Transportation Planning & Management

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Question No-01: What is planning; briefly describe the studies carried out in the scope of transportation planning strategies in their modeling with assumptions & limitations. Present your answer in the form of a formal technical report?

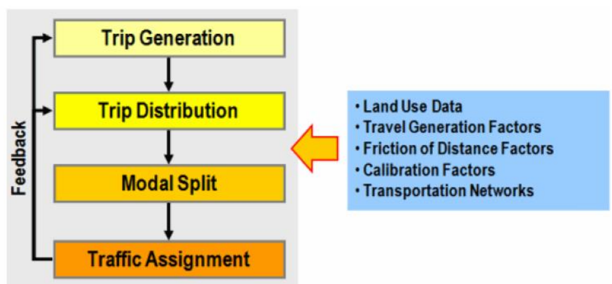
Answer:

Transportation planning:

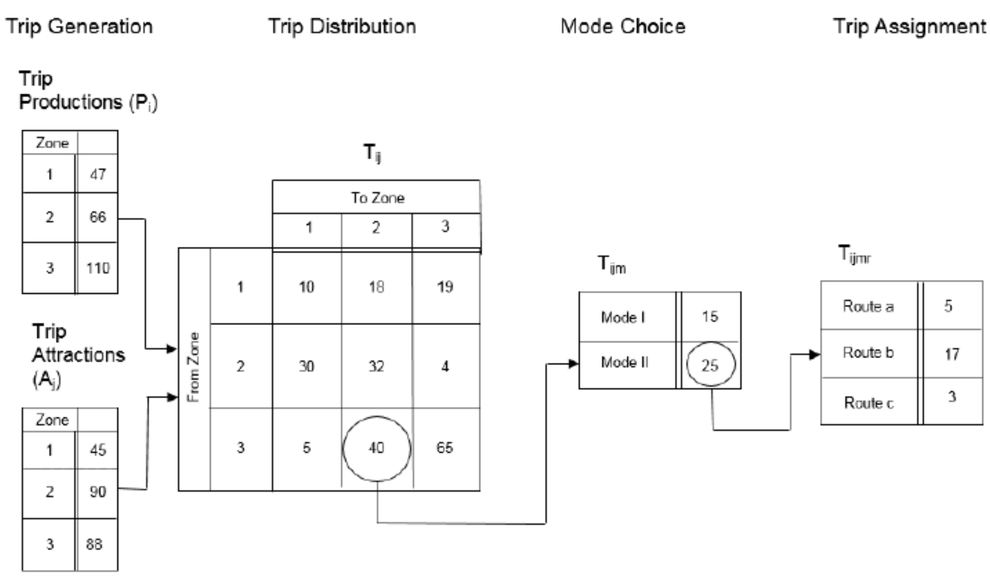
Transportation planning involves the decision-making process for potential improvements to a Community's roadway infrastructure. To aid in the decision-making process, several computer based and manual tools have been developed. Two of these key tools are:

a) Travel demand forecasting models for implementing the four-step urban planning process
b) Travel rate indices for providing congestion and delay information for a community.

Four Steps in Travel Modeling:



Overall (Matrix Manipulation) Process:



The Traditional Four Steps Transportation Modeling Using Simplified Transport Network: A Case Study of Dhaka City, Bangladesh

The 79 wards (the smallest electoral unit) of Dhaka City Corporation area have been selected as the study area. Then these 76 wards are divided into 10 zones known as TAZ (Traffic Analysis Zone).

Figure 1: Dhaka City Corporation (study area)

The above mentioned four steps is briefly explained as a case study as Annexure A.

Shortcomings:

Trip generation

- The factors of trip generation in the traditional approach are typically limited to zone or household attributes, and do not include attributes of travel modes (e.g., insensitivity to transit accessibility

- Trip generation is usually performed using linear regression , and this statistics technique is primarily considered as a “descriptive” and not a “predictive” technique, thus limiting the capabilities of this forecasting step.

- A number of listed trip purposes is limited . Trip purposes are limited to only six to eight trips purposes causing for example all shopping trips to be treated as same (e.g., going to a grocery store, going to a mall, etc.).

- The trip distribution phase is performed separately for each origin zone, thus limiting the holistic perspective on transportation demand.

- Some trips are estimated based on factors that are dependent on trips themselves (e.g. shopping-attracted trips are calculated as a function of retail employment, while the number of retail employee depend on shopping trips).

- Zone’s characteristics and relationships that dictate trip-generation are frequently assumed to be stable over the entire planning horizon.

- An important drawback is the lack of consideration for land use density in trip generation. This further relates to the issues of accessibility and omitting of non-motorized modes, neglecting the important relation between land-use policies and effects on walking/biking

Trip distribution

- A usual approach to trip distribution, using gravity models, although easy to understand and apply, suffers from serious drawbacks and limitations. One of the major issues is the assumption that average travel time would remain constant in the future as well as through the day (i.e. no consideration for peak hour congestion).

- Destination choice problem requires that spatial interaction models have a predefined set of alternative destinations to choose from. The behavioral dilemma results from the lack of knowledge of what the choice set actually is, or how is it different across individual travelers, and their different originating locations and trip purposes. The usual approach is to allow the access to all traffic zones (or all zones chosen by survey participants) to be in the choice set. Although this approach recognizes that more distant or less attractive zones will receive fewer trips, these are still unsupported assumptions for all possible trips – especially considering the effect on those choice sets by multi-destination trip chaining opportunities. As a consequence, the configuration of the gravity concept tends to overestimate the near trips and underestimate the far trips. Consider a simple example – assuming the constant travel time budgets, if road travel becomes faster, people will travel longer distances. This in turn adds to vehicle miles traveled, that relate to greater congestion.

Modal split

- One of the great drawbacks of modal split step is the often focus on auto driver, auto passenger, or transit passenger. This limited focus neglects other travel modes that can have a significant share (e.g., walking or biking). Not including non-motorized travel modes neglects the fact that walking frequently has larger mode share than transit, in medium-sized urban regions . The reasons for this situation could be found in the fact that, in practice, the main purpose of the model is to be used as a tool for capacity analysis of road network, analysis of the network development scenarios, or analysis of the public transport system, etc.

Modal split computations are made using empirical evidence or socioeconomic data. [10]. This frequently oversimplifies the decision-making of travelers, relating the choice of mode to be only the function of household income, without consideration of other factors. Even if the model considers factors such as travel time and cost characteristics, there is still a range of unconsidered factors (e.g., security, attractiveness, etc.). Furthermore, there is a general neglect for access time and walkability in transit utility calculation.

 In the utility functions for mode choice, time value is often assumed constant for all trip purposes, and throughout the entire day/week.

 Similarly to the drawback of trip distribution models, modal split models are also functionally equivalent to logit models. Consequently, they can be interpreted as a result of the “utility maximizing” choices of individual travelers

Traffic assignment

 Traditional traffic assignment models primarily represent urban networks with major streets and highways, without consideration for pedestrian areas or bike paths [9]. Similar as in the case of modal split, focus is on modeling of motorized travel modes. The reason might be because models are usually used for analysis of investment impacts in the network or system with high investment costs.

One of the major simplifications is also that all trips begin and end at a single point in a zone’s centroid.

 There is a discrepancy between trip forecasting, which is done on a daily basis, and traffic assignment, that is typically done for peak hour.

 There are issues with discretionary and off-peak travel activity modeling, since traditional models do not take into consideration the need to model both time of day and day within the week [12]. The overall percentage of non-work or non-peak trips can be even up to 78% of annual trips. In addition, further issues arise taking into consideration that many daily trip chains combine peak hour trips. This is especially important due to the relation to non-transportation control measures (e.g., staggered work hours), or the potential for mixed urban activity centers that encourage midday walk or paratransit for personal business.

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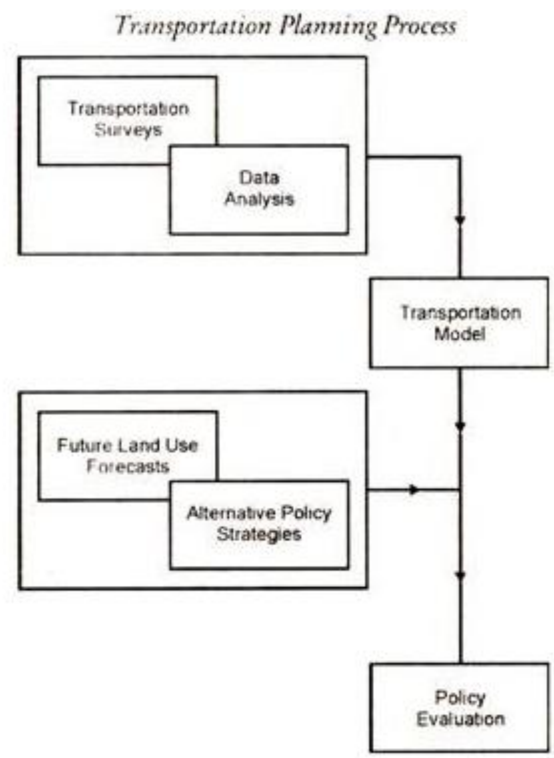
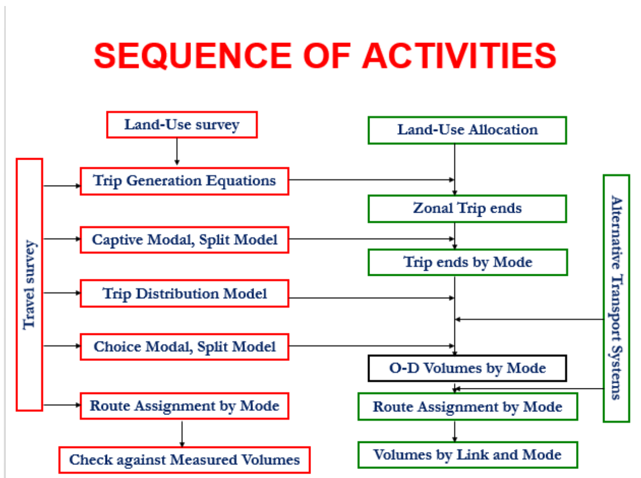
Question No-02: What activities are exercised in planning for a four step conventional transportation modeling, discuss in detail with reference to different zonal productions and attractions attributes?

Answer:

Following Figure shows the activities/Transportation planning process.





1. Collect travel information
2. Identify existing system performance levels
3. Estimate future travel demand
4. Forecast future system performance levels
5. Identify different alternative solutions

The four main stages of the transportation planning process are:

(i) Transportation survey, data collection and analysis;
(ii) Use of transportation model;
(iii) Future land use forecasts and alternative policy strategies; and
(iv) Policy evaluation.

Survey and Data Collection:

The entire planning process of transportation, may be local, regional or national, is based on survey and data collection. This includes all types of literature and data (both government and non-government) available on transportation, journey behavior patterns, nature and intensity of traffic, freight structure, cost and benefits, i.e., income, employment estimates, etc.
The comprehensive knowledge of traffic flows and patterns within a defined area is essential. In addition to traffic data, planners also require land use and population data for their study area. In this connection West Midlands Transportation Study (1968) provides a format, which is useful for transport survey and data collection.
The survey should be well defined and be divided in 'zones' so that origins and destinations of trips can be geographically monitored. The data collection regarding existing travel patterns is time consuming as well as a costly affair. It involves both 'roadside-interview' and 'home-interview'. The variables for both types of interviews are given in the

Home-Interview and Roadside-Interview Survey Variables

Home-Interview	
Trip data	— day and date of journey
	— origin address and time
	— destination address and time
	— journey purpose
	— mode of travel
	— ticket or parking cost
Household data	— number of persons, their age and sex composition and family relationships
	— economic activity status of persons and their occupations
	— vehicle ownership
	— tenure and property type
	— household income
Roadside-Interview	— day and date of journey, cordon crossing point
	— vehicle type and occupancy
	— origin and destination of journey
	— origin starting time
	— goods carried and their weight (commercial vehicle)

The details-of existing transport network are an important source of information. In some cases, a very detailed description of links and nodes in terms of vehicle speed, carriage-way width and nodal type is collected. Travel times and network characteristics of public transport networks are simultaneously collected. Finally, data processing should be done. When this has been completed, planners can begin their data analysis.

The Transportation Model:

The second stage of the transportation planning process is to use the collected data to build up a transportation model. This model is the key to predicting future travel demands and network needs and is derived in four recognised stages, i.e., trip generation, trip distribution, traffic assignment and model split.

Trip Generation:

The first stage of model building process is that of trip generation. Trips are made for a variety of purposes and for various land uses. For convenience, trips are often split into two groups:

(i) Home-based trips:
Such trips have one trip end at the home of the person making the trip, which may be either the origin or destination of the given trip.

(ii) Non-home-based trips:
These have neither origin nor destination trip-end at the home of the person making the trip.
This initial part of the transport model expresses trip-making relationships in a mathematical form so that ultimately we can calculate the total number of trips-ends originating from the defined survey zones.
Multiple regression technique are often used to calibrate a trip-generation model incorporating the above household variables. This model takes the following general form:
$Y = a + b1\ x1 + b2\ x2 + \ldots. + bn\ xn$
where Y = number of trips (by mode and purpose) generated in a given zone
a = constant term
b1…bn = regression coefficients relating to independent variables (e.g. household income, car-owner- ship, house-hold structure, etc.)

New estimates of the independent variables are made and inserted into the equation in order to estimate future levels of trips generation. Multiple regression analysis, therefore, provides a suitable method for estimating future trip levels. Its main disadvantage, however, is that the original regression estimates have been established at a given point in time and are expected to remain constant over the period for which the forecast is required.
Consequently, a more recent approach to trip generation has been to use a technique known as 'category analysis'. The trip-generation stage of the planning process estimates the total number of trips originating in the survey area at one or more future dates.

Trip Distribution:

This is the next stage in the transportation model, it involves on analysis of trips between zones. Lane (1971) states the function of this stage of the model:
It is the function of trip distribution to calculate the number of trips between one zone and another, given the previously determined numbers of trip ends in each zone together with further information on the transport facilities available between these zones.

For example, given that in zone I, gi trip ends are generated and that in zone j, ai trip ends are attracted, it is the purpose of the trip distribution model to determine the number of trips (tij) which would go from zone i to zone j. That is, the trip distribution model calculates the proportion of trip ends generated in zone i which would travel between i and j and so take up a certain proportion of the available attractions in zone j.
Overall, the distribution stage of the transportation model has received considerable attention and has been the main source of research over the last quarter of a century. The earliest attempts to

produce a future trip distribution matrix used simple growth factor methods, taking the following general form:
$Tij = tjj \times E$
where Tij = future flow from zone i to zone j
tjj = base year flow from zone i to zone j
E = agreed expansion factor
The value of the expansion factor can take various forms. For example, Bevis (1956) put forward the idea of a crude expansion factor of the following format:
$E=1/2\ (Ti/ti \times Tj/tj\ )$
Where Tij= future origin zone
ti = base year origins zone i ,
Tj = future destinations zone j,
tj = base year destinations zone j.

This simple model was further refined, but growth-factor techniques are now rarely used. The method is a crude one and has been superseded largely because it does not attempt to measure any future resistance to travel between zones. For this reason, synthetic models tend to be widely used to model trip distribution. The trip-distribution stage of the transport model has received much attention and has been the source of many new developments.

Traffic Assignment:

The third stage of the modelling process is that of traffic assignment, its aim being to stimulate route choice through a defined transport network. Traffic assignment may be considered in two parts.
First, it is necessary to define the transport network and determine criteria for route choice through the network.

Second, using the inter-zonal trip matrix as the input data, trips are assigned to this network.
When future trip levels are assigned it is possible to assess deficiencies in the existing transport network and so determine a list of construction priorities. Network description refers to the process where the highway network is broken down into links and nodes. For each link, data is required on its length, road type, vehicle travel time and traffic capacity. When coding the road network, links are usually identified by the node numbers at each of its ends. In addition to such route-intersection nodes, zone-centroid nodes are also defined. In the assignment process, all traffic originating in a particular traffic zone is assumed to be loaded on to the network at this latter type of node.
The early transportation studies used manual assignment techniques, but with the universal use of computer analysis, the transport network can be specified to the computer in a most detailed manner. Special data collection surveys (especially of journey times) are usually needed to provide this network specification information.

For deriving minimum route paths through the network, it is normally assumed that travellers choose the path, which minimises travel time. This applies for both private and public transport journeys. Travel time has been used in most transportation studies although it is usually used as an approximation for minimising the travel costs of a journey.

A more recent and more realistic assignment procedure is that of capacity restraint. This may be used, with or without diversion curves, for assignments to road and public transport networks. After the initial assignment to the given network, new travel times are calculated for each link. New minimum path trees are then calculated and the assignment procedure reiterated. Further reiterations may follow until most or all of the future traffic volume has been assigned to the network.

This type of procedure has tended to supersede other assignment techniques and has been used in most of the second-generation transportation studies. The assignment stage of the transportation model therefore is the process by which trips are assigned or loaded on to the road network. At the end of this stage, construction priorities can be established and alternative proposals put forward.

Model Split:

This term is used by transport planners to describe the phase where the choice of travel mode is incorporated into the model. The positioning of this stage is neither fixed nor singularly definable since elements of model split are part of the other stages. Its position within the transportation model differs between studies. It is either used at the trip generation stage by stratifying the total trips or at the assignment stage of the model. The main purpose of the model-split stage is to determine the trip shares of public, as against private, transport.

Future Land Use and Travel Demand Forecasting:

The forecasting of future land use inputs is a precarious task, for two important reasons. Firstly, transport planners have to rely on the judgment of to the types of planner for most of their land use forecasts. This information is vitally important since it has a profound effect upon travel forecasts. Secondly, long-term forecasting is beset with many statistical problems.

Since transportation planners are usually working at least 10, and sometimes 25 years ahead, their estimates are inevitably open to much criticism. Nevertheless, estimates of future travel demands have to be made using the best methods, which are available. Some of these forecasting problems are amplified below in the listing of the main land use inputs necessary for travel forecasts to be made.

The most important variables are:

(i) Population – its size, age structure and distribution.
(ii) Employment – as the journey to work is the greatest travel demand.
(iii) Personal income and expenditure.

The above groups of variables have a compound influence upon the overall level of demand for travel at some future date. Further complications arise when their impact upon the spatial pattern of this demand is assessed. So, forecasts of population and economic variables are an important input into the use of the transportation model for forecasting future travel demands.

Evaluation:

The final stage of the transportation planning process is one of evaluating the alternative policies, which have been suggested. The evaluation stage is probably the most important of all, yet has received only limited research attention. An economic evaluation of transport proposals is necessary because vehicle-km and road space are commodities, which are not directly bought and sold.

The technique of cost benefit analysis has consequently evolved as an investment criterion in the public sector. As such, it provides an economic evaluation. On the cost side of the calculation, estimates are made for capital outlay, land purchase and maintenance.

The benefits are those accruing to users, e.g., savings in time, vehicle operation and accidents. The individual costs and benefits are assessed over a particular number of years and discounted back to the base year so that a rate of return can be calculated. On the basis of 'transportation plan', transport policies should be formulated and implemented properly so that systematic 'sustainable' development of transport can be done.

Transport Demand Management in USA:

'Transport Demand Management' (TDM) system as a part of transport policy has been adopted in USA. TDM is the art of modifying travel behaviour in order to reduce the number of trips or modify their nature. It may be categorised according to whether it mainly affects trip generation, trip distribution, and model choice or route selection. As Table 9.2 shows, some implementation strategies rely on changes to the transport system, others on land use policies and still others on alterations to employment conditions and social values.

In the field of TDM, the USA has done considerable work. Persuading a number of large companies to introduce flexible working hours ('flexitime') is a logical way to reduce congestion at peak periods. The introduction of car-pooling is another step in this direction. The most TDM measures are ones that require employers to reduce the number of peak-period car trips made by their worker. In USA at least 20 suburban communities have enacted such programmes.

Transport Demand Management Strategies – USA

Transport planning process	Management objective	Main implementation strategy		
		Transport	Land use	Other
Trip generation	Eliminate trip entirely			* Telecommunications * Shortened work weeks
Trip distribution	Shift locations of origins or destinations to modify spatial distribution of trips		* Zoning policy * Reurbanisation * Mixed use development * Transit-friendly design * Growth management	
Mode choice	Shift from low occupancy mode to higher occupancy mode	* Transit, bicycles, walking facilities * High-occupancy vehicle facilities * Gasoline taxes * Licensing policies	* Parking policies	* Employment based ride-sharing
Route selection (spatial)	Shift trip from a more congested route to a less congested route	* In-vehicle navigation systems * Road pricing		
Route selection (temporal)	Shift trip from a more congested time period to a less congested time period	* Congestion pricing		* Alternative work schedules (flexitime)

Netherlands's Policy for 'Sustainable Development:

National Environmental Policy Plan or NEPP of Netherland has been adopted in 1989. NEPP is an example of environmental protection as well as policy for the control of pollution created by transport. The NEPP recognises that safeguarding environmental quality on behalf of what it calls 'sustainable development' will be a process that will last for several decades. The NEPP is the first step in this process: it contains the medium-term strategy for environmental policy, which is directed at the attainment for sustainable development over the longer period.

The objectives of the NEPP are:

i. Vehicles must be as clean, quiet, safe and economical as possible;

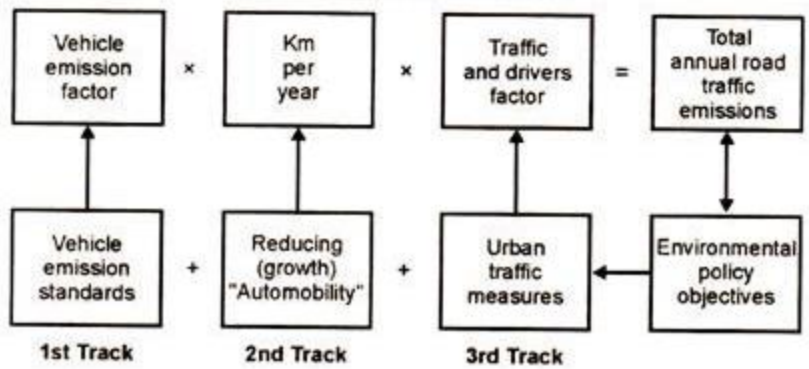
ii. The choice or mode for passenger transport must result in the lowest possible energy consumptions and the least possible pollution; and

iii. The locations where people live, shop, work and spend their leisure time will be coordinated in such a way that the need to travel is minimised.

The approach of the NEPP is shown in Figure 9.3. As pollution from road traffic is seen as a three-step process, these objectives are to be met through a 'three-track' response, the tracks being those of technical vehicle standards, reducing 'automobility' and instigating urban traffic measures.

As shown, the three-track approach has been developed to the abatement of environmental pollution. The first track consists of a series of measures to convert the vehicle fleet into one that is the cleanest possible.

The Dutch Three-Track Approach to the Abatement of Environmental Pollution by Motor Vehicles



The second track, of reducing car use, aims to shift people from cars to public transport for the longer journeys and to cycling or walking for the shorter ones. This is to be achieved through provision of more and better facilities for cycling and public transport, more subsidies, better fare and ticket integration and publicity campaigns.

However, it is recognised that if the policy is to seek a balance between individual freedom, accessibility and the environment, the only way to achieve this is to control the use of cars. Therefore, the strategy is to increase variable motoring costs through fuel taxation and road pricing. Car commuting will be discouraged through a variety of TDM measures including 'kilometre reduction plans', whereby companies and institutions will have to draw up and then implement plans to reduce the distance travelled by employees in the course of work and in commuting to it.
Additionally, the second track will improve the transport of freight by rail and water and will tighten up physical planning policy, to ensure that businesses which are labour-intensive or amenities which attract numerous visitors are not permitted to locate at places which are not well served by public transport.

As well as having cleaner vehicles, which are used less, the NEPP recognises – the third 'track' – that further measures are necessary to alleviate the problems at a local scale. These include stricter enforcement of parking controls, traffic management to influence drivers' choice of routes, circulation schemes to slow traffic and similar measures to improve road safety and increase environmental protection.

The most noticeable feature of the NEPP is the way that its individual measures reinforces each other, to produce an integrated package which links environmental, transport and land use policy. Yet even this impressive, comprehensive approach comes nowhere near solving the problems. Without the NEPP, car-kilometres had been expected to rise by 72 per cent over the period 1986-2010.
With the NEPP this increase is lowered to 48 per cent, a worthwhile reduction but still a very long way from a sustainable level of transport use. The NEPP must be seen only as the first stage in a long-term drive towards sustainability: it serves to illustrate what a difficult task lies ahead of the Dutch (and indeed all motorised countries).

Question No-03: The settle area of KPK is being divided into different districts. Few of them are as 1.Peshawar, 2.Charsadda, 3.Mardan, 4.Nowshera, 5.Swabi, 6.Abbottabad, 7.Kohat. Consider each district an independent zone having attributes of area as given in table below. Calculate the trips generation and attractions of each zone. Comments on your answer

Land Use Category		Area (ha)						
		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7
Residential		7740	24900	17064	40204	29317	576416	53445
Commercial	Retail	6972	5688	26220	6172	126091	15270	1290
	Wholesale	14940	10744	20976	7715	90065	7635	1935
	Services	5976	2528	1748	6172	162117	10180	1720
Manufacturing		1290	4980	1264	1748	4629	36026	12725
Transportation		1935	8964	5688	5244	4629	90065	10180
Public Buildings		2580	9960	4424	6992	3086	252182	30540
Public Open Space		3010	22908	15800	71668	92580	468338	114525

Answer:

Considering the following table for Trips generated per thousand square foot.

Golden Triangle Floor-Space Trip-Generation Rates Grouped by Generalized Land-Use Categories

Land-use category	Thousands of square	Person-trips	Trips per thousand square feet
Residential	2744	6574	2.4
Commercial Retail	6732	54,833	8.1
Services	13,506	70,014	5.2
Wholesale	2599	3162	1.2
Manufacturing	1392	1335	1.0
Transportation	1394	5630	4.0
Public Building	2977	11,746	3.9
Total	**31,344**	**153,294**	
Average			**4.9**

Now first convert Area (Ha) to Area (Square foot as shown in table.

Land Use Category		Area (Square Foot)						
		Zone-1	Zone-2	Zone-3	Zone-4	Zone-5	Zone-6	Zone-7
Residential		833125860	2680211100	1836751896	4327518356	3155652563	62044841824	5752766355
Commercial	Retail	750459108	612250632	2822294580	664347908	13572309149	1643647530	138854310
	Wholesale	1608126660	1156473416	2257835664	830434885	9694506535	821823765	208281465
	Services	643250664	272111392	188152972	664347908	17450111763	1095765020	185139080
Manufacturing		138854310	536042220	136055696	188152972	498260931	3877802614	1369706275
Transportation		208281465	964875996	612250632	564458916	498260931	9694506535	1095765020
Public Buildings		277708620	1072084440	476194936	752611888	332173954	27144618298	3287295060
Public Open space		323993390	2465794212	1700696200	7714271852	9965218620	50411433982	12327356475

Trip generation for each zone is shown in below table:

Land Use Category		Area (Square Foot) (Trip Generation)							Trips generated per thousand square foot from Table
		Zone-1	Zone-2	Zone-3	Zone-4	Zone-5	Zone-6	Zone-7	
Residential		1999502.06	6432506.64	4408204.55	103860441	7573566.151	148907620.4	13806639.25	2.4
Commercial	Retail	6078718.77	4959230.12	22860586.1	5381218.05	109935704.1	13313544.99	1124719.911	8.1
	Wholesale	8362258.63	6013661.76	11740745.5	4318261.4	50411433.98	4273483.578	1083063.618	5.2
	Services	643250664	272111392	188152972	664347908	17450111763	1095765020	185139080	1.2
Manufacturing		138854.31	536042.22	136055.696	188152.972	498260.931	3877802.614	1369706.275	1
Transportation		833125.86	3859503.98	2449002.53	2257835.66	1993043.724	38778026.14	4383060.08	4
Public Buildings		1083063.62	4181129.32	1857160.25	2935186.36	1295478.421	105864011.4	12820450.73	3.9
Public Open space		1587567.61	12082391.6	8333411.38	37799932.1	48829571.24	247016026.5	60404046.73	4.9