0.1	0.1
0.6	0.6	0.7	0.7	0.5	0.6	0.8	0.6	0.6	0.8
0.3	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.3	0.1
0.2	0.2	0.2	0.1	0.6	0.2	0.3	0.2	0.2	0.3
0.5	0.5	0.6	0.6	0.1	0.6	0.6	0.5	0.7	0.6
0.3	0.3	0.2	0.3	0.3	0.2	0.1	0.3	0.1	0.1
0.5	0.6	0.6	0.5	0.3	0.7	0.7	0.5	0.5	0.6
0.3	0.3	0.2	0.3	0.5	0.2	0.2	0.3	0.2	0.1
0.2	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.3	0.3
0.2	0.2	0.4	0.2	0.3	0.2	0.4	0.1	0.1	0.3
0.5	0.6	0.5	0.7	0.5	0.5	0.5	0.7	0.3	0.5
0.3	0.2	0.1	0.1	0.2	0.3	0.1	0.2	0.6	0.2
0.3	0.2	0.4	0.3	0.8	0.2	0.2	0.3	0.3	0.3
0.6	0.5	0.5	0.5	0.1	0.5	0.6	0.6	0.6	0.5
0.1	0.3	0.1	0.2	0.1	0.3	0.2	0.1	0.1	0.2
0.7	0.6	0.4	0.6	0.2	0.6	0.8	0.5	0.7	0.6
0.1	0.1	0.3	0.2	0.6	0.2	0.1	0.3	0.2	0.1
0.2	0.3	0.3	0.2	0.2	0.2	0.1	0.2	0.1	0.3

27	28	29	30	mean
0.3	0.3	0.3	0.3	**0.24**
0.5	0.5	0.5	0.5	**0.54**
0.2	0.2	0.2	0.2	**0.23**
0.1	0.1	0.2	0.2	**0.24**
0.8	0.7	0.6	0.5	**0.56**
0.1	0.2	0.2	0.3	**0.20**
0.5	0.7	0.6	0.6	**0.59**
0.3	0.2	0.3	0.2	**0.20**
0.2	0.1	0.1	0.2	**0.21**
0.5	0.3	0.1	0.2	**0.26**
0.3	0.5	0.6	0.6	**0.51**
0.2	0.2	0.3	0.2	**0.23**
0.7	0.6	0.7	0.7	**0.63**
0.2	0.2	0.1	0.1	**0.18**
0.1	0.2	0.2	0.2	**0.19**
0.1	0.3	0.2	0.2	**0.21**
0.8	0.4	0.5	0.5	**0.58**
0.1	0.3	0.3	0.3	**0.23**
0.2	0.3	0.2	0.2	**0.28**
0.5	0.6	0.4	0.6	**0.48**
0.3	0.1	0.4	0.2	**0.24**
0.4	0.6	0.5	0.5	**0.54**
0.5	0.1	0.2	0.3	**0.26**
0.1	0.3	0.3	0.2	**0.20**
0.3	0.3	0.2	0.2	**0.26**
0.6	0.5	0.4	0.5	**0.50**
0.1	0.2	0.4	0.3	**0.24**
0.3	0.3	0.2	0.2	**0.30**
0.6	0.5	0.5	0.6	**0.48**
0.1	0.2	0.3	0.2	**0.22**
0.5	0.7	0.5	0.3	**0.54**
0.3	0.2	0.2	0.4	**0.23**
0.2	0.1	0.3	0.3	**0.23**

Appendix B

Public rating survey

CSIR-Central Road Research Institute, New Delhi -110020

SUSTAINABILITY ASSESSMENT OF TRANSPORT MEASURES

Personal Details

Gender: M /F /TG

Age:

Profession:

Rate the increase (I) and decrease (D) scenario of given indicators with respect to before and after "Odd-Even scheme" implementation .Here the rating scale 1 to 10 represents the probability of increase and decrease of specific indicators with respect to the Odd-Even scheme in which 1 represents the lowest probability and 10 represents the highest probability and values in between represents moderate probabilities.

1. Before Odd-Even scheme Implementation:

S NO	INDICATORS	SCENARIO	RATING SCALE 1 to 10										
			1	2	3	4	5	6	7	8	9	10	
1	Trip Cost	I											
		D											
2	Trip Time	I											
		D											
3	Safety and Security	I											
		D											
4	Accidents	I											
		D											
5	Users Satisfaction	I											
		D											
6	Congestion level	I											
		D											
7	Parking Demand	I											
		D											
8	Para-transit Demand	I											
		D											
9	Fuel Consumption	I											
		D											
10	Noise Level	I											
		D											
11	Air Quality	I											
		D											

2. After Odd-Even scheme Implementation:

S NO	INDICATORS	SCENARIO	RATING SCALE 1 to 10										
			1	2	3	4	5	6	7	8	9	10	
1	Trip Cost	I											
		D											
2	Trip Time	I											
		D											
3	Safety and Security	I											
		D											
4	Accidents	I											
		D											
5	Users Satisfaction	I											
		D											
6	Congestion level	I											
		D											
7	Parking Demand	I											
		D											
8	Para-transit Demand	I											
		D											
9	Fuel Consumption	I											
		D											
10	Noise Level	I											
		D											
11	Air Quality	I											
		D											

Public rating survey data

public rating survey for bpa assignment for before and after odd-even scheme implementation								
			1		2		3	
			PRE	POST	PRE	POST	PRE	POST
1	Trip cost	I	0.7	0.1	0.6	0.3	0.6	0.2
		D	0.2	0.8	0.2	0.5	0.2	0.5
		N	0.1	0.1	0.2	0.2	0.2	0.3
2	Trip time	I	0.6	0.2	0.5	0.2	0.7	0.3
		D	0.3	0.6	0.3	0.6	0.2	0.6
		N	0.1	0.2	0.2	0.2	0.1	0.1
3	Safety and security	I	0.2	0.7	0.2	0.7	0.1	0.7
		D	0.5	0.2	0.6	0.2	0.6	0.2
		N	0.3	0.1	0.2	0.1	0.3	0.1
4	Accident	I	0.6	0.2	0.7	0.2	0.6	0.1
		D	0.2	0.5	0.2	0.5	0.1	0.5
		N	0.2	0.3	0.1	0.3	0.3	0.4
5	Users satisfaction	I	0.2	0.6	0.3	0.6	0.2	0.5
		D	0.6	0.1	0.5	0.3	0.6	0.2
		N	0.2	0.3	0.2	0.1	0.2	0.3
6	Congestion level	I	0.7	0.3	0.6	0.2	0.7	0.2
		D	0.2	0.5	0.2	0.5	0.2	0.5
		N	0.1	0.2	0.2	0.3	0.1	0.3
7	Parking demand	I	0.5	0.3	0.5	0.2	0.6	0.2
		D	0.2	0.5	0.1	0.5	0.2	0.5
		N	0.3	0.2	0.4	0.3	0.2	0.3
8	Para-transit demand	I	0.3	0.5	0.3	0.5	0.3	0.5
		D	0.5	0.3	0.4	0.2	0.4	0.3
		N	0.2	0.2	0.3	0.3	0.3	0.2
9	Fuel consumption	I	0.6	0.2	0.5	0.2	0.6	0.1
		N	0.3	0.5	0.1	0.6	0.3	0.5
		D	0.1	0.3	0.4	0.2	0.1	0.4
10	Noise level	I	0.4	0.2	0.5	0.3	0.6	0.2
		N	0.3	0.5	0.3	0.5	0.2	0.5
		D	0.3	0.3	0.2	0.2	0.2	0.3
11	Air quality	I	0.3	0.6	0.2	0.5	0.2	0.5
		N	0.5	0.2	0.5	0.3	0.5	0.2
		D	0.2	0.2	0.3	0.2	0.3	0.3

4		5		6		7		8	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.7	0.3	0.7	0.2	0.7	0.3	0.7	0.3	0.6	0.3
0.2	0.6	0.1	0.5	0.2	0.5	0.2	0.5	0.2	0.5
0.1	0.1	0.2	0.3	0.1	0.2	0.1	0.2	0.2	0.2
0.8	0.2	0.6	0.5	0.6	0.2	0.4	0.2	0.5	0.4
0.1	0.7	0.2	0.3	0.3	0.5	0.3	0.6	0.2	0.5
0.1	0.1	0.2	0.2	0.1	0.3	0.3	0.2	0.3	0.1
0.6	0.6	0.2	0.6	0.3	0.6	0.3	0.5	0.2	0.6
0.2	0.3	0.6	0.2	0.5	0.2	0.5	0.1	0.5	0.1
0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.4	0.3	0.3
0.8	0.1	0.7	0.2	0.4	0.2	0.6	0.2	0.5	0.2
0.1	0.7	0.2	0.7	0.5	0.5	0.1	0.5	0.2	0.5
0.1	0.2	0.1	0.1	0.1	0.3	0.3	0.3	0.3	0.3
0.7	0.7	0.2	0.7	0.3	0.6	0.3	0.6	0.2	0.5
0.2	0.2	0.5	0.1	0.4	0.1	0.4	0.1	0.5	0.2
0.1	0.1	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3
0.8	0.3	0.6	0.2	0.3	0.2	0.5	0.2	0.5	0.2
0.1	0.5	0.2	0.5	0.5	0.5	0.2	0.4	0.2	0.4
0.1	0.2	0.2	0.3	0.2	0.3	0.3	0.4	0.3	0.4
0.8	0.2	0.6	0.2	0.3	0.2	0.5	0.4	0.4	0.3
0.1	0.6	0.2	0.5	0.6	0.4	0.3	0.5	0.2	0.5
0.1	0.2	0.2	0.3	0.1	0.4	0.2	0.1	0.4	0.2
0.6	0.6	0.1	0.6	0.6	0.5	0.4	0.6	0.6	0.5
0.3	0.3	0.2	0.3	0.3	0.2	0.5	0.2	0.1	0.1
0.1	0.1	0.7	0.1	0.1	0.3	0.1	0.2	0.3	0.4
0.8	0.3	0.4	0.2	0.4	0.2	0.6	0.2	0.6	0.3
0.1	0.5	0.3	0.6	0.5	0.5	0.1	0.5	0.1	0.5
0.1	0.2	0.3	0.2	0.1	0.3	0.3	0.3	0.3	0.2
0.7	0.3	0.5	0.1	0.4	0.3	0.5	0.2	0.5	0.3
0.2	0.6	0.2	0.5	0.2	0.5	0.1	0.5	0.3	0.5
0.1	0.1	0.3	0.4	0.4	0.2	0.4	0.3	0.2	0.2
0.1	0.5	0.2	0.4	0.6	0.6	0.4	0.5	0.4	0.5
0.8	0.3	0.5	0.2	0.2	0.1	0.1	0.2	0.5	0.2
0.1	0.2	0.3	0.4	0.2	0.3	0.5	0.3	0.1	0.3

9		10		11		12		13	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.6	0.3	0.6	0.3	0.8	0.3	0.7	0.1	0.6	0.2
0.3	0.5	0.2	0.6	0.1	0.4	0.2	0.5	0.2	0.5
0.1	0.2	0.2	0.1	0.1	0.3	0.1	0.4	0.2	0.3
0.5	0.2	0.5	0.3	0.7	0.2	0.6	0.3	0.5	0.3
0.2	0.5	0.1	0.5	0.2	0.5	0.1	0.6	0.3	0.6
0.3	0.3	0.4	0.2	0.1	0.3	0.3	0.1	0.2	0.1
0.3	0.6	0.3	0.6	0.2	0.7	0.3	0.5	0.2	0.6
0.5	0.1	0.6	0.2	0.5	0.1	0.6	0.2	0.5	0.2
0.2	0.3	0.1	0.2	0.3	0.2	0.1	0.3	0.3	0.2
0.6	0.2	0.7	0.4	0.6	0.3	0.5	0.2	0.6	0.2
0.2	0.4	0.1	0.5	0.2	0.5	0.2	0.5	0.2	0.5
0.2	0.4	0.2	0.1	0.2	0.2	0.3	0.3	0.2	0.3
0.3	0.5	0.4	0.6	0.3	0.6	0.3	0.6	0.3	0.7
0.5	0.2	0.5	0.2	0.6	0.3	0.5	0.2	0.5	0.2
0.2	0.3	0.1	0.2	0.1	0.1	0.2	0.2	0.2	0.1
0.6	0.2	0.6	0.2	0.5	0.3	0.6	0.2	0.6	0.2
0.1	0.5	0.2	0.4	0.4	0.5	0.3	0.5	0.2	0.6
0.3	0.3	0.2	0.4	0.1	0.2	0.1	0.3	0.2	0.2
0.6	0.2	0.6	0.3	0.6	0.6	0.6	0.2	0.6	0.3
0.1	0.6	0.2	0.6	0.1	0.3	0.1	0.4	0.3	0.5
0.3	0.2	0.2	0.1	0.3	0.1	0.3	0.4	0.1	0.2
0.4	0.6	0.4	0.5	0.4	0.2	0.3	0.5	0.4	0.6
0.5	0.2	0.5	0.3	0.5	0.5	0.5	0.1	0.5	0.3
0.1	0.2	0.1	0.2	0.1	0.3	0.2	0.4	0.1	0.1
0.6	0.2	0.6	0.4	0.6	0.4	0.6	0.4	0.6	0.2
0.1	0.4	0.3	0.5	0.3	0.5	0.2	0.5	0.2	0.5
0.3	0.4	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.3
0.6	0.3	0.4	0.3	0.6	0.3	0.7	0.4	0.5	0.2
0.3	0.5	0.5	0.5	0.3	0.2	0.1	0.5	0.3	0.4
0.1	0.2	0.1	0.2	0.1	0.5	0.2	0.1	0.2	0.4
0.1	0.5	0.3	0.6	0.3	0.5	0.3	0.5	0.6	0.6
0.5	0.2	0.5	0.1	0.6	0.2	0.6	0.3	0.2	0.2
0.4	0.3	0.2	0.3	0.1	0.3	0.1	0.2	0.2	0.2

14		15		16		17		18	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.7	0.2	0.7	0.2	0.7	0.3	0.6	0.2	0.8	0.3
0.1	0.5	0.2	0.5	0.2	0.5	0.1	0.5	0.1	0.5
0.2	0.3	0.1	0.3	0.1	0.2	0.3	0.3	0.1	0.2
0.6	0.3	0.6	0.3	0.8	0.2	0.5	0.3	0.7	0.2
0.3	0.6	0.2	0.6	0.1	0.5	0.3	0.4	0.2	0.4
0.1	0.1	0.1	0.1	0.1	0.3	0.2	0.3	0.1	0.4
0.2	0.7	0.2	0.6	0.3	0.7	0.3	0.7	0.2	0.6
0.6	0.2	0.5	0.2	0.5	0.1	0.6	0.1	0.6	0.2
0.2	0.1	0.3	0.2	0.2	0.2	0.1	0.2	0.2	0.2
0.7	0.2	0.6	0.2	0.5	0.2	0.8	0.5	0.7	0.2
0.1	0.5	0.2	0.6	0.2	0.7	0.1	0.3	0.1	0.5
0.2	0.3	0.2	0.2	0.3	0.1	0.1	0.2	0.2	0.3
0.2	0.6	0.2	0.6	0.2	0.8	0.3	0.6	0.2	0.6
0.4	0.2	0.5	0.2	0.6	0.1	0.5	0.2	0.5	0.1
0.4	0.2	0.3	0.2	0.2	0.1	0.2	0.2	0.3	0.3
0.6	0.2	0.7	0.2	0.7	0.2	0.5	0.1	0.5	0.2
0.3	0.6	0.1	0.6	0.1	0.5	0.2	0.6	0.2	0.6
0.1	0.2	0.3	0.2	0.2	0.3	0.3	0.3	0.3	0.2
0.6	0.3	0.5	0.2	0.6	0.2	0.6	0.2	0.6	0.2
0.3	0.4	0.2	0.5	0.2	0.7	0.2	0.5	0.1	0.5
0.1	0.3	0.3	0.3	0.2	0.1	0.2	0.3	0.3	0.3
0.3	0.6	0.4	0.6	0.6	0.6	0.4	0.5	0.3	0.6
0.4	0.3	0.5	0.2	0.2	0.2	0.2	0.3	0.4	0.3
0.3	0.1	0.1	0.2	0.2	0.2	0.4	0.2	0.3	0.1
0.6	0.3	0.6	0.2	0.7	0.2	0.7	0.2	0.6	0.2
0.2	0.5	0.1	0.4	0.2	0.7	0.2	0.5	0.1	0.6
0.2	0.2	0.3	0.4	0.1	0.1	0.1	0.3	0.3	0.2
0.7	0.3	0.7	0.3	0.6	0.2	0.8	0.3	0.4	0.2
0.1	0.5	0.2	0.5	0.1	0.7	0.1	0.6	0.2	0.5
0.2	0.2	0.1	0.2	0.3	0.1	0.1	0.1	0.4	0.3
0.3	0.6	0.3	0.6	0.2	0.7	0.2	0.7	0.2	0.6
0.5	0.3	0.5	0.1	0.6	0.2	0.7	0.1	0.6	0.1
0.2	0.1	0.2	0.3	0.2	0.1	0.1	0.2	0.2	0.3

19		20		21		22		23	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.8	0.3	0.7	0.1	0.8	0.2	0.5	0.3	0.8	0.1
0.1	0.5	0.1	0.6	0.1	0.5	0.3	0.5	0.1	0.7
0.1	0.2	0.2	0.3	0.1	0.3	0.2	0.2	0.1	0.2
0.7	0.2	0.5	0.2	0.6	0.3	0.8	0.5	0.6	0.2
0.2	0.5	0.2	0.7	0.2	0.6	0.1	0.1	0.2	0.6
0.1	0.3	0.3	0.1	0.2	0.1	0.1	0.4	0.2	0.2
0.3	0.6	0.4	0.6	0.2	0.7	0.4	0.6	0.2	0.7
0.5	0.1	0.1	0.2	0.7	0.1	0.2	0.3	0.7	0.2
0.2	0.3	0.5	0.2	0.1	0.2	0.4	0.1	0.1	0.1
0.7	0.2	0.2	0.1	0.7	0.2	0.5	0.3	0.7	0.2
0.2	0.7	0.1	0.6	0.1	0.7	0.2	0.2	0.2	0.6
0.1	0.1	0.7	0.3	0.2	0.1	0.3	0.5	0.1	0.2
0.2	0.7	0.6	0.7	0.2	0.7	0.3	0.7	0.2	0.8
0.6	0.2	0.2	0.1	0.7	0.1	0.5	0.1	0.7	0.1
0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.1
0.6	0.2	0.7	0.2	0.7	0.1	0.8	0.2	0.7	0.2
0.2	0.7	0.2	0.7	0.1	0.8	0.1	0.7	0.1	0.7
0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.1
0.6	0.3	0.3	0.2	0.7	0.2	0.7	0.3	0.7	0.3
0.2	0.5	0.1	0.6	0.2	0.7	0.1	0.6	.1`	0.5
0.2	0.2	0.6	0.2	0.1	0.1	0.2	0.1	0.2	0.2
0.3	0.6	0.2	0.2	0.3	0.7	0.5	0.7	0.3	0.6
0.6	0.1	0.6	0.5	0.5	0.1	0.2	0.1	0.5	0.1
0.1	0.3	0.2	0.3	0.2	0.2	0.3	0.2	0.2	0.3
0.7	0.3	0.6	0.1	0.7	0.2	0.7	0.3	0.6	0.2
0.1	0.5	0.3	0.7	0.1	0.6	0.2	0.6	0.1	0.6
0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.1	0.3	0.2
0.6	0.3	0.8	0.2	0.7	0.3	0.5	0.3	0.6	0.3
0.1	0.5	0.1	0.7	0.1	0.5	0.4	0.5	0.2	0.5
0.3	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.2
0.3	0.8	0.2	0.6	0.3	0.7	0.3	0.5	0.2	0.7
0.5	0.1	0.4	0.2	0.6	0.2	0.6	0.4	0.7	0.1
0.2	0.1	0.4	0.2	0.1	0.1	0.1	0.1	0.1	0.2

24		25		26		27		28	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.7	0.2	0.2	0.2	0.8	0.1	0.7	0.3	0.8	0.2
0.2	0.6	0.7	0.6	0.1	0.7	0.2	0.5	0.1	0.6
0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
0.6	0.3	0.5	0.1	0.7	0.2	0.6	0.2	0.7	0.2
0.3	0.5	0.3	0.7	0.2	0.6	0.2	0.7	0.2	0.6
0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.2
0.2	0.6	0.2	0.7	0.3	0.6	0.3	0.7	0.3	0.5
0.5	0.2	0.7	0.2	0.6	0.3	0.5	0.2	0.5	0.3
0.3	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2
0.6	0.2	0.6	0.2	0.7	0.3	0.5	0.2	0.5	0.2
0.2	0.6	0.3	0.6	0.2	0.6	0.3	0.6	0.3	0.5
0.2	0.2	0.1	0.2	0.1	0.1	0.2	0.2	0.2	0.3
0.2	0.7	0.2	0.6	0.3	0.6	0.3	0.6	0.2	0.6
0.6	0.1	0.6	0.3	0.6	0.2	0.5	0.3	0.6	0.2
0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.2
0.7	0.6	0.7	0.2	0.7	0.2	0.7	0.2	0.6	0.2
0.2	0.2	0.1	0.7	0.2	0.6	0.2	0.7	0.1	0.7
0.1	0.2	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.1
0.7	0.6	0.7	0.2	0.7	0.1	0.7	0.2	0.7	0.2
0.2	0.2	0.2	0.7	0.2	0.7	0.1	0.7	0.1	0.7
0.1	0.2	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.1
0.2	0.6	0.2	0.6	0.2	0.5	0.3	0.6	0.2	0.7
0.5	0.2	0.5	0.2	0.5	0.2	0.5	0.2	0.6	0.1
0.3	0.2	0.3	0.2	0.3	0.3	0.2	0.2	0.2	0.2
0.7	0.7	0.7	0.2	0.7	0.3	0.5	0.2	0.6	0.5
0.1	0.1	0.2	0.5	0.2	0.5	0.2	0.6	0.2	0.2
0.2	0.2	0.1	0.3	0.1	0.2	0.3	0.2	0.2	0.3
0.6	0.2	0.7	0.3	0.7	0.3	0.7	0.3	0.5	0.2
0.2	0.7	0.1	0.5	0.2	0.5	0.1	0.5	0.4	0.5
0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.3
0.3	0.7	0.3	0.6	0.4	0.5	0.3	0.6	0.2	0.5
0.6	0.2	0.5	0.3	0.5	0.2	0.6	0.2	0.6	0.3
0.1	0.1	0.2	.1`	0.1	0.3	0.1	0.2	0.2	0.2

29		30		31		32		33	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.6	0.3	0.7	0.2	0.7	0.1	0.6	0.3	0.7	0.2
0.3	0.5	0.1	0.5	0.2	0.7	0.3	0.5	0.2	0.6
0.1	0.2	0.2	0.3	0.1	0.2	0.1	0.2	0.1	0.2
0.5	0.1	0.6	0.3	0.5	0.2	0.8	0.3	0.6	0.3
0.2	0.7	0.3	0.6	0.3	0.6	0.1	0.5	0.3	0.5
0.3	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.1	0.2
0.3	0.7	0.2	0.7	0.2	0.7	0.2	0.6	0.2	0.7
0.6	0.2	0.5	0.1	0.6	0.2	0.5	0.2	0.7	0.1
0.1	0.1	0.3	0.2	0.2	0.1	0.3	0.2	0.1	0.2
0.5	0.2	0.6	0.4	0.7	0.5	0.6	0.7	0.5	0.2
0.3	0.6	0.3	0.3	0.1	0.3	0.2	0.1	0.2	0.6
0.2	0.2	0.1	0.3	0.2	0.2	0.2	0.2	0.3	0.2
0.2	0.8	0.3	0.6	0.5	0.3	0.2	0.7	0.5	0.7
0.4	0.1	0.5	0.1	0.3	0.2	0.5	0.1	0.2	0.2
0.4	0.1	0.2	0.3	0.2	0.5	0.3	0.2	0.3	0.1
0.5	0.3	0.5	0.2	0.5	0.3	0.6	0.2	0.7	0.2
0.2	0.6	0.2	0.5	0.3	0.5	0.1	0.5	0.2	0.7
0.3	0.1	0.3	0.3	0.2	0.2	0.3	0.3	0.1	0.1
0.6	0.2	0.6	0.2	0.6	0.3	0.6	0.3	0.7	0.1
0.3	0.6	0.2	0.6	0.1	0.5	0.1	0.4	0.2	0.5
0.1	0.2	0.2	0.2	0.3	0.2	0.3	0.3	0.1	0.4
0.2	0.6	0.2	0.6	0.3	0.4	0.6	0.5	0.3	0.5
0.5	0.1	0.4	0.2	0.5	0.3	0.1	0.3	0.6	0.2
0.3	0.3	0.4	0.2	0.2	0.3	0.3	0.2	0.1	0.3
0.7	0.2	0.6	0.2	0.6	0.1	0.6	0.4	0.7	0.2
0.1	0.5	0.1	0.6	0.2	0.6	0.2	0.5	0.2	0.5
0.2	0.3	0.3	0.2	0.2	0.3	0.2	0.1	0.1	0.3
0.5	0.2	0.6	0.3	0.6	0.2	0.6	0.2	0.6	0.4
0.3	0.7	0.2	0.5	0.2	0.5	0.2	0.6	0.2	0.5
0.2	0.1	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.1
0.3	0.6	0.2	0.6	0.2	0.2	0.3	0.6	0.2	0.5
0.5	0.3	0.6	0.1	0.6	0.6	0.5	0.1	0.7	0.2
0.2	0.1	0.2	0.3	0.2	0.2	0.2	0.3	0.1	0.3

34		35		36		37		38	
PRI	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
0.6	0.3	0.7	0.2	0.7	0.2	0.7	0.3	0.7	0.3
0.2	0.6	0.1	0.7	0.1	0.5	0.1	0.5	0.1	0.5
0.2	0.1	0.2	0.1	0.2	0.3	0.2	0.2	0.2	0.2
0.7	0.2	0.6	0.3	0.6	0.2	0.6	0.2	0.6	0.2
0.1	0.6	0.1	0.5	0.2	0.6	0.2	0.4	0.1	0.4
0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.4	0.3	0.4
0.3	0.7	0.3	0.6	0.2	0.6	0.2	0.5	0.2	0.6
0.5	0.1	0.6	0.2	0.6	0.2	0.4	0.3	0.4	0.2
0.2	0.2	0.1	0.2	0.2	0.2	0.4	0.2	0.4	0.2
0.6	0.2	0.3	0.2	0.7	0.2	0.6	0.2	0.4	0.2
0.2	0.5	0.5	0.4	0.1	0.6	0.3	0.5	0.3	0.5
0.2	0.3	0.2	0.4	0.2	0.2	0.1	0.3	0.3	0.3
0.7	0.7	0.2	0.6	0.2	0.7	0.3	0.6	0.1	0.6
0.1	0.2	0.6	0.2	0.4	0.2	0.4	0.1	0.5	0.2
0.2	0.1	0.2	0.2	0.4	0.1	0.3	0.3	0.4	0.2
0.7	0.2	0.8	0.3	0.6	0.5	0.7	0.3	0.7	0.2
0.2	0.6	0.1	0.5	0.2	0.3	0.1	0.6	0.2	0.5
0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.3
0.6	0.3	0.6	0.1	0.6	0.6	0.7	0.1	0.7	0.2
0.3	0.6	0.2	0.5	0.1	0.1	0.1	0.7	0.1	0.5
0.1	0.1	0.2	0.4	0.3	0.3	0.2	0.2	0.2	0.3
0.2	0.6	0.2	0.5	0.3	0.7	0.4	0.6	0.3	0.6
0.4	0.3	0.4	0.1	0.6	0.1	0.5	0.2	0.5	0.1
0.4	0.1	0.4	0.4	0.1	0.2	0.1	0.2	0.2	0.3
0.7	0.3	0.7	0.3	0.7	0.7	0.6	0.2	0.6	0.3
0.1	0.5	0.1	0.6	0.2	0.1	0.1	0.6	0.1	0.5
0.2	0.2	0.2	0.1	0.1	0.2	0.3	0.2	0.3	0.2
0.6	0.3	0.7	0.2	0.6	0.3	0.6	0.2	0.5	0.4
0.2	0.5	0.2	0.6	0.2	0.5	0.2	0.6	0.2	0.5
0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.1
0.1	0.6	0.3	0.7	0.2	0.6	0.3	0.7	0.2	0.6
0.6	0.2	0.6	0.1	0.6	0.2	0.6	0.1	0.5	0.1
0.3	0.2	0.1	0.2	0.2	0.2	0.1	0.2	0.3	0.3

39		40		41		42		43	
PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
0.3	0.3	0.3	0.1	0.6	0.3	0.8	0.2	0.4	0.2
0.5	0.6	0.5	0.7	0.2	0.6	0.1	0.7	0.2	0.7
0.2	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.4	0.1
0.2	0.2	0.2	0.7	0.8	0.3	0.8	0.3	0.6	0.1
0.6	0.6	0.7	0.2	0.1	0.5	0.1	0.5	0.1	0.6
0.2	0.2	0.1	0.1	0.1	0.2	0.1	0.2	0.3	0.3
0.7	0.7	0.8	0.7	0.7	0.6	0.3	0.5	0.7	0.5
0.2	0.1	0.1	0.1	0.2	0.1	0.4	0.3	0.1	0.2
0.1	0.2	0.1	0.2	0.1	0.3	0.3	0.2	0.2	0.3
0.3	0.2	0.4	0.2	0.3	0.2	0.6	0.2	0.4	0.3
0.3	0.6	0.2	0.6	0.1	0.5	0.2	0.6	0.2	0.6
0.4	0.2	0.4	0.2	0.6	0.3	0.2	0.2	0.4	0.1
0.8	0.8	0.6	0.8	0.4	0.6	0.2	0.8	0.5	0.6
0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.2
0.2	0.1	0.2	0.1	0.4	0.3	0.1	0.1	0.3	0.2
0.8	0.2	0.8	0.2	0.8	0.2	0.8	0.2	0.8	0.2
0.1	0.6	0.1	0.6	0.1	0.7	0.1	0.7	0.1	0.7
0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1
0.8	0.3	0.8	0.1	0.3	0.2	0.8	0.2	0.8	0.1
0.1	0.6	0.1	0.7	0.5	0.6	0.1	0.6	0.1	0.6
0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.2	0.1	0.3
0.2	0.6	0.3	0.7	0.6	0.6	0.3	0.6	0.2	0.5
0.4	0.2	0.5	0.2	0.2	0.1	0.5	0.2	0.7	0.3
0.4	0.2	0.2	0.1	0.2	0.3	0.2	0.2	0.1	0.2
0.2	0.1	0.2	0.2	0.6	0.2	0.8	0.4	0.8	0.2
0.4	0.6	0.2	0.7	0.2	0.7	0.1	0.5	0.1	0.7
0.4	0.3	0.6	0.1	0.2	0.1	0.1	0.1	0.1	0.1
0.2	0.3	0.6	0.3	0.2	0.2	0.6	0.4	0.5	0.3
0.2	0.5	0.3	0.6	0.3	0.6	0.2	0.5	0.1	0.5
0.6	0.2	0.1	0.1	0.5	0.2	0.2	0.1	0.4	0.2
0.2	0.6	0.1	0.5	0.3	0.5	0.1	0.4	0.2	0.6
0.6	0.2	0.5	0.3	0.5	0.3	0.8	0.3	0.5	0.2
0.2	0.2	0.4	0.2	0.2	0.2	0.1	0.3	0.3	0.2

44		45		46		47		48	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.6	0.1	0.7	0.2	0.5	0.1	0.7	0.1	0.6	0.1
0.2	0.6	0.2	0.6	0.2	0.7	0.2	0.7	0.3	0.7
0.2	0.3	0.1	0.2	0.3	0.2	0.1	0.2	0.1	0.2
0.5	0.1	0.8	0.1	0.7	0.3	0.8	0.2	0.8	0.2
0.3	0.7	0.1	0.7	0.2	0.6	0.1	0.6	0.1	0.6
0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.2
0.1	0.6	0.4	0.6	0.4	0.5	0.7	0.8	0.7	0.7
0.7	0.2	0.5	0.3	0.5	0.3	0.2	0.1	0.2	0.2
0.2	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1
0.4	0.2	0.4	0.3	0.4	0.3	0.5	0.2	0.8	0.2
0.1	0.7	0.3	0.6	0.3	0.6	0.4	0.5	0.1	0.7
0.5	0.1	0.3	0.1	0.3	0.1	0.1	0.3	0.1	0.1
0.2	0.8	0.2	0.7	0.3	0.7	0.3	0.7	0.6	0.7
0.5	0.1	0.6	0.1	0.6	0.1	0.6	0.1	0.3	0.2
0.3	0.1	0.2	0.2	0.1	0.2	0.1	0.2	0.1	0.1
0.8	0.3	0.8	0.2	0.8	0.1	0.8	0.2	0.8	0.3
0.1	0.5	0.1	0.6	0.1	0.8	0.1	0.6	0.1	0.6
0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.1
0.8	0.6	0.7	0.2	0.5	0.3	0.8	0.2	0.8	0.1
0.1	0.1	0.1	0.6	0.3	0.6	0.1	0.6	0.1	0.7
0.1	0.3	0.2	0.2	0.2	0.1	0.1	0.2	0.1	0.2
0.2	0.3	0.2	0.7	0.4	0.7	0.4	0.7	0.2	0.8
0.6	0.5	0.7	0.2	0.3	0.2	0.5	0.1	0.6	0.1
0.2	0.2	0.1	0.1	0.3	0.1	0.1	0.2	0.2	0.1
0.8	0.3	0.8	0.2	0.7	0.4	0.8	0.1	0.4	0.2
0.1	0.5	0.1	0.5	0.1	0.5	0.1	0.7	0.2	0.7
0.1	0.2	0.1	0.3	0.2	0.1	0.1	0.2	0.4	0.1
0.6	0.8	0.5	0.2	0.5	0.2	0.7	0.2	0.7	0.2
0.3	0.1	0.3	0.5	0.3	0.6	0.1	0.6	0.2	0.7
0.1	0.1	0.2	0.3	0.2	0.2	0.2	0.2	0.1	0.1
0.6	0.2	0.1	0.6	0.2	0.8	0.1	0.6	0.2	0.7
0.3	0.6	0.8	0.2	0.5	0.1	0.8	0.2	0.6	0.2
0.1	0.2	0.1	0.2	0.3	0.1	0.1	0.2	0.2	0.1

49		50		51		52		53	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.3	0.3	0.8	0.1	0.6	0.2	0.7	0.2	0.5	0.1
0.3	0.6	0.1	0.7	0.2	0.6	0.2	0.6	0.1	0.7
0.4	0.1	0.1	0.2	0.2	0.2	0.1	0.2	0.4	0.2
0.8	0.1	0.8	0.2	0.7	0.6	0.6	0.1	0.8	0.2
0.1	0.7	0.1	0.6	0.2	0.1	0.2	0.8	0.1	0.6
0.1	0.3	0.1	0.2	0.1	0.3	0.2	0.1	0.1	0.2
0.8	0.6	0.6	0.7	0.7	0.6	0.8	0.7	0.6	0.8
0.1	0.3	0.3	0.2	0.2	0.3	0.1	0.2	0.1	0.1
0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.1
0.8	0.2	0.7	0.2	0.5	0.2	0.6	0.2	0.7	0.4
0.1	0.7	0.2	0.5	0.3	0.6	0.3	0.6	0.1	0.5
0.1	0.1	0.1	0.3	0.2	0.2	0.1	0.2	0.2	0.1
0.2	0.6	0.4	0.7	0.4	0.7	0.7	0.8	0.1	0.6
0.4	0.2	0.5	0.2	0.2	0.1	0.2	0.1	0.8	0.2
0.4	0.2	0.1	0.1	0.4	0.2	0.1	0.1	0.1	0.2
0.8	0.2	0.8	0.6	0.8	0.2	0.8	0.1	0.8	0.1
0.1	0.7	0.1	0.1	0.1	0.6	0.1	0.6	0.1	0.8
0.1	0.1	0.1	0.3	0.1	0.2	0.1	0.3	0.1	0.1
0.8	0.2	0.8	0.1	0.8	0.2	0.8	0.2	7.8	0.3
0.1	0.7	0.1	0.6	0.1	0.5	0.1	0.7	0.1	0.6
0.1	0.1	0.1	0.3	0.1	0.3	0.1	0.1	0.2	0.1
0.1	0.5	0.7	0.6	0.3	0.5	0.2	0.5	0.1	0.6
0.6	0.3	0.2	0.2	0.2	0.3	0.6	0.2	0.4	0.1
0.3	0.2	0.1	0.2	0.5	0.2	0.2	0.3	0.5	0.3
0.4	0.3	0.7	0.2	0.6	0.1	0.8	0.1	0.5	0.3
0.1	0.6	0.2	0.7	0.2	0.7	0.1	0.3	0.2	0.5
0.5	0.1	0.1	0.1	0.2	0.2	0.1	0.6	0.3	0.2
0.3	0.3	0.1	0.2	0.4	0.3	0.5	0.3	0.8	0.3
0.1	0.6	0.8	0.6	0.2	0.6	0.4	0.6	0.1	0.5
0.6	0.1	0.1	0.2	0.4	0.1	0.1	0.1	0.1	0.2
0.1	0.8	0.2	0.7	0.2	0.5	0.1	0.7	0.3	0.6
0.5	0.1	0.6	0.2	0.7	0.3	0.6	0.2	0.5	0.1
0.4	0.1	0.2	0.1	0.1	0.2	0.3	0.1	0.2	0.3

54		55		56		57		58	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.7	0.3	0.5	0.3	0.6	0.1	0.6	0.3	0.6	0.1
0.2	0.5	0.4	0.5	0.3	0.7	0.1	0.6	0.3	0.7
0.1	0.2	0.1	0.2	0.1	0.2	0.3	0.1	0.1	0.2
0.5	0.1	0.5	0.1	0.8	0.2	0.8	0.1	0.7	0.2
0.1	0.8	0.3	0.7	0.1	0.5	0.1	0.8	0.2	0.7
0.4	0.1	0.2	0.2	0.1	0.3	0.1	0.1	0.1	0.1
0.2	0.5	0.5	0.7	0.4	0.8	0.3	0.7	0.6	0.8
0.6	0.3	0.3	0.2	0.2	0.1	0.3	0.1	0.3	0.1
0.2	0.2	0.2	0.1	0.4	0.1	0.4	0.2	0.1	0.1
0.7	0.5	0.8	0.3	0.5	0.2	0.7	0.2	0.4	0.2
0.2	0.3	0.1	0.5	0.3	0.5	0.1	0.6	0.5	0.5
0.1	0.2	0.1	0.2	0.2	0.3	0.2	0.2	0.1	0.3
0.1	0.7	0.1	0.6	0.6	0.7	0.3	0.7	0.2	0.6
0.8	0.2	0.7	0.2	0.3	0.1	0.5	0.1	0.7	0.1
0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.3
0.8	0.1	0.8	0.3	0.7	0.1	0.8	0.2	0.8	0.2
0.1	0.8	0.1	0.4	0.2	0.8	0.1	0.6	0.1	0.6
0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.2	0.1	0.2
0.8	0.2	0.1	0.3	0.6	0.3	0.8	0.3	0.8	0.2
0.1	0.5	0.8	0.6	0.3	0.6	0.1	0.5	0.1	0.6
0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2
0.2	0.4	0.7	0.6	0.6	0.5	0.2	0.6	0.7	0.8
0.4	0.5	0.2	0.1	0.3	0.3	0.6	0.1	0.2	0.1
0.4	0.1	0.1	0.3	0.1	0.2	0.2	0.3	0.1	0.1
0.7	0.3	0.7	0.3	0.5	0.3	0.8	0.3	0.7	0.2
0.2	0.6	0.2	0.5	0.3	0.5	0.1	0.5	0.2	0.5
0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.2	0.1	0.3
0.8	0.3	0.1	0.3	0.6	0.4	0.6	0.4	0.6	0.5
0.1	0.6	0.8	0.5	0.3	0.5	0.2	0.5	0.3	0.4
0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1
0.2	0.5	0.3	0.7	0.2	0.6	0.1	0.6	0.1	0.6
0.5	0.3	0.5	0.2	0.4	0.3	0.8	0.1	0.8	0.2
0.3	0.2	0.2	0.1	0.4	0.1	0.1	0.3	0.1	0.2

59		60		61		62		63	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.4	0.2	0.4	0.2	0.7	0.2	0.7	0.3	0.8	0.3
0.2	0.7	0.2	0.7	0.2	0.5	0.2	0.5	0.1	0.5
0.4	0.1	0.4	0.1	0.1	0.3	0.1	0.2	0.1	0.2
0.6	0.3	0.7	0.3	0.6	0.3	0.6	0.2	0.5	0.2
0.3	0.6	0.2	0.6	0.1	0.6	0.1	0.4	0.3	0.6
0.1	0.1	0.1	0.1	0.3	0.1	0.3	0.4	0.2	0.2
0.8	0.7	0.8	0.6	0.2	0.7	0.3	0.5	0.2	0.6
0.1	0.1	0.1	0.2	0.6	0.1	0.4	0.1	0.4	0.3
0.1	0.2	0.1	0.2	0.2	0.2	0.3	0.4	0.4	0.1
0.5	0.2	0.8	0.1	0.6	0.2	0.7	0.1	0.6	0.1
0.4	0.7	0.1	0.7	0.1	0.6	0.2	0.5	0.1	0.6
0.1	0.1	0.1	0.2	0.3	0.2	0.1	0.4	0.2	0.3
0.6	0.7	0.3	0.6	0.1	0.7	0.2	0.6	0.2	0.7
0.3	0.1	0.5	0.3	0.6	0.1	0.5	0.2	0.5	0.1
0.1	0.2	0.2	0.1	0.3	0.2	0.3	0.2	0.3	0.2
0.7	0.2	0.8	0.2	0.6	0.2	0.7	0.2	0.7	0.2
0.2	0.6	0.1	0.6	0.1	0.5	0.1	0.6	0.1	0.5
0.1	0.2	0.1	0.2	0.3	0.3	0.2	0.2	0.2	0.3
0.8	0.1	0.8	0.1	0.7	0.2	0.6	0.2	0.7	0.2
0.1	0.8	0.1	0.6	0.1	0.5	0.2	0.6	0.1	0.4
0.1	0.1	0.1	0.3	0.2	0.3	0.2	0.2	0.2	0.4
0.2	0.6	0.3	0.6	0.3	0.6	0.4	0.6	0.3	0.5
0.4	0.2	0.6	0.2	0.5	0.3	0.3	0.2	0.4	0.2
0.4	0.2	0.1	0.2	0.2	0.1	0.3	0.2	0.3	0.3
8.1	0.3	0.4	0.1	0.5	0.2	0.5	0.3	0.6	0.2
0.1	0.5	0.3	0.7	0.1	0.5	0.1	0.5	0.1	0.4
0.1	0.2	0.3	0.2	0.4	0.3	0.4	0.2	0.3	0.4
0.4	0.4	0.4	0.2	0.7	0.2	0.6	0.2	0.6	0.2
0.2	0.5	0.3	0.6	0.2	0.5	0.3	0.5	0.1	0.5
0.4	0.1	0.3	0.2	0.1	0.3	0.1	0.3	0.3	0.3
0.1	0.8	0.1	0.7	0.2	0.5	0.2	0.2	0.2	0.5
0.3	0.1	0.3	0.2	0.5	0.3	0.5	0.1	0.5	0.2
0.6	0.1	0.6	0.1	0.3	0.2	0.3	0.7	0.3	0.3

64		65		66		67		68	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.7	0.3	0.7	0.2	0.7	0.3	0.7	0.3	0.7	0.1
0.2	0.5	0.2	0.5	0.2	0.5	0.2	0.5	0.2	0.6
0.1	0.2	0.1	0.3	0.1	0.2	0.1	0.2	0.1	0.3
0.6	0.2	0.6	0.3	0.6	0.2	0.6	0.2	0.6	0.2
0.1	0.5	0.1	0.5	0.3	0.5	0.2	0.5	0.2	0.5
0.3	0.3	0.3	0.2	0.1	0.3	0.2	0.3	0.2	0.3
0.2	0.6	0.2	0.6	0.1	0.6	0.2	0.7	0.2	0.6
0.7	0.2	0.6	0.2	0.4	0.2	0.7	0.2	0.6	0.1
0.1	0.2	0.2	0.2	0.5	0.2	0.1	0.1	0.2	0.3
0.7	0.2	0.7	0.2	0.7	0.2	0.7	0.2	0.7	0.2
0.1	0.6	0.2	0.6	0.1	0.6	0.2	0.5	0.2	0.6
0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.3	0.1	0.2
0.2	0.7	0.2	0.7	0.2	0.7	0.2	0.7	0.1	0.7
0.6	0.1	0.6	0.1	0.7	0.2	0.5	0.1	0.7	0.1
0.2	0.2	0.2	0.2	0.1	0.1	0.3	0.2	0.2	0.2
0.7	0.2	0.7	0.2	0.7	0.1	0.6	0.5	0.8	0.2
0.2	0.5	0.1	0.7	0.1	0.7	0.2	0.3	0.1	0.5
0.1	0.3	0.2	0.1	0.2	0.2	0.2	0.2	0.1	0.3
0.7	0.2	0.7	0.2	0.7	0.2	0.3	0.2	0.8	0.2
0.2	0.6	0.2	0.5	0.1	0.5	0.5	0.5	0.1	0.5
0.1	0.2	0.1	0.3	0.2	0.3	0.2	0.3	0.1	0.3
0.3	0.5	0.3	0.7	0.3	0.6	0.7	0.6	0.3	0.6
0.5	0.3	0.4	0.2	0.4	0.3	0.2	0.2	0.5	0.2
0.2	0.2	0.3	0.1	0.3	0.1	0.1	0.2	0.2	0.2
0.7	0.2	0.6	0.2	0.6	0.2	0.5	0.2	0.7	0.3
0.1	0.5	0.3	0.5	0.1	0.5	0.3	0.5	0.2	0.4
0.2	0.3	0.1	0.3	0.2	0.3	0.2	0.3	0.1	0.3
0.7	0.2	0.6	0.3	0.7	0.3	0.3	0.1	0.6	0.4
0.1	0.6	0.2	0.5	0.2	0.5	0.6	0.5	0.2	0.5
0.2	0.2	0.2	0.2	0.1	0.2	0.1	0.4	0.2	0.1
0.3	0.3	0.2	0.6	0.4	0.6	0.2	0.5	0.2	0.6
0.4	0.4	0.5	0.3	0.5	0.3	0.7	0.3	0.5	0.2
0.3	0.3	0.3	0.1	0.1	0.1	0.1	0.2	0.3	0.2

69		70		71		72		73	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.8	0.3	0.6	0.3	0.6	0.4	0.5	0.4	0.8	0.6
0.1	0.5	0.3	0.5	0.2	0.5	0.4	0.5	0.1	0.3
0.1	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1
0.7	0.2	0.5	0.2	0.5	0.3	0.5	0.3	0.7	0.4
0.2	0.5	0.2	0.5	0.3	0.5	0.4	0.4	0.2	0.5
0.1	0.3	0.3	0.3	0.2	0.2	0.1	0.3	0.1	0.1
0.2	0.6	0.2	0.7	0.2	0.6	0.2	0.6	0.2	0.6
0.5	0.2	0.6	0.1	0.5	0.1	0.6	0.2	0.5	0.1
0.3	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.3	0.3
0.6	0.1	0.7	0.2	0.7	0.1	0.7	0.2	0.6	0.2
0.2	0.5	0.2	0.6	0.2	0.5	0.2	0.5	0.2	0.5
0.2	0.4	0.1	0.2	0.1	0.4	0.1	0.3	0.2	0.3
0.3	0.6	0.1	0.6	0.2	0.6	0.2	0.6	0.2	0.6
0.5	0.2	0.6	0.1	0.7	0.1	0.6	0.1	0.7	0.1
0.2	0.2	0.1	0.3	0.1	0.3	0.2	0.3	0.1	0.3
0.7	0.1	0.6	0.2	0.7	0.1	0.7	0.2	0.6	0.2
0.1	0.5	0.1	0.6	0.1	0.6	0.1	0.6	0.2	0.7
0.2	0.4	0.3	0.2	0.2	0.3	0.2	0.2	0.2	0.1
0.7	0.2	0.6	0.2	0.7	0.1	0.6	0.1	0.6	0.2
0.1	0.5	0.1	0.4	0.1	0.6	0.2	0.4	0.2	0.5
0.2	0.3	0.3	0.4	0.2	0.3	0.2	0.5	0.2	0.3
0.3	0.6	0.3	0.6	0.3	0.6	0.3	0.5	0.2	0.5
0.4	0.1	0.5	0.2	0.5	0.2	0.4	0.2	0.4	0.2
0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.3
0.6	0.2	0.6	0.2	0.7	0.1	0.6	0.2	0.6	0.2
0.1	0.6	0.2	0.5	0.2	0.5	0.1	0.5	0.2	0.5
0.3	0.2	0.2	0.3	0.1	0.4	0.2	0.3	0.2	0.3
0.5	0.3	0.7	0.2	0.6	0.1	0.7	0.1	0.7	0.2
0.4	0.5	0.1	0.5	0.3	0.5	0.2	0.6	0.1	0.6
0.1	0.2	0.2	0.3	0.1	0.4	0.1	0.3	0.2	0.2
0.3	0.5	0.2	0.6	0.2	0.6	0.2	0.5	0.3	0.7
0.5	0.3	0.6	0.2	0.5	0.3	0.5	0.3	0.5	0.1
0.2	0.2	0.2	0.2	0.3	0.1	0.3	0.2	0.2	0.2

74		75		76		77		78	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.7	0.6	0.6	0.4	0.6	0.4	0.6	0.4	0.6	0.4
0.2	0.2	0.2	0.5	0.2	0.5	0.2	0.5	0.2	0.5
0.1	0.2	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1
0.6	0.4	0.6	0.3	0.5	0.3	0.5	0.3	0.5	0.5
0.1	0.3	0.2	0.5	0.3	0.4	0.3	0.4	0.3	0.4
0.3	0.3	0.2	0.2	0.2	0.3	0.2	0.3	0.2	0.1
0.2	0.5	0.2	0.6	0.2	0.5	0.2	0.5	0.2	0.5
0.5	0.2	0.5	0.1	0.5	0.1	0.5	0.1	0.5	0.2
0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.4	0.3	0.3
0.6	0.2	0.6	0.2	0.6	0.2	0.6	0.2	0.6	0.5
0.2	0.5	0.1	0.4	0.2	0.5	0.2	0.5	0.2	0.2
0.2	0.3	0.3	0.4	0.2	0.3	0.2	0.3	0.2	0.3
0.2	0.6	0.2	0.5	0.2	0.6	0.2	0.6	0.2	0.5
0.4	0.2	0.5	0.2	0.6	0.1	0.6	0.1	0.5	0.2
0.4	0.2	0.3	0.3	0.2	0.3	0.2	0.3	0.3	0.3
0.6	0.2	0.6	0.1	0.7	0.1	0.7	0.1	0.6	0.2
0.2	0.5	0.1	0.5	0.1	0.6	0.1	0.6	0.2	0.6
0.2	0.3	0.3	0.4	0.2	0.3	0.2	0.3	0.2	0.2
0.6	0.2	0.6	0.1	0.7	0.2	0.7	0.2	0.5	0.7
0.1	0.5	0.1	0.5	0.1	0.5	0.1	0.5	0.3	0.2
0.3	0.3	0.3	0.4	0.2	0.3	0.2	0.3	0.2	0.1
0.4	0.2	0.3	0.5	0.2	0.6	0.2	0.6	0.2	0.2
0.5	0.6	0.5	0.3	0.5	0.1	0.5	0.1	0.4	0.6
0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.2
0.6	0.6	0.7	0.2	0.7	0.2	0.7	0.2	0.5	0.2
0.1	0.2	0.1	0.5	0.1	0.6	0.1	0.6	0.4	0.5
0.3	0.2	0.2	0.3	0.2	0.2	0.2	0.3	0.1	0.3
0.6	0.2	0.7	0.2	0.7	0.1	0.7	0.1	0.5	0.6
0.2	0.6	0.1	0.5	0.1	0.6	0.1	0.6	0.4	0.3
0.2	0.2	0.2	0.3	0.2	0.3	0.2	0.3	0.1	0.1
0.2	0.4	0.2	0.6	0.3	0.2	0.3	0.2	0.2	0.7
0.6	0.3	0.6	0.2	0.6	0.1	0.5	0.1	0.6	0.2
0.2	0.3	0.2	0.2	0.1	0.7	0.2	0.7	0.2	0.1

79		80		81		82		83	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.7	0.3	0.7	0.4	0.6	0.4	0.6	0.4	0.6	0.4
0.1	0.5	0.1	0.5	0.3	0.5	0.2	0.5	0.1	0.5
0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.1	0.3	0.1
0.6	0.3	0.5	0.4	0.6	0.4	0.6	0.4	0.6	0.4
0.2	0.5	0.1	0.5	0.3	0.5	0.2	0.5	0.1	0.5
0.2	0.2	0.4	0.1	0.1	0.1	0.2	0.1	0.3	0.1
0.2	0.6	0.5	0.6	0.2	0.6	0.3	0.5	0.2	0.6
0.6	0.1	0.3	0.2	0.5	0.1	0.6	0.1	0.6	0.1
0.2	0.3	0.2	0.2	0.3	0.3	0.1	0.4	0.2	0.3
0.6	0.2	0.2	0.3	0.5	0.1	0.5	0.3	0.6	0.2
0.1	0.6	0.6	0.5	0.2	0.5	0.1	0.5	0.1	0.6
0.3	0.2	0.2	0.2	0.3	0.4	0.4	0.2	0.3	0.2
0.2	0.7	0.7	0.6	0.2	0.6	0.2	0.6	0.2	0.6
0.7	0.1	0.1	0.1	0.5	0.1	0.6	0.1	0.6	0.1
0.1	0.2	0.2	0.3	0.3	0.3	0.2	0.3	0.2	0.3
0.7	0.2	0.3	0.2	0.6	0.1	0.6	0.2	0.7	0.2
0.1	0.7	0.5	0.6	0.2	0.6	0.1	0.5	0.1	0.6
0.2	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2
0.7	0.2	0.6	0.2	0.6	0.2	0.6	0.1	0.7	0.2
0.1	0.5	0.1	0.6	0.2	0.6	0.1	0.5	0.1	0.6
0.2	0.3	0.3	0.2	0.2	0.2	0.3	0.4	0.3	0.2
0.4	0.7	0.7	0.6	0.2	0.7	0.3	0.6	0.2	0.7
0.5	0.1	0.1	0.1	0.5	0.2	0.4	0.2	0.5	0.2
0.1	0.2	0.2	0.3	0.3	0.1	0.3	0.2	0.3	0.1
0.7	0.3	0.3	0.2	0.6	0.2	0.6	0.2	0.7	0.1
0.1	0.5	0.5	0.7	0.2	0.6	0.1	0.5	0.1	0.7
0.2	0.2	0.2	0.1	0.2	0.2	0.3	0.3	0.2	0.2
0.7	0.3	0.7	0.2	0.6	0.2	0.6	0.2	0.7	0.2
0.1	0.5	0.2	0.6	0.1	0.6	0.2	0.5	0.1	0.6
0.2	0.2	0.1	0.2	0.3	0.2	0.2	0.3	0.2	0.2
0.7	0.7	0.3	0.7	0.3	0.7	0.3	0.6	0.2	0.7
0.1	0.2	0.6	0.1	0.6	0.1	0.6	0.2	0.6	0.2
0.2	0.1	0.1	0.2	0.1	0.2	0.1	0.2	0.2	0.1

84		85		86		87		88	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.7	0.4	0.8	0.6	0.7	0.3	0.6	0.4	0.8	0.5
0.1	0.5	0.1	0.3	0.2	0.5	0.2	0.5	0.1	0.4
0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1
0.7	0.4	0.8	0.3	0.7	0.3	0.6	0.4	0.8	0.3
0.1	0.5	0.1	0.5	0.2	0.5	0.2	0.5	0.1	0.5
0.2	0.1	0.1	0.2	0.1	0.2	0.2	0.1	0.1	0.2
0.2	0.5	0.2	0.7	0.2	0.6	0.2	0.6	0.3	0.6
0.5	0.1	0.6	0.1	0.6	0.2	0.5	0.1	0.5	0.1
0.3	0.4	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.3
0.6	0.2	0.7	0.2	0.6	0.3	0.6	0.3	0.5	0.3
0.2	0.5	0.1	0.7	0.2	0.6	0.3	0.5	0.4	0.6
0.2	0.3	0.2	0.1	0.2	0.1	0.1	0.2	0.1	0.1
0.2	0.5	0.5	0.7	0.2	0.6	0.2	0.6	0.2	0.7
0.6	0.1	0.4	0.1	0.6	0.1	0.6	0.2	0.5	0.1
0.2	0.4	0.1	0.2	0.2	0.3	0.2	0.2	0.3	0.2
0.6	0.2	0.7	0.2	0.7	0.2	0.7	0.1	0.8	0.2
0.1	0.5	0.1	0.7	0.1	0.6	0.1	0.6	0.1	0.7
0.3	0.3	0.2	0.1	0.2	0.2	0.2	0.3	0.1	0.1
0.6	0.2	0.7	0.1	0.7	0.2	0.7	0.3	0.8	0.2
0.1	0.5	0.1	0.6	0.1	0.6	0.1	0.5	0.1	0.7
0.3	0.3	0.2	0.3	0.2	0.2	0.2	0.2	0.1	0.1
0.2	0.6	0.2	0.7	0.3	0.7	0.3	0.6	0.3	0.8
0.4	0.2	0.5	0.2	0.6	0.1	0.5	0.2	0.6	0.1
0.4	0.2	0.3	0.1	0.1	0.2	0.2	0.2	0.1	0.1
0.6	0.2	0.7	0.2	0.7	0.2	0.7	0.7	0.6	0.2
0.1	0.6	0.1	0.7	0.1	0.6	0.1	0.2	0.3	0.6
0.3	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.1	0.2
0.6	0.2	0.7	0.3	0.7	0.3	0.7	0.3	0.5	0.3
0.1	0.5	0.1	0.5	0.1	0.6	0.2	0.5	0.3	0.6
0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.1
0.2	0.6	0.3	0.4	0.3	0.8	0.1	0.7	0.2	0.7
0.6	0.1	0.6	0.2	0.6	0.1	0.6	0.1	0.7	0.2
0.2	0.3	0.1	0.4	0.1	0.1	0.3	0.2	0.1	0.1

89		90		91		92		93	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.6	0.3	0.5	0.3	0.5	0.4	0.6	0.3	0.5	0.3
0.2	0.5	0.2	0.5	0.2	0.5	0.1	0.6	0.4	0.6
0.2	0.2	0.3	0.2	0.3	0.1	0.3	0.1	0.1	0.1
0.6	0.3	0.6	0.2	0.7	0.2	0.8	0.2	0.5	0.3
0.2	0.5	0.1	0.6	0.1	0.6	0.1	0.5	0.3	0.5
0.2	0.2	0.3	0.2	0.2	0.2	0.1	0.3	0.2	0.2
0.2	0.5	0.2	0.5	0.3	0.7	0.3	0.6	0.3	0.6
0.5	0.3	0.6	0.2	0.5	0.1	0.5	0.1	0.6	0.2
0.3	0.2	0.2	0.3	0.2	0.2	0.2	0.3	0.1	0.2
0.4	0.3	7.1	0.3	0.6	0.2	0.4	0.3	0.6	0.3
0.3	0.4	0.1	0.4	0.1	0.5	0.2	0.5	0.3	0.6
0.3	0.3	0.2	0.3	0.3	0.3	0.4	0.2	0.1	0.1
0.2	0.5	0.3	0.7	0.6	0.6	0.3	0.6	0.3	0.6
0.5	0.1	0.5	0.2	0.2	0.2	0.6	0.1	0.6	0.2
0.3	0.4	0.2	0.1	0.2	0.2	0.1	0.3	0.1	0.2
0.6	0.3	0.7	0.3	0.7	0.3	0.7	0.6	0.6	0.3
0.1	0.6	0.2	0.6	0.1	0.6	0.1	0.1	0.3	0.6
0.3	0.1	0.1	0.1	0.3	0.1	0.2	0.3	0.1	0.1
0.6	0.2	0.7	0.3	0.8	0.3	0.7	0.3	0.5	0.3
0.1	0.6	0.2	0.6	0.1	0.5	0.2	0.5	0.2	0.6
0.3	0.2	0.1	0.1	0.1	0.2	0.1	0.2	0.3	0.1
0.2	0.7	0.2	0.7	0.6	0.6	0.2	0.6	0.3	0.7
0.6	0.1	0.7	0.2	0.2	0.2	0.7	0.2	0.6	0.2
0.3	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.1	0.1
0.7	0.2	0.8	0.3	0.2	0.3	0.8	0.2	0.7	0.2
0.1	0.7	0.1	0.5	0.5	0.6	0.1	0.6	0.2	0.5
0.2	0.1	0.1	0.2	0.3	0.1	0.1	0.2	0.1	0.3
0.7	0.2	0.6	0.2	0.8	0.3	0.6	0.3	0.5	0.2
0.1	0.7	0.2	0.5	0.1	0.5	0.3	0.5	0.3	0.5
0.2	0.1	0.2	0.3	0.1	0.2	0.1	0.2	0.2	0.3
0.2	0.7	0.2	0.6	0.6	0.7	0.2	0.6	0.3	0.3
0.7	0.1	0.7	0.2	0.3	0.2	0.5	0.2	0.6	0.5
0.1	0.2	0.1	0.2	0.1	0.1	0.3	0.2	0.1	0.2

94		95		96		97		98	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.5	0.4	0.6	0.2	0.6	0.3	0.4	0.3	0.7	0.2
0.3	0.5	0.2	0.5	0.2	0.5	0.3	0.4	0.2	0.5
0.2	0.1	0.2	0.3	0.2	0.2	0.3	0.3	0.1	0.3
0.4	0.3	0.7	0.3	0.7	0.2	0.6	0.2	0.5	0.3
0.3	0.5	0.1	0.5	0.1	0.6	0.2	0.5	0.3	0.5
0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2
0.3	0.6	0.4	0.6	0.4	0.5	0.3	0.6	0.3	0.7
0.5	0.3	0.3	0.2	0.5	0.3	0.4	0.3	0.5	0.2
0.2	0.1	0.3	0.2	0.1	0.2	0.3	0.1	0.2	0.1
0.5	0.5	0.5	0.2	0.6	0.3	0.5	0.3	0.5	0.4
0.2	0.3	0.2	0.5	0.1	0.5	0.2	0.5	0.4	0.5
0.3	0.2	0.3	0.3	0.3	0.2	0.3	0.2	0.1	0.1
0.4	0.6	0.4	0.4	0.3	0.6	0.3	0.5	0.3	0.4
0.5	0.1	0.5	0.3	0.5	0.2	0.5	0.2	0.5	0.2
0.1	0.3	0.1	0.3	0.2	0.2	0.2	0.3	0.2	0.4
0.6	0.4	0.6	0.3	0.6	0.3	0.7	0.3	0.6	0.3
0.2	0.5	0.2	0.5	0.1	0.5	0.1	0.5	0.2	0.5
0.2	0.1	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.2
0.6	0.3	0.6	0.2	0.6	0.3	0.6	0.3	0.5	0.3
0.2	0.6	0.1	0.5	0.2	0.5	0.2	0.4	0.3	0.5
0.2	0.1	0.3	0.3	0.2	0.2	0.2	0.3	0.2	0.2
0.3	0.7	0.3	0.6	0.2	0.6	0.2	0.2	0.3	0.6
0.6	0.2	0.5	0.2	0.4	0.2	0.4	0.6	0.5	0.3
0.1	0.1	0.2	0.2	0.4	0.2	0.4	0.2	0.2	0.1
0.7	0.2	0.7	0.2	0.7	0.3	0.7	0.2	0.7	0.4
0.1	0.6	0.1	0.5	0.2	0.5	0.1	0.6	0.1	0.5
0.2	0.2	0.2	0.3	0.1	0.2	0.2	0.2	0.2	0.1
0.5	0.3	0.6	0.2	0.6	0.3	0.5	0.3	0.6	0.3
0.3	0.5	0.2	0.5	0.3	0.5	0.4	0.5	0.3	0.4
0.2	0.2	0.2	0.3	0.1	0.2	0.1	0.2	0.1	0.3
0.3	0.6	0.2	0.6	0.2	0.6	0.3	0.7	0.3	0.6
0.6	0.3	0.5	0.3	0.5	0.3	0.5	0.1	0.5	0.3
0.1	0.1	0.3	0.1	0.3	0.1	0.2	0.2	0.2	0.1

99		100		101		102		103	
PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
0.5	0.3	0.5	0.2	0.5	0.3	0.8	0.3	0.7	0.3
0.2	0.4	0.2	0.5	0.3	0.6	0.1	0.5	0.1	0.5
0.3	0.3	0.3	0.3	0.2	0.1	0.1	0.2	0.2	0.2
0.6	0.3	0.6	0.3	0.6	0.7	0.8	0.3	0.7	0.3
0.3	0.6	0.1	0.4	0.2	0.2	0.1	0.5	0.1	0.5
0.1	0.1	0.3	0.3	0.2	0.1	0.1	0.2	0.2	0.2
0.3	0.5	0.4	0.6	0.4	0.8	0.3	0.6	0.5	0.6
0.4	0.3	0.3	0.2	0.5	0.1	0.6	0.3	0.1	0.3
0.3	0.2	0.3	0.2	0.1	0.1	0.1	0.1	0.4	0.1
0.4	0.3	0.6	0.4	0.6	0.3	0.4	0.5	0.3	0.2
0.3	0.5	0.2	0.3	0.3	0.5	0.3	0.2	0.5	0.4
0.3	0.2	0.2	0.3	0.1	0.2	0.3	0.3	0.2	0.4
0.3	0.6	0.3	0.6	0.2	0.6	0.3	0.7	0.6	0.3
0.5	0.2	0.4	0.2	0.6	0.3	0.4	0.1	0.1	0.2
0.2	0.2	0.3	0.2	0.2	0.1	0.3	0.2	0.3	0.5
0.7	0.3	0.5	0.3	0.6	0.3	0.7	0.2	0.6	0.5
0.1	0.6	0.3	0.5	0.2	0.4	0.1	0.6	0.1	0.1
0.2	0.1	0.2	0.2	0.2	0.3	0.2	0.2	0.3	0.4
0.6	0.4	0.7	0.3	0.6	0.3	0.7	0.2	0.3	0.2
0.2	0.5	0.2	0.6	0.1	0.5	0.1	0.6	0.5	0.5
0.2	0.1	0.1	0.1	0.3	0.2	0.2	0.2	0.2	0.3
0.2	0.6	0.2	0.6	0.3	0.7	0.2	0.6	0.5	0.6
0.4	0.2	0.5	0.2	0.4	0.2	0.6	0.1	0.3	0.1
0.4	0.2	0.3	0.2	0.3	0.1	0.2	0.3	0.2	0.3
0.8	0.3	0.7	0.3	0.7	0.4	0.7	0.2	0.5	0.2
0.1	0.6	0.1	0.5	0.2	0.5	0.1	0.6	0.1	0.5
0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.2	0.4	0.3
0.7	0.3	0.6	0.3	0.8	0.4	0.7	0.2	0.3	0.2
0.2	0.5	0.3	0.5	0.1	0.5	0.1	0.6	0.6	0.5
0.1	0.2	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.3
0.3	0.7	0.2	0.7	0.3	0.5	0.2	0.7	0.2	0.6
0.5	0.2	0.4	0.1	0.6	0.1	0.6	0.1	0.6	0.1
0.2	0.1	0.4	0.2	0.1	0.4	0.2	0.2	0.2	0.3

104		105		106		107		108	
PRE	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**	**PRE**	**POST**
0.7	0.3	0.7	0.3	0.8	0.2	0.5	0.2	0.7	0.2
0.1	0.4	0.2	0.5	0.1	0.6	0.3	0.5	0.1	0.6
0.2	0.3	0.1	0.2	0.1	0.2	0.2	0.3	0.2	0.2
0.7	0.4	0.6	0.2	0.7	0.2	0.7	0.1	0.6	0.3
0.1	0.5	0.2	0.7	0.2	0.6	0.1	0.6	0.3	0.5
0.2	0.1	0.2	0.1	0.1	0.2	0.2	0.3	0.1	0.2
0.2	0.5	0.3	0.7	0.3	0.5	0.6	0.7	0.2	0.7
0.7	0.1	0.5	0.2	0.5	0.3	0.1	0.1	0.5	0.1
0.1	0.4	0.2	0.1	0.2	0.2	0.3	0.2	0.3	0.2
0.2	0.3	0.5	0.2	0.5	0.2	0.5	0.3	0.6	0.3
0.5	0.4	0.3	0.6	0.3	0.5	0.3	0.5	0.1	0.6
0.2	0.3	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.1
0.3	0.6	0.3	0.6	0.2	0.6	0.7	0.6	0.2	0.7
0.4	0.1	0.5	0.3	0.6	0.2	0.1	0.2	0.7	0.2
0.3	0.3	0.2	0.1	0.2	0.2	0.2	0.2	0.1	0.1
0.6	0.2	0.7	0.2	0.7	0.2	0.7	0.3	0.6	0.3
0.1	0.6	0.2	0.7	0.1	0.7	0.1	0.5	0.3	0.6
0.3	0.2	0.1	0.1	0.2	0.1	0.2	0.2	0.1	0.1
0.6	0.2	0.7	0.2	0.7	0.2	0.6	0.3	0.8	0.3
0.1	0.6	0.2	0.7	0.1	0.7	0.2	0.5	0.1	0.5
0.3	0.2	0.1	0.1	0.2	0.1	0.2	0.2	0.1	0.2
0.4	0.7	0.3	0.6	0.2	0.7	0.5	0.6	0.3	0.7
0.5	0.1	0.5	0.2	0.5	0.1	0.1	0.2	0.5	0.1
0.1	0.2	0.2	0.2	0.3	0.2	0.4	0.2	0.2	0.2
0.7	0.2	0.5	0.2	0.6	0.2	0.7	0.3	0.7	0.3
0.1	0.6	0.2	0.6	0.2	0.5	0.1	0.6	0.1	0.6
0.2	0.2	0.3	0.2	0.2	0.3	0.2	0.1	0.2	0.1
0.7	0.2	0.7	0.3	0.5	0.2	0.6	0.2	0.8	0.2
0.1	0.6	0.1	0.5	0.3	0.5	0.3	0.6	0.1	0.6
0.2	0.2	0.2	0.2	0.2	0.3	0.1	0.2	0.1	0.2
0.2	0.7	0.3	0.6	0.2	0.5	0.2	0.7	0.2	0.6
0.6	0.1	0.6	0.2	0.6	0.3	0.6	0.1	0.7	0.1
0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.3

109		110		111		112		113	
PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
0.7	0.3	0.7	0.3	0.6	0.3	0.7	0.4	0.6	0.3
0.1	0.5	0.1	0.5	0.2	0.5	0.2	0.5	0.3	0.5
0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.2
0.7	0.3	0.8	0.3	0.5	0.3	0.5	0.2	0.5	0.2
0.1	0.5	0.1	0.5	0.2	0.5	0.3	0.4	0.2	0.5
0.2	0.2	0.1	0.2	0.3	0.2	0.2	0.4	0.3	0.3
0.5	0.6	0.2	0.3	0.3	0.6	0.3	0.5	0.2	0.6
0.4	0.1	0.6	0.2	0.5	0.2	0.5	0.2	0.5	0.2
0.1	0.3	0.2	0.5	0.2	0.2	0.2	0.3	0.3	0.2
0.5	0.4	0.4	0.4	0.6	0.3	0.6	0.2	0.4	0.3
0.3	0.5	0.3	0.3	0.1	0.6	0.2	0.5	0.1	0.5
0.2	0.1	0.3	0.3	0.3	0.1	0.2	0.3	0.5	0.2
0.3	0.5	0.3	0.5	0.2	0.6	0.3	0.6	0.2	0.5
0.2	0.3	0.5	0.2	0.6	0.2	0.6	0.1	0.5	0.2
0.5	0.2	0.2	0.2	0.2	0.2	0.1	0.3	0.3	0.3
0.7	0.2	0.7	0.2	0.7	0.3	0.8	0.3	0.5	0.2
0.1	0.6	0.1	0.5	0.1	0.6	0.1	0.5	0.1	0.5
0.2	0.2	0.2	0.3	0.2	0.1	0.1	0.2	0.4	0.3
0.7	0.2	0.7	0.2	0.7	0.3	0.7	0.3	0.5	0.1
0.1	0.6	0.1	0.4	0.2	0.5	0.2	0.5	0.1	0.7
0.2	0.2	0.2	0.4	0.1	0.2	0.1	0.2	0.4	0.2
0.4	0.7	0.3	0.6	0.3	0.7	0.2	0.6	0.2	0.7
0.5	0.2	0.6	0.1	0.6	0.1	0.6	0.1	0.6	0.1
0.1	0.1	0.1	0.3	0.1	0.2	0.2	0.2	0.2	0.2
0.7	0.2	0.7	0.2	0.7	0.3	0.5	0.2	0.7	0.4
0.1	0.7	0.1	0.5	0.1	0.6	0.3	0.6	0.2	0.5
0.2	0.1	0.2	0.3	0.2	0.1	0.2	0.2	0.1	0.1
0.7	0.2	0.8	0.2	0.8	0.3	0.4	0.3	0.5	0.3
0.1	0.7	0.1	0.6	0.1	0.5	0.2	0.6	0.2	0.6
0.2	0.1	0.1	0.2	0.1	0.2	0.4	0.1	0.3	0.1
0.3	0.7	0.3	0.7	0.3	0.6	0.4	0.7	0.2	0.6
0.6	0.1	0.6	0.1	0.6	0.1	0.5	0.2	0.6	0.2
0.1	0.2	0.1	0.2	0.1	0.3	0.1	0.1	0.2	0.2

114		115		116		117		118	
PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
0.7	0.2	0.6	0.3	0.5	0.3	0.6	0.2	0.6	0.2
0.1	0.5	0.1	0.5	0.3	0.6	0.2	0.7	0.2	0.5
0.2	0.3	0.3	0.2	0.2	0.1	0.2	0.1	0.2	0.3
0.8	0.2	0.6	0.3	0.6	0.2	0.5	0.3	0.6	0.3
0.1	0.4	0.2	0.5	0.1	0.5	0.3	0.5	0.2	0.5
0.1	0.4	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.2
0.3	0.5	0.2	0.6	0.3	0.6	0.6	0.6	0.7	0.6
0.6	0.2	0.6	0.2	0.6	0.1	0.2	0.2	0.2	0.1
0.1	0.3	0.2	0.2	0.1	0.3	0.2	0.2	0.1	0.3
0.7	0.4	0.5	0.2	0.7	0.2	0.7	0.2	0.6	0.3
0.1	0.3	0.1	0.6	0.1	0.5	0.2	0.6	0.3	0.6
0.1	0.3	0.4	0.2	0.2	0.3	0.1	0.2	0.1	0.1
0.2	0.7	0.2	0.7	0.3	0.6	0.2	0.6	0.3	0.7
0.6	0.1	0.6	0.1	0.4	0.2	0.6	0.1	0.6	0.1
0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.3	0.1	0.2
0.7	0.2	0.6	0.3	0.7	0.2	0.7	0.3	0.7	0.2
0.1	0.5	0.1	0.6	0.1	0.6	0.2	0.5	0.1	0.6
0.2	0.3	0.3	0.1	0.2	0.2	0.1	0.2	0.2	0.2
0.6	0.3	0.7	0.2	0.5	0.2	0.6	0.6	0.8	0.2
0.1	0.4	0.2	0.6	0.3	0.6	0.1	0.1	0.1	0.7
0.3	0.3	0.1	0.2	0.2	0.2	0.3	0.3	0.1	0.1
0.2	0.6	0.3	0.7	0.3	0.7	0.2	0.7	0.2	0.7
0.5	0.1	0.6	0.2	0.5	0.1	0.5	0.2	0.6	0.1
0.3	0.3	0.1	0.1	0.2	0.2	0.3	0.1	0.2	0.2
0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.2	0.8	0.2
0.1	0.4	0.1	0.5	0.1	0.6	0.1	0.6	0.1	0.7
0.2	0.3	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.1
0.5	0.2	0.7	0.3	0.6	0.2	0.3	0.3	0.3	0.2
0.3	0.5	0.1	0.4	0.2	0.6	0.2	0.5	0.2	0.6
0.2	0.3	0.2	0.3	0.2	0.2	0.5	0.2	0.5	0.2
0.2	0.6	0.3	0.6	0.2	0.7	0.1	0.7	0.3	0.7
0.5	0.1	0.6	0.2	0.6	0.1	0.6	0.2	0.6	0.2
0.3	0.3	0.1	0.2	0.2	0.2	0.3	0.1	0.1	0.1

119		120		average	
PRE	**POST**	**PRE**	**POST**	**pre**	**post**
0.6	0.3	0.4	0.3	**0.63**	**0.27**
0.2	0.5	0.3	0.4	**0.19**	**0.54**
0.2	0.2	0.3	0.3	**0.17**	**0.19**
0.5	0.3	0.6	0.2	**0.61**	**0.27**
0.2	0.5	0.2	0.5	**0.19**	**0.53**
0.3	0.2	0.2	0.3	**0.20**	**0.20**
0.6	0.6	0.3	0.6	**0.34**	**0.61**
0.1	0.1	0.4	0.3	**0.44**	**0.18**
0.3	0.3	0.3	0.1	**0.22**	**0.21**
0.7	0.2	0.5	0.3	**0.60**	**0.25**
0.1	0.6	0.2	0.5	**0.20**	**0.52**
0.2	0.2	0.3	0.2	**0.20**	**0.23**
0.2	0.6	0.3	0.5	**0.29**	**0.63**
0.7	0.2	0.5	0.2	**0.49**	**0.16**
0.1	0.2	0.2	0.3	**0.22**	**0.21**
0.5	0.3	0.7	0.3	**0.66**	**0.23**
0.2	0.6	0.1	0.5	**0.16**	**0.56**
0.3	0.1	0.2	0.2	**0.18**	**0.21**
0.7	0.3	0.6	0.3	**0.70**	**0.24**
0.1	0.6	0.2	0.4	**0.16**	**0.54**
0.2	0.1	0.2	0.3	**0.14**	**0.22**
0.2	0.7	0.2	0.2	**0.32**	**0.59**
0.7	0.1	0.4	0.6	**0.45**	**0.21**
0.1	0.2	0.4	0.2	**0.23**	**0.20**
0.8	0.3	0.7	0.2	**0.64**	**0.25**
0.1	0.6	0.1	0.6	**0.16**	**0.54**
0.1	0.1	0.2	0.2	**0.20**	**0.21**
0.5	0.3	0.5	0.3	**0.58**	**0.27**
0.2	0.4	0.4	0.5	**0.22**	**0.53**
0.3	0.3	0.1	0.2	**0.20**	**0.20**
0.3	0.5	0.3	0.7	**0.25**	**0.59**
0.6	0.2	0.5	0.1	**0.55**	**0.20**
0.1	0.3	0.2	0.2	**0.20**	**0.21**

APPENDIX C

Public questionnaire survey

CSIR-Central Road Research Institute, New Delhi -110020

SUSTAINABILITY ASSESSMENT OF TRANSPORT MEASURES

Gender: - Male / Female

2. Age Group: a) ‹ 18 b) 18-30 c) 30-60 d) 60 +

3. Travelling Mode Car / RTV / Auto / E-vehicle

4. Origin: Destination:

5. Distance: Km Time: min

6. Trip cost

a) Car:(fuel cost)

b) Auto/RTV/E-Rickshaw (Fare)

7. No of Cars (only in case of cars) 0/1/2 How many normally use:1/2/3

8. Frequency of travel: a) daily b) twice a week c) once a week d) rare

9. Time spent in traffic jams: A) 3min b) 5 min c) 10 min d) 15 min e) >15min

10. Number of trips (for vehicle other than car):

11. Occupancy: (number of people in the vehicle): a) 1 b) 2 c) 3 d) ›5 e) ›10

12. How safe and secure you feel in car sharing with friends and family (0…10)

13. How safe and secure you feel in car sharing with unknowns (0……10)

14. Noise perception in traffic (0……10)

15. Air pollution/GHG emission /global warming perception in traffic (0…10)

16. Parking space availability at office/ shop (0……10)

17. Financial loss due to accident per person (0……10,000) and per vehicle (…)

Survey data

Pre –implementation stage

		1	2	3	4
1	**Gender**	F	M	M	F
2	**Age Group**	18-30	18-30	30-60	30-60
3	**Travelling Mode**	car	auto	RTV	car
5	**Origin**	NFC	kalu sarai	madanpur khadar	kalkaji
6	**Destination**	LSRC	nehru place	nehru place	LSRC
7	**Distance**	10	5	10	8
8	**Time**	30	20	30	20
9	**Trip cost**	80	60	150	50
10	**No of Cars**	3			2
11	**No daily used**	3			2
12	**Frequency of Travel**	D	D	D	D
13	**Time Spent in traffic jams**	20	20	20	15
14	**Number of trips**		8	8	
15	**Occupancy**	1	1	1	1
16	**safety and security with family and friends**	8			8
17	**safety and security with with unknowns**	1			2
18	**noise peception**	5	7	8	6
19	**air pollution**	6	5	5	5
20	**parking space availability**	4	5	5	4

5	6	7	8	9	10	11
M	M	M	M	F	M	M
30-60	30-60	18-30	30-60	30-60	18-30	18-30
Car	auto	car	car	taxi	car	auto
kailash colony	kailash colony	rk puram	kalkaji	sarita vihar	nizamuddin	south extension
nehru place	lajpat nagar	bharat nagar	rk puram	hauz khas	cr park	cr park
8	10	20	12	15	12	15
25	25	60	35	40	15	50
80		120	120	150	60	80
2		2	1		2	
2		2	1		2	
TW	D	D	D	D	D	D
20	10	15	20	25	25	20
	10			8		10
1	1	1	1	1	1	1
7		8	7	9	9	
2		1	2	2	1	
6	8	8	8	7	8	6
6	5	6	7	6	7	7
6	4	6	6	5	5	6

12	13	14	15	16	17	18	19
M	M	M	M	M	M	M	M
30-60	30-60	30-60	30-60	18-30	18-30	30-60	18-30
Taxi	auto	auto	auto	car	car	car	car
sarita vihar	lajpat nagar	dakhpuri	lajpat nagar	gurgaon	noida	gk 1	defence colony
n place	n place	kalkaji	kailash colony	kalkaji	kalkaji	okhla p 1	saket
10	8	20	9	25	15	5	15
35	25	45	30	35	45	30	30
80	60	180	40	100	120	40	80
				3	1	2	2
				3	1	2	2
D	D	D	D	D	D	D	D
25	15	25	20	30	30	25	25
6	8	8	9				
2	2	3	3	2	3	2	2
9				8	10	10	8
3				2	2	2	3
7	8	8	8	8	5	5	10
6	8	7	7	7	10	8	8
5	4	5	6	4	6	3	8

20	21	22	23	24	25	26	27	28
M	M	M	M	M	F	M	M	M
18-30	18-30	18-30	18-30	30-60	30-60	18-30	30-60	18-30
car	rtv	car	car	car	car	car	car	auto
okhla p 1	n place	rk puram	rk puram	hauj khas	lajpat nagar	kalkaji	dwarka	okhla mandi
katwaria sarai	badarpur	badarpur	n place	noida	munirka	dwarka	nfc	munirka
40	10	60	40	40	20	20	25	15
150	75	120	90	60	50	60	70	45
200	100	200	150	250	120	150	120	80
3		1	1	1	2	2	2	
2		1	1	1	2	2	2	
TW	D	D	D	D	D	D	TW	D
40	30	35	30	30	20	30	15	15
	15							10
2	10	2	1	2	1	2	1	2
6		8	8	7	9	9	9	
4		5	1	1	2	1	2	
8	7	7	7	9	8	8	7	6
8	6	7	7	9	7	8	8	8
2	3	5	5	3	2	6	7	8

29	30	31	32	33	34	35	36	37
M	F	M	M	M	M	F	M	M
18-30	18-30	30-60	18-30	18-30	18-30	18-30	18-30	30-60
AUTO	car	E vehicle	E vehicle	car	auto	car	car	car
n place	kalakaji	lsrc	garhi gaon	kaiash colony	sarai jullena	n place	garhi gaon	lajpat nagar
saket	noida	kailash metro	lsrc	kalkaji	munirka	hauz khas	igi airport	n place
9	20	5	10	10	12	5	30	12
30	60	15	30	30	30	20	80	30
50	120	40	50	80	70	30	150	60
	2			2		2	3	1
	2			2		2	3	1
D	D	D	D	D	D	D	D	D
20	30	10	15	20	20	20	25	15
8		10	12		8			
1	2	3	5	2	2	1	1	1
	7			8		9	8	9
	5			6		2	2	2
8	6	7	6	8	7	8	7	8
5	7	8	8	6	6	6	7	8
3	7	6	7	5	6	5	6	4

38	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**
M	F	M	M	M	M	M	M	M
18-30	30-60	30-60	30-60	30-60	18-30	30-60	18-30	30-60
car	car	auto	car	auto	auto	auto	RTV	E vehicle
munirka	n place	south ex	n place	n place	sangam vihar	kalkaji	ali village	garhi gaon
lajpat nagar	lajpat nagar	badarpur	muknand	sangam vihar	govind puri	south ex	kalka garhi	lajpat metro
20	9	15	3	10	5	8	10	4
45	20	90	15	60	30	35	30	20
100	50	150	30	70	30	70	150	50
2	1		2					
2	1		2					
D	TW	D	D	D	D	D	D	D
25	20	25	10	10	5	20	35	15
		8		12	10	8	7	10
1	2	3	2	3	5	3	5	5
9	8		8					
8	2		2					
9	7	6	7	8	6	5	9	5
9	6	7	8	7	7	4	4	4
6	6	4	5	6	7	3	5	3
47	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**
M	M	M	M	M	M	M	M	M
30-60	30-60	18-30	18-30	30-60	18-30	18-30	30-60	18-30
Evehicle	auto	car	car	car	auto	car	rtv	cab
lsrc	rohini	m pur khadar	noida	tilak nagar	sangam vihar	kailash colony	sangam vihar	okhla
kailash metro	n place	n place	pargati maidan	n place	lsrc	n place	kalkaji	wazirpur
2	30	11	30	25	20	5	7	80
20	120	30	120	45	35	15	45	180
50	200	60	200	200	120	40	150	300
			2	2		3		2
			2	2		3		2
D	D	D	D	D	D	D	D	D
10	40	20	25	30	30	10	25	40
10	4	8			7		10	5
5	2	1	3	1	2	2	10	2
		8	8	8		7		8
		3	4	2		5		5
8	8	8	7	8	7	7	7	8
8	9	9	8	7	7	9	9	8
5	5	5	6	5	6	5	4	4

47	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**
M	M	M	M	M	M	M	M	M
30-60	30-60	18-30	18-30	30-60	18-30	18-30	30-60	18-30
Evehicle	auto	car	car	car	auto	car	rtv	cab
lsrc	rohini	m pur khadar	noida	tilak nagar	sangam vihar	kailash colony	sangam vihar	okhla
kailash metro	n place	n place	pargati maidan	n place	lsrc	n place	kalkaji	wazirpur
2	30	11	30	25	20	5	7	80
20	120	30	120	45	35	15	45	180
50	200	60	200	200	120	40	150	300
			2	2		3		2
			2	2		3		2
D	D	D	D	D	D	D	D	D
10	40	20	25	30	30	10	25	40
10	4	8			7		10	5
5	2	1	3	1	2	2	10	2
		8	8	8		7		8
		3	4	2		5		5
8	8	8	7	8	7	7	7	8
8	9	9	8	7	7	9	9	8
5	5	5	6	5	6	5	4	4
56	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**
M	M	M	M	M	M	M	M	M
30-60	18-30	30-60	18-30	30-60	18-30	30-60	18-30	30-60
cab	cab	cab	car	cab	rtv	cab	rtv	auto
GK	aya nagar	GK	GK	dwarka	sangam vihar	kalkaji	virat	badarpur
delhi- ncr	delhi - ncr	delhi-ncr	lajpat nagar	delhi-ncr	n place	delhi-ncr	n place	r k puram
200	250	250	8	150	15	200	8	30
300	250	360	30	300	60	300	30	90
600	360	200	120	300	100	500	100	250
3	3	3	1	1		3		
3	3	3	1	1		3		
D	D	D	D	D	D	D	D	D
40	60	40	25	40	30	60	20	30
4	5	10		5	10	7	12	8
3	3	3	2	5	5	3	5	2
9	8	7	8	4		7		
1	2	1	2	2		2		
8	9	6	8	8	9	8	8	9
5	8	7	9	8	9	8	8	9
3	2	4	1	3	1	3	1	2

65	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**
M	M	M	F	M	M	M	M	M
18-30	30-60	30-60	30-60	18-30	18-30	30-60	30-60	30-60
car	auto	car	car	rtv	cab	auto	E vehicle	cab
kalkaji	m pur khadar	g noida	noida	govin d puri	nfc	jullena	kailash colony	noida
sangam	n place	n place	v kunj	n place	v kunj	r k puram	lajpat nagar	n place
7	10	25	30	12	16	15	10	25
20	30	60	70	40	30	50	30	75
60	90	150	200	120	120	120	60	120
2		2	2					
2		2	2					
D	D	D	D	D	D	D	D	D
20	30	20	25	20	30	20	20	30
	7			8	8	7	10	8
3	3	1	1	5	2	2	5	2
5		9	7		8			8
5		8	1		3			3
6	6	7	6	7	7	7	8	7
5	7	6	8	8	8	9	8	6
5	5	5	6	6	7	6	3	3
74	**75**	**76**	**77**	**77**	**78**	**79**	**80**	**81**
M	M	F	M	M	M	M	M	M
18-30	30-60	30-60	18-30	18-30	18-30	30-60	18-30	30-60
cab	cab	cab	car	car	car	car	car	car
josola	tamoornagar	kalkaji	sarai kale khan	zakir nagar	s vihar	kalkaji	GK 1	govindpuri
lajpat nagr	masgid moth	munirka	pompos h	cr park	jia sarai	kailash colony	lajpat nagar	r k puram
20	12	8	20	15	13	8	6	15
60	35	25	60	45	35	25	25	50
100	80	60	120	120	80	50	50	150
			2	1	3	2	1	3
			2	1	3	2	1	3
D	D	D	TW	D	D	D	D	D
25	15	20	20	15	25	15	20	30
7	6	8						
1	2	2	1	1	1	1	1	1
8	7	8	9	8	8	8	8	8
5	1	5	2	5	6	3	1	4
8	7	8	8	5	8	5	8	6
7	8	9	9	6	9	6	5	8
5	6	6	6	5	6	3	4	6
M	F	M	M	M	M	M	M	M

82	83	84	85	86	87	88	89	90
M	F	M	M	M	M	M	M	M
18-30	30-60	30-60	30-60	30-60	30-60	18-30	18-30	30-60
car	car	auto	auto	auto	auto	rtv	rtv	rtv
lajpat nagar	kailash colony	n place	jajpat nagar	kalkaji	jamia	badarpur	sarita vihar	m pur khadar
kalu sarai	sukhdev vihar	dwarka	saket court	airport	munirka	n place	n place	n place
20	8	12	9	14	15	9	7	8
60	30	30	25	60	50	30	30	30
160	80	100	80	115	150	250	250	250
2	2							
2	2							
D	D	D	D	D	D	D	D	D
25	20	30	20	30	20	20	15	15
		8	8	7	6	8	10	10
2	1	2	2	3	2	10	10	10
7	9							
1	1							
7	7	7	8	8	7	8	8	9
6	5	3	4	9	8	4	8	8
5	6	5	3	3	4	6	5	5
91	92	93	94	95	96	97	98	99
M	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**
30-60	18-30	30-60	18-30	30-60	60+	30-60	18-30	30-60
car	car	car	auto	car	car	auto	rtv	rtv
v kunj	munirka	hauzkhas	rk puram	v kunj	mansoravar	laxmi nagar	badarpur	badarpur
n place	n place	n place	badarpur	n place	n place	nehru place	n place	n place
12	14	13	30	12	25	14	20	20
30	30	30	60	30	60	90	40	50
60	80	80	150	70	100	150	300	250
3	2	3		1	2			
3	2	3		1	2			
TW	TW	D	D	TW	TW	D	D	D
20	20	25	60	20	15	25	30	30
			8			4	8	10
3	1	2	3	2	2	3	10	10
8	8	5		8	8			
4	6	5		5	4			
5	8	10	6	7	2	5	4	3
10	4	8	9	6	2	3	2	6
5	5	5	2	4	3	4	6	7

100	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**
M	M	M	M	M	M	M	F	M
30-60	30-60	30-60	18-30	30-60	18-30	18-30	18-30	30-60
rtv	car	car	car	car	car	car	car	auto
govindpuri	gk 2	sangam vihaar	cp	saket	gk	noida	kalkaji	cr park
n place	n place	n place	n place	n place	noida	n place	lsrc	bharat nagar
12	3	10	40	15	70	25	5	10
40	10	30	180	60	180	120	20	30
150	20	150	250	150	250	200	80	80
	3	2	1	2	1	3	2	
	3	2	1	2	1	3	2	
D	D	D	D	D	D	D	D	D
25	20	30	30	30	40	30	10	15
10								8
10	2	2	1	1	1	2	1	1
	6	10	6	8	8	5	9	
	3	1	4	3	3	3	2	
5	8	8	7	9	9	8	7	7
3	4	8	8	9	9	9	8	9
7	9	4	3	3	4	7	6	2
109	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**
M	M	M	F	F	M	F	M	M
18-30	30-60	18-30	18-30	30-60	18-30	30-60	18-30	30-60
cab	cab	cab	cab	cab	car	car	auto	cab
munika	noida	noida	g noida	jamia nagar	kalkaji	bhrat nagar	noida	noida
n place	gurgaon	n place	cr park	v kunj	mohan state	cr park	lajpat nagar	lajpat nagar
10	30	25	30	20	12	8	30	30
45	90	45	80	60	35	20	60	60
100	200	120	200	180	70	60	120	200
					3	2		
					3	2		
D	D	D	D	D	D	D	D	D
25	30	20	25	20	20	20	15	15
8	8	5	6	8			10	5
2	2	3	2	2	1	1	2	1
9	7	8	8	8	9	7		8
3	2	6	6	2	3	5		6
8	7	7	6	7	8	5	5	7
7	7	8	6	8	7	6	8	6
3	6	6	6	5	5	4	3	5

118	**119**	**120**
M	M	M
18-30	18-30	18-30
rtv	rtv	cab
n place	badarpur	n place
jaitpur	n place	delhi-ncr
15	12	200
60	60	300
150	200	400
		3
		3
D	D	D
30	25	45
10	10	5
10	10	2
		8
		2
8	4	7
8	7	7
4	3	4

Post implementation stage

		1	2	3	4
1	**Gender**	M	M	M	F
2	**Age Group**	30-60	30-60	18-30	30-60
3	**Travelling Mode**	E vehicle	car	car	car
5	**Origin**	garhi gaon	tilak nagar	noida	noida
6	**Destination**	lajpat nagar	cr park	gurgaon	munirka
7	**Distance**	4	30	35	25
8	**Time**	20	45	120	70
9	**Trip cost**	50	250	300	200
10	**No of Cars**		2	2	3
11	**No daily used**		1	1	2
12	**Frequency of Travel**	D	D	D	D
13	**Time Spent in traffic jams**	10	20	20	20
14	**Number of trips**	12			
15	**Occupancy**	5	2	2	2
16	**safety and security with family and friends**		7	8	7
17	**safety and security with with unknowns**		2	2	5
18	**noise peception**	5	7	7	8
19	**air pollution**	4	5	8	7
20	**parking space availability**	7	5	8	5

5	**6**	**7**	**8**	**9**	**10**	**11**	**12**
M	M	M	M	F	F	M	F
18-30	30-60	30-60	18-30	18-30	18-30	30-60	30-60
car	auto	car	Evehile	car	car	car	car
abul fazal	bawana	g noida	lsrc	nfc	nfc	n place	lajpat nagar
munirka	cr park	jasola	kailash metro	lsrc	blue bell school	v kunj	blue bells school
15	35	20	2	10	8	10	10
40	90	70	10	30	30	35	30
100	250	200	50	80	100	120	120
2		2		3	2	1	2
1		1		2	1	1	1
D	D	D	D	D	D	D	D
15	30	20	5	15	10	20	15
	10		12				
2	2	2	5	2	2	1	2
7		7		8	7	7	7
2		2		1	2	2	1
5	8	4	8	5	5	5	8
4	7	5	4	5	5	6	7
7	5	8	2	7	6	8	6
13	**14**	**15**	**16**	**17**	**18**	**19**	**20**
F	M	M	F	F	F	M	M
18-30	30-60	18-30	18-30	30-60	30-60	18-30	30-60
car	auto	E vehicle	cab	cab	cab	car	car
nfc	noida	kailash colony	jasola vihar	tamoor nagar	kalkaji	sarai kale khan	zakir nagar
lsrc	kalu sarai	lajpat nagar	shaheen bagh	masgid moth	munirka	pomposh	c r park
7	30	10	8	12	8	20	15
30	90	30	20	35	25	60	45
120	200	60	100	80	60	120	20
3						2	1
2						1	1
D	D	D	D	D	D	TW	D
10	20	10	10	10	10	15	10
	12	14	10	10	12		
1	3	5	2	3	3	2	2
9			8	7	8	8	8
1			4	1	5	2	2
7	8	6	5	7	5	5	5
5	5	8	6	4	5	6	4
6	7	4	9	9	8	8	8

21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**
M	M	M	F	M	F	M	M	M
18-30	30-60	18-30	18-30	18-30	30-60	30-60	30-60	18-30
car	car	car	car	car	car	auto	auto	auto
sukhdev vihar	kalkaji	gk 1	govind puri	lajpat nagar	kailash colony	n place	lajpat nagar	kalkaji
jia sarai	kailash colony	lajpat nagar	r k puram	kalu sarai	sukhdev vihar	dwarka	saket	igi
13	8	6	15	20	8	12	9	14
35	25	25	50	60	30	30	25	60
80	50	50	150	160	80	100	80	115
3	2	1	3	2	2			
2	1	1	2	1	1			
D	D	D	D	D	D	D	D	D
10	10	10	15	15	10	10	10	25
						12	12	12
2	2	2	3	3	2	2	2	3
8	7	7	9	8	9			
6	2	2	2	5	4			
5	6	5	7	4	4	7	8	5
4	7	6	5	5	3	5	4	4
8	7	8	6	9	9	8	8	8
30	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**
M	M	M	M	M	M	M	M	M
30-60	18-30	30-60	18-30	30-60	18-30	30-60	18-30	30-60
auto	rtv	rtv	rtv	car	car	car	auto	car
jamia	badarpur	sarita vihar	m pur khadar	v kunj	munirka	hauzkhas	rk puram	v kunj
munirka	n place	n place	n place	n place	n place	n place	badarpur	n place
13	9	7	10	12	14	13	35	12
30	30	30	30	30	30	30	60	30
110	250	250	250	60	80	80	200	70
				3	2	3		1
				1	1	2		1
D	D	D	D	TW	D	D	D	D
10	15	10	10	10	10	15	25	10
10	12	15	14				12	
3	10	10	10	2	3	3	3	2
				8	9	9		8
				1	7	2		2
7	4	5	8	2	6	6	5	7
8	5	4	6	6	4	5	6	5
4	8	3	7	9	8	8	4	8

39	**40**
M	M
60+	30-60
Car	auto
mansarowar	laxmi nagar
cr park	n place
25	14
60	120
100	130
2	
1	
TW	D
10	15
3	3
9	
5	
7	7
6	6
8	7

41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**
M	M	M	M	M	M	M	M	M
18-30	30-60	18-30	30-60	30-60	18-30	18-30	18-30	18-30
rtv	rtv	rtv	car	car	rtv	car	car	rtv
badarpur	badarpur	govindpuri	gk 2	sangam vihar	baadarpur	cp	saket	n place
n place	n place	n place	n place	n place	n place	n place	n place	jaitpur
20	20	12	3	10	12	40	10	25
30	45	30	10	30	60	120	45	70
300	250	120	20	150	150	150	120	100
			3	2		1	2	
			2	1		1	1	
D	D	D	D	D	D	D	D	D
15	10	15	15	20	20	20	15	20
12		15			12			14
10	10	10	3	3	12	2	3	10
			9	9		6	9	
			1	2		4	2	
5	7	5	6	4	4	8	5	8
5	6	4	5	5	5	7	5	6
7	7	7	7	6	7	6	6	5
50	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**
M	M	M	M	M	M	F	M	M
30-60	18-30	18-30	30-60	30-60	18-30	30-60	18-30	30-60
cab	car	car	auto	cab	cab	car	car	car
n place	gk	noida	jullena	noida	munirka	nfc	cr park	dwarka
delhi-ncr	noida	n place	munirka	gurgaon	lotus temple	munirka	dwarka	nfc
200	70	25	12	30	12	15	20	25
360	120	120	40	80	40	40	60	70
400	250	200	120	200	200	120	150	120
3	2	3				2	2	2
2	1	1				1	1	1
D	D	D	D	D	D	D	D	D
20	10	10	15	25	15	10	15	10
6			10	10				
3	3	3	3	4	3	2	3	2
9	8	5		8	9	9	7	8
2	3	3		6	2	2	3	2
7	8	6	8	8	8	4	6	5
7	7	6	5	4	5	5	5	6
4	6	5	8	5	4	7	7	7

59	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**
M	M	M	M	M	F	M	F	M
30-60	30-60	18-30	30-60	18-30	30-60	18-30	30-60	18-30
car	car	car	auto	cab	cab	car	car	auto
noida	lajpat nagar	kalkaji	n place	noida	jamia nagar	cr park	jullena	noida
lajpat nagar	munirka	lajpat nagar	bharat nagar	cr park	v kunj	mohan estate	cr park	n place
35	20	10	12	30	16	14	10	20
150	90	30	30	80	50	40	20	60
250	150	80	80	200	150	120	60	120
2	3	2				3	2	
1	2	1				1	1	
TW	D	D	D	D	D	D	D	D
15	10	5	10	20	15		15	20
			12	10	12			12
2	1	2	3	2	3	2	2	3
9	8	9				8	8	
3	4	1				4	3	
5	6	6	4	7	5	6	5	6
5	5	5	5	4	6	5	4	4
8	8	8	8	7	7	8	7	6
68	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**
M	M	M	M	M	M	M	M	M
18-30	30-60	30-60	18-30	18-30	30-60	30-60	30-60	18-30
cab	Evehicle	car	car	car	cab	cab	car	auto
g noida	garhi gaon	lsrc	kailash colony	gk	noida	gk	v kunj	noida 37
cr park	lsrc	kalakaji	n place	lajpat nagar	munirka	delhi-ncr	nfc	n place
30	10	6	5	15	30	250	12	10
120	30	30	20	20	80	360	40	30
200	50	60	100	150	120	200	150	120
		2	2	1			3	
		1	1	1			1	
D	D	D	D	D	D	D	D	D
20	10	5	10	15	15	20	20	20
7	15				12	10		10
5	5	3	3	2	3	3	2	3
8		8	8	7	8	9	7	
6		4	4	3	3	2	2	
6	7	5	8	6	5	8	5	7
6	6	7	7	8	4	7	4	6
8	6	7	5	7	8	5	7	7

77	**78**	**79**	**80**	**81**	**82**	**83**	**84**	**85**
M	M	M	M	M	M	M	M	M
18-30	18-30	18-30	18-30	30-60	18-30	18-30	30-60	30-60
car	car	car	auto	E vehicle	car	car	car	car
garhi	noida	tamoor nagar	n place	lajpat nagar	munirka	v kunj	kalkaji	jamia nagar
iit delhi	cr park	lsrc	jamia nagar	kailash colony	bluebell school	bluebell school	lsrc	kailash colony
12	30	12	8	6	12	14	6	10
40	60	30	30	20	30	30	20	30
120	200	150	120	50	120	120	100	150
2	2	2			1	2	2	2
1	2	1			1	1	1	2
D	D	D	D	D	D	D	D	D
20	15	15	20	15	15	15	10	20
			12	13				
2	2	2	3	5	3	2	3	2
7	7	7			8	7	7	8
2	3	2			7	3	2	7
6	5	8	5	8	8	8	8	5
5	5	5	4	7	6	7	7	6
7	7	7	7	5	7	6	6	7
86	**87**	**89**	**90**	**91**	**92**	**93**	**94**	**95**
M	M	M	F	F	M	M	F	M
30-60	18-30	18-30	18-30	30-60	18-30	18-30	18-30	30-60
car	car	auto	car	car	car	car	car	car
tilak nagar	kalkaji	noida	n place	kalu sarai	kailash colony	lajpat nagar	n place	lajpat nagar
n place	patel nagar	lajpat nagar	aiims	jmi	jia sarai	v vihar	iit	cr park
25	25	30	16	15	15	20	8	14
45	90	80	40	30	50	50	25	30
300	200	200	150	150	120	150	60	60
2	2		1	2	2	3	2	1
1	1		1	1	1	2	1	1
D	D	D	D	D	D	D	D	D
20	20	20	15	15	20	15	10	10
		10						
3	2	3	2	3	2	2	2	2
8	8		8	9	8	8	8	8
3	4		4	2	7	4	4	4
6	8	8	7	8	8	7	6	6
7	7	7	8	7	6	5	5	5
8	6	5	8	6	8	8	8	6

96	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**
F	M	M	M	M	M	F	M	M
18-30	30-60	30-60	18-30	18-30	18-30	18-30	18-30	30-60
car	Evehicle	auto	car	E vehicle	car	car	auto	car
kalkaji	kailash colony	munirka	mayur vihar	lsrc	cp	noida	defence colony	noida
noida	lsrc	bharat nagar	cr park	kailsh metro	munirka	lsrc	jia sarai	bluebells
20	5	15	30	2	40	25	20	25
60	15	45	90	20	120	90	60	90
80	40	130	150	50	250	150	180	180
2			3		1	2		1
1			2		1	1		1
D	D	D	D	D	D	D	D	D
15	10	20	15	10	15	10	15	15
	12	15		12			8	
2	5	2	2	5	1	2	2	1
8			8		8	9		9
3			1		2	3		3
5	6	9	5	6	4	2	4	3
6	5	8	4	5	3	3	4	5
7	7	9	7	8	8	7	9	8
105	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**
M	M	M	F	M	M	M	M	M
18-30	30-60	30-60	18-30	18-30	18-30	30-60	30-60	30-60
car	rtv	auto	car	auto	auto	car	car	car
rohini	badarpur	laxmi nagr	kalkaji	n place	okhla	dwarka	lajpat nagar	hauzkhas
n place	n place	n place	noida	saket	munirka	nfc	munirka	noida
35	10	14	20	10	15	25	20	40
120	40	90	40	25	45	70	50	120
200	250	130	90	50	80	120	120	250
1			2			2	2	1
1			1			2	1	1
D	D	D	D	D	D	TW	D	D
10	15	15	20	10	15	15	10	10
	12	8		10	12			
2	10	5	2	3	2	1	1	2
8			7			9	9	7
1			5			2	2	5
4	3	5	6	5	6	7	8	9
7	5	3	7	7	7	8	7	9
9	8	7	7	7	8	7	2	3

114	115	116	117	118	119	120
M	M	M	M	M	M	M
18-30	18-30	30-60	30-60	18-30	30-60	18-30
auto	car	car	auto	auto	cab	car
n place	okhla	defence colony	lajpat nagar	lajpat nagar	sarita vihar	cp
badarpur	katwaria	masgid moth	jia sarai	n place	n place	cr park
10	40	20	9	8	10	30
70	120	40	30	20	30	90
100	200	100	60	60	80	120
		2				2
		1				1
D	TW	D	D	D	D	D
10	10	15	10	15	10	15
15			12	8		
3	3	2	3	2	2	3
	6	9			7	9
	4	2			2	1
7	6	5	6	6	7	6
6	5	6	5	7	6	4
3	7	5	7	8	5	8

Summation (pre)

	Summation
Distance(km)	3161
Time(min)	7460
Cost(Rs)	16075
No of Cars	125
No Daily used	124
Time Spent in Traffic Jams	2925
Number of trips	547
Occupancy	331
Number od car surveyed	50
Car occupancy	77
number of autos surveyed	26
number of taxis surveyed	20
number of E-vehicle surveyed	5
autos occupancy	59
taxis occupancy	45
E-vehicle occupancy	23
autos trip	197
taxis trip	132
E-vehicles trip	52

Summation (post)

	Summation
Distance(km)	2455
Time(min)	6715
Cost(Rs)	16245
No of Cars	140
No Daily used	83
Time spent in traffic jams	1695
number of trips	529
Occupancy	374
number of car surveyed	50
car occupancy	113
number of autos surveyed	21
number of taxis surveyed	10
number of E-vehicle surveyed	7
autos occupancy	59
taxis occupancy	31
E-vehicle occupancy	35
autos trips	234
taxis trips	99
E-vehicles trips	99

Appendix D

AHP Survey

CSIR-Central Road Research Institute, New Delhi - 110020

SUSTAINABILITY ASSESSMENT OF TRANSPORT MEASURES: AN EVALUATION OF ODD-EVEN SCHEME

Scale: 1-Equal importance, 3- Moderate importance, 5-Strong importance, 7- Very strong importance, 9-Extreme importance (2, 4, 6, 8 values in between). With respect to above evaluation which criterion is more important, and how much more on a scale 1 to 9?

INDICATORS		Which is more important? A or B	Equal	How much more?							
A	B		1	2	3	4	5	6	7	8	9
Trip Cost	Trip Time										
	Safety and Security										
	Accidents										
	Users Satisfaction										
	Congestion Level										
	Parking Demand										
	Para-transit Demand										
	Fuel Consumption										
	Noise Level										
	Air Quality										
Trip Time	Safety and Security										
	Accidents										
	Users Satisfaction										
	Congestion Level										
	Parking Demand										
	Para-transit Demand										
	Fuel Consumption										
	Noise Level										
	Air Quality										

Scale: 1-Equal importance, 3- Moderate importance, 5-Strong importance, 7- Very strong importance, 9-Extreme importance (2, 4, 6, 8 values in between). With respect to above evaluation which criterion is more important, and how much more on a scale 1 to 9?

INDICATORS		Which is more important? A or B	Equal	How much more?							
A	B										
			1	2	3	4	5	6	7	8	9
Safety and Security	Accidents										
	Users Satisfaction										
	Congestion Level										
	Parking Demand										
	Para-transit Demand										
	Fuel Consumption										
	Noise Level										
	Air Quality										
Accidents	Users Satisfaction										
	Congestion Level										
	Parking Demand										
	Para-transit Demand										
	Fuel Consumption										
	Noise Level										
	Air Quality										
Users Satisfaction	Congestion Level										
	Parking Demand										
	Para-transit Demand										
	Fuel Consumption										
	Noise Level										
	Air Quality										

Scale: 1-Equal importance, 3- Moderate importance, 5-Strong importance, 7- Very strong importance, 9-Extreme importance (2, 4, 6, 8 values in between). With respect to above evaluation which criterion is more important, and how much more on a scale 1 to 9?

INDICATORS		Which is more important? A or B	Equal	How much more?							
A	B										
			1	2	3	4	5	6	7	8	9
Congestion Level	Parking Demand										
	Para-transit Demand										
	Fuel Consumption										
	Noise Level										
	Air Quality										
Parking Demand	Para-transit Demand										
	Fuel Consumption										
	Noise Level										
	Air Quality										
Para-transit Demand	Fuel Consumption										
	Noise Level										
	Air Quality										
Fuel Consumption	Noise Level										
	Air Quality										
Noise Level	Air Quality										

SNO	INDICATORS	1	2	3	4	5	6	7
1	Trip Cost	0.012	0.032	0.07	0.031	0.152	0.063	0.116
2	Trip Time	0.033	0.078	0.071	0.058	0.117	0.063	0.055
3	Safety and Security	0.174	0.147	0.161	0.32	0.119	0.266	0.217
4	Accidents	0.263	0.013	0.265	0.32	0.052	0.316	0.108
5	Users Satisfaction	0.029	0.15	0.042	0.037	0.032	0.021	0.125
6	Congestion Level	0.068	0.076	0.216	0.057	0.064	0.037	0.077
7	Parking Demand	0.014	0.024	0.021	0.019	0.03	0.024	0.038
8	Para-Transit Demand	0.025	0.03	0.024	0.03	0.07	0.083	0.04
9	Fuel Consumption	0.028	0.023	0.045	0.055	0.113	0.084	0.038
10	Noise Level	0.154	0.211	0.045	0.036	0.108	0.012	0.066
11	Air Quality	0.201	0.216	0.04	0.037	0.143	0.03	0.12

8	9	10	11	12	13	14	15	16	17
0.043	0.032	0.196	0.031	0.049	0.046	0.074	0.076	0.083	0.072
0.038	0.026	0.069	0.133	0.184	0.074	0.074	0.082	0.082	0.103
0.031	0.102	0.09	0.084	0.103	0.076	0.046	0.041	0.079	0.141
0.122	0.083	0.097	0.1	0.95	0.086	0.073	0.072	0.063	0.077
0.025	0.038	0.033	0.035	0.106	0.171	0.131	0.138	0.16	0.084
0.09	0.203	0.096	0.208	0.138	0.16	0.121	0.115	0.077	0.085
0.028	0.027	0.023	0.025	0.05	0.025	0.022	0.019	0.058	0.077
0.026	0.025	0.023	0.022	0.024	0.022	0.031	0.032	0.063	0.084
0.155	0.163	0.106	0.105	0.078	0.073	0.086	0.11	0.079	0.074
0.158	0.127	0.119	0.102	0.072	0.118	0.119	0.106	0.079	0.076
0.284	0.174	0.147	0.154	0.101	0.15	0.223	0.209	0.176	0.128
18	19	20	21	22	23	24	25	26	27
0.027	0.091	0.026	0.05	0.021	0.03	0.154	0.16	0.036	0.042
0.074	0.091	0.126	0.116	0.088	0.164	0.355	0.201	0.088	0.106
0.079	0.091	0.114	0.105	0.116	0.135	0.018	0.02	0.147	0.176
0.07	0.091	0.116	0.106	0.102	0.084	0.053	0.05	0.137	0.095
0.066	0.091	0.14	0.136	0.151	0.128	0.082	0.089	0.083	0.086
0.127	0.091	0.091	0.101	0.105	0.091	0.096	0.258	0.128	0.102
0.044	0.091	0.027	0.02	0.027	0.055	0.016	0.015	0.021	0.065
0.077	0.091	0.049	0.049	0.027	0.057	0.014	0.014	0.021	0.06
0.074	0.091	0.073	0.049	0.08	0.058	0.05	0.049	0.08	0.069
0.147	0.091	0.114	0.131	0.115	0.061	0.067	0.064	0.108	0.099
0.216	0.091	0.123	0.161	0.169	0.138	0.094	0.08	0.151	0.099

28	29	30	**MEAN**
0.036	0.039	0.039	**0.064**
0.165	0.118	0.08	**0.104**
0.148	0.1	0.073	**0.117**
0.095	0.088	0.096	**0.141**
0.088	0.065	0.115	**0.089**
0.148	0.1	0.164	**0.116**
0.069	0.081	0.034	**0.036**
0.047	0.063	0.029	**0.042**
0.041	0.064	0.092	**0.076**
0.051	0.103	0.107	**0.099**
0.112	0.179	0.17	**0.144**

Appendix E

Vehicle count survey

Lala lajpat Rai Marg					
	Before Implementation				After Implementation
BUS	34				41
CAR	1102				914
TAXI	143				168
AUTO	514				596
RTV	12				16
		Captain Guar Marg			
BUS	36				43
CAR	1351				1188
TAXI	205				232
AUTO	447				532
RTV	16				19
		Outer Ring Road			
BUS	42				51
CAR	1436				1164
TAXI	237				279
AUTO	497				602
RTV	13				17

Appendix F

Noise level Data

		Outer Ring Road			
TIME	Before Implementation				After Implementation
	Sound Level (dBA)				Sound Level(dBA)
0-15	83.6				78.5
15-30	85.6				78.8
30-45	77.3				80.1
45-60	87.6				77.3
Mean	83.525				78.675
		Lalalajpat Rai Marg			
0-15	74				79.7
15-30	74.7				75.1
30-45	76.6				76.8
45-60	87				78.2
Mean	78.075				77.45
		Captain Gaur Marg			
0-15	88.5				78.1
15-30	75.9				82.2
30-45	75.2				78.2
45-60	78.4				79.9
Mean	79.5				79.6

Appendix G

Parking and fuel consumption Data

Parking	**% decrease**	
	1st phase	2nd phase
Nehru Place Market	50	20
Nehru Place Metro	40	20

Fuel consumption Data			
S.NO	**% decrease**		**average**
	1st phase	2nd phase	
1	17	9	13
2	25	15	20
3	15	12	14
4	18	10	14