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PUBLIC TRANSPORT SURVEY

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THE PUBLIC TRANSPORT SURVEY REPORT

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PREFACE

The first phase of the Urban Transportation Project outlined in the project proposal of March 3, 1977 was completed. Traffic volumes and vehicular travel behavior in the greater Cairo metropolitan area have been monitored, and standard survey procedures and documents have been developed. Work is in progress to apply a traffic assignment model which will predict traffic flows and speeds given alternative forms of the Cairo street network.

The transit portion of the travel behavior surveys, forming the second phase of the project, was excluded from the first year's program since resources were limited. Hence, the principal purpose of this year's research is to investigate mass transit. There are additional reasons for doing this:

- Inspite of the fact that vehicle traffic on the street network is normally the basis for expansion of system capacity, well over 60% of the total daily mechanised trips are made by public transit in comparison to only 8% by private modes.

- In terms of its social role and its significance to the growing economy, public transit is the most important mode. However, it suffers from severe problems of under-investment and overcrowding. Although the population of Cairo is nearly 8.5 million people, it is served by a fleet of only 1300 buses supplemented by small tram and

trolly-bus systems.

The study of Cairo's public transport system has the following principal objectives:

a) To develop an analytical tool which can be relied upon to give realistic simulations of public transport demand and supply.

b) To identify deficiencies which may exist in the public transport services of Cairo.

c) To analyze proposed modifications and extensions of the public transport network.

d) To extend the capabilities of the transportation project programming methodology, which is currently under development, to include public transport projects as candidates for future funding.

In order to achieve these objectives, public transport travel behaviour together with Origin/Destination matrices for public transport passenger movements by trip purpose and by time of day on different modes have to be developed.

It was therefore agreed upon by the CU/MIT research team, the Cairo Transport Authority and the Transpor Planning Authority that a comprehensive public transport survey is needed.

The USAID in Cairo agreed to sponsor the survey and signed the contract number 263-78-G-010 with the Transport Planning Authority on 13 March 1978.

This report describes the methodology selected to collect and process the data required to achieve the aims of this study.

On the other hand, the Public Transport survey, described in this report, has been considered under the general supervision of *Prof. Dr. M. Abdel Rahman El Hawary*, and the cooperative efforts of *Eng. M. Abdel Aaal El Salamawy*, and the *MIT Urban Transportation* team.

Section A describes the preparation and execution of the survey.

Section B describes the Data Collection.

Section C describes the Coding System.

Section D describes the System Design.

Section E describes the Data Processing Implementation.

It is to be noted that *Dr. Farouk Abdel Bary*, *Dr. Tarik El-Ridy* and *Dr. M. Owais* were responsible for the physical formulation of the PT Survey, described in Sections A,B and C in Part I, while, *Eng. M. Hisham El-Sherif* was responsible for the Data Processing System Design, and Computer Implementation phases described in Sections D and E in Part II.

PART I

DATA COLLECTION AND CODING SYSTEM

CHAPTER A

PREPARATION AND EXECUTION

OF THE SURVEY

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A. PREPARATION & EXECUTION OF THE SURVEY:

A-1) Introduction:

The public transport systems in Cairo are operated by three different organizations:

i) The Cairo Transport Authority, which is an element of the Cairo Governorate and under the technical supervision of the Ministry of Transport & Communications. The Authority operates buses, trams, trolley-buses and ferries in the Greater Cairo Area.

ii) The Heliopolis Reconstruction Company, which is an element of the Ministry of Housing and Reconstruction. The Company operates the Heliopolis Metro transit line.

iii) The General Organization of Egyptian Railways, an independent organization, which operates the urban railway lines between Kobry El Lamoon and El-Marg, and between Bab El Loke and Helwan.

The survey described in this report was carried out in the period of April 17-20 and 22, 1978. The first four days of the survey focused on the primary public transport mode (the bus network), with all other modes being surveyed on the fifth day.

A-2) Selection of The Appropriate Survey Technique

A-2-1) Zoning System

In order to permit the integration of the results of the public transport survey with the results of the vehicular survey which was conducted in 1977, it was determined that the same 60-zone configuration would be utilized for the public transport survey. This will facilitate comprehensive studies and analysis in the future.

However, it was then noted that the area between the enlarged downtown and the outer cordon of the urban area-which was divided into 14 zones in the vehicular survey - is relatively well served by the different public transport modes. These are generally newly developed areas with low level of car ownership. In order to obtain more accurate results, it was decided to subdivide these zones into 54 subzones as shown in the attached maps (see Appendix IV). The rest of the zoning system remained identical to the one used for the vehicular survey. It has to be noted that the same concepts were used to disaggregate the outer traffic zones.

A-2-2) Survey Techniques for All Modes Other Than the Urban Railway Line.

The ticketing and boarding procedures of the urban railway lines necessitated a special survey technique, described in

Section A-2-3 below. The procedures outlined here were utilized for buses, trams, trolleys, ferries and metros.

Location of Interviews

There were basically two possible interview locations. These two alternatives were:

a) Interviewing passengers at boarding/disembarkment stops. This technique offers two primary advantages:

- Avoidance of the problems associated with interviewing passengers on board of the frequently overcrowded vehicles.
- All interviews could be grouped on an hourly basis for computational purposes.

It has the following disadvantages:

- Interviewing at stops would tend to exclude arriving passengers and include primarily those waiting to board.
- In case where more than one line serves a single stop, enlargement of the interview sample to population size would be impossible within reasonable levels of accuracy.

b) Interviewing passengers on board. The procedure would have one interviewer surveying passengers on board

throughout each run. To achieve a safe minimum sample size, one interviewer would be assigned to each vehicle along each route. The interviewers would be assigned a seat, varying in position, on successive vehicles in the following pattern: next to the front door in the first vehicle, at an intermediate position in the second vehicle, and near the back door in the third vehicle. The advantage of this procedure would be to avoid biasing the sample towards those passengers who boarded at one of the trip ends.

In order to assess the difficulties associated with each of the alternative techniques, and to measure the rate at which interviews could be completed, a test of both methods was conducted on January 17, 1978, from 6:30 a.m. to 2:30 p.m. Two ten-man teams of trained interviewers from the Cairo Transport Authority were assembled. Ten interviewers were assigned to bus routes number 44, 44', and 26 (one per bus), and ten interviewers were assigned to bus stops.

The analysis of the results of these interviews indicated that passengers were very co-operative and responded to the questions asked by the interviewers. The on-board surveyors averaged twelve interviews per hour; the rate for the surveyors at the bus stops was twenty-five interviews per hour. Aside from the crowded conditions of the buses, a key reason for the

difference in the interview rates was that the passengers surveyed on-board asked a number of questions about the survey and also used the opportunity to lodge service complaints. Passenger interviewers at bus stops did not experience this delay-causing factor.

As a result of this experiment, it was decided to adapt the on-board survey technique in order to avoid any bias in the results.

Survey Form: The design of survey methodology has been refined through a process of incremental development. The survey form was also developed incrementally. The form is to be used to sample public transit O/D movements by trip purpose and time of day, and to provide information to allow enlargement of the sample O/D matrix (survey techniques will be referred to later).

As a first trial, interview form No. (1) was designed to interview passengers on board as well as at bus stops.

This form provided for the collection of the following information:

Status of trip-maker, origin-destination, purpose of trip, time of day, preferable bus route, walking and waiting

time to and at stops and transfer points. The form No. (2) is designed specifically to interview passengers on-board.

Forms (1) & (2) are shown in Appendix 1.

Main features of this simpler form are:

- It gives bus travel time for each cycle.
- It gives origin-destination by trip purpose.
- It gives information concerning fare collection desired by CTA.

However, a review of the plans of the survey was conducted by the CU/MIT team towards the end of March 1978 and decided to include two additional items in the survey form: sex of interviewee and shopping as a possible trip purpose. (See form 2, Appendix 1).

Sampling Procedure

It was determined by Cairo University and MIT teams, that further investigation of possible biases in the sampling technique should be investigated; particularly with regard to a potential bias toward long-distance passengers who would have a higher probability of being interviewed during the survey. An experiment was conducted to test for any such bias.

Two bus routes were selected for this experiment. The first, Bus Route Number 50', extends from Guesr El Suez to Tahrir Square. This route (17.95 km.) is representative of long-distance routes. The second, Bus Route Number 5, extends from Mit Okba to Ataba Square. This route (5.1 km.) is representative of short-distance routes. These routes were selected so as to fulfill the following criteria:

a) Each route should pass through several zones.

b) No route should be circular.

c) The overall trip-lengths between terminals should be representative of both long and short distance routes.

Two alternative data collection procedures were tested:

Alternative A. In this procedure, three vehicles on each bus route were surveyed, with one interviewer per bus. The position of the interviewer varied for each vehicle; next to the front door in the first vehicle, near the back door in the second vehicle, and in an intermediate position in the third vehicle. The intermediate position was included so as to avoid collecting data solely from the short distance passengers who usually stand by the doorways.

Alternative B. In this procedure, three interviewers were allocated to one vehicle along each bus route. They were seated

one near the front entrance, one near the rear, and one in an intermediate position. The hypothesis here is that this procedure will, by increasing the sample size of passengers interviewed on a single bus, result in an unbiased sample of the total population. The primary drawback of this procedure is that only one-third as many buses can be surveyed as in Alternative A due to manpower limitations.

The interview procedures also had several characteristics in common:

a) A common questionnaire was utilized.

b) On the day of the experiment, two conductors were assigned to each vehicle surveyed in order to maximize the number of tickets issued.

c) Similarly, two inspectors were allocated to each vehicle. Each inspector was provided with a counting sheet (see Form 3, Appendix 1), on which they recorded information on every passenger (if possible) with respect to the bus stop of the origin and that of the destination of their trip.

d) The inspectors were also asked to make a visible mark on the ticket or pass of each passenger they interviewed in order to avoid duplication.

e) The survey was implemented during the morning peak period, and included three round trips on each vehicle.

For each bus route, the following calculations were made:

a) Origin/Destination matrices were constructed from the count sheets with respect to the bus stops along the route -- these represent the total passenger population. Similar matrices were constructed from the survey sheets -- these represent the sample.

b) With data concerning the distance between successive stops, it was possible to construct an Origin/Distination matrix of distances between any pair of stops along the route.

c) From (a) and (b) above, it was possible to calculate a frequency distribution of the passengers with respect to their trip length along the route for both the sample and total passenger populations for each alternative.

The statistical analysis of the experiment data consisted of testing the goodness of fit of the frequency distribution of the sample to the frequency distribution of the population. The results of this test are shown in Tables A-1 through A-5.

TABLE A-1

The Average Sample Size and Population Size Per Round Trip of Each Route for Each Alternative

Bus Route	ALTERNATIVE A		ALTERNATIVE B	
	Sample (1 interviewer per bus)	Population (2 inspectors)	Sample (3 interviewers per bus)	Population (2 inspectors
50	80	366	180	294
5	46	173	60	213

TABLE A-2

BUS ROUTE 50, ALTERNATIVE A

CLASS INTERVAL (KM)	FREQUENCY		χ^2 TEST		
	Population	Sample	Observed (O)	Expected (E)	O^2/E
0 - 1.0	4 (0.87)*	0			
1.01 - 2.0	20 (4.37)	8	8	5.24	12.21
2.01 - 3.0	38 (8.31)	8	8	8.31	7.70
3.01 - 4.0	56 (12.24)	10	10	12.24	8.17
4.01 - 5.0	80 (17.49)	18	18	17.49	18.52
5.01 - 6.0	80 (17.49)	12	12	17.49	8.23
6.01 - 7.0	76 (16.61)	14	14	16.61	11.80
7.01 - 8.0	84 (18.36)	10	10	18.36	5.45
8.01 - 9.0	50 (10.93)	12	12	10.93	13.17
9.01 -10.0	62 (13.55)	26	26	13.55	44.89
10.01 -11.0	40 (8.74)	12	12	8.74	16.47
11.01 -12.0	28 (6.12)	2			
12.01 -13.0	26 (5.68)	6	8	11.80	5.42
13.01 -14.0	20 (4.37)	4			
14.01 -15.0	16 (3.50)	2	6	7.87	4.57
15.01 -16.0	14 (3.06)	4			
16.01 -17.0	14 (3.06)	10			
17.01 -18.0	24 (5.25)	2	16	11.37	22.52
TOTAL	732 (160.0)	160	160	160	184.13

$$\chi^2 = \frac{O^2}{E} - N = 184.13 - 160 = 24.13$$

Number of degrees of Freedom = 13 - 1 = 12

Tabulated χ^2 (α = 0.05) = 21.03

* Figures in brackets represent the frequency of the population at the respective class interval after reducing it by the ratio of sample size to population size in order to apply the χ^2 test.

TABLE A-3

BUS ROUTE 50. ALTERNATIVE B

CLASS INTERVAL (KM)	FREQUENCY		χ^2 TEST		
	Population	Sample	Observed (O)	Expected (E)	O^2/E
0 - 1.0	2 (0.82)*	1.33**			
1.01 - 2.0	9 (3.69)	3.33			
2.01 - 3.0	17 (6.98)	4.67	9.33	11.49	7.58
3.01 - 4.0	17 (6.98)	10.67	10.67	6.98	16.31
4.01 - 5.0	17 (6.98)	13.33	13.33	6.98	25.46
5.01 - 6.0	16 (6.57)	12.67	12.67	6.57	24.43
6.01 - 7.0	37 (15.19)	11.33	11.33	15.19	8.45
7.01 - 8.0	32 (13.14)	6.67	6.67	13.14	3.39
8.01 - 9.0	24 (9.85)	10.00	10.00	9.85	10.15
9.01 -10.0	27 (11.08)	11.33	11.33	11.08	11.59
10.01 -11.0	19 (2.80)	8.67	8.67	7.80	9.64
11.01 -12.0	16 (6.57)	8.00	8.00	6.57	9.74
12.01 -13.0	15 (6.16)	2.67			
13.01 -14.0	13 (5.34)	4.67	7.44	11.50	4.81
14.01 -15.0	4 (1.64)	0.67			
15.01 -16.0	6 (2.46)	4.67			
16.01 -17.0	10 (4.10)	2.00			
17.01 -18.0	13 (5.34)	4.00	11.34	13.54	9.50
TOTAL	294 (120.69)	(120.68)	120.68	120.69	141.05

$$\chi^2 = \frac{O^2}{E} - N = 141.05 - 120.69 = 20.36$$

Number of degrees of freedom = 12 - 1 = 11

Tabulated χ^2 ($\alpha = 0.05$) = 19.06

* Figures in brackets represent the frequency of the population at the respective class interval after reducing it by the ratio of sample size to population size in order to apply the χ^2 test.

** On the day of the experiment, one of the buses carrying one interviewer on board broke down. In order to obtain a fair comparison between the two alternatives, the frequency distribution of the passengers interviewed on the bus carrying 3 interviewers was multiplied by 2/3.

TABLE A-4

BUS ROUTE 5. ALTERNATIVE A

CLASS INTERVAL (M)	FREQUENCY		χ^2 TEST		
	Population	Sample	Observed (O)	Expected (E)	O^2/E
0 - 500	0 (0.0)*	0			
501 - 1000	8 (2.12)	2			
1001 - 1500	24 (6.38)	12	14	8.50	23.00
1501 - 2000	50 (13.30)	12	12	13.30	10.83
2001 - 2500	62 (16.48)	12	12	16.48	8.14
2501 - 3000	84 (22.34)	16	16	22.34	11.46
3001 - 3500	40 (10.64)	8	8	10.64	6.02
3501 - 4000	20 (5.32)	4			
4001 - 4500	42 (11.16)	14			
4501 - 5000	0	0			
5001 - 5500	16 (4.26)	12	30	20.74	43.39
TOTAL	346 (92.0)	92	92	92.00	103.5

$$\chi^2 = \frac{O^2}{E} - N = 103.5 - 92 = 11.5$$

Number of degrees of freedom = 6 - 1 = 5

Tabulated χ^2 ($\alpha = 0.05$) = 11.07

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* Figures in brackets represent the frequency of the population of the respective class interval after reducing it by the ratio of sample size to population size in order to apply the χ^2 test.

TABLE A-5

BUS ROUTE 5. ALTERNATIVE B

CLASS INTERVAL (M)	FREQUENCY		χ^2 TEST		
	Population	Sample	Observed (O)	Expected (E)	O^2/E
0 - 500	1 (0.19)*	0.00**			
501 - 1000	2 (0.38)	1.33			
1001 - 1500	16 (3.00)	3.33			
1501 - 2000	27 (5.07)	2.67	7.33	8.64	6.22
2001 - 2500	39 (7.32)	4.67			
2501 - 3000	42 (7.89)	5.33	10.00	15.21	6.57
3001 - 3500	27 (5.07)	2.67			
3501 - 4000	9 (1.69)	3.33	6.00	6.76	5.33
4001 - 4500	22 (4.13)	2.67			
4501 - 5000	0 (0.00)	0.00			
5001 - 5500	28 (5.26)	14.00	16.67	9.39	29.59
TOTAL	213 (40.00)	40.00	40.00	40.00	47.71

$$\chi^2 = \frac{O^2}{E} - N = 47.71 - 40 = 7.71$$

Number of degrees of freedom = 4 - 1 = 3

Tabulated χ^2 (α = 0.05) = 7.81

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* Figures in brackets represent the frequency of the population at the respective class interval after reducing it by the ratio of sample size to population size in order to apply the χ^2 test.

The conclusion drawn from the experiments of alternative sampling techniques, is that the data collected by three interviewers on a single bus more closely fit the freqency distribution of the total population than the data collected by three interviewers on three consecutive buses. Both bus routes produced the same results, though it is significant at the 5% level only for bus route 5. However, in the case of bus route 50, the degree of confidence associated with Alternative A (one interviewer per bus and three buses) was 1.95%, while that associated with Alternative B (three interviewers per bus and one bus) was 4.06%.

Hence, it was decided to assign as many interviewers as possible per vehicle (within the manpower limitations), and also to assign two inspectors per vehicle to collect the on and off counts that will serve as the basis for enlarging the sample to represent the total population. The on and off counts were collected on the forms previously prepared by the Cairo Transport Authority (see Form 4, Appendix 1).

The Sample-to-Population Enlargement Factor

The procedure for deriving the enlargement factor for each line is outlined below:

a) Let: N = total number of passengers traveling on surveyed vehicles on a specific line. Taken from count sheets of the inspectors for the entire survey time period.

T = Total number of tickets sold by the conductor for the same surveyed vehicles during the same time period. (Taken from conductor's manifesto).

Then CF = N/T

where : CF = a correction factor (greater than one) arising from the fact that some passengers are using season tickets or due to the conductor's inability to issue tickets to all passengers as a result of the overcrowding conditions.

b) Multiply the number of tickets sold on surveyed vehicles of this line by the correction factor (CF).

c) Let: R_i = Number of runs for surveyed vehicles on a specific line during hour (i.)

M_i = Number of runs for all vehicles on that line during hour (i.)

S_i = Number of tickets sold during hour i for surveyed vehicles on that line taken from conductor's manifesto.

Then: $$P_i = S_i \times CF \times \frac{M_i}{R_i}$$

Where P_i = total number of passengers using that line during hour (i).

d) Let : I_i = total number of passengers interviewed on that line by the surveyors during hour i; (from form 2).

Then: $E_i = \frac{P_i}{I_i}$

Where: E_i = enlargement factor for each line during hour(i).

A-2-3) Survey Technique for the Urban Railway Lines

The on-board survey technique described above cannot be utilized for the urban railway lines for the following reasons:

a) Urban railway tickets sold by the ticket office are valid for a one-hour period -- the passenger may board any train that passes through during the next hour. Therefore, the number of tickets sold does not represent the number of passengers on any specific train.

b) The number of passengers carried on each line is approximately 250,000 per day, the result being overcrowded conditions in the railway cars. This would seriously hinder an interviewer attempting to conduct the survey.

For these reasons, it was decided that platform survey technique would be utilized for the urban railway lines. Two factors facilitate data processing for the survey: every stop is served by only one line, and collected data can be classified at a predetermined time interval. Form 5 (See Appendix 1). was used for this survey.

Tickets for use on the urban railway lines may be purchased from the ticket office at the platform or from an on-board conductor. Seasonal tickets are also available.

A full record of origin and destination for the tickets sold from the ticket office can be assembled by assigning an observer at each ticket-selling position at every station. The observer recorded -- on a special form (see Form 6, Appendix 1) -- the destination of every passenger buying a ticket at the ticket office.

The following procedure was carried out to deduce the total population using the urban railway lines:

1) For each line all the interviews carried out at the different stations in both directions during the same time interval (6.30 , 7.30 .... 15.30) were compiled together to represent the sample size for this particular time interval. The interviews were then given a serial number.

2) For each time interval the total number of tickets sold by the ticket-selling positions on all stations in both directions was calculated.

3) The time centroid for each run was calculated knowing the beginning and end of each run. Thus every trip was allocated to a certain time interval.

4) The tickets sold on board by the conductor for all trips falling within the same time interval in both directions were calculated.

5) Results of steps (2) & (4) were added for the same time interval to represent the total number of tickets issued by hour.

6) From the information gathered from each passenger about the type of ticket he uses for his trip (full fare, season ticket or free pass) it was possible to calculate an average percentage of passengers using season tickets and free passes for every hour of the survey.

7) The total number of passengers using the route for each time interval = Total number of issued tickets (1 + %of passengers using season-tickets + % free riders).

A-3) Execution of the Survey

A-3-1) Vehicles Surveyed

As noted earlier, the bus fleet (1439 buses) necessitated the survey to be carried out on four successive days. Table A-6 shows the number of buses included in the survey, the total number of buses operating from each of the garages, and the date of the survey for each garage.

The number of buses surveyed on a particular route was a proportion of the total number of buses operating on that route. The ratios used are shown in Table A-7.

The determination of which garage to survey on which day was made with the intent of maximizing the area of the city covered in the survey every day.

The survey of all other modes was carried out on the fifth day of the survey i.e. on April the 22nd. Table A-8 shows the number of units surveyed (based on the ratios shown in Table A-7) and distribution of the different fleets and their garages. Details of each route are included in Appendix 2.

TABLE A-6

DISTRIBUTION OF BUSES AND NUMBER OF BUSES SURVEYED

Serial Number	Garage	Survey Date	Number of Lines	Total Number of Buses	Number of Buses Included in the Survey
1	El Mezallat	17/4/78	22	173	63
2	Guesr El Suez		17	117	29
3	Asar El Naby		19	109	25
4	El Teraa	18/4/78	22	158	60
5	El Amireya		18	119	31
6	El Guiza		11	60	14
7	Port Said	19/4/78	4	57	10
8	Nasr		18	123	32
9	El Bassateen		33	160	38
10	Fateh	20/4/78	19	117	26
11	Embaba		20	117	29
12	El Moneeb		17	129	28
TOTAL			220	1439	345

TABLE A-7

PROPORTIONS OF OPERATING BUSES SURVEYED ON EACH ROUTE

Number of Buses Operating On a Route	Number of Buses Included In the Survey
6	1
7-10	2
> 10	3

TABLE A-8

DISTRIBUTION OF VEHICLES OF OTHER MODES AND NUMBER SURVEYED

Mode	Garage	Survey Date	Number of Lines	Total Number of Units	Number of Units Surveyed
Tram	Abassieh	22/4/78	13	91	17
	Mezallat		7	53	10
	Port Said		1	12	3
	Total		21	156	30
Trolley	El Moneeb	22/4/78	6	74	16
Ferries		22/4/78	6	18	6
Heliopolis Metro	Nozha	22/4/78	1	7	2
	Merghany		1	6	1
	Abdel Aziz		1	7	2
	Alf Maskan		1	4	1
	Roxy		1	7	2
	Matareya		2	9	3
	Almaza		1	5	1
	TOTAL		8	45	12
Urban Railways	Bab El Luk	22/4/78	1	72	(conducted at Stations)
	El Marg		1	30	

A-3-2) Manpower

Tables A-9 and A-10 show the pattern of manpower utilization (interviewers, inspectors and observers) for the survey. With regard to all but the urban railway mode, the plan was to assign four interviewers and two inspectors for each unit. Some modification of this plan was required for the following reasons:

a) Some of the buses (operating from the Port Said garage) are articulated vehicles with two doors per unit.

b) The minibuses (Routes 30, 70, 80 and 90), and the Nile River ferries were assigned two interviewers and one inspector per unit.

c) When the surveyor substitutes (see Section A-3-3) available exceeded the number of absentee surveyors, 5 surveyors were assigned to each unit.

For the urban railway line survey, the number of interviewers assigned to each station was based on prior counts of the number of passengers utilizing that station, and the number of ticket office observers at a station was equal to the number of ticket selling positions at a station (see Appendix 2 for further details).

TABLE A-9

DISTRIBUTION OF SURVEY MANPOWER: BUSES, TRAMS, TROLLEY BUSES AND METROS

Mode	Garage	Manpower	
		Interviewers	Inspectors
Buses	El Mezallat	165	79
	Guesr El Suez	112	57
	Asar El Naby	102	50
	El Teraa	162	80
	El Amireya	131	62
	El Guiza	67	28
	Port Said	38	37
	Nasr	132	59
	El Basateen	151	76
	Fatah	104	50
	Embaba	131	56
	El Moneeb	119	56
Trams	Abbassieh	71	48
	Mezallat	41	30
	Port Said	30	17
Trolley Buses	El Moneeb	68	32
River Ferries		27	6
Heliopolis Metro	Nozha	39	24
	Merghany	18	12
	Abdel Aziz Fahmy	30	24
	Alf Maskan	8	6
	Roxy	16	12
	Matareya	29	22
	Almaza	6	6
TOTAL		1797	929

TABLE A-10

DISTRIBUTION OF SURVEY MANPOWER: URBAN RAILWAY LINES

ROUTE	MANPOWER	
	Interviewers	Ticket Office Observers
Kobry El Lamoon - El Marg	39	14
Bab El Luk - Helwan	45	23
TOTAL	84	37

A-3-3) Survey Logistics

The manpower utilized for the survey consisted of 660 students from the Faculty of Engineering, Cairo University, who volunteered to work one or more days of the survey (out of which 130 students were assigned to the urban railway survey on the fifth day). The Cairo Transit Authority provided 200 men to record the on and off counts on buses, trams, trolley buses and the Heliopolis Metro.

A survey file, with the appropriate forms enclosed, was compiled for each interviewer, inspector and observer. These were distributed to the personnel each morning of the survey. Table A-11 shows the number of each of the forms printed, and the number placed in each file.

TABLE A-11

NUMBER OF FORMS

Form Number	Total Number Printed	Number of Forms Per File
2	60,000	25
4	7,000	4
5	35,000	35
6	35,000	35

The following information was included on each file's cover:

- Mode
- Garage
- Student Name
- Student Serial Number
- Route Number (station name for urban railway survey)
- Vehicle number (omitted in case of the urban railway survey)
- Type of work to be carried out
- Survey starting time
- Survey ending time.

Each student was provided with a pass which listed his name and serial number, and had his photograph attached. On the reverse side, the pass contained all the information listed above for each day the student was to participate in the survey.

Training lectures for the student surveyors were held at the Faculty of Engineering, Cairo University, on April 15, 16 and 21, 1978. Instruction sheets for survey methodology (see Appendix 3) were distributed at these lectures.

A notice requesting the public's cooperation with the survey personnel was posted in the urban railway stations and in the vehicles of the other modes.

Transportation was provided for students to travel to the garages on appropriate days. Nine Greater Cairo Area bus routes gathered the students from their homes and transport them to Cairo University where special buses were scheduled to take them to the garages.

Every garage operating vehicles to be surveyed on a certain day sent two buses to the assembly point at the University on that day. The student identified the appropriate garage and the bus to board from the pass he was given (see above). Buses left the Cairo University assembly point at 4.30 a.m.

For the urban railway survey, the interviewers and ticket office observers assigned to the stations along the route rode the first trains out to El Marg and Helwan and got off at the appropriate station so as to be ready to start the survey at 5:30 A.M. The work at the stations was supervised by sixteen men from the Egyptian Railway Authority.

For all other modes, a team of six men (three men on the minibus and ferry routes) was assigned to each vehicle -- four student interviewers and two on-and-off counting inspectors provided by the Cairo Transit Authority. One of the latter was designated as the team leader and had the following responsibilities:

a) Facilitating the interviewers' jobs.

b) Distributing the files to the team at the beginning of the shift and collecting them at the end of the shift.

c) Collecting information about the number of tickets sold every trip from the terminal stations' headmasters.

Every garage was assigned a group leader responsible for the operation as a whole. He was equipped with a radio car to facilitate his communications with other garages and the supervisors at the main terminal stations.

As a vehicle to be surveyed left the garage, it was boarded by one team.

Every garage was allocated an extra 10% of its manpower as substitutes who were to take over in the case of any absence. Where the number of substitutes exceeded the number of absentees, they were assigned as a fifth interviewer on the overloaded routes. A similar arrangement was undertaken for

the urban railways. As discussed earlier, the manpower limitation led to the restriction of the survey to a morning shift only. Consequently, in order to cover the two morning peaks (to and from work), it was decided to end the survey with a trip ending at one terminal at or later than 3:30 p.m.

Certain additional items of information were collected at the end of the survey:

- Information related to the urban railway lines:

  a) Total number of tickets sold by the conductors during one trip.

  b) The actual departure and arrival times of each train for each trip.

  c) Total number of season tickets valid on the day of the survey.

- Information related to all other modes:

  The manifestos for all routes investigated for all vehicles surveyed were collected at the end of each day of the survey and included in their proper files. The manifestos concerning the vehicles which were not surveyed for the same routes were also collected in a separate file.

Then for each mode and for each garage the files collected from the survey were grouped together in batches. Each batch contains a) files of interviewers on a specific route b) the manifestos for the vehicle(s) surveyed on that route c) files containing the ON & OFF counting sheets d) files containing manifestos for the vehicles which were not surveyed. These batches were sent to the Faculty of Engineering, Cairo University to be coded.

CHAPTER B

DATA COLLECTION

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B. DATA PROCESSING:

B-1) Introduction

The public transport survey has to provide CU/MIT team with basic data about traffic characteristics, processed in the appropriate forms, which enable the team to achieve the objectives set for the Cairo Urban Transportation Research Project. Furthermore, the data have to be processed in a form that can be directly used by the Cairo Transport Authority officials to improve the operational efficiency of their system. This can be achieved for example if the bus routes and the number of units along each route are close enough to the pattern of the desire lines of travel. This analysis is obtained from a direct comparison between the origin/destination matrices for a certain mode of transport during the peak hour and the network corresponding to that mode.

Another possible way of increasing the network efficiency can be achieved through the relocation of the terminal stations to avoid the congested areas or by reducing the number of passengers who interchange mode/route between their origins and their destinations. This is only possible if the collected information is processed in a form giving O/D matrices for passengers who interchange (mode/route) as well as the relative number of interchanging passengers at a terminal station to its total load capacity.

The data collected during the survey have therefore to be presented in different tables and matrices. These are illustrated in this section of the report together with the necessary calculations to obtain these tables.

B-2) Processing the ON/OFF Counts:

The ON/OFF counts are presented in tables giving the number of passengers carried by MODE, for each ROUTE and for every HOUR of the survey. This is achieved as follows:

i) Get the number of tickets issued on the surveyed unit(s) during the total survey period.

ii) Get the average ON/OFF counts on the same unit(s) for all the survey period.

iii) The correction factor = $\frac{\frac{ON + OFF}{2}}{Tickets} \geqslant 1.0$

Hence the corrected number of passengers in the surveyed unit(s) for each hour is equal to the number of tickets issued on each unit during that hour times the correction factor.

The above steps were carried out manually and were calculated by using forms 7, 8 and 9 of Appendix 1.

It is to be noted that the enlargement factor discussed under item A-2-2 was also computed manually.

Table B-1

Table B-1 illustrates the tabular form of the computer printout obtained from the input data showing the total number of passengers carried by MODE, for each ROUTE for every HOUR of the survey.

Table B-1

Total No. of Passengers Carried by MODE,
By LINE for Each Hour of the Survey

MODE LINE

(1)	(2)
Time	Number of Passengers
0600 - 0700	
0700 - 0800	
⋮	
1500 - 1600	
Total	

Table B-2

This table is a summation of table B-1 for all LINES of the same MODE.

Table B-2-a

Total Number of Passengers Carried During Each
HOUR of the Survey for a Certain MODE

MODE

Time	Bus	Tram		Total
0600 - 0700				
0700 - 0800				
⋮				
1500 - 1600				
Total				

Table B-2-b

Percentage of Passengers Carried by Each MODE
During Every HOUR of the Survey

Time	Bus	Tram	
0600 - 0700			
0700 - 0800			
⋮			
1500 - 1600			
Total	100		

Table B-2-c

Percentage of Passengers Carried During Each HOUR of
the Survey for Different MODES

Time	Bus	Tram		Total
0600 - 0700				100
0700 - 0800				
⋮				
1500 - 1600				

B-3) Processing the Interview Forms:

B-3-1) Interchanging Passengers

Table B-3

Table B-3 illustrates the tabular form of the computer printout obtained from the input data showing the number of passengers interviewed by MODE, for each ROUTE & for every HOUR of the survey including those passengers who interchange MODE/ ROUTE and their percentages.

Table B-3

Total Number of Passengers Interviewed by ROUTE by MODE as well as the Number of Interchanges

MODE: ROUTE

(1)	(2)	(3)	(4)	(5)
Time	Total No. of Passengers Interviewed	No. of Interchanging Passengers	No. of Passengers Interviewed Without Interchange	% of Passengers Interviewed Without Interchange
0600-0700				
0700-0800				
⋮				
1500-1600				
Total				

Table B-4

This is a summation of table B-3 for all lines of the same MODE

Table B-4

Total Number of Passengers Interviewed by MODE as well as the Number of Interchanges.

MODE:

(1)	(2)	(3)	(4)	(5)
Time	Total No. of Passengers Interviewed	No. of Interchanging Passengers	No. of Passengers Interviewed Without Interchange	% of Passengers Interviewed Without Interchange
0600-0700				
0700-0800				
⋮				
1500-1600				
Total				

Table B-5

This table shows the sample size ratio for each MODE, for every ROUTE and for every HOUR of the survey.

Table B-5

The Sample Size Ratio and the Enlargement Factor for Each MODE, for Each ROUTE & for Every HOUR

MODE: ROUTE:

Time (1)	Sample Size Ratio* (2)	Enlargement Factor** (3)
0600 - 0700		
0700 - 0800		
⋮		
1500 - 1600		

$$* \text{ Sample Size Ratio} = \frac{\text{Table (B-3) col. (2)}}{\text{Table (B-1) col. (2)}}$$

$$** \text{ Enlargement Factor} = \frac{1}{\text{Sample Size Ratio}}$$

3-3-2) O/D Matrices

Table B-6

This table illustrates the computer printout of the O/D matrices for interchanging passengers by hour of day. This is achieved as follows:

i) Calculate the sample O/D matrix of the interchanging passengers for each mode, for each route, for each hour.

ii) Multiply each matrix thus obtained by the corresponding enlarging factor (Table B-5 column 3).

iii) Add all matrices for all routes and all modes corresponding to the same time interval.

iv) Due to the fact that the number of passengers who interchange more than once during the same trip is negligible, it was decided to assume that interchange takes place only once. Therefore by multiplying the hourly matrices obtained under (iii) by 0.5, the resultant matrices will be the one corresponding to the number of passengers interchanging mode/route between any O/D pairs during one trip for the different hours of the survey.

Table B-6

O/D Matrix for Interchanging Passengers
on all Modes for all Purpose

Time (00-00)

O \ D				Total
Total				

Table B-7

This table illustrates the computer printout for the O/D matrices by HOUR for each MODE for all passengers. (approximate Methods). This is achieved is follows:

i) Obtain an O/D matrix from the interviewed passengers who do not interchange for each ROUTE & for each MODE for every HOUR of the survey.

ii) Multiply each cell by the corresponding enlargement factor obtained in table B-5 (col. 3).

iii) Add for all lines of the same MODE & multiply each cell by (2-Table B-4 col. (5)) to get an O/D matrix by time of day & MODE for all purposes.

Table B-7

O/D Matrix for all Purposes (Approximate Method)
for Every MODE & Every HOUR

MODE TIME

O \ D				Total
Total				

Table B-8

This table is a summation for all matrices of the same HOUR for all modes & all trip purposes.

Table B-8

O/D Matrices for all Purposes and all Modes
(Approximate Method)

TIME

O \ D	xxx							Total
xxx								
Total								

Table B-9

This table illustrates the computer printout of the O/D matrices by time of day for all modes and for all purpose (exact method). This is achieved as follows:-

i) Calculate the sample O/D matrix of all passengers interviewed for each route for each mode and for each hour of the survey.

ii) Multiply each matrix by the corresponding enlarging factor (Table B-5 column 3).

iii) Add all matrices for all routes for all modes corresponding to the same time interval.

iv) Substract from each matrix obtained under (iii) the corresponding matrix obtained in table (B-6), to get the exact O/D matrix for all passengers for all modes by hour.

v) Calculate the error & the relative error in the matrices obtained by the approximate method in tables (B-7) by substracting the exact matrices obtained under step (iv) from the approximate matrices obtained from table (B-7).

vi) Add the correct matrices obtained from step (iv) for the whole survey period.

vii) Calculate the error & relative between the 2 methods in the resultant matrix (for all hours, all modes, all routes).

Table B-9

O/D Matrix for all Modes and Purposes

(Exact Method)

Time

O \ D				Total
Total				

B-3-3) Trip Purpose

Table B-10

Produce the following three summary tables for public trips by time of day for all modes for every HOUR of the survey.

Table B-10-a

Number of Trips by Time of day for Each Trip Purpose for all Modes

Time	Sex	Trip Purpose				Total
		Home/Work	Work/Home	.....		
0600-0700 :	M					
	F					
	Σ					
1500-1600	M					
	F					
	Σ					
Total						

Table B-10-b

Percentage of Trips for Each Trip Purpose by Time of Day

Time	Sex	Trip Purpose			
		Home/Work	Work/Home	.....	
0600-0700 :	M				
	F				
	Σ				
1500 1 1600	M				
	F				
	Σ				
Total					

Table B-10-c

Percentage of Trips for Each HOUR by Trip Purpose.

Time	Sex	Trip Purpose				Total
		Home/Work	Work/Home	Home/Educ.		
0600-0700	M					100
	F					100
						100
1500-1600	M					
	F					

Table B-11

This is a summary table of the above B-10 table by MODE for all hours of the survey. Three tables can be produced:

Table B-11-a

Number of Trips by MODE & Purpose for all Hours of the Survey.

Mode	Sex	Trip Purpose					Total
		Home/ Work	Work/ Home	Home/ Educ.	Educ./ Home		
Bus	M						
	F						
Rail-way	M						
	F						
Total							

Table B-11-b

Percentage of Trips by MODE for Each Trip Purpose

Mode	Sex	Trip Purpose				
		Home/ Work	Work/ Home	Home/ Educ.	Educ./ Home	
Bus	M					
	F					
⋮						
Rail-ways	M					
	F					
Total		100				

Table B-11-c

Percentage of Trips by PURPOSE for Each Mode

Mode	Sex	Trip Purpose					Total
		Home/ Work	Work/ Home	Home/ Educ.	Educ./ Home		
Bus	M						100
	F						
Rail-ways	M						
	F						

B-3-4) Trip Distribution According to Area Type Combinations

Table B-12

Produce tables indicating whether public transport trips are internal, external or some combination. The following area types are considered:

Down Town (D)

Enlarged down town (ED)

Urbanised (U)

Rural (R)

Three tables will be generated for O/D movements by area types. for each mode, for every hour of the survey.

Table B-12-a

Number of Trips by Mode and O/D Area Type

Mode	Area Type				Total
	D/D	ED/D	ED/U		
Bus ⋮					
Railways					
Total					

Table B-12-b

Percentage of Trips by Mode for Each Area Type

Time:

Mode	Area Type			
	D/D	ED/D	ED/U	
Bus ⋮				
Railways				
Total	100			

Table B-12-c

Percentage of Trips by Area Type for Each Mode

Time

Mode	Area Type				Total
	D/D	ED/D	ED/U		
Bus ⋮					100
Railways					

The above tables are obtained from table B-7 after identifying the zones of each area type.

Table B-13

This table is a summation of all tables B-12 for the whole survey period.

Table B-13-a

Number of Trips by Mode and Area Type for the Whole Survey Period

Mode	Area Type				Total
	D/D	D/ED	ED/U		
Bus ⋮					
Railways					
Total					

Table B-13-b

Percentage of Trips by Mode for Each Area Type

Mode	Area Type			
	D/D	D/ED	ED/U	
Bus ⋮				
Railways				
Total	100			

Table B-13-c

Percentage of Trips by Area Type for Each Mode

Mode	Area Type				Total
	D/D	D/ED	ED/U		
Bus ⋮					100
Railways					

B-3-5) Load Capacity at the Different Stations:

Table B-14

Three tables will be generated for interchange between mode/route at the main terminal stations. Table shows the 99 stations included in the study.

Table B-14-a

Number of Passengers Interchanging at the Terminal Stations for the Whole Survey Period by Mode & by Station.

Mode \ Station	Tahrir	Ramsis		Others	Total
Bus/Bus ⋮ Railway/Railway					
Total					

Table B-14-b

Percentage of Interchanging Passengers for Each Mode by Station

Station / Mode	Tahrir	Ramsis		Others
Bus/Bus				
Bus/Tram				
⋮				
Railway/Railway				
Total	100			

Table B-14-c

Percentage of Interchanging Passengers by Mode For Each Station

Station / Mode	Tahrir	Ramsis		Others	Total
Bus/Bus					100
Bus/Tram					
⋮					
Railway/Railway					

Table B-15

Tables will be generated giving the loading capacity of each terminal station for each mode. This includes those passengers who start or end their trip at a particular station plus those passengers who use this station to change mode/ route.

Table B-15

Interchange and Load Capacity for
the Different Stations by mode

Station	Trips Originating from	%	Trips Destinated to	%	Interchange	%	Total
Tahrir Ramsis							
Others							

Table B-16

This is a summary table for all modes

Table B-16

Interchange and Load Capacity for
the Different Stations for all Modes

Station	Trips Originating from	%	Trips Destinated to	%	Interchange	%	Total
Tahrir Ramsis							
Others							

Table B-17

Produce three tables that show the pattern of movement between the different combinations of area types and its relation to the different stations.

Table B-17-a

Number of Interchanging Passengers by Area Type for Each Station.

Interchange at Station:	Area Type				Total
	D/D	ED/D	U/D		
Tahrir Ramsis ⋮ Others					
Total					

Table B-17-b

Percentage of Interchanging Passengers for Each Station by Area Type

Interchange at station:	Area Type				Total
	D/D	ED/D	U/D		
Tahrir Ramsis ⋮ Others					100

Table B-17-c

Percentage of Interchanging Passengers for Each Area Type by Station.

Interchange at Station	Area Type			
	D/D	ED/D	U/D	
Tahrir				
Ramsis				
⋮				
Others				
Total	100			

CHAPTER C

THE CODING SYSTEM

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C. CODING OF THE PUBLIC TRANSPORT PASSENGERS MOVEMENTS

C-1) Preliminary Steps to Form the Sample

The following steps were carried out for all vehicles surveyed on every line by 2 groups consisting of 12 students and 2 supervisors in all:

i) The files previously gathered together and containing the information about the interviews and the on/off counts of one vehicle were distributed to the students, one each.

ii) One student identified each run by calling out its starting time, ending time and serial number to ensure that the timing of the run under consideration is the same in the six files. In case of disagreement, the run is identified according to the majority.

iii) The time centroid of each run was calculated and allocated to the proper class interval (i.e. any time between 0600 hr - 0700 hr is recorded in the 0630 hr class interval) which is then written clearly in the top right hand corner of each sheet(s) related to this particular run.

iv) The supervisor then collected all the sheets with the same time interval for all the surveyed vehicles of each line to represent the sample of this particular line during that specific period.

v) The interviews within the same time period were then given a serial number which will be used in the coding process (e.g. 1-90 for the 0630 hr. class interval, 1-105 for the 0730 hr. class interval and so on.

Example

Mode: Bus Line : 888

No. of surveyed vehicles: 3 vehicles with serial numbers 1,5,6

Line No.: 888

Vehicle Serial No. 1.				Vehicle Serial No. 5	Vehicle Serial No. 6
File 1	File 2	File 3	File 4		

Compiled all these files in one file after calculating the time centroid of each run.

File A File B File C

Runs with the same time centroid in the three files A,B & C are compiled together to give the sample interviewed for each line for each hour.

C-2) The Actual Coding

C-2-1) Coding Sheet:

One hundred students divided into 50 groups were supervised by 5 research graduates during the coding process, out of which 10 groups (20 students) were allocated to the revision stage*.

In each group one student called the information while the other picks up the relevent code and records it in the coding sheet Form 10 Appendix 1. It was decided to code two trips per card and hence the coding sheet was divided as follows:

TABLE (A)

Columns	Information	
1	Mode	
2-5	Line	
6	Date of the Survey	
7-10	Time	
11-13	Trip Serial Number	
14	Sex	
15	Trip purpose	)
16-17	Station number	) Origin of the trip
18-22	Zone number	)

* As the time was pressing it was decided to use 2 shifts for coding: a morning shift from 8 a.m. -3.0 p.m. and an afternoon shift from 3.0 p.m. to 9.0 p.m. daily.

Columns	Information	
23	Trip Purpose	Destination of the trip.
24-25	Station number	
26-30	Zone number	
31	Identifier	Interchange
32	Mode	
33-34	Station number	
35-38	Interchange line	
39-41	Trip Serial number**	
⋮		
63-66	Interchange Line	
67-71	Total number of passengers/line/hr.	

From the above coding formet it can be seen that the data on the cards are divided into 3 types of information:

- The IDENTIFICATION SECTION

  This consists of 10 columns from 1-10. It is written only once in the coding sheet as it is identical for all serial numbers lying in the time period under consideration; but it will be punched on every card.

** Start of the Coding of the Following Trip.

- The INFORMATION SECTION

  This consists of 28 columns for each trip. The trips with odd numbers are recorded in columns 11 - 38 and the trips with even numbers are recorded in columns 39 - 66.

- The MAGNIFICATION SECTION

  This consists of the number of passengers per hour and is shown in columns 67 - 71. This value is obtained from the manual processing of the on/off counts (see the data processing section).

C-2-2) Coding Keys:

The following are some explanstory notes plus the keys to code the above information.

C-2-2-1) **Mode**

Mode	Bus	Tram	Trolley	Metro	Ferry	Railways	Taxi	Others
Code	1	2	3	4	5	6	7	8

C-2-2-2) Line

In a field of 4 digits, the 2nd, 3rd & 4th digits are reserved for the Line number. The first digit is either 2, 1 or zero according the whether the line considered is identified with 2 dashes, 1 dash or without dashes respectively. In case where the line is identified by means of alphabetic letters, the first digit takes the value of 3. As far as urban railway lines are concerned, a code of 7777 was given to El-Marg line while 2 codes were given to Helwan line*: 8888 for trips between Bab el Luk & Torah El Balad station and 9999 for trips between Kotsika and Helwan Hammamat stations.

Examples

Line 10	0	0	1	0
Line 10	1	0	1	0
Line 152	2	1	5	2
Line G 8	3	0	0	8

* The number of passengers using that line (≃ 30 km. long) were over 999/hr. within some time intervals. With the field allocated to the trip serial number being 3 digits only, it was decided to split the trips along the line into two sections and hence two different "routes".

C-2-2-3) Date of the Survey:

Date	17/4/78	18/4/78	19/4/78	20/4/78	22/4/78
Code	1	2	3	4	5

C-2-2-4) Time

The time is represented in 4 digits as follows:

0730	0	7	3	0
1530	1	5	3	0

C-2-2-5) Information about the Trip Characteristics:

- Trip Serial Number

  It consists of 3 digits starting from 1 for the first trip within a certain time period to the last trip within the same time period.

- Sex

  It consists of one digit which either reads 1 if the interviewed passenger is a male or 2 otherwise.

- Trip Origin:

  It consists of 8 digits coded as follows:

  The first digit designates the purpose and takes any value from the following table:

Home	Work	Education	Shopping	Others
1	2	3	4	5

The 2nd and 3rd digits represent the station at which the passenger boarded the vehicle. These stations are coded according to table (C-1).

The remaining 5 digits represent the zone number at the origin of the trip. The address is first located on the attached maps and then coded according to the zone in which it lies.

It is to be noted that the available maps of Cairo were not up to date. Consequently, an extra effort was devoted to identify the street names in the "newly" developed areas so as to ease the coding of trip origins/destinations. (See Appendix 4).

- Trip Destination:

The eight digits reserved for the trip destination are coded in a similar way to the ones coded for the trip origin.

- The Interchange:

It consists of 8 digits coded as follows:

The first digit represents an identifier which can read:

1 in the case where no interchange took place

2 in the case where the interchange took place before the interview.

3 in the case where the interchange took place after the interview.

It is to be noted that if more than one interchange occur during one trip only the one before the interview is considered (code 2)

The second digit represents the interchange mode

The 3rd & 4th digits represent the station where the interchang took place.

The remaining 4 digits were supposed to represent the route before/after the interchange.

However, it was found that due to the dense network, the passenger has a choice between lines at the interchanging station and hence the line number quoted is not necessarily the one he uses every time for the same trip. It was therefore decided to be left blank.

Table (C-1)

Coding Numbers of the Main
Terminal Stations.

1.	Embaba	2.	Om El Massreyyeen
3.	Imam Shafei	4.	Opera
5.	Alf Maskan	6.	Al Abaguia
7.	Asar El Naby	8.	Isaaf
9.	Iskan Sarie	10.	Awal El Manial
11.	Abu El Haul	12.	Boulak El Dakruor
13.	Basateen	14.	Bain El Sarayat
15.	Bab El Wazeer	16.	Tahrir
17.	Taawon	18.	El Tounsy
19.	Guiza Square	20.	Al Azhar University
21.	Cairo University	22.	Nasr Garage
23.	Galaa	24.	Guesr El Suez
25.	Game Amr	26.	Helwan
27.	El Hay El Sabee	28.	Hadayek El Kobbah
29.	Hay El Zohoor	30.	Hadayek Shobra
31.	Hadayek Zunhom	32.	Khalafawy
33.	Khaled Ben Walid Sq.	34.	Khlousy
35.	Darrassah	36.	Deir El Malak
37.	Ramsis	38.	Roxy
39.	Rodah	40.	Road El Farag
41.	Zamalek	42.	El Sahel

43. Sayeda Zenab
44. El Sawah
45. El Sayeda Nafissa
46. El Sayeda Aisha
47. El Sakakiny
48. Shobra El Kheyma
49. Sheikh Ramadan
50. Tolombat Abu El Naga
51. El Daher
52. Ataba
53. Abbassieh
54. Ain Shams
55. Ain El Syra
56. Agouza
57. Ghamra
58. El Falaky
59. El Fostat
60. El Kolaly
61. El Kalaa
62. El Kanater
63. Koleyet El Banat
64. Lazoghly
65. Lebanon Square
66. Mazallat
67. Messarrah
68. Mamaleek
69. Matarieh
70. Messallah
71. Medinet El Talaba
72. Masaken El Kahraba
73. Masaken Almaza
74. Markaz El Bohoos
75. Madinet El Bohoos
76. Masaken El Amerieh
77. El Matbaa
78. Masr El Kadima
79. Mokattam
80. Mathaf Zeraa
81. El Mabyiada
82. Cairo Airport
83. Almaza
84. Meet Okba
85. Maadi
86. Masaken El Helmia
87. El Moneeb
88. Nady El Remeya
89. El Haks Teb
90. El Wayly

91. El Nozha-El Sabak
92. El Zaytoon
93. El Marg
94. Dar El Salam
95. Thakanat El Maady
96. Torah El Balad
97. El Maasara
98. Wady Hof-Zahraa Helwan
99. Ein Helwan.

PART II

SYSTEM DESIGN AND COMPUTER IMPLEMENTATION

PART II

SYSTEM DESIGN AND COMPUTER IMPLEMENTATION

CHAPTER D

THE SYSTEM DESIGN

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CHAPTER D

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III. Glossary

SYSTEM SPECIFICATIONS

D.I.1 INTRODUCTION

The Data Processing System Design that reflects the main goals of the Public Transport Survey is discussed in this Chapter. In fact, the input data (data collected), to this system, represents a total of 282000 interviewed, with different trip characteristics, gathered over a period of 5 days at a rate of 10 hours per day. Consequently, an effective system design should be developed.

D.I.2 OBJECTIVES

In order to achieve the primary goals of the Public Transport Survey [page 2], the System Design should provide a firm and reliable data base for trip patterns and trip characteristics of the different modes. This is achieved by creating the following:

(1) An accurate master file of this large sample.

(2) A comprehensive and effective system that produces the different information required.

In addition, this effective system should be characterized by the following:

(1) Reliability (2) Flexibility (3) Simplicity
(4) Economy, and (5) Acceptability.

D.I.3 SCOPE

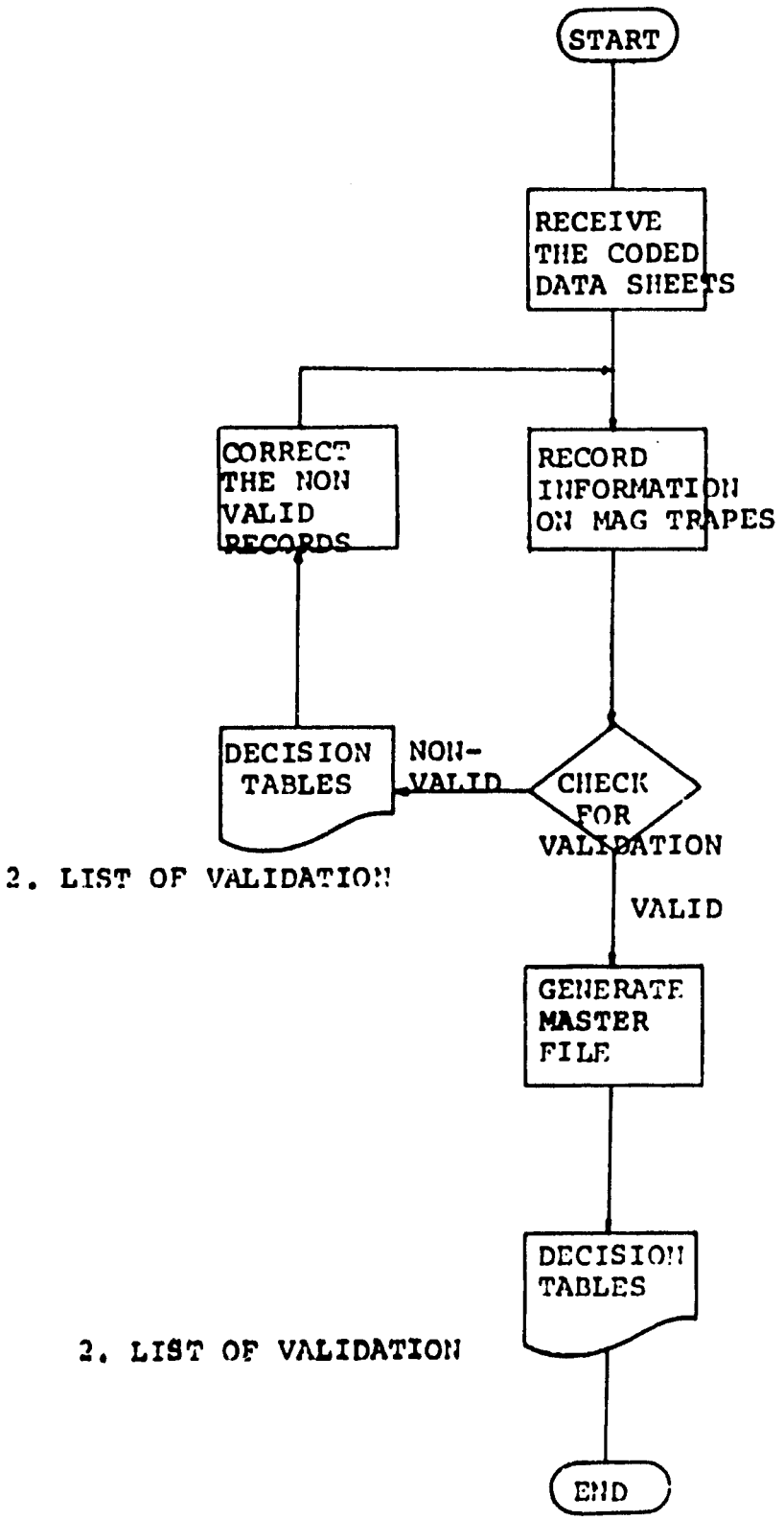
The Data Processing System Design consist of two main phases: the data preparation phase, and the programming phase.

D.I.3.1 *Preparation Phase*

The data collected during the survey was coded as described in Chapter C, by making use of [form 10], shown there. These coded sheets were the input to this phase, which should be checked after that. Therefore, various logical relations between the different parameters (that found in the system design) were determined to verify the validity of the data. Once the coding sheets were ready, the information was recorded on magnetic tapes, checked for validity and the wrong records were corrected. This cycle was repeated until the predetermined accuracy was reached (i.e. not more than 0.5% error) or an accuracy of more than 99.5%, all over the different blocks of data. Fig. D.1 shows the process of data preparation.

D.I.3.2 *The Programming Phase*

This phase is devoted to obtain the various trip characteristics. These are divided in the system design stage, into groups, each one of which consists of those characteristics having common relations, in order to simplify the processing efforts. The following are the major characteristics:



FLOWCHART OF THE DATA PREPARATION PHASE

I. The Number of Public Transport Passengers

A. The number of P.T. passengers for each line.

B. The number and percentage of P.T. passengers for each mode.

C. The number and percentage of passengers for each line (Mode) without interchange.

II. The Sample Size Ratio and Enlargement Factors

A. Line/Mode.

B. Mode.

III. The Origin Destination Matrices

A. O/D matrices by mode/time.

B. O/D matrices by time.

C. O/D matrix for the whole survey period.

D. O/D matrices of interchanging passengers by mode/time.

E. " " " " " by time.

F. O/D matrices (second method) by mode/time.

G. " " " " by time.

H. Error O/D matrices by time.

I. Relative error O/D matrices by time.

J. " " " matrix.

IV. Trip Making (Generating) Characteristics

A. Trip making by purpose by time.

B. Trip making by purpose by mode.

C. Trip making by area type by hour and mode.

D. " " " " " by mode.

V. Public Transport Loading Characteristics

A. Public transport loading characteristics by stations (for each interchanged mode/station).

B. The public transport station loading by mode.

C. " " " " " for all modes.

D. " trip making by area type characteristic at each station.

All these characteristics are developed using the Hierarchy plus input-process-output (HIPO) and structured functions and detailed procedures in order to achieve this functional design. HIPO consists of two basic components: a hierarchy chart, which shows how each function is divided into subfunctions, and input-process-output charts, which express each function in the hierarchy in terms of its input and output. The use of these two types plus the detailed procedures are explained under functional design.

In addition, a sample test data was prepared to check the correctness of the validation program, as well as the test of the programs of the system.

In a word, the system design consists of two major phases: the data preparation, and the programming phase. Therefore, design implementation, and supervision procedures have been developed for carrying out this survey.

D.I.4 BASIC STEPS

There are certain steps which should be followed in data processing procedure. These main steps are summarized as follows:

A) System analysis and design.

B) Preparation of data.

C) Recording of data.

D) Analysis of Data and correction of unvalid data.

E) Programming.

F) Compilation.

G) Preparation of Test Data.

H) Test for execution.

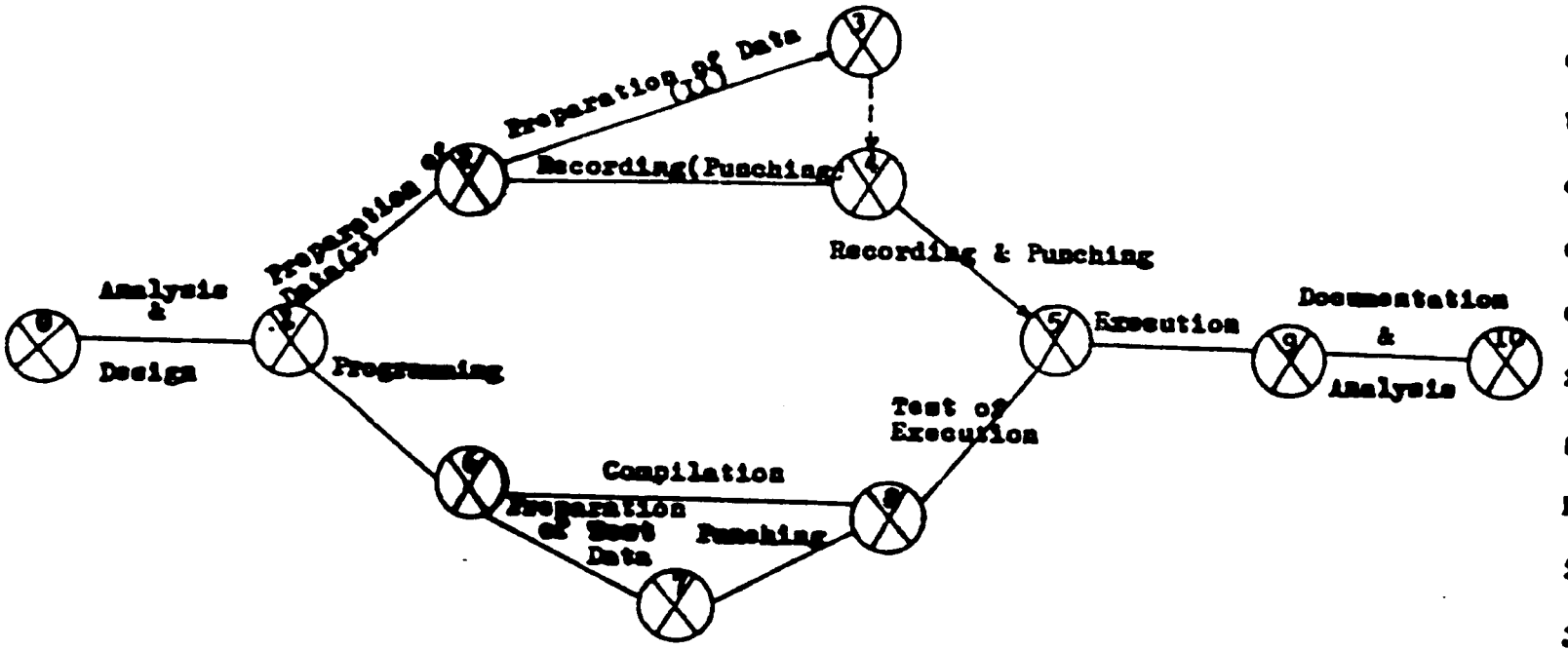
I) Execution.

J) Documentation.

In fact, the execution of these various steps need a lot of man power. A complete specification of that, will be described in the computer implementation (Part E), and in the public transport data processing report, together with the acknowledgement of those who have done tremendous work in the implementation of this survey and in its various stages.

D-4) **Time Scheduling of Computer Work:**

Following Chart Shows Scheduling of the Different Activities necessary for Computerised Data Processing (It is proposed to achieve the whole job in 10 Weeks)



Activities

a) System Analysis & Design

b) Preparation of Data

c) Recording (Punching)

d) Analysis of Data

e) Programming

f) Compilation

g) Preparation of Test Data

h) Test for Execution.

i) Execution

j) Documentation

Activity i	a	b	c	d	e	f	g	h	i	j
Estimated time of Activity										

D.I.5 FILE SPECIFICATION AND FIELD UTILIZATION

The file specification and field utilization are as shown in the following table:

File specification				
Field Ref.	Field name	Picture	Character Positions	Remarks
1	Mode	9	1	Takes values from 1-6
2	Line No.	9999	2-5	
3	Survey Date	9	6	
4	Trip Time	9999	7-10	
5	Serial No.	999	11-13	
6	Sex	9	14	
7	Origin Purpose	9	15	
8	Station	99	16-17	
9	Address	99999	18-22	
10	Destination Purpose	9	23	
11	Station	99	24,25	
12	Address	99999	26-30	
13	Interchange Identifier	9	31	
14	Mode	9	32	
15	Station	99	33,34	
16	Line No.	9999	35-38	Not used
18	Total No. of Passengers	99999	67-71	

RECORD LAYOUT

B/C	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		
Min.																						
Max.																						
Field name.	W/C	MODE	LINE NO.	DAY	TIME	VOLUME PER HOUR	SERIAL	SEX	ORIGIN			DISTINATION			CHANGE							
								PURPOSE	STATION	ADDRESS	P.	ST.	ADDRESS		IDENT.	MODE	ST.					
	1	2	3	4	10	5	6	7	8	9	10	11	12		13	14	15					

D.I.6 VALIDATION PROCESS

The validation process involves the verification of the correctness of the data and their logical interpretations. This involves setting the rules for validation at the design stage and checking the validation of these logical rules during implementation. Therefore, Decision Tables are developed, which enables controlling the number and type of valid and invalid records over each of the various blocks of the Modes, hours, and lines of the survey.

Moreover, a summary of all errors together with their type over the whole survey period is produced. The errors are classified as follows:

1. *Error Type A*: Address error, which indicates the absence of the address (it has not been coded).

2. *Error Type G*: Gap error, which shows that there is a gap in the serial numbers of the interviewed passengers of the same line, at the same time.

3. *Error Type P*: Primary errors, meaning one of the following errors:

- Address or zone error (origin or destination).
- Purpose (origin or destination).
- Serial: when the serial is not numeric.

4. *Error Type S*: Secondary error, which indicates that an error in one of the following fields occurs:

- Mode.
- Line.
- Origin Station (O.ST).
- Destination Station (D.ST).
- Volume of passengers per hour, V.P.H. (Numeric on the same time, line, and mode).
- Identifier coded as 2 or 3 should be associated with an interchanging mode, and interchanging station.
- Duplication in the serial.
- Sex.

The error - of any type - is printed against the erroneous record. This enables the team responsible for correcting these recorded data, to detect the error quickly and, hence to correct it.

It is to be noted here that error type P is a significant error and cannot be corrected unless the information about this particular trip is coded once more, assuming that this information exist in the original documentation, otherwise, this will be a search record. On the other hand, the secondary errors are corrected by the validation and revision teams, since the sources of these errors are easily detected, because they are personal error either from the coder during the coding

stage or from data recorders during the recording stage onto the magnetic tapes. Finally, errors type A, indicate that the address of the interviewed passenger does not exist. Such records, are not processed in the different O/D matrices.

Table D.1, Table D.2, and Table D.3 show an example of the different error types as they appear in different decision tables (per line, per hour, and per mode).

Table D.1

A. Decision Table for Each Hour, for Each Line, for Each Mode.

Mode	Line No.	Hour	No.of valid records	No. of invalid records				Total No.of invalid records	Total No.of records
				ERR P	ERR S	ERR A	ERR G		

Table D.2

B. Decision Table for Each Line/Mode (All hours)

Mode	Line No.	No. of Valid Records	Number of Invalid Records				Total No.of Invalid Records	Total No.of Records
			ERR P	ERR S	ERR A	ERR G		

Table D.3

C. Decision Table for Each Mode (All Lines)

Mode	No. of Valid Records	Number of Invalid Records				Total No. of Invalid Records	Total No. of Records
		ERR P	ERR S	ERR A	ERR G		

On the other hand, an associated validation listing should be produced in order to correct the wrong records according to the appropriate error messages, together with a resultant statistics for each block (Mode, Line, Hour). A sample of the output of the validation is shown in the Appendix F. Tables D.4, D.5 and D.6 show the logic relations between the different fields.

Table D.6 shows the station/mode relationships over all the area under study.

Validation Rules

The following Tables give the validation rules which should be used to check key recording:

Table D.4

Field	Digits	False Relation	True Relation
1	1	0, 7	
2	2	4	
	3,4,5	Table 1	
3	6	0, 6	
4	7,8	any value 05 or 16	
	9		= 3 only
	10		= 0 only
5			should be odd
17			should be even
6	14	0, 3	
7	15	0, 6	

Table D.4 - (Cont'd)

Field	Digits	False Relation	True Relation
8	16,17	0	
9	18,22	18, 3	*If 18=0 then = 04,07,10,13,16,19,22, 25,28,31,34,37,40,43, 46,49,52,55,58,67,70, 73,76,78,82,85,88,91 & 21,22 = 00 *If 18=1 then 19,20 = 01 to 14 (serially) & (21,22) ≠ 00 *If 18=2 then 19,20 = 01 to 25 serially; 21=0, 22=1 to 7 serially.
10	23	0, 6 same as 7.	
11	24,25	0 same as 8.	
12	26-30	same as 9.	
13	31	0, 4	
14	32	= 9	
15		0 same as 8,11	
1 U2	1,(2-5)	1=1U DZ(1) =2U DZ(2) Table =3U DZ(3) C.1 =4U 8 =5U 7	
1 U8 1 U11 1 U15			Table D.1
13			If 13=0 then 14=0,15=0
5,6,9, 10,12 13			5 6 7 9 10 12 13 ≠ 0 If II i = 0 then make flage and after finishing the whole line sort them and generate the new sequence

Table D.5

Route Numbers that do not Exist in the Network for Different Modes

Bus (Field 1) Code 1			Tram (Field 1) Code 2	Trolley (Field 1) Code 3
23	121----123	413	3	1----14
27	125----127	415----430	7	16
29	129	433----439	9	19---29
31	131	443	10	31---43
34	133	446----499	12	46---
56	135----149	501----544	17	
58	151	556----599	18	
67	155----159	601----665	19	
71	161----165	667----669	25	
73---77	168----169	701----799	26	
79	171	801----887	27	
83	177----181	889----899	28	
86	183----189	901----	29	
90	191----199		31---	
91	201----209			
94	211----299			
97	301----309			
101--103	311----333			
105	336----399			
108--110	402----409			
112--119	406----410			

Table D.6

Station/Mode Relationships

No.	Station	1 Bus	2 Tram	3 Trolly	4 Metro	5 Waterway	6 Railway
01	Embab	*		*		*	
02	Om El Massreyin	*		*			
03	El Imam El Shafei	*	*				
04	Obera	*	*	*			
05	Alf Maskan	*			*		
06	Al Abagia	*	*				
07	Asar El Naby	*		*		*	
08	Isaaf	*	*				
09	Iskan Sarie	*			*		
10	Awal El Manial	*		*			
11	Abu El Haul	*					
12	Boulak El Dakrour	*					
13	Basateen	*	*	?			
14	Bain El Sarayat	*					
15	Bab El Wazeer	*					
16	Tahrir	*	*	*			
17	Taawan	*					
18	El Taunsy	*	*	?			
19	El Giza SQ.	*		*			
20	El Azhar Univ.	*			*		
21	Cairo University	*		*		*	
22	Nasr Garage	*					
23	El Galaa	*				*	
24	Guesr El Suez	*			*		

Table D.6 -- (Cont'd)

No.	Station	1	2	3	4	5	6
25	Gama Amro Bin El Ass	*				*	
26	Helwan	*					*
27	El Hay El Sabee	*			*		
28	Hadayek El Kobbah	*			*		*
29	Hay El Zohoor	*			*		
30	Hadayek Shoubra	*	*				
31	" Zienhom	*	*				
32	El Khalafawy	*	*				
33	Khaled Ben Walid SQ.	*		*			
34	Khulusy	*	*				
35	El Darrasa	*			*		
36	Dier El Malak	*			*		*
37	Ramsis	*	*		*		*
38	Roxy	*			*		
39	El Rodah	*		*			
40	Road El Farag	*	*			*	
41	El Zamalek	*					
42	El Sahel	*	*			*	
43	El Sayeda Zeinab	*	*				*
44	El Sawah	*	*				
45	El Sayeda Nafisa	*	*				
46	" " Aisha	*	*				
47	El Sakakiny	*	*				
48	Shoubra El Kheyma	*	*				

Table D.6 - (Cont'd)

No.	Station	1	2	3	4	5	6
49	El Sheikh Ramadan	*					
50	Tolombat	*					
51	El Daher	*	*	*			
52	El Ataba	*	*	*			
53	El Abasia	*	*	*			
54	Ain Shams	*					*
55	Ain El Syra	*				*	
56	El Agouza	*		*			
57	Ghamra	*	*		*		
58	El Falaky	*	*	*			*
59	El Fostat	*		*		*	
60	El Kolali	*	*				
61	El Kalaa	*	*				
62	El Kanater	*				*	
63	Koleyet El Banat	*			*		
64	Lazoghly	*	*				
65	Lebanon SQ	*					
66	Mazallat	*	*				
67	Messarrah	*	*				
68	Mamaleek	*					
69	Materieh	*	*		*		*
70	Messallah	*				*	
71	Madinet El Talaba	*					
72	Masaken El Kahraba	*					
73	Masaken Almaza	*			*		

Table D.6 - (Cont'd)

No.	Station	1	2	3	4	5	6
74	Markaz El Buhoos	*					
75	Madinet El Boo'us	*			*		
76	Masaken El Amirieh	*	*		*		
77	El Matbaa	*					
78	Masr El Kadima	*				*	*
79	Mokattam	*					
80	Mathaf Zeraii	*					
81	El Mabyiada	*	*				
82	Cairo Airport	*					
83	Almaza	*			*		
84	Met Okbah	*					
85	Maadi	*					*
86	Masaken El Melmeya	*	*		*		
87	El Mounib	*		*			
88	Nadi El Remaya	*					
89	El Kaksteb	*			*		*
90	El Waily	*					
91	El Nozha El Sabag	*			*		
92	El Zaiton	*					*
93	El Marg	*					*
94	Dar El Salam	*					*
95	Thakanat El Maadi	*					*
96	Tora El Balad	*					*

Table D.6 - (Cont'd)

No.	Station	1	2	3	4	5	6
97	El Masara	*					*
98	Wadi Houf (Zahra Helwan)	*					*
99	Ain Helwan	*					*
00	Others	*	*	*	*	*	*

D.II FUNCTIONAL DESIGN

D.II.1 INTRODUCTION

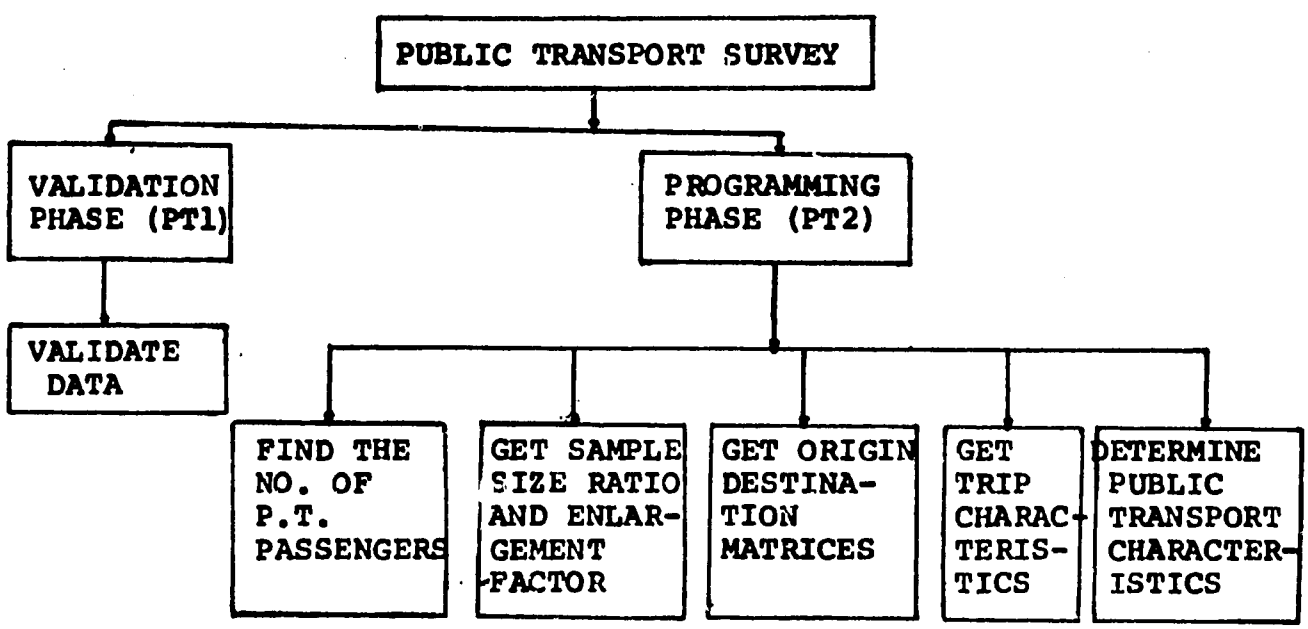
The functional design of the system is explained here using the HIPO (Hierarchy plus Input-Process-Output) technique, structure functions, and the detailed procedure of each function. This explanation is carried out from three main levels:

(1) System Level,

(2) Program Level, and

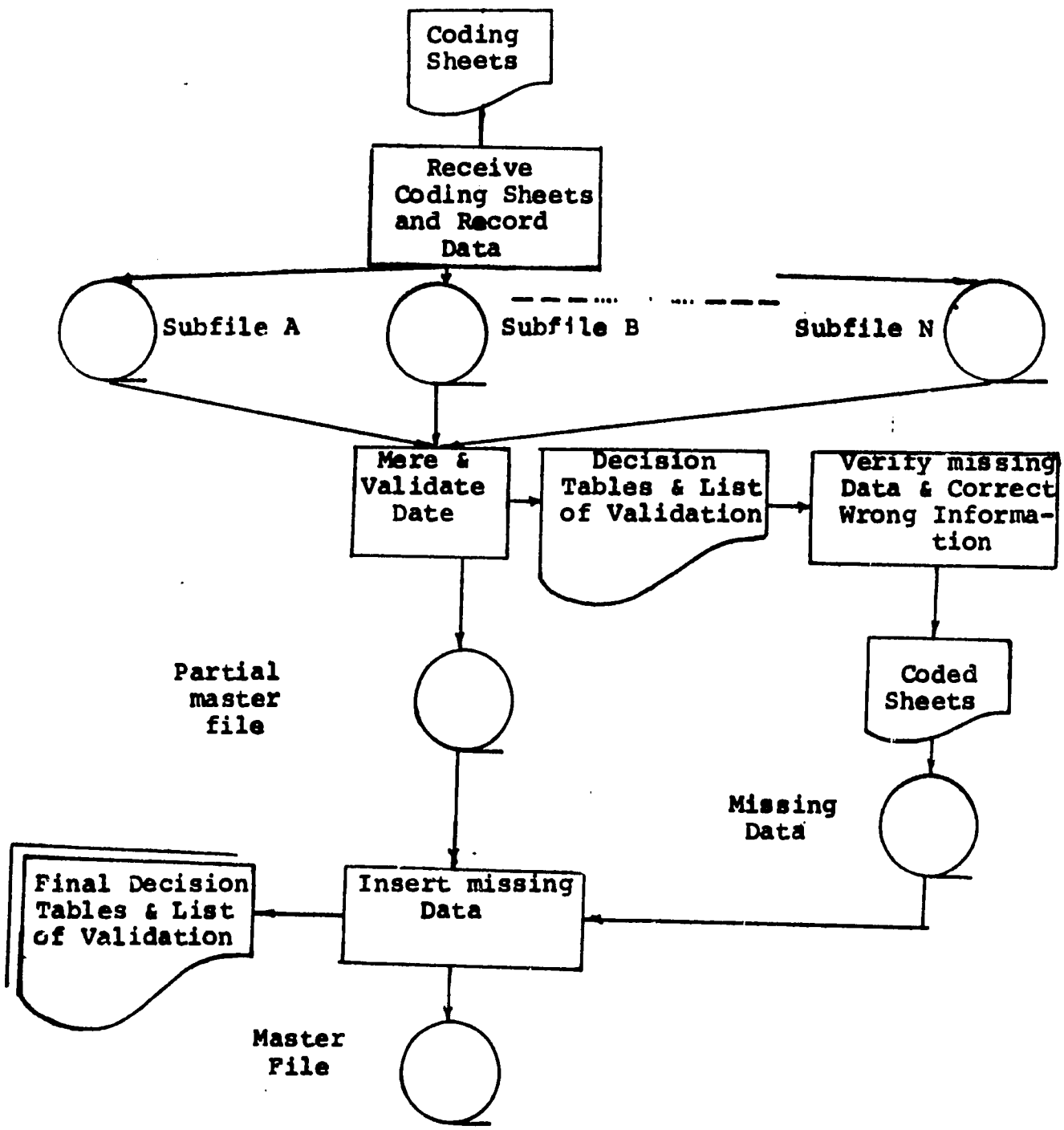
(3) Module Level.

D.II.2 SYSTEM LEVEL



D.II.1 *Data Preparation and Validation Phase*

The process of data preparation is carried out according to the chart of Fig. 2. In fact, the coded sheets which represents the final output of the questionnaire, and the input of the data processing phase would be submitted to the data preparation center, by one of our members. There, the process of data recording is carried out by a number of data

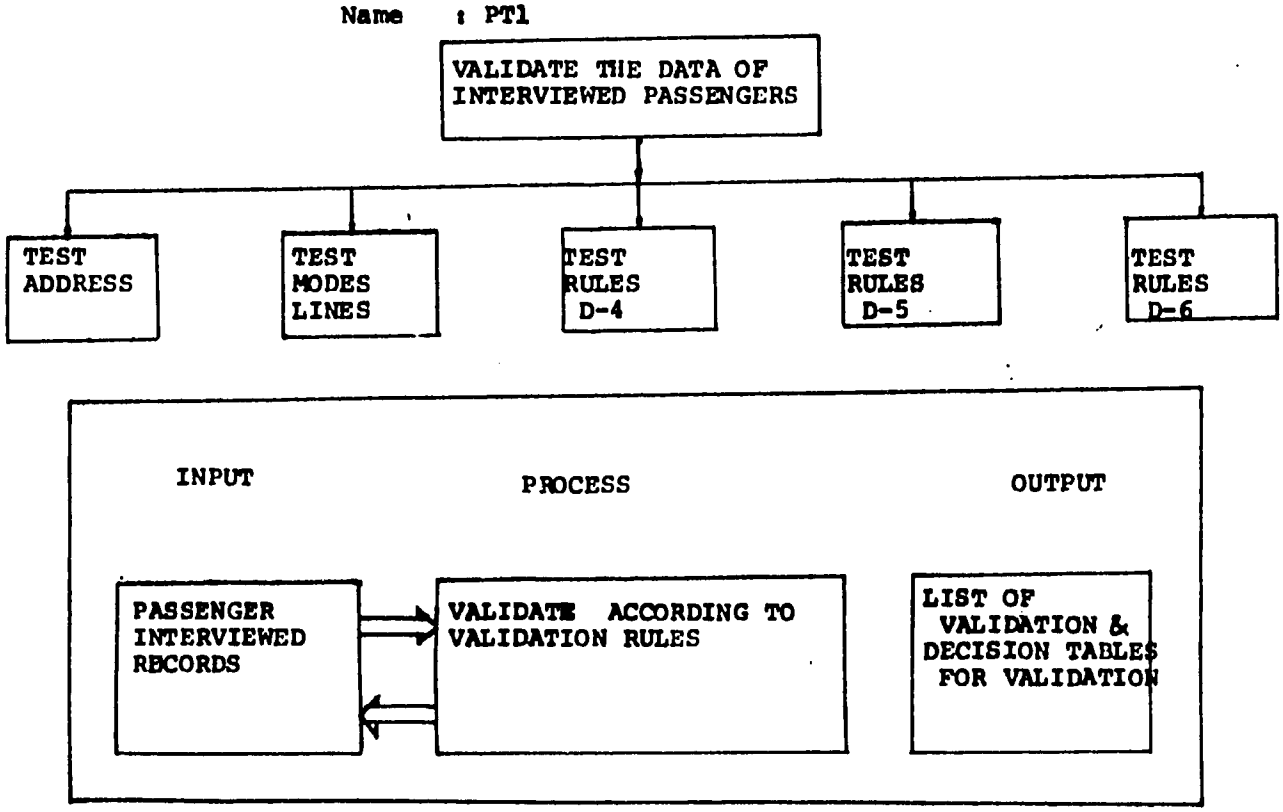


recorders. After that a merging, and validation phase should be carried out, which has two main kinds of outputs: decision tables and lists of validation, and a partial master file. The decision tables and the list of validation are reviewed by a team of students at Cairo University, and verification of the outputs and correction of the wrong recorded information are carried out. Consequently, certain coded sheets of the corrected information are recorded once more and then creation of the master file, after checking the final output, will be occurred. In fact, this process, will be done many times until we reach given predetermined accuracy of 99.5% all over the whole blocks of data.

Phase 1: *Validation Phase*

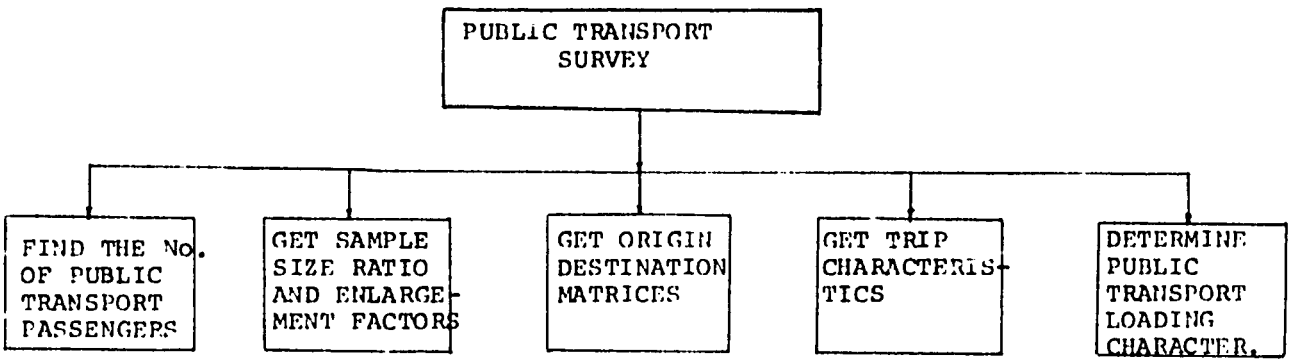
Program Level

Name : PT1



D.II.2.2 *Programming Phase*

Name PT2

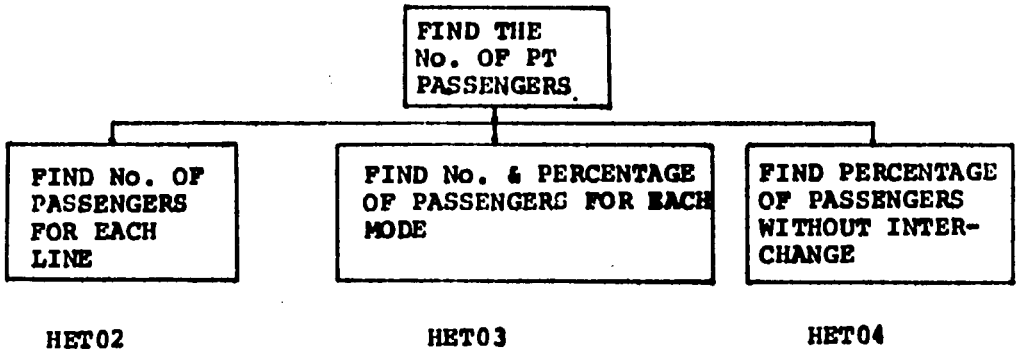


Note: The whole set of programs are stored on magnetic tape, and set operating macros of individual programs are stored on a macro PT2.

D.II.3 *The Number of Public Transport Passengers*

PROGRAM LEVEL

NAME: HPTP2MLT



1.

INPUT	PROCESS	OUTPUT
I) Mode Line Time Total No. of passengers per line/ time The No. of passengers interviewed with inter-change & without	1. Get the total No. of passengers for a mode and their %. 2. Get the total No. of passengers for a certain time & their %. 3. Calculate the No. of passengers with inter-change & without inter-change. 4. Find their percentage.	1. The No. of passen-gers carried by line by time for each mode. 2. a)The No. of passen-gers carried for each mode for each hour of the survey & total No. of passengers for the whole survey period. b)The % of hourly passenger volume for each mode. 3. The % of passengers interviewed without interchange to the total No. of passen-gers for each mode for each line for each hour.

MODULE LEVEL

There are three modules which compute and process the requirements of this program. These modules are the following:

(1) Find the number of passengers by line by time.
(2) Find the number of passengers by mode by time.
(3) Find the number of passengers interviewed with and without interchange by line by mode.

(1) Number of Passengers by Line by Time

Name : HET02

Purpose : To show the total number of passengers carried by mode for each line number.

Requirement: Number of passengers by line by time

LINE No. \ TIME	0600-0700	0700-0800		1500-1600	TOTAL
----	xxxxx	xxxxx		xxxxx	xxxxx

I/P : Total number of passengers for each line, for each hour.
Line number for each mode.

Calculate :

1) Total number of passengers for each line = No. of passengers for all hours (0600-1500).

2) For HET03 Calculate

The number of passengers for each mode for each hour

= NP_i all lines

(i) = set of all hours

Record Utilization[4]: (1,2,4,18)

(2) <u>Number of Public Transport Passengers by Mode by Hour</u>

Name : HET03

Purpose : To find the number of passengers carried by MODE for each hour of the survey and the total number of passengers carried for the whole survey period.
To find the percentage of hourly passenger volume for each mode from the total number of passengers for the survey period and the percentage of the hourly number of passengers for each mode to the total hourly number of passengers for all modes.

Requirements:

a) Number of public transport passengers by mode by hour.

b) Percentage of number of passengers carried by each mode during every hour of the survey period.

c) Percentage of number of passengers carried by each

---

* File specification and record utilization is shown in Appendix

mode during the different hours of the survey period.

	Bus	Tram	Trolly	Metro	Ferry	Railway	$Total_i$
0600-0700	xxxxx	xxxxx	xxxxx	xxxxx	xxx		
Percentage	---%	---%					
1500-1600	xxxxx						
Percentage							
$Total_j$	xxxxx						
Percentage	---%	---%	---%				

I/P : Number of passengers for each mode for each hour.

Calculate :

$$Total_i = \sum_{j=1}^{6} (NP)_{ij} \quad \text{for all modes } j=1 \text{ to } 6$$

$$Percentage = \frac{(NP)_{ij}}{Total_i} \times 100$$

$$\text{Total}_j = \sum_{i=1}^{10} (NP)_{ij} \quad \text{for all hours } i=1 \text{ to } 10$$

$$\text{Percentage} = \frac{(NP)_{ij}}{\text{Total}_j} \times 100$$

Record/Utilization: See HET02.

(3) Number of Passengers Interviewed by Line by Mode

Name : HET04

Purpose : To find the percentage of passengers interviewed without interchange to the total number of passengers interviewed, for each mode, for each line, for each hour.

Requirement: Number of passengers interviewed by interchange by line by mode.

MODE: --- LINE: ---

Time	No. of passengers interviewed including interchange	No. of interchanging passengers	No. of passengers interviewed without interchange	Percentage of passengers without interchange (PR)
0600-0700	---	----	---	-----
0700-0800	(2)	(1)	(3)	(4)
1500-1600				
Total				

I/P : Number of passengers interviewed including interchange.
Number of passengers interviewed without interchange.

Calculate : Number of passengers excluding interchange.
Percentage of passengers without interchange.

Record-Utilization: Fields (1,2,4,5,13).

Procedure: (1) For each mode for each line No. for each hour count the No. of interviewed passengers with interchanges = <ident> = <13>.

(2) The No. of interviewed passengers is given.

(3) No. of passengers interviewed excluding interchanges = (2) - (1).

(4) $\% = \frac{(3)}{(2)} \times 100.$

(4) <u>Number of Passengers Interviewed by Interchange by Mode</u>

Name : HET05

Purpose : Same as HET04 except in HET05 is the sum of all values for each MODE.

Requirement: Number of Passengers Interviewed by Interchange by Mode.

MODE: ---

Time	No. of Passengers Interviewed	No. of Interchanging Passengers	No. of Interviewed Passengers excluding interchanges	Percentage (PR2)
0600-0700				
0700-0800				
1500-1600				
Total				

I/P : There are two possible ways:

(1) To enter the data directly from I/P record as in HET04.

(2) To make use of the results of HET04 (if it has been generated).

Calculate : (1) Percentage only (for (2) only), or

(2) No. of passengers excluding interchanges (1).

Field/Utilization: Same as HET04.

D.II.4 *The Sample Size Ratio and Enlargement Factors*

PROGRAM LEVEL

Name : HET2MLT

GET SAMPLE SIZE RATIO AND EN-LARGEMENT FACTORS

I/P	PROCESS	OUTPUT
Total No. of passengers No. of inter-viewed passen-gers including interchanges	Get sample size ratio (SSR) Get enlargement factor (EF)	SSR & EF by line by mode for each hour

Sample Size Ratios and Enlargement Factors

Name : HET06

Purpose : To calculate the sample size ratio of interviewed passengers given by mode and hour of the day for each line.

Requirement: Sample size ratio and enlargement factors by MODE by line for each hour

MODE: --- LINE: ----

Time	Sample size ratio (SSR)	Enlargement factor $= \frac{1}{SSR}$
0600-0700	---	---
1500-1600		

I/P : Total No. of passengers.

No. of interviewed passengers including interchanges HET04.

Calculate :

Sample size ratio =

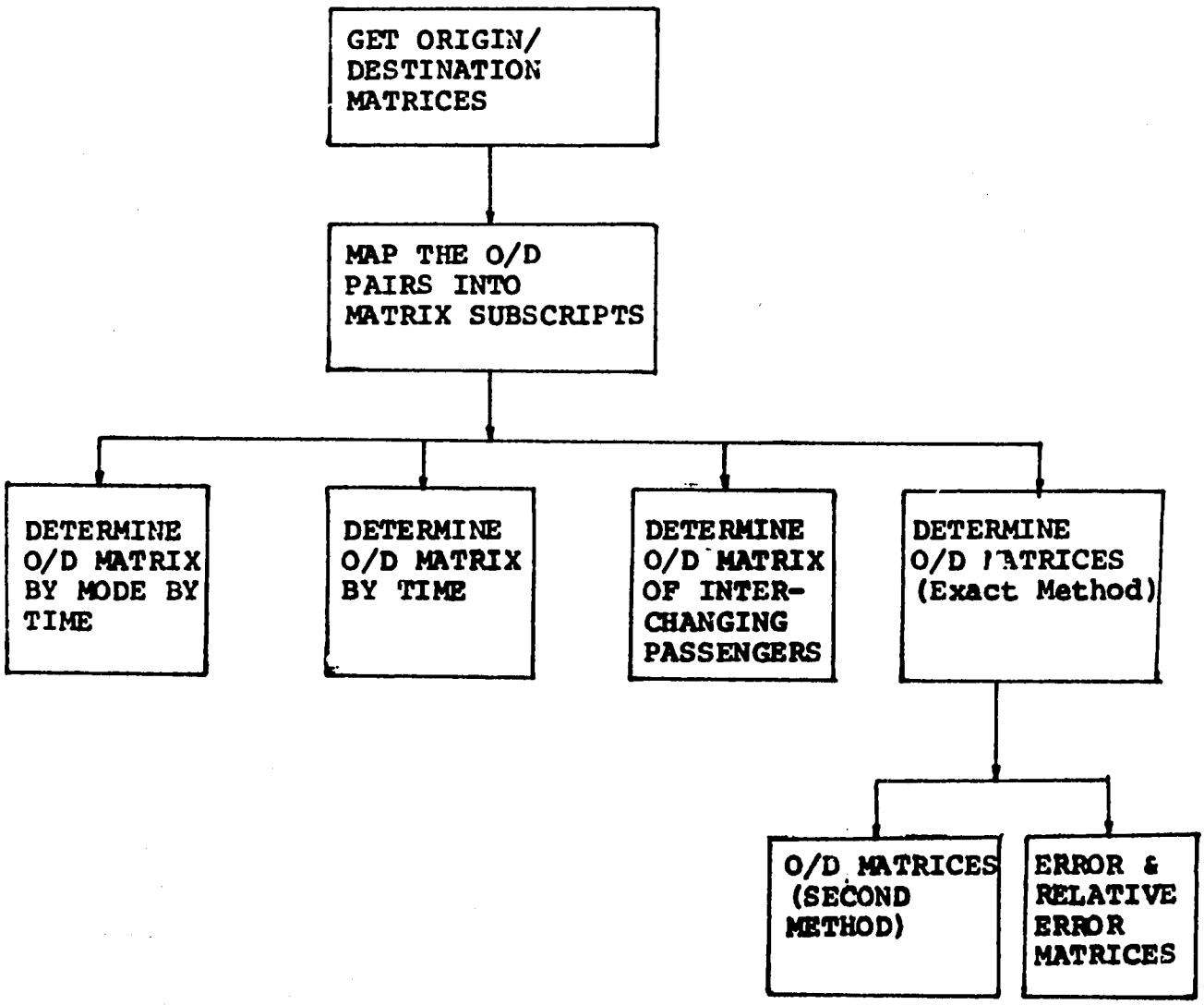
$$\frac{\text{Table (4) column (2) by hour}}{\text{Corresponding value of Table (2)}}$$

Enlargement Factor (EF) = $\frac{1}{SSR}$

Record/Utilization: = 18 results of HET04.

= HET02 " " "

D.II.5 THE ORIGIN/DESTINATION MATRICES



PROGRAM LEVEL 1

Name : HODF2MT

GET ORIGIN/DESTINATION MATRIX BY MODE BY HOUR (FIRST METHOD)

INPUT	PROCESS	OUTPUT
O/D matrix of all interviewed passengers per line Enlargement factors % of passenger without interchange per line, per mode, per hour	Get matrix of the line by enlarging the interviewed sample Get matrix of passengers without interchange of the mode Enlarge matrix by multiplying by average % of interchanging passengers	O/D matrix by mode by hour

(1) <u>Origin/Destination Matrix by Mode by Hour (Approximate Method)</u>

Name : HET07

Purpose : Compose the origin/destination matrix of all passengers interviewed (with and without interchange) per mode per hour.

Requirement: O/D Matrix by Mode by Hour

MODE: TIME:

Origin \ Destination	xxxxx	xxxxx		
xxxxx				
xxxxx				

I/P : O/D of all passengers.

Record/Utilization: Fields (1,2,4,9,12)

Procedure: (1) TEMP = 0 (n x n matrix n = 140)

(2) Select Hour.

(3) Update the O/D matrix i.e. $a_{ij} = a_{ij}+1$ where i = <9> , j = <12>.

(4) Continue for all passengers within the same line.

(5) Multiply by EF for this line to get O/D matrix; EF is obtained for the corresponding time from HET06.

(6) Multiply each matrix by the corresponding factor in Table HET04 step 4 (column 4) (i.e. % of passengers without interchange).

(7) TEMP = TEMP + $[a_{ij}]$ * EF.

(8) Continue for all lines.

(9) Multiply each cell by (2-HET05 column 5) and print

TEMP = TEMP *(2-(HET05 column 5)/100).

(10) Add for all hours and print it for each mode.

PROGRAM LEVEL 2

Name : HODF2T

GET ORIGIN/DESTINATION MATRIX BY MODE

INPUT	PROCESS	OUTPUT
O/D matrices for all modes	Computer O/D matrix for each hour	O/D matrices for each hour of the survey

(2) <u>Origin/Destination Matrix by Hour for All Modes (Approximate Method)</u>

Name : HET08

Purpose : To find the O/D matrices for each hour of the day. In other words, each one is a summary matrix for all P.T. modes for all purposes.

To find the O/D matrix for all hours.

Requirement: O/D Matrix by Hour on all Modes

TIME:

O \ D	xxxx		Total
xxxx			
Total			

I/P : Data from all O/D matrices for all modes for the corresponding time.

Record/Utilization: Same as HET07.

Procedure: (1) Htemp = 0

(2) Temp2 = 0

(3) Temp2 = Temp2 + Temp 1 (call 7)

where Templ is obtained in step 9 in HET07

For each time interval O/D matrix = O/D mat's all modes

(4) Repeat (3) for all modes

(5) Print Temp2

(6) Htemp = Htemp + Temp2

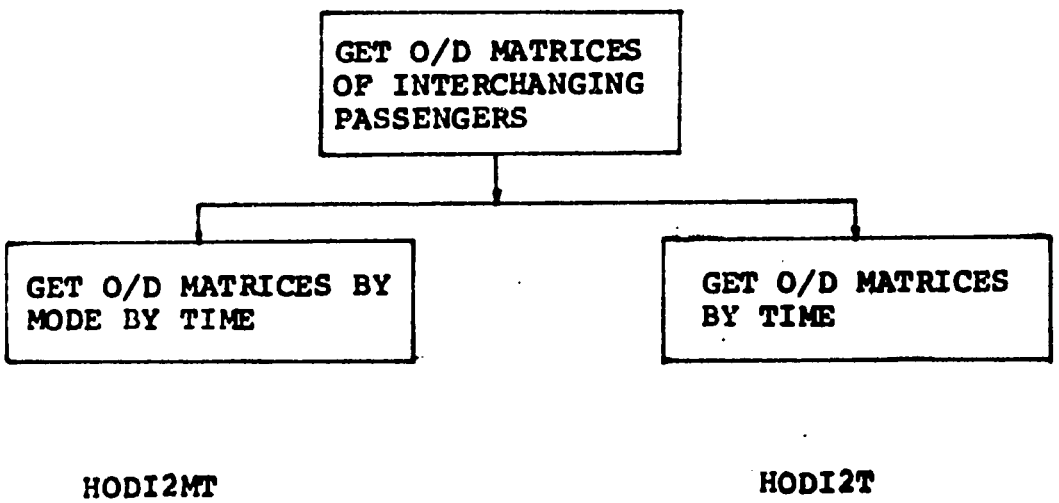
(7) Continue for all hours

(8) Print Htemp

PROGRAM LEVEL 3

Name : HODI2MT

HODI2T



INPUT	PROCESS	OUTPUT
The number of interviewed passengers who interchange Enlargement factor per line per hour per mode	Check the interchange Get the O/D matrix of interchange	O/D matrices of interchange

(3) <u>Origin/Destination Matrix of Interchanging Passengers</u>

Name : HET17

Purpose : To find the O/D matrix of interchanging passengers by hour.

Requirement: O/D Matrix of Interchanging Passengers

TIME: (00 - 00)

O \ D	xxxxx		xxxxx
xxxxx			
xxxxx			

I/P : The number of passengers interviewed with interchanges between O/D pairs.

Note : This can be achieved in parallel with HET07.

Record/Utilization: (2,9,12,13).

Procedure:

(1) TEMP2 = 0

(2) Select Hour I

(3) TEMP1 = 0

(4) Select Mode M

(5) L = 0

(6) Select Line L

(7) Check if <13> = 1 exclude it & go to 9

(8) $\ell_{ij} = \ell_{ij} + 1$

(9) Continue for all passengers of the same line

(10) TEMP1 (I,J) = TEMP1 (I,J)+L(I,J)*EF

(11) Continue for all lines of the same mode

(12) TEMP1 (I,J) = 0.5 A_i * TEMP1 (I,J)

(13) PRINT TEMP1 (I,J)

(14) TEMP2(I,J) = TEMP2(I,J) + TEMP1(I,J)

(15) Continue for all modes

(16) PRINT TEMP2(I,J)

(17) TEMP3(I,J) = TEMP3(I,J) + TEMP2(I,J)

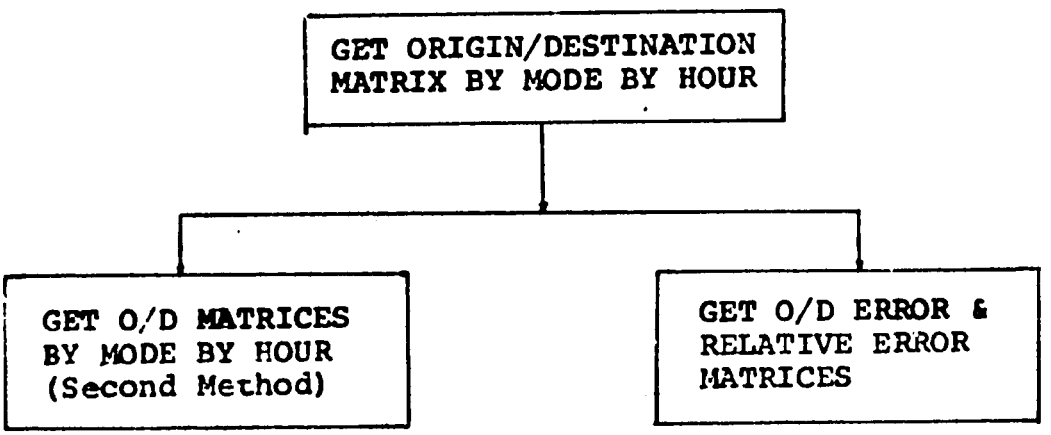
(18) Continue for all hours

(19) PRINT TEMP3(I.J)

Program Level 4

Name : HODS2MT

HODS2E



HODS2MT

HODS2E

I/P	O/P
O/D Pairs of all passengers HODF2MT HODF2T HODI2MT HODI2T	Get exact O/D matrices Get O/D error & relative error matrices

(4) Origin/Destination Matrix by Hour on All Modes (Exact Method)

Name : HET18

Purpose : To find O/D matrices by hour for the whole passengers (2nd method). There are three requirements.

Requirement: O/D Matrix by Hour for all MODES

O/D Matrix by Hour for all Hours for all Modes (Result)

The relative error O/D matrix.

D / O	xxxxx		xxxxx
xxxxx			
xxxxx			

I/P : O/D pairs of all passengers.

Compute : 1) New O/D matrix = matrix generated by this method

- corresponding matrix generated in T17.

2) Error in method 1) = Result matrix - Result matrix (1st method).

Field Utilization: (1,2,4,9,12).

Procedure:

1. D4(I,J) = 0
2. Select hour I
3. Select Mode M
4. Select Line L
5. Find O/D matrix for each line. D1(I,J)

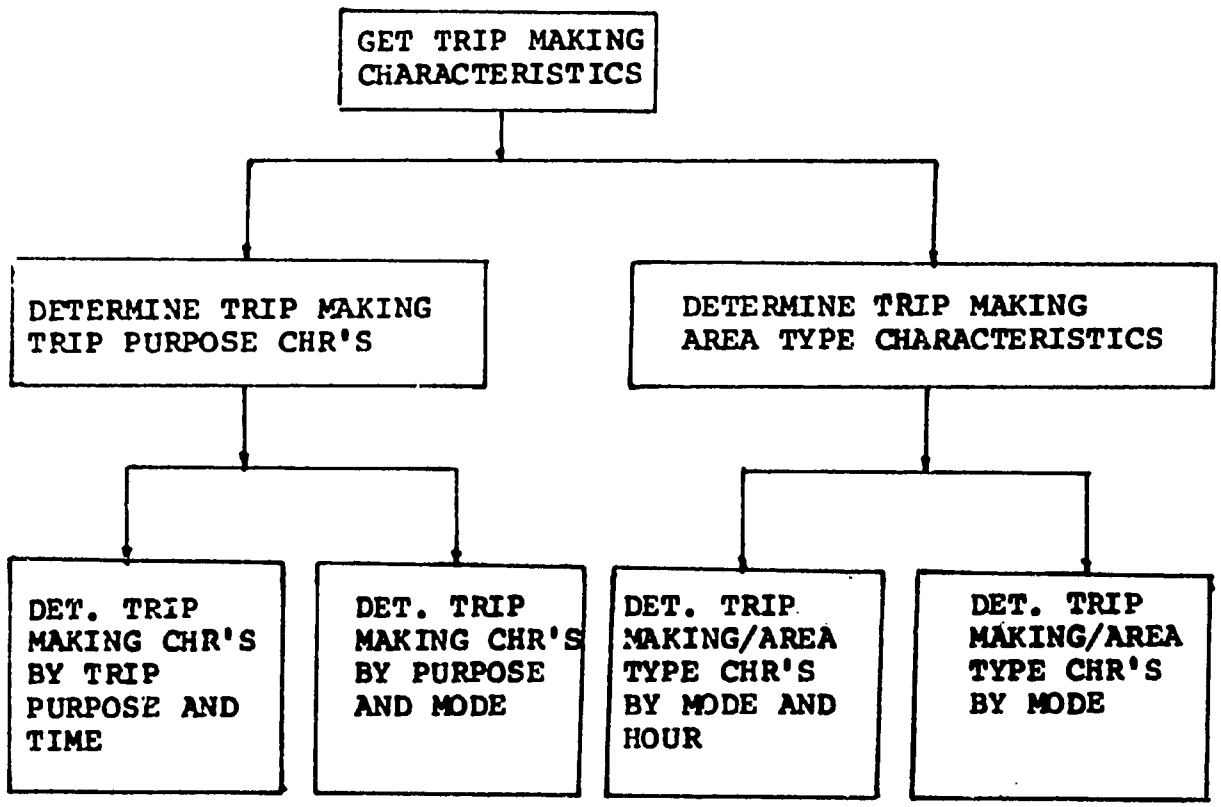
$$d1_{i,j} = d1_{i,j} + 1$$

6. Continue for all passengers of the same line
7. D2(I,J) = D2(I,J) + D1(I,J)*EF
8. Continue for all lines (is it of the same mode ??)
9. NTEM(I,J) = D2(I,J) - TEMP1(I,J) (Step 12, Table 17)

   Error (I,J) = NTEM(I,J)-TEMP7(I,J) (from Table 7)
10. D3(I,J) = D3(I,J) + D2(I,J)
11. Print NTEM(I,J), ERROR(I,J)
12. Continue for all modes
13. NTEMI(I,J) = D3(I,J)-TEMP2(I,J) (from Step 16, Table 17)

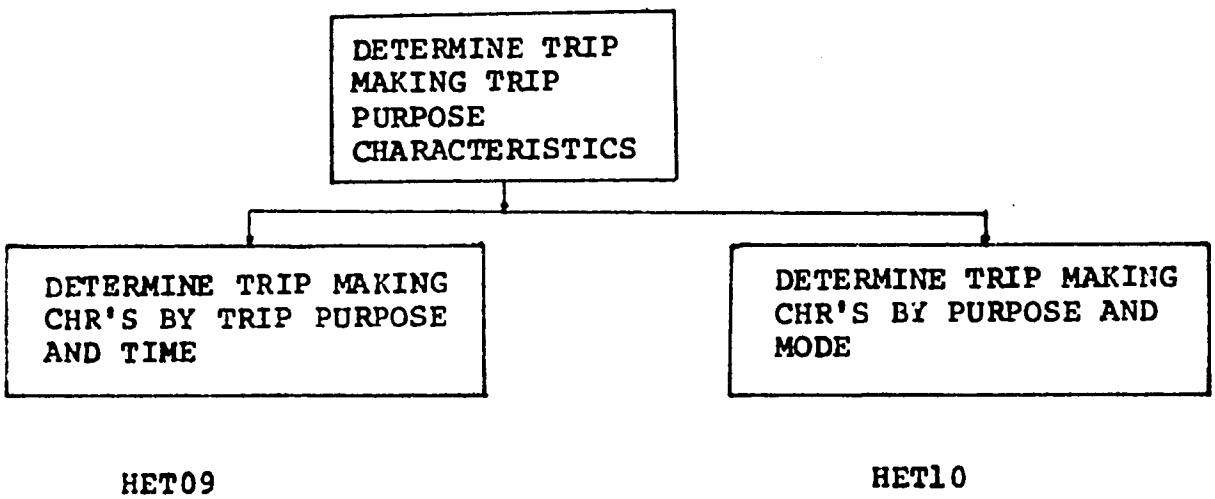
    ERROR(I,J) = NTEMI(I,J)-TEMP8(I,J) (from Table 8)
14. Print NTEMI, ERROR1
15. NTEM2 = NTEM2 + NTEM1
16. Continue for all hours
17. RESULT = NTEM2(I,J)
18. Print RESULT
19. Calculate ERROR2 = RESULT- Htemp
20. RERROR = ERROR/RESULT
21. Print RERROR

D.II.6 TRIP MAKING CHARACTERISTICS



Program Level 1

Name : HNTP2MST



INPUT	PROCESS	OUTPUT
For each trip: Purpose (O & D) Sex Time	Calculate the No. of trips by time of the day (or by mode) for each trip purpose Percentage of trips by time of the day (or by mode) for each trip purpose Percentage of trips by trip purpose for each hour (or for each mode)	Trip making characteristics by trip purpose and time Trip making characteristics by trip purpose by mode Calculate the above characteristics by sex

MODULE LEVEL

There are two modules for the determination of the trip making/trip purpose characteristics. These two modules are:

(1) Trip making by trip purpose by time, and

(2) Trip making by trip purpose by mode.

(1) Trip Making by Trip Purpose and Time

Name : HET09

Purpose : To generate a table for all lines and modes giving trip purpose by time of the day. There are three requirements.

Requirement: a) Number of trips by time of the day for each trip purpose.

b) Percentage of trips by time of day for each trip purpose.

c) Percentage of trips by trip purpose for each hour.

Time	Sex	Trip purpose				Total
		Home/Work	Work/Home	Home/Educ.		
0600-0700	M					
	F					
	Σ					
0700-0800	M					
	F					
	Σ					

Note: Three of the above tables will be given.

I/P : Trip purpose from/to

No. of passengers for each hour and their sex.

Record/Utilization: Fields (4,6,7,10).

Calculate:

No. of trips = $M_p + F_p$ & total for (9-a)

$$\text{Percentage}_b = \frac{\text{No. of passengers for certain trip purpose}}{\text{Total No. of passen. for certain time interval}}$$

$$\text{Percentage}_c = \frac{\text{No. of passengers for certain trip purpose}}{\text{Total No. of passengers for the same trip purpose}}$$

<u>Procedure:</u> Read previously generated number of trips or for all modes for the same time interval read trip purpose of each passenger and update the corresponding cell.

(2) <u>Trip Making by Mode and Purpose</u>

Name : HET10

Purpose : To generate summary tables from all lines and hours giving the mode by purpose.

Requirement: a) Number of trips by mode & trip purpose.

b) Percentage of trips by mode for each trip purpose.

c) Percentage of trips by trip purpose for each mode.

Mode	Sex	Trip purpose				Total
		Home/Work	Work/Home	Home/Educ.		
Bus	M					
	F					
	Σ					
Tram	M					
	F					
	Σ					
Total						

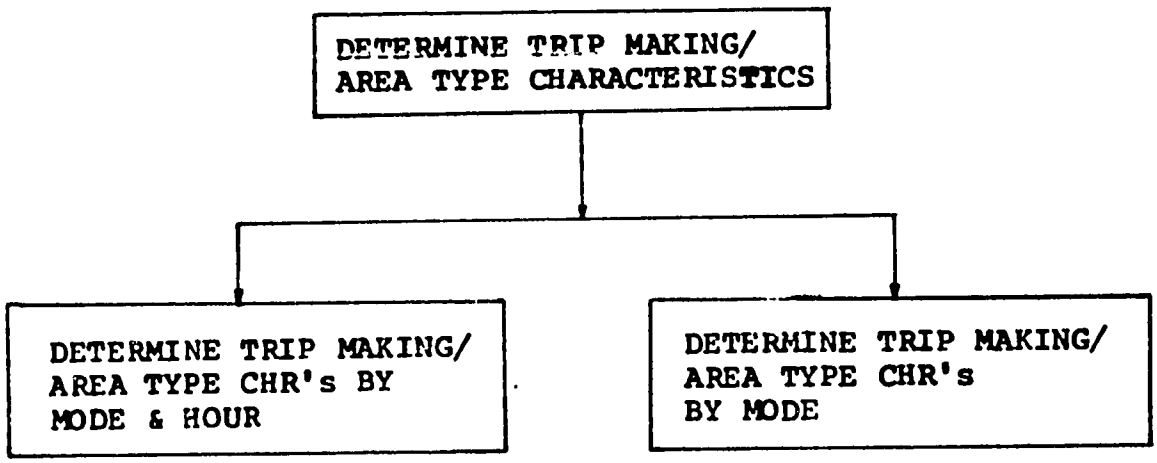
I/P : Same as in HET09

Record/Utilization: (1,6,7,10)

Calculate :
Procedure : Same as HET09

PROGRAM LEVEL 1

Name : HNTAT2TM



INPUT	PROCESS	OUTPUT
For each trip: Purpose Sex Mode	Calculate the No. of trips by mode and O/D area type for each hour (and for the whole survey period) Percentage of trips by mode for each O/D area type for each hour (and for the whole survey period) Percentage of trips by O/D area type for each mode for each hour (and for the whole survey period)	Tables indicating the kind of P.T. trips according to O/D area types

MODULE LEVEL

There are two modules which compute and process the trip making/area type characteristics. The first module (HET11) determines the trip making area type characteristics by mode for each hour of the survey period, while the second module (HET12) determines the same characteristic for the whole survey period.

(3) Trip Making by Mode, Area Type and Hour

Name : HET11

Purpose : To indicate the kind of PT trips according to the origin and destination area types. Three tables will be generated.

Requirement: a) Number of trips by Mode and the O/D area type.

b) Percentage of trips by Mode for each O/D area type.

c) Percentage of trips by O/D area type for each Mode.

TIME: 00 - 00

Mode	D/D	ED/ED	D/ED	D/U	ED/U	U/U	D/R	ED/R	U/R	R/R	Total
Bus											
Tram											
Total											

where: D (Down Town); ED (Enlarged Down Town); U (Urban); R (Rural).

Note: D is obtained by checking <9>, <12> (the first , 2nd, and 3rd digits.

I/P : The number of trips for each cell are generated during HET07 program by generating an array containing the kind of trips for each area type for each mode.

<u>or</u> during the processing of the rest of the programs (11 - 16).

Record/Utilization: (1,4,9,12).

Procedure: *For each mode an array is generated that consist of 10 elements, each one representing a counter which is updated according to the O/D in phase of HET07.

$$*\text{Total}_c = \sum_{\text{modes}} \text{No. of trips}$$

$$\text{Total}_b = \sum_{\text{area type}} \text{No. of trips}$$

*Get percentage.

(4) <u>Trip Making by Mode, Area Type and for the Whole Survey Period</u>

Name : HET12

Purpose: To find public transport trips by mode and area type for all the survey period. Three tables were generated.

Requirement: a) Number of trips by mode and O/D area type for the whole survey.

b) Percentage of trips by mode for each O/D area type for the whole survey period.

c) Percentage of trips by O/D area type for each mode for the whole survey period.

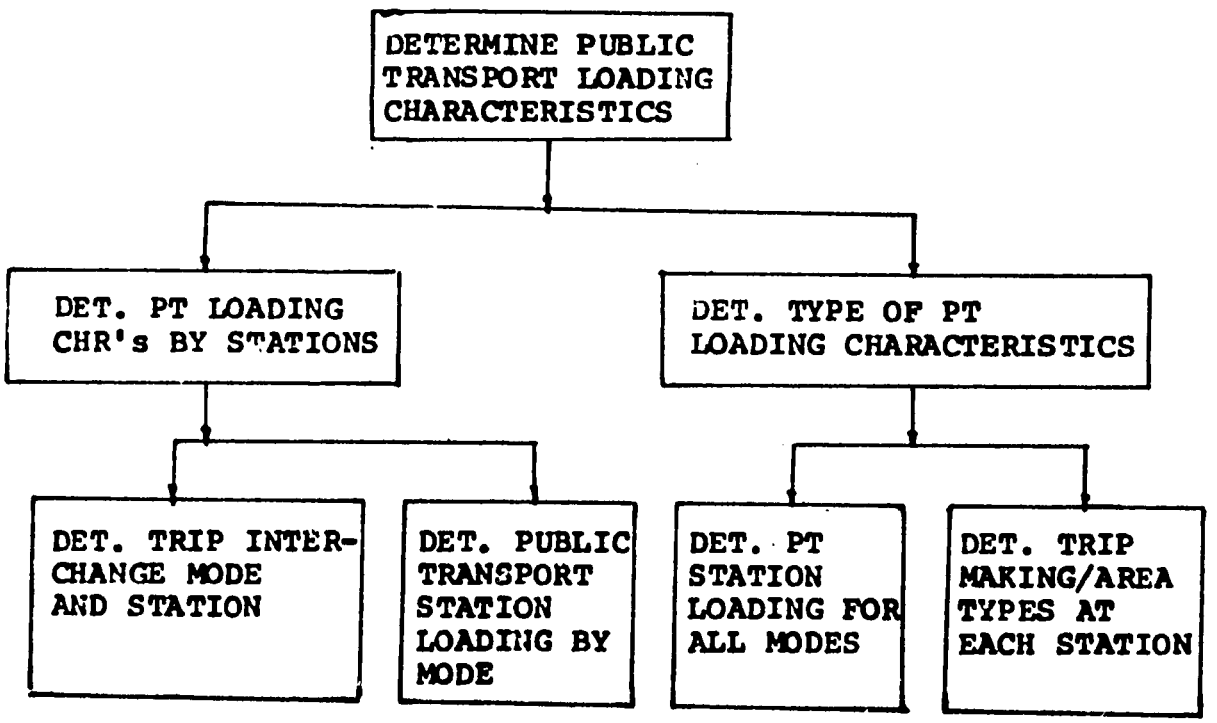
Mode	Area type										Total
	D/D	ED/ED	D/ED	D/U	ED/U	U/U	D/R	ED/R	U/R	R/R	
Bus											
Tram											
Total											

I/P : Same as HET11

Record/Utilization: (1,9,12)

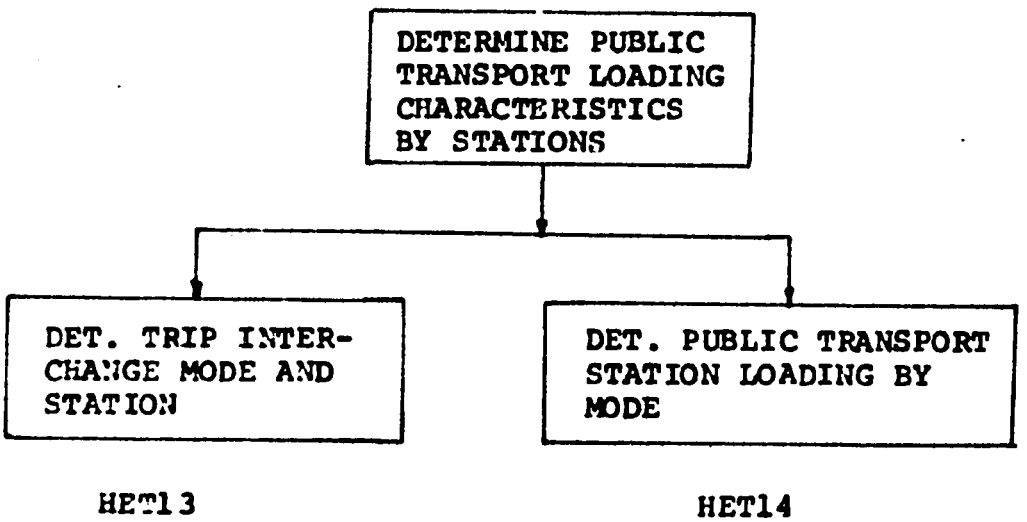
Procedure: For each mode an array is generated consisting of 10 elements, each one is a cell, in which the values of the corresponding elements in the generated arrays in HET11, are added.

D .II.7 PUBLIC TRANSPORT LOADING CHARACTERISTICS



PROGRAM LEVEL 1

Name : HNIT2MS



INPUT	PROCESS	OUTPUT
For each trip: Mode Station (O & D & I)	Calculate the No. of trips at each station according to: a) the interchanged trips, and b) the mode of interchange	No. of broken trips between modes by stations & percentages PT station loading trips (originating, destinating or inter-changing) by mode

(1) Trip Interchange by Mode and Station

Name : HET13

Purpose: Tables describing the interchange between modes by stations. There are three requirements.

Requirements: a) Number of broken trips between modes by stations for all survey period.

b) Percentage of broken trips between modes for each station.

c) Percentage of broken trips on the stations for each mode .

Station / Mode	Tahrir	Ramsis	Ataba ...	Others	Total
Bus-Bus Percentage	xxxxx	xxxxx		xxxxx	xxxxxx 100%
Bus-Tram Percentage					
15					
Total Percentage	xxxxx 100%	xxxxx 100%			

Note: This table can be divided into two tables.

I/P : The number of passengers who make interchanges, and the mode of interchange.
The corresponding place of interchange.
The number of passengers who make interchanges for a particular mode.

Calculate:

$$\text{Percentage} = \frac{\text{No. of passengers interchanging mode at each station}}{\text{Total No. of interchanging passengers for that mode}}$$

Procedure: (1) Select mode.

(2) Find passengers who make interchanges check <13>, if <13> ≠ 1 go to (3) otherwise select another record.

(3) Select mode <14>, station <15>; (1-14) Mode (i) 15 j.

(4) Update a_{ij}.

(5) Continue.

(2) <u>Public Transport Station Loading by Mode</u>

Name : HET14

Purpose: To find all interchanges and passenger loads at any PT station. The table gives public transport trips originating from or desinated to or having interchanges at stations by mode for the whole survey period.

Requirements: Trips originating, destinating or interchanging at PT stations by mode for the whole survey period.

MODE ...

Station	Trips originating		Trips destinated		Interchange		Total
Tahrir	xxxxx	---%	xxxxx	----%	xxxxx	---%	
Ramsis							
99 Stations							
Others							

I/P : The origin station.

The destination station.

The interchanging station.

Record/Utilization: Fields (1,8,11,15).

Procedure: For each mode check the following:

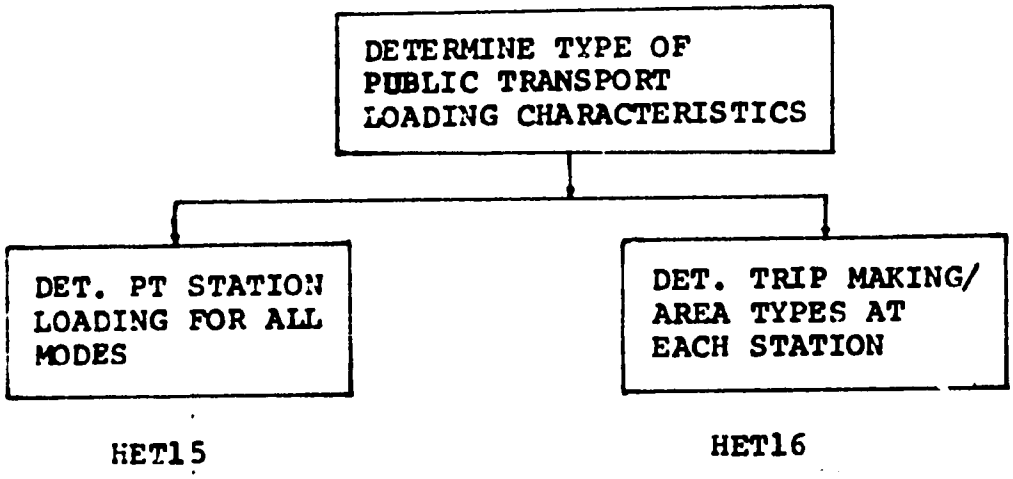
<8> update the origin. a_{i1} i = 8

<11> " " dest. a_{i2} i = 11

<15> " " inter-change. a_{i3} i = 15

PROGRAM LEVEL 2

Name : HNTAT2S



INPUT	PROCESS	OUTPUT
For each trip: Station (O & D & I) Area type	Calculate the No. of trips at each station for: 1) each area type 2) for all modes	PT station loading trips (originating, destinating, or interchanging) for all modes PT station loading by area types

MODULE LEVEL

There are two modules, which calculate and process the loading characteristic types at each stations. The first module (HET15) considers the determination of PT station loading for all modes. On the other hand, the other module (HET16) determines the number of PT trips at each station for the different area types for all modes.

(3) Public Transport Station Loading for all Modes

Name : HET15

Purpose: Same as in HET14, but it contains the summation for all modes.

Requirement : Trips originating from or destinated to or interchanging at PT stations (all modes and for whole survey period).

Station	Trip originating	Trip destination	Interchange	Total
Tahrir	xxxxx ----%	xxxxx ----%	xxxxx ---%	
99 Stations				
Others				

I/P : Same as HET14

or the O/P from all HET15 O/P's.

(4) Trip Making by Area Type and Station

Name : HET16

Purpose : It describes the interchange station and the O/D area type for the total survey period. Three tables are generated.

Requirement : a) No. of trips for O/D area type at each station.

b) Percentage of trips for O/D area type at each station.

c) Percentage of trips for each O/D area type on all PT stations.

ALL MODES

	D/D	D/ED	ED/ED	R/R	Total
El Tahrir	xxxxx	xxxxx			xxxxx
El Ataba					
99 Stations					
Others					
Total					

I/P : During the processing of HET14, HET15 this table is generated; for each cell the corresponding cell is updated.

Record/Utilization: (9,12,15).

Field / Utilization.

Program Name	Module Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Remarks.
HPTP2MLT	HET02	*	*		*														*	
	HET03	*	*		*														*	
	HET04	*	*		*	*								*						
	HET05	*	*		*	*								*						
HET2MLT	HET06																		*	
HODF2MT	HET07	*	*		*					*			*							
HODF2T	HET08	*	*		*					*			*							
HODI2MT	HET17		*							*			*	*						
HODS2MT	HET18	*	*		*					*			*							
HNTP2MST	HET09				*		*	*			*									
	HET10	*					*	*			*									
HNTAT2TM	HET11	*			*					*			*							
	HET12	*								*			*							
HNIT2MS	HET13	*							*			*		*	*	*				
	HET14	*							*			*				*				
HNTAT2S	HET15								*			*				*				
	HET16									*			*			*				

CHAPTER E

DATA PROCESSING

TABLE OF CONTENTS

I. INTRODUCTION

II. DIFFERENT STAGES OF DATA PROCESSING IMPLEMENTATION

II.1 Designing the System

II.2 Terms of Reference

II.3 Evaluation of Different Proposals

II.4 Implementation Phase

a) Validation Processes

b) Programming Processes

II.5 Preparation of Test Data

a) Validation of Test Data

b) Program Testing

II.6 System Integration

THE DATA PROCESSING REPORT

E.1 *INTRODUCTION*

This chapter describes the different stages of the implementation procedure which were undertaken after the development of the system design.

All computer centers in Cairo and Alexandria were invited to bid for the implementation of this system. The system design associated with the reference items were sent to all these centers, and different interviews were carried out by our representative Eng. M. Hisham El Sherif, who has been responsible for the Data Processing system design and preparation, analysis, design and supervision of the implementation processes. Consequently, an evaluation to all the received proposals, according to the selection criteria which he had set, was carried out and a computer center was chosen to carry out the job.

The implementation phase was then carried out. It consists of two phases:

(a) The data preparation phase, to create the master file of public transport survey, and

(b) The programming, which represents the implementation of different procedures, predescribed in the system design.

These two phases include the preparation of the test data, and the manual calculation of different programming outputs

according to these test data. Then, the system integration was carried out, after checking the results produced by the module level, and the program level.

Finally, a test for the whole system was made to prove the validity of the system results, then, the actual run was carried out. This chapter, represents the policy followed, and the practical experience associated with the implementation of the Public Transport Survey.

II. DIFFERENT STAGES OF DATA PROCESSING IMPLEMENTATION

E.II.1 *Designing the System*

The system design was carried out through three main phases: system analysis, system specification, and the functional design stage. Each of these phases was described in detail in the previous chapters.

E.II.2 *Terms of Reference*

The following represent the reference items, sent to all computer centers in the proposal request stage (bidding phase):

Public Transport Research Project

There are certain factors that characterize the implementation of the public transport data processing system, the majority of which had better be identified in the proposal.

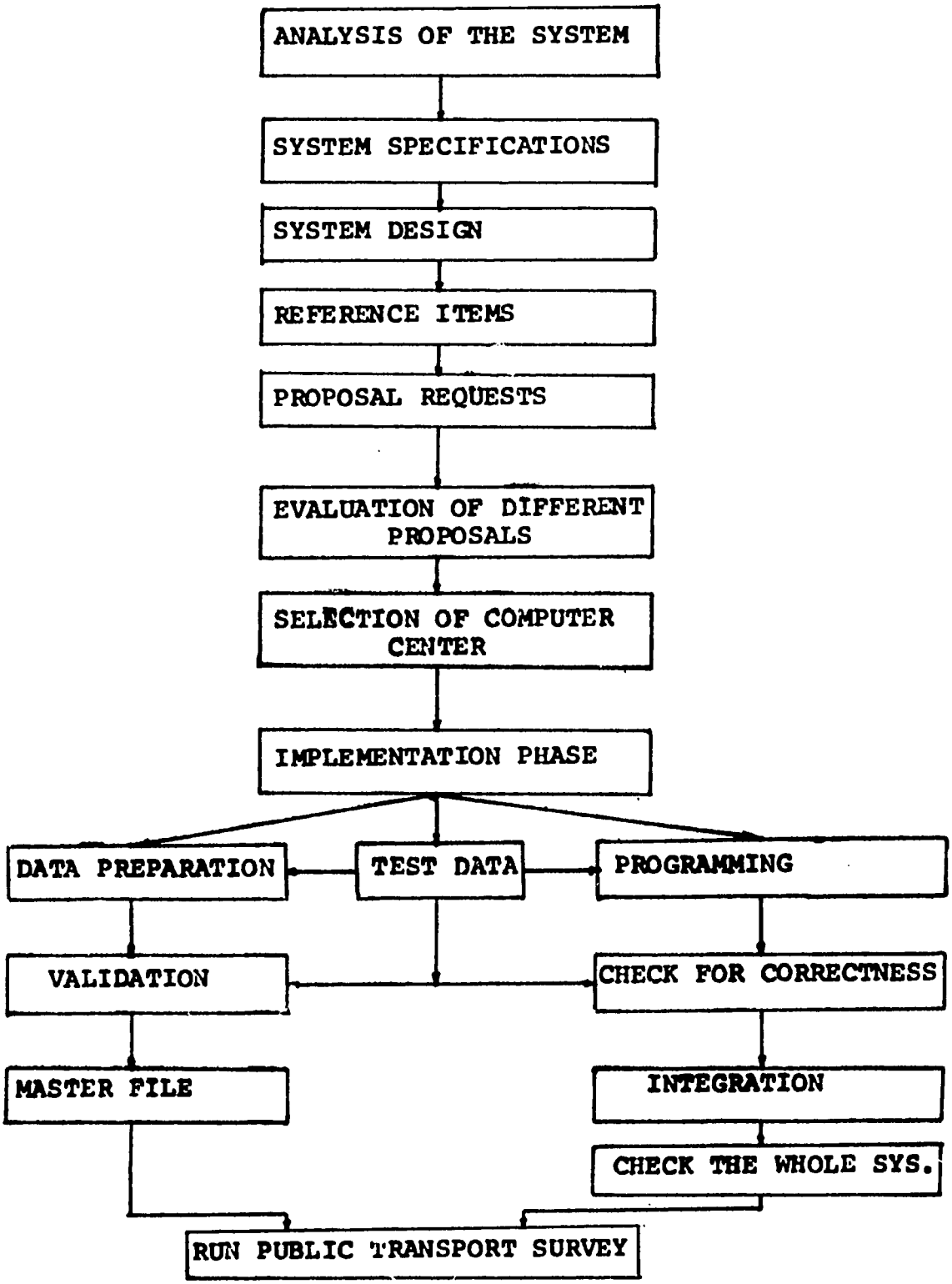


Fig. E.1 Public Transport Data Processing Implementation Procedure.

Consequently, the MOT/CU (Ministry of Transport/Cairo University) ask different parties to make the following into consideration:

(1) The second party will be responsible for the process of data preparation either on punched cards or magnetic tapes. Moreover, he will insure the correctness of the data, (i.e. he will be responsible for the validation and verification of the data at no additional charges).

(2) The second party will deliver all programs and the results of the survey according to the specification defined in the system design or any further amendments specified by the MOT/CU program, on or before November 1, 1978.

(3) The second party is responsible for preparing all the 18 programs that comprise the package and the control program, which has all the control points and checks all logical relations specified in the system design and control the usage of the package, and any further amendments notified by the user.

(4) The second party will be responsible for the preparation of test data and tests for execution no later than October 10th, 1978. Then, the results of this execution should be reviewed, approved by MOT/CU persons and returned together with any additional comments to the second party no later than October 15, 1978.

(5) The programming process, in our point of view, includes writing the program, compiling it, preparing the test data and executing the program using these test data and any enhancement required by the technical group during the acceptance period.

(6) The MOT/CU program will not be responsible for the results of any problem related to the availability or the capability of the second party's system.

(7) The second party will deliver the necessary documentation for all programs which consist of (program name and calling, data structure, input, output, procedure used, detailed flow-chart and the running statistics).

(8) All programs should be written in ANS COBOL. On the contrary, the programs should be written so that they will be compatible to any m/c uses a compiler of the same high level language.

(9) All technical questions related to the data processing implementation of this survey will be answered by Eng. Mohamed Hisham El Sherif, who is responsible for the preparation, analysis, design and supervision of the implementation process.

(10) The system design associated with this contract consists of pages divided in three sections:

Section I describes the tabulation requirements.

Section II describes the coding system and all logical relations needed for the data verification stage.

Section III Glossary.

(11) The output format of any program should be made according to the required forms specified in the additional sheets (output forms).

(12) It is to be noted that the Ministry of Transport, Cairo University program is a research project which has different phases, and it will be carried out for another two years.

Please, fill in the appropriate place, the cost figure and time required for carrying out each item.

Serial	Item	Item cost	Total cost	Time required	Comment
I	Data preparation & verification				
	a) Punched cards	Mills./card			
	b) Mag tape	Mills./ coded record			
	Select one (a or b)				According to the facilities you have in your system.
II	Programming	a) L.E./hr.			
		b) L.E./ program			
	Select one (a or b)				
III	Execution	L.E./hr.			Please specify values for different core size.
IV	Additional requirements				
	a) Disc	a) per unit			
	b) Meg tape	b) " "			
V	Others (please specify)				
		TOTAL			

F.II.3 EVALUATION OF DIFFERENT PROPOSALS

All computer centers in Cairo and Alexandria were asked to submit their proposals for the implementation of the Public Transport System. By implementation, it was meant the preparation of data, whether recording it on magnetic tapes, or punching it on cards, and the programming implementation for all programs. The selection criteria for evaluation of these different proposals was set to contain the following:

- Cost,
- Time,
- Efficiency & accuracy,
- Compatibility with other systems,
- Availability,
- Experience,
- Contracting ability, and
- Amendment agreement and modifications.

In addition, different interviews were carried out with these computer centers managers, by Eng. Hisham El Sherif, who explained the system, and answered any of the related questions, moreover, he carried out with them the negotiation process. Afterwards, all proposals were submitted and the evaluation process started. Consequently, technical evaluation committee from all members of CU team headed by Prof. Dr. M. Abdel Rahman El Hawary, Prof. of Transport Planning and Principal Supervisor of Cairo University/MIT TAP (Transportation Project). On the other hand, Eng. Abdel All Salmawi, Director of the Transport Planning Authority (TPA) was the

head of the Final Evaluation and Selection Committee.

Besides, Members of the evaluation committee were:

Prof. Dr. Farouk Abdel Bary	Assist. Prof., Cairo University
Dr. Mohamed Owais	Lecturer, Assiut University
Dr. Tarek El Reedy, and	" , Alexandria University
Eng. M. Hisham El Sherif	System Engineer

The decision was taken to select the lowest cost governmental center's offer, which had been at L.E.11165 subjected to the actual volume of data (it was agreed that the price per card (two records) is 3 piasters). The figure supplied was for 200,000 cards, while the actual number of cards is (281843 record) or 140922 cards, which would cause the reduction in the project cost by a proportional amount.

The given table shows the final evaluation weighting figure from the 10 computer centers, which supplied their offers:

	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10
x1	2.77	2.17	2.308				5.45		3.63	8.7
x2		3.81								
x3		3.67	3.708							
x4				2.45						
x5	5.7	5.1	5.138	5.2	7.8		8.23		6.46	8.3
x6						9.92				
x7										
x8	5.422	4.822	4.860				8.002		6.18	8.02
x9									5.41	
x10										2.52

where x_i represents the ith computer center.

In fact, the decision was taken to select the NCC, since it was the lowest cost offer among all governmental centers that entered the bid. Letters of acceptances from both parties, were sent, then the implementation phase started.

E.II.4 IMPLEMENTATION PHASE

As discussed earlier, the implementation pahse consists of the data preparation process and the programming process.

The rules, procedures and specifications determined in the system design were explained in detail to the programming and data recording personnel. Any further consultation was the responsibility of the system engineer in charge, Eng. Hisham El Sherif.

Furthermore, the implementation stages were backed up by two teams, one was responsible for the detection, and correction of the invlid data and the other team was responsible for correcting the wrong output results.

The number of work man hours in the validation team was hours, while the number of work man hours in the other team was . The system of work of both teams, was designed, so that to minimize the time and cost and to maximize the accuracy and precision.

E.II.4.1 *The Validation Process*

The calculation of the number of coded records, which had been sent to be recorded, showed that the number of these records was 281843. On the other hand, the number of the actual valid

records, after certain validation processes, has reached the figure 280732. This has been achieved through ten revision processes, conducted by the team responsible for the validation process.

The progress in the creation of the master, through different stages of validation, is explained in Table 1, which shows the number of each error type in each validation phase and the total number of records. It is to be noted that the master file contains no error of Type P or Type S, they have been all corrected, and there are 1111 Error Type A (address error) in the whole master file, all of which belong to the absence of information about the addresses of these interviewed passengers.

Table 1

The Progress of the Validation Process

Date	Valid Records	Error Type				Invalid records	Total No. of records
		P	S	A	G		
1/11/78	144713	10929	31815	772	7068	43516	188229
5/11/78	56026	1276	11524	245	32605	13045	69071
17/12/78	2784	240	136	10	0	386	3170
8/1/79	56951	1773	8013	305	3538	10091	67042
9/1/79	270434	46	320	1221	15085	1587	272021
28/1/79	8930	894	2895	46	0	3835	12765
29/1/79	10003	894	1822	46	0	2762	12765
3/2/79	11266	894	559	46	0	1499	12765
11/2/79	280732	0	0	1111	7974	1111	281843

E.II.4.2 *Programming Process*

The National Computing Center followed a policy of distributing the work among different programers. Therefore, continuous consultation of the implementation of all programming activities, were given. At the same time, test data were prepared to check the correctness of the algorithms, and the programs. In fact, the efficiency and availability of the computer at NCC, was not that good, which can be explained by the time devoted in the implementation of this project, which exceeds four months. However, one should not forget the sincere and continuous efforts done by:

Mrs. Hikmat Mahmoud Hassanein

Mr. El Shahat Faheim Hikal, and

Mr. Adel Mohamed Tewfik.

The senior programmers at the NCC, towards the implementation of this project, together with their team of programmers.

Therefore, one can summarize this process as follows:

CU/MIT Team Activity	*NCC Activity*
Design	-
Preparation of Test Data & Results of Test Data	-
Explanation of the System	Studying the System
Consultation	Program Writing
Checking the Correctness	Correcting
Analysis of Results	Implementation

In fact, the system consists of 14 programs, and control program. One for the validation phase, and the rest for the tabulation requirements. The following represent the names and requirements of the MACRO's required to operate any of tabulation requirements:

Phase I:

Name	Purpose	Output
HPT1	Validation	PT1-OUT1 (O/P of validation)

Phase II:

Name	Purpose	Output
HPTP2MLT	Find the No. of PT Passengers	Tables 2,3,4
HPIP2MT	Find No. of Percentage of interchange	Passenger 5
HEF2MLT	Get sample size ration & enlargement	Factor 6
HNTP2MST	Determine trip making by purpose	9,10
HNTAT2TM	Determine trip making by area	Type 11,12
HNTAT2S	Determine PT loading/ unloading	13,14
HODF2MT	" " " "	15,16
HODT2T	Get origin/destination matrix by mode by hour	7
HODI2MT	Get origin/destination matrix by hour	8
HODI2T	Get origin/destination of interchange mode/hour	17 (A)

HODS2MT	Get origin/destination of interchange mode/hour	17
HODS2E	" " " (Exact method)	18 (A)
	Get origin/destination Error & Relative error matrix	18

For each of the previous MACROS set operating instructions was written, and the actual requirements of each one is explained in detail in the User Manual and Data Processing Report.

E.II.5 TEST DATA

In order to check the validity and correctness of the system at the macro level as well as the micro level, a set of test data was prepared. The sample test set consists of about 600 records, normally selected from five modes: Bus, Tram, Trolly, Metro, and Railway. The policy of selection was to select about 10 records from each line from 5 hours of the survey, i.e. two records/line per hour, or to select these 10 records randomly from any two hours. Therefore, a selection of 60 lines from the actual data, was made, thus forming, the sample test data.

(a) Validation of Test Data

A check for the validation of test data, was made and the nonvalid records were excluded from the sample test. This reduced the sample test data to 456 records, a description of which is

made in Appendix ( ) and it is also stored in a file for checking purposes.

(b) Program Testing

Based upon the test data, all outputs of the system were manually calculated in order to check the correctness of the different programs. The result of this test is shown in Appendix ( ). Test data of the users manual, which can be used to check the system program correctness is in future use. In fact, calculating these test results involves a tremendous and sincere work of a lot of people, that was achieved by the following team whose work is very much appreciated:

Eng. Nagih Ibrahim Moustafa,

Eng. Ibrahim El Senosi,

Eng. Housein El Sayed Hasan,

Eng. Ahmed Alaa El Din,

Eng. Amani El Kafafi,

Eng. Ibrahim Ek Disoki,

Eng. Farouk Ahmed El Twoni,

Eng. Ahmed Abad El Rashid, and

Eng. Wagied Yousef El Shahed.

E.II6 SYSTEM INTEGRATION

In this stage all program levels were completed, i.e. they were written, compiled, and checked with the test data, and correct outputs, were approved. After that, the integration of the whole system was made. Consequently, there exist two main phases:

HPT1 THE VALIDATION PHASE, and

HPT2 THE SYSTEM PROGRAM PHASE,

where HPT1, HPT2 are two macro's, one for each phase, the detailed description of each is described in the data processing report. In fact, HP2 comprises all programs the constitute the Public Transport Survey, examples of which are shown in Appendix II.

GLOSSARY

Area type	There are four area types depending on the location of each zone.
Destination	A place where trip ends.
Enlargement factor	It is the inverse of SSR.
Interchanging Passenger	A passenger who has to change mode/line to get from an origin to a destination.
Interchanging Station	A station where interchange between mode/line takes place.
Line	Vehicles of a certain mode following a pre-determined route.
Mode	Means of carrying passengers from an origin to a destination (buses, trams, etc...)
Origin	Place where trip starts.
O/D Pairs	It is the origin and destination of a passenger trip.
PT	Public transport.
Sample Size Ratio (SSR)	It is the ratio of the interviewed passengers to the total number of passengers using the line for certain sampling period.