ECONOMIC APPRAISAL (EA) OF ROAD INFRASTRUCTURE INVESTMENT

AN OVERVIEW
Economic Appraisal

• Economics concerned with allocating scarce resources – land, labour and capital

• In many sectors price system does this

• Road sector different - users do not pay for roads at time and place of use

• EA is system for allocating resources on behalf of community
Economic Appraisal

- Is project intervention worthwhile from community point of view?
- Is project practicable? Are there social or technical barriers to implementation?
- Is project financially sustainable? Is there a revenue stream to maintain the assets?
- How will project be funded and how will debt be repaid?
- What is pattern of gains and losses? Do benefits and costs accrue to rich or poor? What is impact on identifiable social groups?
3 main uses of EA are:

1. Accept/reject projects
2. Choose between alternatives
3. Prioritisation of projects
Economic Appraisal

- EA is not new – applied in road sector since mid-1950’s
- Widely used in health, education, water, environmental and other public investment sectors
- Greatly facilitated by advent of computers and ability to model dynamics of operating a road system
Economic Appraisal

Computer Modelling

• Interaction – construction and maintenance costs

• Interaction – maintenance and VOC

• Total cost of Transport

Construction + Maintenance + VOC = minimum
Economic Appraisal

• 3 main steps

1. Estimate costs
2. Estimate benefits
3. Compare costs and benefits

• Do for with and without project situation
EA – Measuring Costs

• Distinct difference between financial and economic costs

• Financial - that paid to a banker

• Economic

  1. Real use of resources - exclude transfer payments

  2. Adjust for market distortions in unskilled and skilled labour, capital, foreign exchange

  3. Consider all costs but ignore construction cost interest and inflation
EA – Measuring Costs

Shadow pricing labour in road construction

- Financial cost per km $10,000
- Percent unskilled labour cost in total 40%
- Shadow wage factor 0.5
- Economic cost per km $8,000
- Economic /financial cost 0.8
EA - Measuring Benefits

- Benefits are the economic impact of project over its lifetime +ve and -ve
- Some – improved health, education – difficult to give monetary value
- Many take time to develop and are difficult to forecast
- Some require complementary investments in other sectors
Main benefits from road investment

1. Reduced vehicle operating costs (VOC)
2. Savings in time to people, goods and vehicles
3. Reduced road maintenance costs
4. Improved road safety
5. Increased economic activity
• VOC savings are expected from most road improvements

• Provide major justification for investment

• Vary with vehicle type, speed and condition of road surface

• Estimated mainly from models that simulate vehicle operations
<table>
<thead>
<tr>
<th>Component</th>
<th>Private Cars</th>
<th>Trucks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel</td>
<td>10-35</td>
<td>10-30</td>
</tr>
<tr>
<td>Lubricating Oil</td>
<td>&lt;2</td>
<td>&lt;2</td>
</tr>
<tr>
<td>Spare parts</td>
<td>10-40</td>
<td>10-30</td>
</tr>
<tr>
<td>Maintenance (labour)</td>
<td>&lt;6</td>
<td>&lt;8</td>
</tr>
<tr>
<td>Tyres</td>
<td>5-10</td>
<td>5-15</td>
</tr>
<tr>
<td>Depreciation</td>
<td>15-40</td>
<td>10-40</td>
</tr>
<tr>
<td>Crew costs</td>
<td>0</td>
<td>5-50</td>
</tr>
<tr>
<td>Other costs and overheads</td>
<td>10-15</td>
<td>5-20</td>
</tr>
</tbody>
</table>
EA–Time Savings

• **Users**
  – *Working time*: shadow price of average wage rate + adjustments
  – *Non-working time*: locally derived % of working time rate
  – *In-vehicle/walking/waiting*
  – *Adult/child*

• **Goods**
  – Interest on capital

• **Vehicles**
  – time cost for commercial vehicles
## EA–Time Savings

### World Bank Recommendations

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work</td>
<td>1.33 W</td>
</tr>
<tr>
<td>Non-work</td>
<td>0.3 H (adult)</td>
</tr>
<tr>
<td></td>
<td>0.15 H (child)</td>
</tr>
<tr>
<td>Freight/Public transport</td>
<td>Vehicle time cost + driver wage cost + occupants time</td>
</tr>
</tbody>
</table>
EA – Maintenance Savings?

• Questionable if these really exist on most rural roads?

• Need to define (realistically) maintenance regime pre and post investment and associated costs

• Difficult to estimate maintenance - VOC and journey time trade offs on rural roads
EA – Maintenance Costs?

• Costs and expenditures

• Maintenance categories
  – Urgent (special or emergency)
  – Routine
  – Recurrent
  – Periodic

• Maintenance standards
• Unimproved roads have high accident rates

• Improvements in geometry and road surfaces can substantially reduce accident risks

• Quantifying potential accident risk changes requires years of careful research

• Typically road accidents cost 1-3% of GNP
## Typical Fatal Accident Costs

<table>
<thead>
<tr>
<th>Related costs</th>
<th>Cost US $</th>
<th>Average No./accident</th>
<th>Total US $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal casualty</td>
<td>150,000</td>
<td>1.1</td>
<td>165,000</td>
</tr>
<tr>
<td>Serious casualty</td>
<td>10,000</td>
<td>0.5</td>
<td>5,000</td>
</tr>
<tr>
<td>Slight casualty</td>
<td>1,500</td>
<td>1.2</td>
<td>1,800</td>
</tr>
<tr>
<td>Fatal accident</td>
<td>5,000</td>
<td>1</td>
<td>5,000</td>
</tr>
<tr>
<td>Serious accident</td>
<td>3,000</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Slight accident</td>
<td>2,000</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Damage only accident</td>
<td>1000</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td><strong>Total Fatal accident</strong></td>
<td></td>
<td></td>
<td><strong>176,800</strong></td>
</tr>
</tbody>
</table>
EA – Increased Economic Activity

• Commonly thought main reason for road investment

• Very difficult to quantify in practice

• Usually done indirectly by estimating traffic generated by investment

• Most estimation methods crude and imprecise
EA – Environmental Impacts

- Confusion between social and environmental impacts

- Some are dis-benefits (costs)
  - Health and safety impacts
  - Possible exploitation or damage to natural resources
  - Land acquisition and involuntary resettlement
  - Impacts on man made environment (cultural property)
  - Indigenous people’s

- EA should include prevention, restitution or compensation costs
EA – Comparing Costs and Benefits

• Value of *money* varies year-to-year

• $100 today worth more in 5 years

• **Same principle applies in reverse**

• Benefits and costs occur over years - need *common comparison basis*

• Costs and benefits *discounted* year of first cost
• All comparisons highly sensitive to choice of discount rate

• Compromise between social time preference rate and opportunity cost of capital

• World Bank uses 12 per cent
EA – Comparing Costs and Benefits

1. \( \frac{\sum \text{Discounted Benefits}}{\sum \text{Discounted Costs}} > 1 \)

2. \( \sum \text{Discounted Benefits} - \sum \text{Discounted Costs} = \text{NPV} \)

3. \( \text{IRR} = \text{Discount rate that makes } \sum \text{Benefits} = \sum \text{Costs} \)

4. \( \text{FYRR} = \frac{\sum \text{Benefits year 1}}{\sum \text{Discounted Costs}} \)
EA-Low Volume Rural Roads

- Dominant system for many people
- Many perform vital social function
- With < 50 vpd benefits may not exceed full improvement costs
- Data scarce environment and low investment costs preclude detailed planning studies
ROAD NETWORK PROPERTIES

Percentage of vehicle-kilometres, \( V \), carried by the busiest \( U \) per cent of the road-kilometres.
ROAD NETWORK PROPERTIES

PERCENTAGE OF RURAL ROAD-KILOMETRES CARRYING GIVEN OR LESS FLOW

- Kenya 1970
- Zambia 1964
- Jamaica 1964
- U.K. 1968
EA – Cost Effectiveness

• Applied to roads with < 50 vpd
• Highest economic returns - provision of basic access

+VE
• Simple and easy to calculate in data poor environments

-VE
• No reference scale
• No provision for maintenance
1. Classify proposed projects – major/minor; qualitative/quantitative

2. Appraise separate projects separately

3. Use total project concept where relevant

4. Analyse alternatives (including do nothing as a base case) in relation to objectives

5. Consider only Future (not Sunk) Costs

6. Consider only Future (not Past) Benefits

7. Distinguish economic from financial appraisal
8. Establish criteria for decision making

9. Be skeptical of projects with distant benefits

10. Consider Time Value of Money

11. Incorporate non-monetary (measurable) consequences

12. Remember
   1. Use a multi-talented approach – where relevant
   2. Quantify wherever possible – but don’t overdo
   3. Numbers are not a substitute for good judgement
   4. Ministry staff have to implement the EA system