

DATA – BASE MANAGEMENT

- Inventory data – physical description of the infrastructure facilities – GIS based preferable
- Construction data – design details, materials, quality, cost etc.
- Performance data – real time data, if possible, periodical performance data – structural as well as functional
- Maintenance – history, condition, strategy, operation, cost, policy

Data

- Inventory data
- Climate data
- Environmental data
- In-service performance data

LEVELS OF MANAGEMENT

- Network level planning – preparation of master plan, demand estimation, planning budget needs, prediction of future condition and work programmes – annual and multi-year planning
- Project level planning – Deals at local level, more detailed data requirements, detailed cost estimates, selection of best alternative based on economic analysis, implementation

PLANNING HORIZON

- Design life and service life
- Life cycle cost analysis
- Definition of 'failure criteria'
- Service life depends on:
 - Design and construction methods
 - Quality of construction
 - Usage
 - Climate and environment
 - Maintenance - time, type and frequency

PERFORMANCE

- How the infrastructure facility serves the intended purpose with accumulated usage?
- How the condition changes during the design life?
- Project level – defined by distresses, loss of serviceability, damage
- Network level – less concern for individual projects; overall condition; needs for present and future funding estimation

PREDICTION OF PERFORMANCE

- Primary response models - Predict the primary response ; models – mechanistic, empirical, mechanistic-empirical
- Structural performance models – Predicts distress in the infrastructure facility – models – empirical or mechanistic -empirical
- Functional performance models – Predicts serviceability over time
- Damage models – models from structural or functional performance models

PERFORMANCE INDICATORS

- Highway infrastructure
 - Riding quality
 - Distress – cracking, rutting, pot holes
 - Pavement condition index
 - Structural condition index
- Environmental and water resources infrastructure
 - Leakage
 - Quality
 - Number of disruptions per year

ENVIRONMENTAL IMPACT

- Impact of the infrastructure on:
 - Pollution – air, noise, vibration
 - Ecological factors
 - Environmental Engineering – flood, drainage, mitigation measures, evaluation of alternate measures/alternate designs
 - Social factors – rehabilitation and resettlement, natural and social forests

DEMAND FORECASTING

- Estimate future demand – select appropriate design, operation and maintenance alternatives
- Tools – statistical, analytical
 - Regression analysis
 - Time series models
 - Neural network methods

TRAFFIC FORECASTING (Example)

Source: IRC: 108-1996

- Factors governing traffic growth
 - Economic
 - Gross national product (GNP), Gross domestic product (GDP)
 - Agricultural output
 - Industrial output
 - Demographic
 - Population
 - Rural / Urban mix of population

DETERMINATION OF PAST TRENDS

- Traffic growth indicators
 - Traffic flow from census
 - Vehicle registration
 - Fuel sales
- Compare the growth rate for each of the above
- Minimum ten years historical data – desirable for establishing reliable growth rate
- Regression analysis

EXTRAPOLATION FROM PAST TRENDS

- Assumption – Constant growth rate as in the past
- Acceptable for short term forecast say, 5 to 10 years
- Erroneous for long range forecasting
- Economic conditions may change over time
- Different growth factors for different vehicle types
- New types of vehicles

ECONOMETRIC MODELS

- Requirements

- Past data on traffic for a number of years
- Data on economic indicators – example GNP
- Econometric models

$$\text{Log}_e P = A_0 + A_1 \text{Log}_e \text{GNP}$$

P = Traffic volume

GNP = Gross National Product

A_0 = Regression Constant

A_1 = Regression Co-efficient (Elasticity Co-efficient)

Growth rate of traffic = $(A_1) * (\text{GNP growth rate})$

EXAMPLE

- Econometric Model

$$\text{Log}_e P = 12 + 1.75 \text{Log}_e \text{GDP}$$

- Elasticity Co-efficient = 1.75
- If growth rate of GDP for the period 2005-15 = 6%, traffic growth rate = $1.75 \times 6 = 10.5\%$
- If growth rate of GDP for the period 2015-25 = 5%, traffic growth rate = $1.75 \times 5 = 8.75\%$

MODIFICATIONS

- To account for possible traffic diversions and generated traffic
- Design period in case of stage construction = 5 to 10 years
- Design period for large projects = 15 to 20 years
- Check whether projected volume exceeds the capacity ?

LIFE CYCLE MANAGEMENT

- Cost Components – Initial construction cost, maintenance cost, user cost, salvage value
- Importance of life cycle cost analysis
- Quantify the maintenance cost – time and treatment to estimate the effectiveness and selection of optimal strategy
- Needs estimation of performance prediction
- Financial planning for the operation and maintenance