The method of policy capturing for the transportation disadvantaged: simulation results

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Abstract

In the previous study called "A Modelling Approach for the Transportation Disadvantaged", which was an experimental one calibrated in a small town in Turkey, it was observed that an integrated TPM for the disadvantaged category was probable, and the findings were observable at all stages of the sequential modelling, however, with slight differences compared to the Normal model's results. Following the previous one, this study shows the method of how "policy capturing" could be possible on the basis of these differences, which aims to help improve the adverse conditions of the disadvantaged. The method is sort of category analysis based on the cluster analysis results, since it is clearly verified that the "disadvantage indices" identified as the single-disadvantage groups match with the values of cluster centres. Using TRANUS software, three simulations are run for three dimensions of disadvantage: socio-economic (categorical), spatial and the positional. The simulation results, evaluated from different criteria, showed that socio-economic dimension was the most fruitful area for policy capturing.

Introduction: being disadvantaged in urban travel

It has been emphasized in various studies that the conventional TPMs (Transportation Planning Models) have not much novelty to the travel needs of Transportation Disadvantaged (TD) [1][2][3]. TD could be an umbrella term representing various disadvantaged sub-groups that might be affected adversely

from the existing travel conditions, such as the elderly, the disabled, access impaired, transit captives, non-car owners, etc. Thus, it was also suggested in our previous study that there should be a "special modelling approach" or method that consider their situation as a whole [4].

Briefly, in that study of Duvarcı [4], the so-called "disadvantaged" had been identified for a case study conducted in the city of Aydın in Turkey, covering eleven sub-categories of disadvantaged (represented also by eleven data fields/variables), by means of cluster analysis. According to this clustering procedure, the disadvantaged occupied 64% of the sampled universe. The sequential (four-step) modelling procedures were run for this category separately. The last two stages were calculated using TRANUS while Trip Generation and Distribution were calculated manually. Then, the model results of the disadvantaged were compared to those of Normal case. There observed – though trivial- some differences between the disadvantaged category and Normal for each stage of modelling. The data also included such preference and comfort-related information that reveals existing travel conditions of the citizens. All the process of modelling was described in the previous study [4]. In Figure 1, the equalisation part of this process is given in detail.
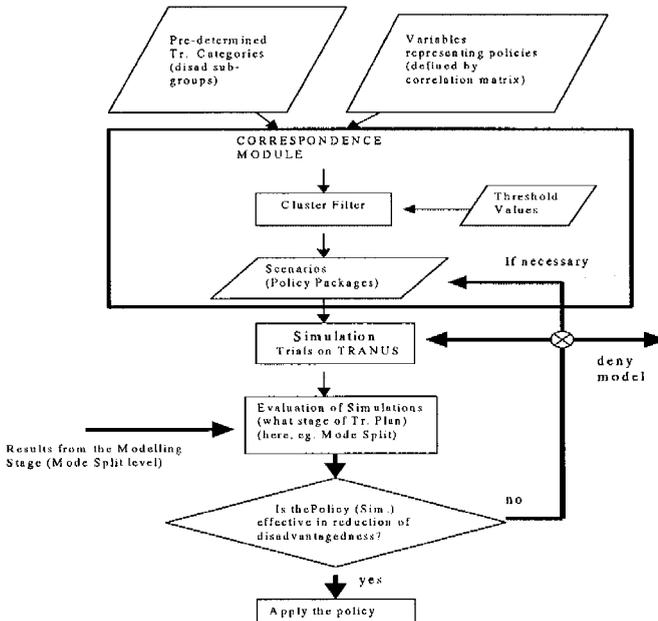

Figure 1: The flowchart of the equalization process

There observed three advantages of such a modelling with the clustering approach: One advantage of clustering was that it provided a person-by-person multi-criteria identification of the disadvantaged across the data variables considered, as well as the objectivity. The second advantage, with such self-organized definition of the disadvantaged, would be that it provides the division line between the advantaged and the disadvantaged, a "reference line" to which all other sub-groups (single-categories) of disadvantaged could be measured in terms of the number of persons falling beyond this line (ie, the "domain of disadvantagedness"). One another advantage was also the configuration of the social, spatial and situational (ie, type of disadvantage) dimensions of the disadvantaged travels, associating them to relevant social, geographical and positional (disadvantage) categories in the data. From here, likely the specific "disadvantagedness indices" could be drawn for each peculiar category of disadvantaged, with which a gauge could be obtained to be used in the policy-making. In this study, following the previous one, we can move on to the final step; the method of categorical handling of "disadvantagedness" is presented; the necessary steps that planner should take were exemplified over the same case study to show how the policies could be captured in order to help improve the travel conditions of the disadvantaged, that is what makes the modelling effort normative. Also, the effectiveness of the method was to be tested through simulations based on the sample policies captured. The cluster analysis results for the eleven major variables are summarized in Table 1. Note that there are huge differences between the two categories, especially for the vehicle availability (VEH.AVA) and income (INC.PER) variables.

Upon any significant presence of difference between the results of the two models, equation of those disadvantaged groups to the Normality becomes the major concern at this paper, since the model serves basically the "search of equity".

Table 1. Cluster centers of the disadvantaged and advantaged across the variables (Source: Duvarci, 2002)

	Cluster	
Variables	**1**	**2**
VEH.AVA	6.37	54.73
ACCESS	45.88	50.48
IMPED1	86.51	85.05
DEPEND	58.53	64.81
EDU.FAM1	36.68	43.41
ILK.TRAV	63.78	69.70
INC.PER	9.43	18.63
IMPED3	73.40	73.94
VEH.COM	37.59	38.41
IMPED2	95.89	96.07
PUB.COM	68.17	68.47

Equalization of the disadvantaged to the advantaged: "correspondence module"

For the equity process, first of all, the basics of equity must be well understood. Equity differs from the term "equality" in that, while former represents the equation process, the "struggle", on the basis of <u>deserve</u>, latter represents the equation on the basis of <u>sameness</u> at the input or final output [5][6]. Different equity types had been defined in the literature, most known being Harvey's [7]: (1) according to need, (2) contribution to common good, and (3) according to merit. Yet, these equity types will not be examined in detail, here. "equality of outputs" was preferred in this study since it seems more meaningful than the equality supplied at the beginning (input). From the other point of view, since the disadvantaged is the needy one for the improvement of his conditions, the <u>need</u> type (the first type) of equity was adopted as the guiding principle.

In providing equity, there are two important points that should be resolved: first, **who** really needs the equity treatment, and second, the evaluation method for the judgment of equity treatment should be cleared [5][8]. For the first problem, (**who** is the disadvantaged), "disadvantaged" should refer to the meaningfully identified socio-economic and demographic (or, even geographical) groups that require the equity treatment. Cluster Analysis serves the resolution of the two points well: It was used in the identification of the disadvantaged in an objective manner, and then, provided the gauge with which the amount of equity treatment is measured. For measuring the usefulness of the method, whether the equity is met (totally or partially) **in the desired direction** is checked through simulations designated for this purpose with the <u>relevant</u> policy options (scenarios).

Similar to Gini coefficient idea (Theil's T Statistics, Shares approach, MRPI, etc.) [8][9], our measurement of inequity is urged upon the "presence of difference" between the disadvantaged and Normality (or, ideality). "Ideality" is where equity should *totally* be met. If not, the equity is <u>still</u> met, but, *partially,* which can be described simply as in Figure 2.
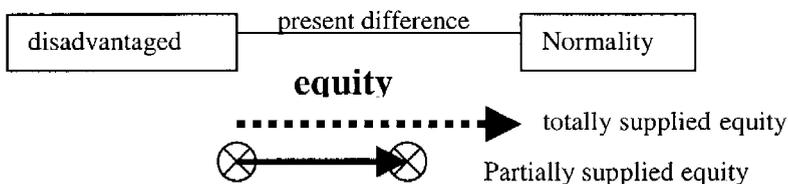

Figure 2: Difference between the disadvantaged and normality as the measure of equity

In practice, such efforts as reducing private car travel, employing non-monetary measures like restriction of car parking, priorities enabling public transport (frequency or alternative modes and probably a more urban coverage), pedestrianism are proposed in overcoming the inequity [10]. Pricing and monetary measures against motorists and compensation means that are to favour the disadvantaged are either suggested as strong tools [11]. Policy measures can be many, which are both demand and supply type [12]. The policy exploration process can be a standardised policy-definition system based on the correlated variables. This method has been a method known for a long time [13][12]. The sign direction of the correlation gives the hint about the conflict, thus, policy direction between the variable pairs.

Commonly agreed, there is no one "good" way of policy analysis as a universal technique to apply on every case, but are case specific try-and-error approaches [14]. Thus, the principle of equity becomes "trying to get as close to the ideal point as possible" in the outcome.

The Method of equalization: Here is a module proposal called "Correspondence Module" that is to be integrated to the final stage of the Modelling Approach for the TD, which will simply enable us to associate various transportation categories with the levels of need, via correlating to their "disadvantagedness indices" defined (scores). It helps us to determine the policy priorities to be determined.

As the second step, it requires the introduction of the pre-defined transportation categories (11 categories defined before). Those groups were pre-defined to be disadvantaged from the literature: (1) peak hour captives, (2) those exposed to uncomfortable travel conditions, (3) disabled, (4) elderly, (5) economically disadvantaged, (6) non-vehicle owners, (7) inaccessible to urban amenities, (8) inaccessible to transport facilities (stops, car park, etc.), (9) household dependent, (10) transit captives, (11) those exposed to physical barriers (eg, less space for pedestrian curb) [15][16]. In a sense, we will try to verify whether their disadvantage is severe, or not. The outcome of the Correspondence Module will be a matrix showing the disadvantagedness frequencies, as the numbers of persons, for all single-categories (columns) pre-defined. These values will be converted to the percentage (or, probability) values across the policy variables (raws), which had been defined through the high correlation values. For example, if the disadvantagedness ratio is relatively high across the transit captive groups, or, peak-hour captive groups, then this must stimulate the policy-maker to take precautions against those "disadvantage-causing" factors to remove these factors off over the transit riders.
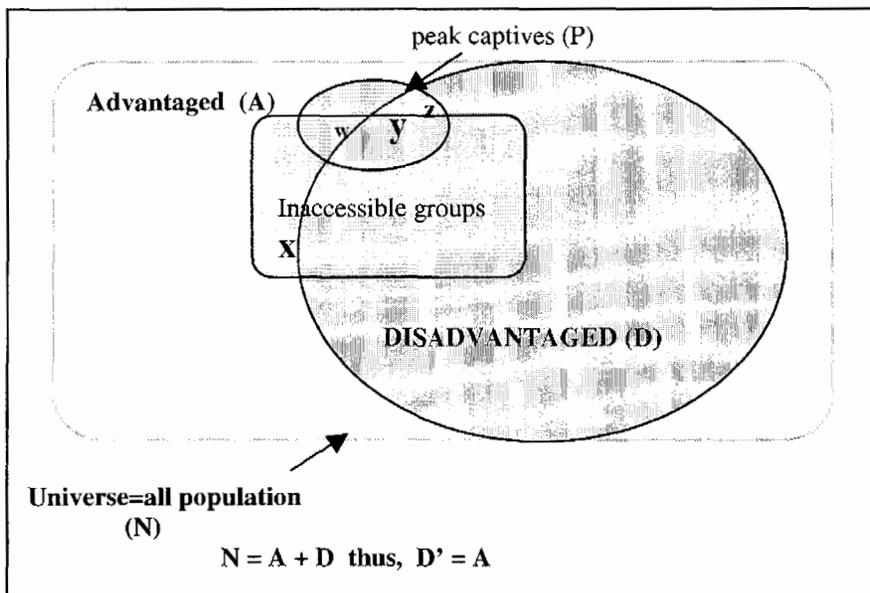
Figure 3: The Venn Diagram of disadvantage

Such a complex situation can be solved by the aid of the Venn Diagram, and, requires the application of the basics of Sets Analysis. This situation can be clearly explained in Figure 3, supposing the universe (N) (all population) is the Normality and the Event of Disadvantaged (D) is the complementary of Advantaged (A). Such composition of disadvantage includes those small fragments of the intersection, represented by small letters: w, x, y, z in the Figure 3. First of all, we should be aware of the overlapping cases that may be repetitive in the calculations. The composition (L) can be formulated as:

$$L = (w+x+y+z) = (I \cap D) \cup [(P \cap I) \cap A] \cup [(P \cap D) \cap I']$$

where, instead of A, D' could be used interchangeably.

The single-disadvantaged categories would be conceived as conditional probabilities as:

$$P_{Di} = P(D_i \setminus D) = P(D_i \cap D) / P(D)$$
$$\text{Where, } \sum_i P(D_i) \geq P(D)$$
$$\sum_i P(D_i) = P(D_1) + P(D_2) + P(D_3) + \ldots + P(D_n)$$

D_i is the single disadvantage category, and,

D is the general category of disadvantaged, which is the oval shape in the Venn Diagram.

Consequently, the probability of the single-category disadvantaged (such as disabled people) within the main category of disadvantaged is found (Alternatively, pairwise cross-probabilities of each single-category can either be found if such a $d_i x d_i$ matrix is set.).

To summarize, the steps of the Filtering Process, that comprises the large part of Correspondence Module, are explained in the following order (check also from the Figure 1):

- Definition of the single <u>disadvantaged categories</u>, and the <u>policy variables</u> determined by the higher correlation values (eg, ** significance levels in SPSS output view files).
- Determining <u>software (TRANUS)-compatible variables</u> (parameters). Incompatible ones are eliminated (thus, the size of the job is further reduced).
- <u>The Cluster Filter</u>: filtering of disadvantaged persons for each category (by 'data filter' in Excel) for both Disadvantaged data and the Normal data. It should be kept in mind that major role of cluster filter for both the Normal population and the disadvantaged population lies in the fact that **if the filtered value in the disadvantaged population gets closer to the value found for the Normal, it shows the degree to which so far a policy variable is disadvantaged for the specified category.**
- <u>Zonal Filtering</u>: exactly the same with the cluster filter but, this time for the zones (See Figure 4 in Scenario 1). Here, disadvantagedness was related to the average disadvantage of all zones. The findings were found consistent with the information obtained from the household interview surveys. With zonal filtering, it is aimed to find which zones are disadvantaged and, thus, *where* the policy should densely be applied.

The General Disadvantagedness Summary of The Zones to each Other and to the Average
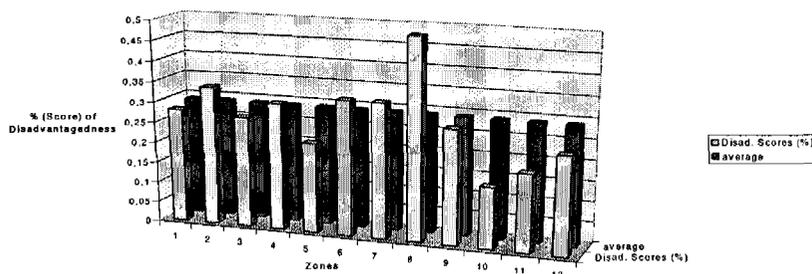
Figure 4: The disadvantage levels of the zones

- Finally, the definition of the <u>policy scenarios</u> on the basis of priorities determined: Respectively, the priorities are defined from three perspectives: categories, zones and policy type separately that are different approaches to generate scenarios.

To start filtering requires threshold values to entitle persons disadvantaged, which differs for each variable. By introducing threshold values, sort of "manual" clustering is applied in order to validate the cluster analysis results. The overall summary results can be seen in Table 2 for the disadvantaged only (Normal's has the similar pattern). When the table is examined, it can be noticed that especially vehicle availability, income, access and comfort related variables are problematic (above the score 0,4) again.

Consequently, the "Filter" results (as the differences between disadvantage scores) of disadvantaged and Normal provide a useful information base for <u>priority definition</u> in the form of category-variable (policy) matrix, which can be described symbolically:

$[d_{ij}]^{dis}$, $[d_{ij}]^{Nor}$; two filter result matrices for disadvantaged, and for Normal, respectively

if $(\Sigma_i d_{ij} / \Sigma D_i) = R_{ij}$; individual ratio of disadvantage for the single-   category of disadvantaged (D_i)

$\Delta_{ij} = (\Sigma d_{ij} / \Sigma D_i)^{dis} - (\Sigma d_{ij} / \Sigma D_i)^{Nor}$;results as matrix of differences,
     $\Delta_{ij} = (R)^{dis} - (R)^{Nor}$

$(\Sigma d_{ij} / \Sigma D_i)^N$ or,   = $\Delta_{ij} / (R)^N$; ratio of the difference to the matrice of normal
                                             (which is sort of disadvantage index for each single-category)

In the above notation, d (out of D) represents the number of disadvantaged persons for the single-category of disadvantaged (eg, number of old people) (j) and the objective variable (i), while D standing for only the total number of disadvantaged observed <u>in</u> the variable (i) as the result of cluster analysis. d_{ij} can be perceived as the intersection area of variable (i) and category (j). D_i enclaves $d_{ij,}$ thus, d value can at most be the value of D_i. Here Σ symbolically means the frequency for that matrix cell (Table 2.)

Finally, from the Filtering Process, the variables (and categories) that we must focus on in preparing the policies are derived. However, we could have found the policy variables directly from the cluster centre values after the Cluster Analysis study **without undergoing the tiresome filtering procedure** described here.

Table 2. Disadvantagedness frequencies and percentages of the single-
categories across the policy variables

threshold values(*)	for all	2.2	2	all sum	all sum	14.03	2	48.18	2	61.67	38	>1
	name	peakcaptive	curblacks	disabled	older	lowincome	novehicle	accesimpair	transitcaptiv	highdepende	discomfort	inaccesfacil
	var.name	Peak1,2	pedewidt	disab.no	dd.no	INC.PER	Veh.own	ACCESS	Typ.mcd	DEPEND	VEH.COM	stop.acc
	tot. disad	109	695	115	165	680	523	449	328	487	603	331
>4	regtrp	8	43	11	6	41	26	32	20	33	43	17
>2	wait.dura	4	26	9	1	17	15	14	12	18	24	20
>1	wait.stop	47	278	42	59	252	199	191	178	186	218	182
>0(sum)	veh.bisi	13	59	13	0	42	0	25	23	38	51	19
sum	walk.dos	49	344	25	33	319	222	181	120	205	270	141
*	VEH.AVA	68	457	89	131	487	523	334	234	353	401	225
>3	cost.tra	16	80	18	15	79	32	47	36	61	79	46
3	comfor	13	112	14	29	103	79	77	59	65	120	80
1(sum)	tran.edu	7	44	1	0	37	26	44	28	20	27	16
*	inc.per	69	516	106	133		425	337	242	413	439	261
*	IMPED2	47	310	43	72	280	228	198	170	194	246	186
>3	dura.tot	20	106	19	22	101	65	65	64	80	106	71
>3	stop.cond	33	193	20	46	170	145	137	101	128	153	112
*	EDU.FAM	49	363	80	111	382	289	247	164	240	309	189
sum	unemp.no	33	316	86	57	343	247	242	135	380	232	166
sum	serv.edu	6	18	0	2	26	3	15	14	12	15	5
3	klima	14	89	14	23	81	65	57	62	54	107	50
3	acc.work	51	281	22	49	294	213	289	159	242	263	136

threshold values(*)	%	2.2	2	all sum	all sum	14.03	2	48.18	2	61.67	38	>1	
	name	peakcaptive	curblacks	disabled	older	lowincome	novehicle	accesimpair	transitcaptiv	highdepende	discomfort	inaccesfacil	
	var.name	Peak1,2	pedewidt	disab.no	dd.no	INC.PER	Veh.own	ACCESS	Typ.mcd	DEPEND	VEH.COM	stop.acc	
%	tot. disad	0.12	0.75	0.12	0.18	0.73	0.56	0.48	0.36	0.52	0.65	0.36	SUM
>4	regtrp	0.07	0.06	0.10	0.04	0.06	0.05	0.07	0.06	0.07	0.07	0.05	0.699995
>2	wait.dura	0.04	0.04	0.08	0.01	0.03	0.03	0.03	0.04	0.04	0.04	0.06	0.41706
>1	wait.stop	0.43	0.40	0.37	0.36	0.37	0.38	0.43	0.54	0.38	0.36	0.55	4.566449
>0(sum)	veh.bisi	0.12	0.08	0.11	0.00	0.06	0.00	0.06	0.07	0.08	0.08	0.06	0.724775
sum	walk.dos	0.45	0.49	0.22	0.20	0.47	0.42	0.40	0.37	0.42	0.45	0.43	4.319148
*	VEH.AVA	0.62	0.66	0.77	0.79	0.72	1.00	0.74	0.71	0.72	0.67	0.68	8.092339
>3	cost.tra	0.15	0.12	0.16	0.09	0.12	0.06	0.10	0.11	0.13	0.13	0.14	1.296364
3	comfor	0.12	0.16	0.12	0.18	0.15	0.15	0.17	0.18	0.13	0.20	0.24	1.803973
1(sum)	tran.edu	0.06	0.06	0.01	0.00	0.05	0.05	0.10	0.09	0.04	0.04	0.06	0.557894
*	inc.per	0.63	0.74	0.92	0.81	0.00	0.81	0.75	0.74	0.85	0.73	0.79	7.76886
*	IMPED2	0.43	0.45	0.37	0.44	0.41	0.44	0.44	0.52	0.40	0.41	0.56	4.869726
>3	dura.tot	0.18	0.15	0.17	0.13	0.15	0.12	0.14	0.20	0.16	0.18	0.21	1.801816
>3	stop.cond	0.30	0.28	0.17	0.28	0.25	0.28	0.31	0.31	0.26	0.25	0.34	3.028381
*	EDU.FAM	0.45	0.52	0.70	0.67	0.56	0.55	0.55	0.50	0.49	0.51	0.57	6.077907
sum	unemp.no	0.30	0.45	0.75	0.35	0.50	0.47	0.54	0.41	0.78	0.38	0.50	5.444498
sum	serv.edu	0.06	0.03	0.00	0.01	0.04	0.01	0.03	0.04	0.02	0.02	0.02	0.27775
3	klima	0.13	0.13	0.12	0.14	0.12	0.12	0.13	0.19	0.11	0.18	0.15	1.516391
3	acc.work	0.47	0.40	0.19	0.30	0.43	0.41	0.64	0.48	0.50	0.44	0.41	4.672456

The simulation trials: measuring the effectiveness of the method

Three scenarios as the captured policies: The Assessment is based on the idea that all effects solely accrue from the policy. Thus, the results must be perceived as the "policy-relevant consequences" even if in the form of "compound impacts" as both direct or intended and indirect or unintended [17]. Yet, uncertainty still takes place in this area. Rank order technique of simulation alternatives for each criterion (indicator) was adopted. Finally, a simulation alternative getting the highest success (score) across the criteria was to be selected.

TRANUS was used to simulate the policy impacts as the alternative scenarios. The scenarios should be designed in order to eliminate the differences in travel quality between the disadvantaged and Normality. Using the information base, so far obtained from the "correspondence module", or cluster filtering described in the previous section, three Knowledge-Based (KB) scenarios will be prepared for simulations, and, their output will be contrasted in order to find the best solution. The solution that has the applicable policies must prove that the model for the disadvantaged will, at least, approximate to those of the Base-case (Normal) model run. The purpose of KB scenario-making is to avoid uncertainty (or, redundancy). Accordingly, the three scenarios should be derived systematically from three perspective. Such three knowledge sources in the evaluation of the simulations were clarified: Zones as the <u>spatial</u> dimension, Categories as the <u>social</u> dimension and the Policy Variables as the <u>disadvantage areas</u> (objective variables). The intention is to employ only the most effective policies as far as possible. Or, a combination of them should be applied if no such a unique strong policy variable is available.

A formulation was found for scenario-making: One scenario should address to spatial terms in particular and be Zone-specific, and one should address to social terms (ie, category sensitive), and the other should address to the policies (ie, variable-based) themselves.

First scenario (zone-based): Here, the policies will specifically be deployed for the chosen zones. The hint (knowledge source) for the policy determination is obtained from Figure 4 that provides the information of "which zones are seriously disadvantaged".

According to this chart, the most disadvantaged zone is clearly the 8th one (O. Yozgatlı and İstiklal districts). The other significantly disadvantaged zones are 2nd (Mesudiye and Köprülü), 6th (Orta, Ilıca and Ata districts) and 7th (A. Menderes and Yedi Eylül) as compared to the average, which primarily constitute the Southern and Eastern parts of the city except the 2nd one that takes place in North-western part. This information had been verified with the zonal cluster analysis results in the previous study.

Second scenario (category-based): This scenario is a sort of "social" one in terms of people groups as the disadvantage is shared onto various single-categories (ie, presumed groups). Out of 11 sub-categories, 'pedewidt', 'INC.PER', 'Veh.own', 'DEPEND', 'VEH.COM', and loosely 'ACCES' are found significantly disadvantaged. Thus, they are the categories of interest. In the TRANUS simulation, category of disadvantaged can be benefited in the penalty-type parametric manipulations against the "advantaged". However, it is interesting to note that both the categories of disabled ('disab.no') and elderly ('old.no') seem less significant because of their relatively small representation among population. Thus, their representation power is extended by multiplying their frequencies by their proportions in population. The proportions were %7 for both elderly (from the case study) and disabled from the national statistics.

The information of "policy" category(ies) is obtained from the chart derived from the matrix of Disadvantagedness as the outcome of the filtering (See Figure 5).

Third scenario: Here, the policy variables that can be applicable in TRANUS are chosen while the parameters are held constant for all zones and categories. Policy areas or variables meant the variables or subjects of concern at which disadvantagedness is felt strongly, thus, the policy type is determined for application safely.

Checking from the chart in Figure 6, which is the summary form derived from the filtering matrix of Disadvantagedness (Table 2), the similar results can be observed as in the previous scenarios, with the leading income, vehicle ownership, access-to-work and general cost (IMPED2) variables. Typically, vehicle availability can be the dividing factor in policy area determination on public mode users and private mode users.

The simulation results: For the vastness of the simulation and evaluation results, detailed explanation and results of this part are reserved to another paper to be published elsewhere.

Only, the specified disadvantaged zones were considered for the policy applications. Major applications were:

- the additional transit routes
- pedestrian walkways

Together with some other minor policy objectives, those worked in an expected manner (Figure 7 and 8) that encouraged especially the increase of trips of once private travellers of advantaged to use more transit. Yet, the goals are not fully met for the disadvantaged. Finally, according to the LOS results of First Simulation, no capacity overload problem is observed on the links.
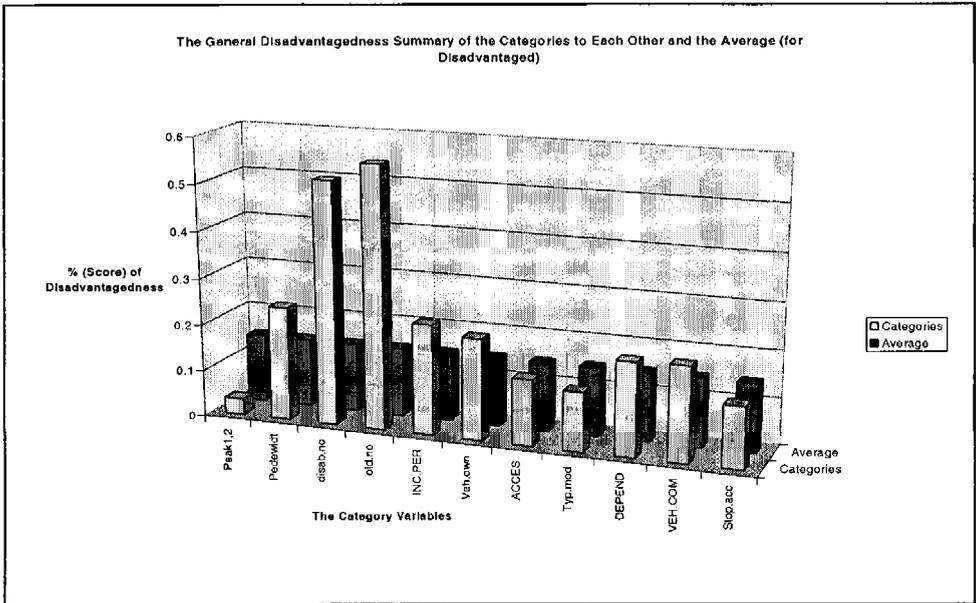
Figure 5: The disadvantagedness levels of the categories
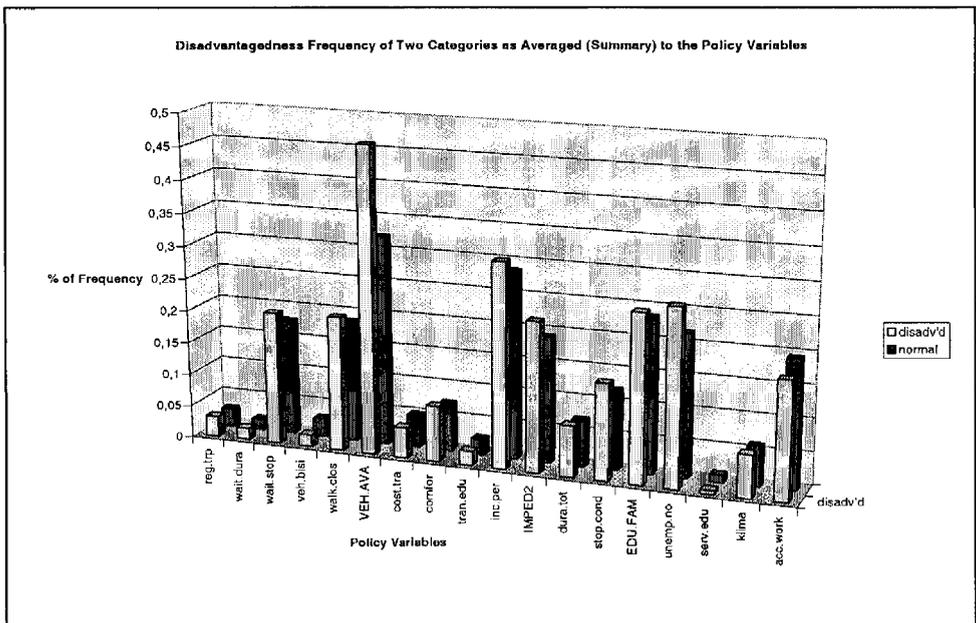
Figure 6: The disadvantagedness levels of the policy variables
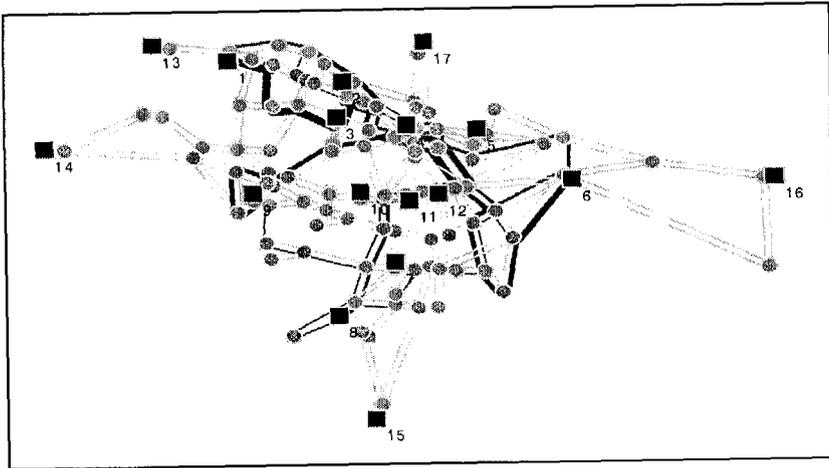
Figure 7: The total volumes (passengers) that additional transit lines attracted in simulation 1.
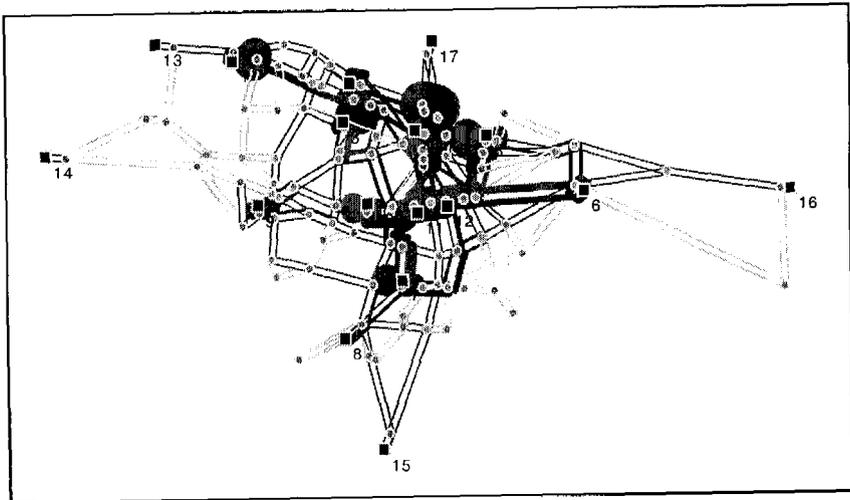
Figure 8: Pedestrian assignments after the additional walkways in simulation 1

The policies and objectives of the <u>Second Simulation</u> address to the specified category areas for all zones:

• Additional transit services with some peculiar characteristics and improvements in the services

- Additional On-call paratransit service (operator) with flexible routes and discounted ticket fee for elderly, disabled and poor.
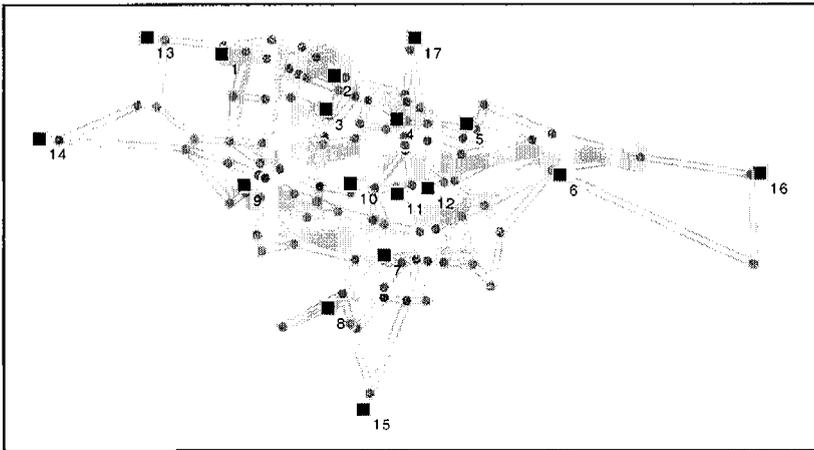
Figure 9: Demand attracted to the paratransit service as the result of simulation 2

The policies worked especially for the areas where the elderly, disabled and the poor densely populated. The paratransit service attracted most of the existing transit rideshare (almost 90%) (Figure 9). Yet, in this simulation, the number of public trips of disadvantaged are little more than the First Simulation's. Meanwhile, there is considerable reduction in the private trips of both categories. There appeared some capacity problems on the links.

Third Simulation rather focused solely on the income and car availability parameters of TRANUS (that create the same impact on the re-distribution of wealth), and on accessibility, especially for the pedestrians. For accessibility, urban-wide pedestrian ways that are converged towards the city center with the shortest connections to work and activity areas. This required the reversion of some vehicle streets to no-vehicle streets (as sort of penalization against private drivers). As a result, this application became successful and attracted large volumes of pedestrian trips (Figure 10). While private trips of advantaged sharply decreased, the public trips showed an increase. In terms of their balances between the categories, the Third Simulation recorded the best results. And, in terms of LOS, there appeared only few problematic links (under LOS D). The results indicate that income and mode type related policies are more fruitful in getting the expected results.

The evaluation of the simulations: For the objective evaluation of the simulations, mainly, TRANUS' display and reporting programs were utilized: IMPTRA (general/summary results), MATS (display trips by mode and category) and MATESP (detailed results). Three simple evaluation techniques were applied:
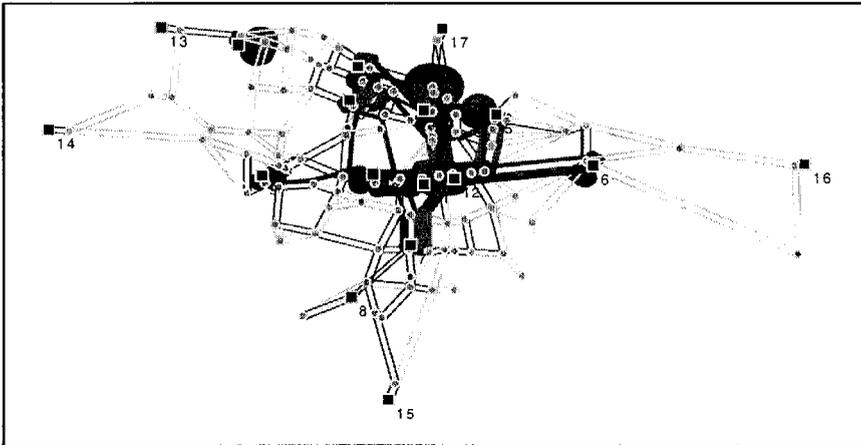
Figure 10: Total new pedestrian volumes attracted by the
walkways after the new additions in simulation 3

1. Averaged Statistical Results for the Disadvantage Category Only: Five
   indicators that are readily provided by TRANUS were used as the
   performance measures to measure the "disadvantagedness": distance, cost,
   travel time, wait time and disutility. In conclusion, the best simulation
   seemed the **Second** one.
2. Absolute Changes in the Number of Trips By Mode and Category: The
   modal shifts across the categories are observed for each simulation as the
   difference from the base-year values. The best choice seems to be the **Third**
   one with the highest percentage of change: 6,9% increase in the public trips
   of advantaged.
3. Per Capita Averages of the Statistical Results: The same procedure as in the
   first evaluation technique is applied only as per capita with the weighted
   sums technique (See Table 3). Again the **Third** Simulation was found
   successful.

As a result of all these evaluations, the Third Simulation in which the income
and mode related policies are represented is preferable. Of course, there is the
factor of input amount of policy applied. But, the input amount of the policies for
each scenario was not the concern here, and, can not be justly measured. As, it is
many times emphasized, that we are rather interested in the output amount
(impact) which may vary little only from one simulation to another.

Conclusions

The model approach inspired from the Gini index, offered a new measure of
equity and a way to eliminate the inequity between the urban travellers. Because
of the difficulty of the identification of the disadvantaged precisely in real life
due to its multi-criteria nature, the identification procedure especially needed to

be as simple but multivariate as possible in the modelling stage. This could be performed well by multi-variate cluster analysis method. As assumed, the "ideality condition" for the disadvantaged is getting closer to the Normality where the conditions of disadvantaged equate to others. Thus, the policies must be defined on the basis of the differential rates observed. The differential rate is actually the person type (n) vector of the travel demand. For the case study area, the overall rate had been found to be around 0,64 from the previous study of ours (modelling stages). As far as the comparability is maintained between the data of the two categories, it looks possible to deploy appropriate policies based on the differences between the modelling results, employing the cluster analysis results (without requiring the filtering process in Correspondence Module explained in this paperwork because of the similar results) to remove the disadvantage situations, albeit the uncertainty lies out there.   The policy applications are tested in the simulation environment of TRANUS software, and the best one is nominated. The aim of the study is not, however, about finding of which solution might be the best, but the learning from the results they provide. The simulation results would give idea about the ways to choose from among the various policy types. Consequently, it was verified not surprisingly that the "disadvantagedness" is largely the outcome of income and automobile ownership factors. The policies that alleviate the disadvantagedness around these factors would be the "captured policies" that can be successful, and, more palpable impacts can be obtained. Similarly, "disadvantagedness" is, to a greater extent, the result of socio-economic factors that can be obtained from household data. However, personal satisfaction and preferences are also effective that require naturally person-based studies.

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