Transport Analysis

1) Modes of transport
2) Relative important of transport
3) Controlling factor of transport cost
4) Types of transport cost
5) Principles of transport cost
6) Transport network Analysis
   - → Element of transport network graph
   - → patterns of transport network
   - → Methods of transport network analysis

① Modes of Transport :

i) Road transport
ii) Rail transport
iii) water transport
iv) Air transport

(v) Pipeline transport

② Relative important of Modes of transport :

The selection of modes of transport depends on the following factors —

i) speed of transport
ii) cost of transport
iii) Frequency or regularity of transport relative flexibility of the transport mode.

(i) climate factor দ্বারা জন্য water এবং Air transport বেশিরভাগ প্রভাবিত হয়।

(ii) Road transport এর flexibility "Rail transport এর তুলনায় অনেক বেশি।

3) <u>controlling factor of transport cost</u>:

i) Distance and amount of materials
ii) Types of terrain or topography
iii) nature of goods
iv) Types of carrier
- oil tanker
- Pipe line

v) competition of the modes of transport

4. <u>Types of Transport cost</u>:

i) Line haul cost
ii) overhead cost
iii) Transfer cost

i) <u>Line haul cost</u>: (Means Running cost)

Which incurred the cost of Process of moving including mainly the cost of <u>fuel</u> and <u>wages</u>.
(কোনো transport চালু রাখার জন্য যে খরচ)

বেশি — Road
Rail
water

ii) <u>overhead cost</u>:

It is mainly the cost of equipments such as terminal cost, rail track, road construction, repair shop, offices.

বেশি — water
Rail
Road

iii) <u>Transfer cost</u>:

It includes different type of indirect cost like insurances cover for the cargo (মাল বয়ে নিয়ে যায় যে) etc.

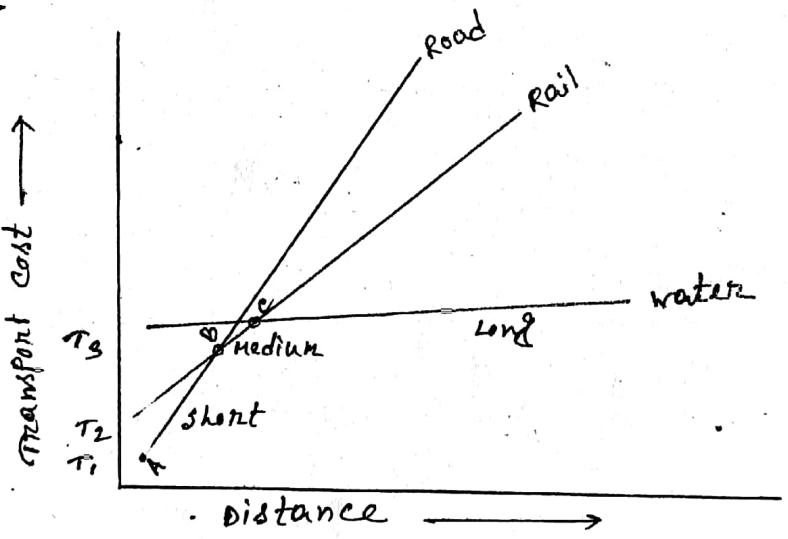
⑧ Terminal cost:

কোনো transport এর জন্য initial এ যত টাকা terminal cost হবে,

* Air-এ transport cost এর কোন্ অংশের পরিমাণ সবচেয়ে বেশি হয়ে থাকে,

In case of road, rail and water transport line haul cost and terminal cost (overhead cost) are different. In water transport terminal cost is more but line haul cost is less. Because the transport cost is divided huge amount of cargo. In road transport terminal cost is less but line haul cost is more as the amount of cargo is less. In rail transport terminal cost and line haul cost both are medium that is in between road transport and water transport.

Terminal cost and line haul cost in case of these three modes of transport are shown in the figure below



T_1, T_2 and T_3 are the terminal cost of road, rail and water respectively.

From the figure it is clear that for short distance (A-B) road transport is suitable, for medium distance (B-C) rail transport will be suitable and for long distance (beyond C) water transport is suitable to minimize the transport cost.

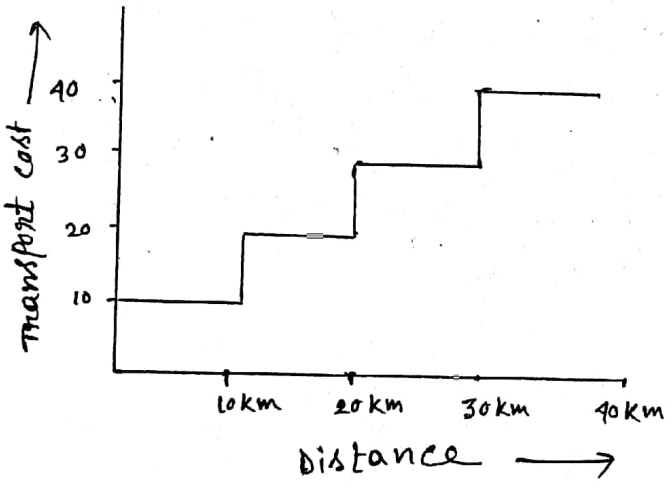
5. Principles of transport cost:

Transport cost always following two main principles —

1) step like principle
2) Tapering principle

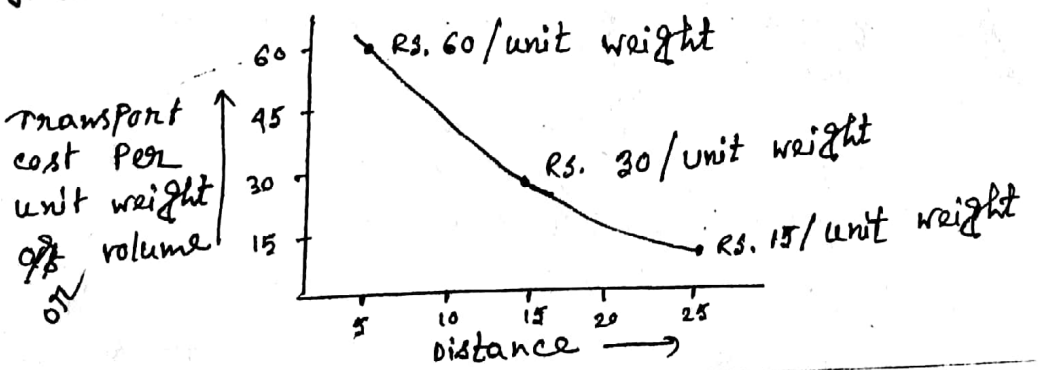
1) step like principle:

Generally the increase of transport cost occurs in a step like pattern. From the starting point, transport cost remains equal upto certain distance and then it increases. Again it remains equal upto certain distance and then it increases.



2. Tapering Principle:

Transport cost per unit volume or weight of material transported decrease with the increase of distance. Large the distance less is the transport cost per unit weight or volume of material.



⊛ Topological map:

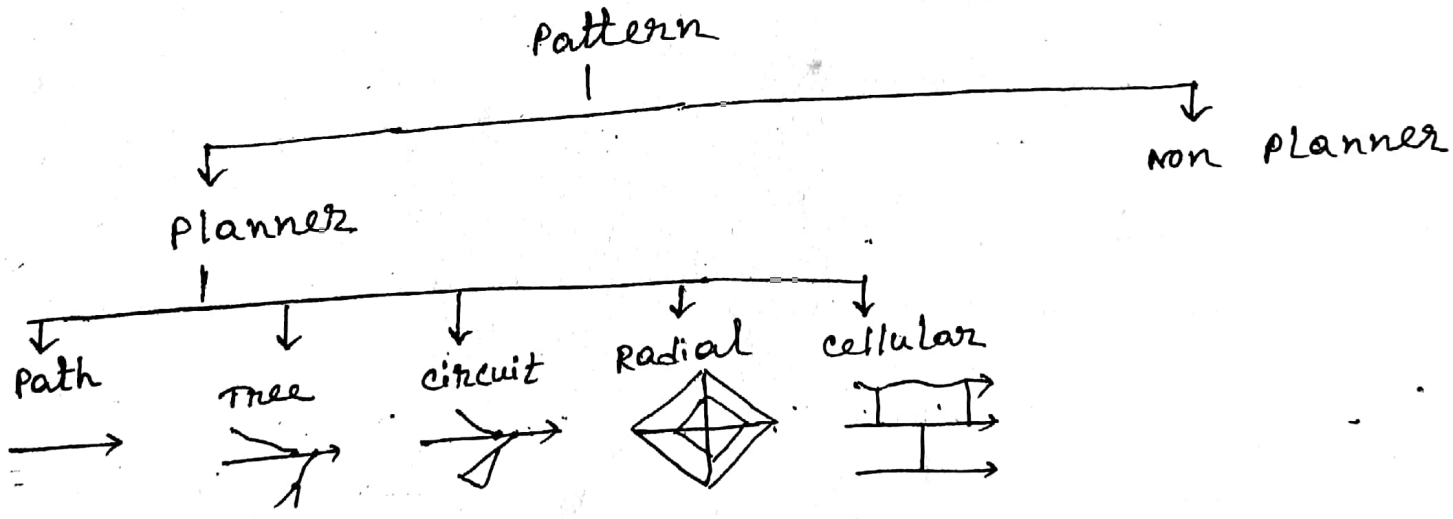
simply form of topographical map (in case of transport ~~cost~~ network) in which direction and scale are not preserved, only the relative position is maintain.

6. Transport Network Analysis:

A. Element of Transport network graph:

i. Node
ii. Arc / Link
iii. Path
iv. Region
v. Branch
vi. circuit

B. Pattern of transport network:



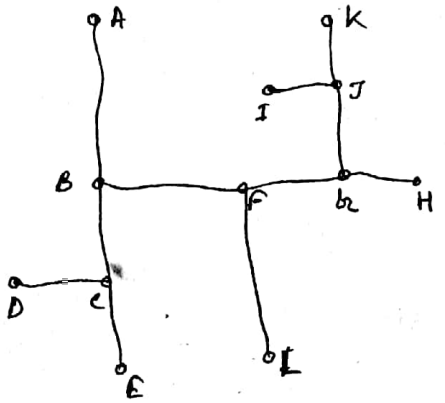
Direct Link – 1
Indirect Link – 0

Method of transport network Analysis:

- centrality or Accessibility Analysis
- Detour Index
- connectivity Analysis
  - β Index
  - cyclomatic number
  - α Index
  - γ Index
- ...
- Spread & Diameter

1. centrality or Accessibility Analysis:

This method is suitable to understand the central location or place of a transport network system that is more accessible place in a transport network can easily be selected by this method.



From \ To	A	B	C	D	----	L	Associated number/ Konig number	Shimbel Index (SI)
A	0	1	2	3		5	5	26
B	1	0	1	2		4	4	21
C								
D								
i								
L								

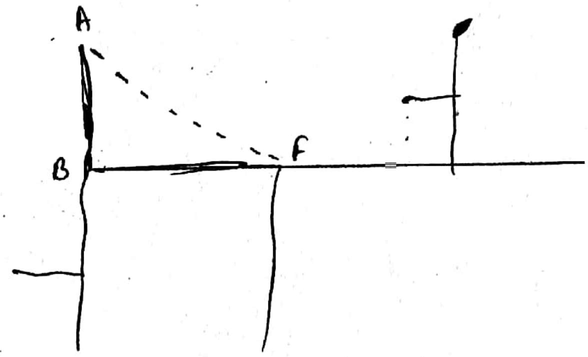
This is called shortest path Analysis and Table is called shortest path Matrix.

- koniq number/Index এর মাধ্যমে centrality measurement করা হয়, value যত কম হবে centrality তত বেশি হবে,
- Associated number কম হলে Shimbel Index কম হওয়ার chance থাকে, তাই Associated number ও SI এর সম্পর্ক রয়েছে,
- Minimum number যার SI হবে, সেটাই centrality or Accessibility হবে,
- centrality কে distance এবং direction কে গুরুত্ব দেওয়া হয়নি,

II. Detour Index :

$$DI = \frac{\text{Actual Distance}}{\text{Shortest Distance}} \times 100$$

* Base F- কে ধরা হয় (যেকোন একটি ধরতে হয়)



Station	Actual Distance (Km)	Shortest distance (Km)	Detour Index (DI)
A	5	3	$\frac{5}{3} \times 100 = 166\%$
B	2	1.9	$\frac{2}{1.9} \times 100 = 100\%$
"			
L			

* Detour Index is what amount of extra road we covered.

III. Connectivity Index:

1) β Index
2) cyclomatic Index
3) α Index
4) γ Index

1. β Index :

$$\beta \text{ Index} = \frac{a}{n}$$

$a = E$
$n = V$

a = number of Arc
n = number of node

$$\beta \text{ Index} = \frac{E}{V}$$

E = Edge
V = vertex

i) In case of path or tree like network the value of β index will be less than 1 but in circuit network the value will be 1.

ii) The value of β index ≥ 3 will indicate the better connectivity in a region.

2. Cyclomatic Number (M):

$$M = a - n + 1$$
or, $M = E - V + P$
$= 13 - 10 + 1$
$= 4$

Where,
P = number of graph

i) In case of path or tree network value of cyclomatic number will be '0'.

ii) The value '0' indicates no connectivity, 1-2 indicates lower connectivity, 3-4 indicates ~~midimum~~ midium connectivity, ≥ 5 indicates better connectivity.

iii) Minimum value of 1 will indicate the circuit network. Increase of value from 1 will indicates the development of circuit.

3. α Index:

$$\alpha \text{ Index} = \frac{M}{2(n-5)}$$

or, $\frac{M}{2(r-5)}$

where,

$2(r-5)$ = number of maximum possible circuit

i) The value of α-index ranges from 0-1.

ii) The value of '0' means no connectivity and '1' means highest or better connectivity.

iii) In path or tree network the value will be '0' and circuit network the value will be '1'.

iv) The value of α-Index >1 indicates the extra or unnecessary path or arc.

4. γ Index:

$$\gamma \text{ Index} = \frac{a}{3(n-2)}$$

or, $= \frac{E}{3(r-2)}$

where,

$3(r-2)$ = number of maximum possible path

i) The value ranges between '0' and '1'.

ii) In case of rejected graph the value of gamma Index will be '0', in path or tree graph the value will be between '0' and '1' and in circuit graph the value will be highest that is '1'

* Rejected graph: এমন চিত্রকে যেখানে, কোন arc নেই,

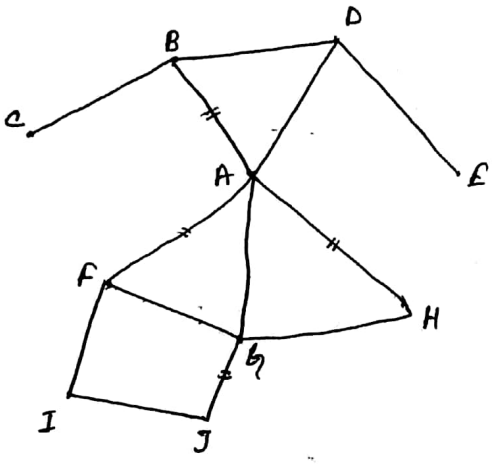
iv. Spread & Diameter:

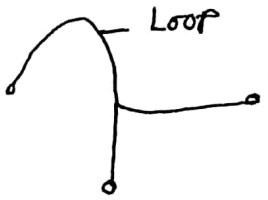
It indicates the number of arc on shortest possible path between two farthest node.

Diameter:

The fewest number of steps needed to connect the vertices which are farthest apart topologically.

Back tracking, detours and loops are excluded.





Diameter = 4

- Diameter 4 মানের এটি গ্রাফের যে কোনো দুটি node এর মধ্যের দূরত্ব,
- এগুলির extra গ্রাফের কোনো circuit মানের(না),

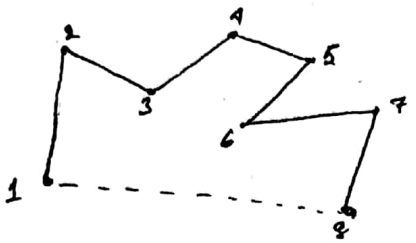
a) Pi Index (π)
b) Eta Index (η)
c) Theta Index (Φ)

a) Pi Index:

- Represents the relationship or ratio between the total length of a graph [L(G)] and the distance along its diameter [D(d)].
- It is called Pi-Index because of its similarity with the constant Pi (3.14), which represent the ratio between the circumference and the diameter of a circle.

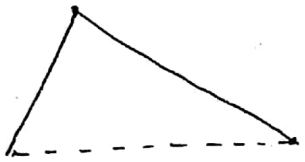
- It measures the length of path or arc or graph per unit diameter and represent the shape of the network or graph.

- Higher the value of Pie-Index, developed the transport network.

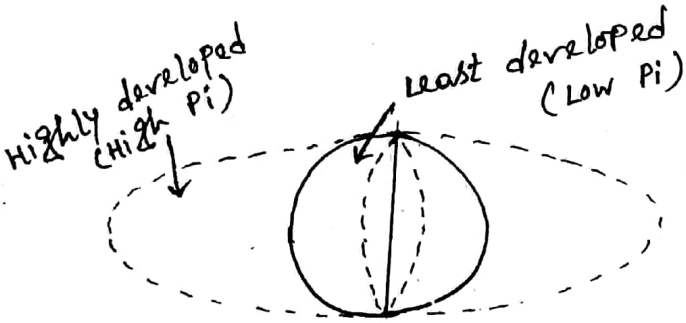


$$\text{Pi-Index} = \frac{L(H)}{D(d)} = \frac{20\,cm}{5\,cm}$$

$$= 4$$



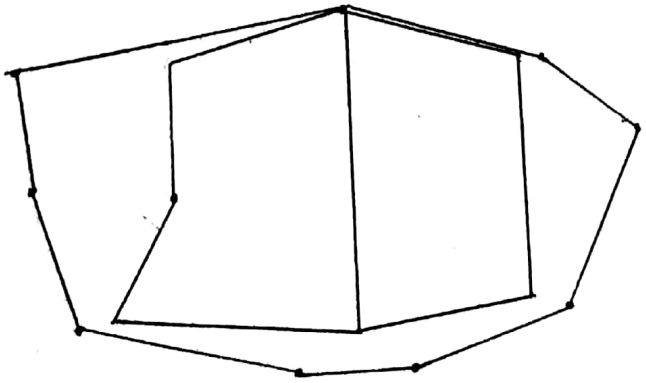
$$\text{Pi-Index} = \frac{12\,cm}{5\,cm} = 2.4$$



* Diameter = vertical Axis
  Length = Horizontal Axis

$$2\pi R$$

or, $2R : \pi$



b) **Eta Index (η):**

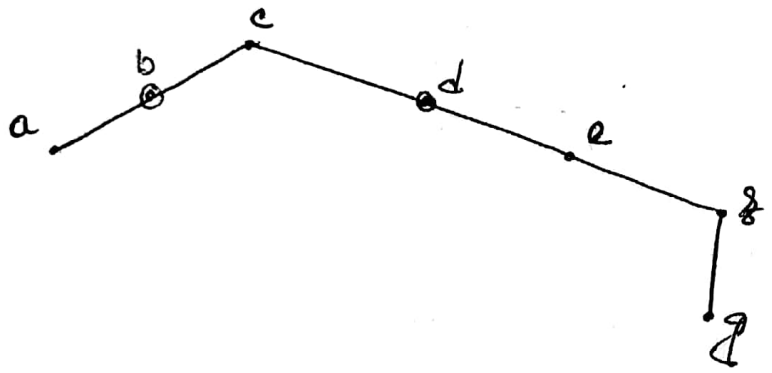
Average length per link. Adding the nodes in the transport network will decrease the value of Eta Index because the average length per link will decrease due to it.

$$\eta \text{ Index} = \frac{L(h)}{e(a)}$$

where,

$L(h)$ = Total length

e = Edge } same
a = Arc }



η Index $= \frac{16\text{cm}}{1} = 1\text{cm}$

η Index $= \frac{16\text{cm}}{6} = 2.67\text{cm}$

c) **Theta Index (θ):**

Its represents the function of a node that is the average amount of traffic per intersection. Higher the value of theta index (θ) greater the load on the transport network.

$$\theta \text{ Index} = \frac{Q(h)}{v}$$

where,

Q = Quantity

$Q(h)$ = Quantity / Total amount of traffic

v = number of vertex

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