Determinants of Profitability

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Structure of this Presentation

1. Understanding the competitive position
2. Analysis to determine profitability
3. Monitoring internal & external factors
4. Ensuring long-term success
   – Station management
1 Understanding the Competitive Position
1 What are Railways Good At?

- Commuter passenger
- Heavy, longer-distance freight
- Inter-urban passenger
  - but “reasonable” speed needed
1 Understanding the Competitive Position

• Passengers and freight customers *not* simply driven by one factor
  – e.g. fare or journey time
• But by a basket of factors
  – Sparse networks & low frequencies both important in Africa
  – Overall disutility/”index of hassle” important
1 Generalised Cost

\[ G = \frac{F}{V} + b_1 t_a + b_2 t_w + b_3 t_r + n.I + b_0 \]

- \( F \) = Fare
- \( V \) = Value Of Time
- \( t_a \) = Access Time
- \( t_w \) = Waiting Time
- \( t_r \) = Running (in-vehicle) time
- \( b_1, b_2, b_3 \) = parameters
- \( n \) = number of interchanges
- \( I \) = interchange penalty
- \( b_0 \) = other factors (e.g. quality, modal preference)

All of the terms in the equation above have units of time e.g. minutes

- Implications are huge
  - e.g. don’t reduce fares if they are not the problem
1 Elasticities

• Need to understand how passengers & freight customers respond to changes in the different elements of generalised cost

• Elasticities are a measure of sensitivity

\[ e_f = \frac{\text{% change in demand}}{\text{% change in fares}} \]

\[ e_{gc} = \frac{\text{% change in demand}}{\text{% change in gen cost}} \]
1 Elasticities

- Vary by market segment
  - journey purpose, socio-economic group, commodity
- Elasticities of components of generalised cost vary by
  - How onerous that activity is
  - The proportion of gen. cost accounted for by that activity
- Matter because of the scale of railways
  - The consequences of wrong decisions are large
2 Analysis to Determine Profitability
2 Analysis to determine Profitability

• Profit = revenues – costs
• But, in a railway, what are costs?
  – Franchise bidding costs?
  – Vehicle replacement costs?
  – Track renewal costs?

• Highlights a key issue for railways:
  – Short-run and Long-run costs
2 Analysis to determine Profitability

• Long-term costs are a high proportion (≈40%) of total railway costs
• Many railways have focussed on short-term costs and failed to survive the asset replacement of large items
2 Steps in the Cost Function

• Railways are inherently ‘big’ items of transport
  – Capacity comes in large chunks

• If these are not well-used, costs are too high and profit is extinguished
2 Steps in the Cost Function

- Trainsets are a large cost element, so need to be used efficiently

- Many African railways suffer from low speed
  - Not only does this make them uncompetitive
  - But the number of trainsets required to provide the service is higher than necessary
  - Aiming for reasonable speed would reduce operating costs
3 Internal & External Factors
3 Internal & External Factors

• 5 key factors underlie good railway profitability
  – Geography
  – Engineering
  – Management
  – Regulation
  – Economics

• Governments and railways need to
  – Understand the impact of these on their railways
  – Work together to achieve a positive background
3 Geography: Environmental Factors

• Physical geography impacts upon
  – Construction & operating costs
  – Population distribution
  – Presence of heavy industries
  – Industrial location
  – Quality of modal alternatives
  – Existence of transit traffic
3 Geography: Demographic Factors

• Economic geography impacts upon
  – Population size
  – Population density
  – Settlement size:
    • are there major cities?
  – Population income
  – Car ownership
  – Trip patterns

• In Africa, income is low but so is car ownership
3 Engineering: Technological Factors

• Cost-effective technology adding value over its whole life
• Appropriate technology
• Avoidance of multiple technologies e.g.
  – Signalling systems
  – Track/loading gauges
  – Rolling stock types
• Openness towards new methods & technologies
3 Engineering: Investment Factors

- System approach
- Sufficient finance to invest just before items become life-expired
- Renewal of assets to enhance performance
- Attention to ‘golden’ assets
- Cost-effective maintenance to sustain performance
3 Management Factors

- Clear vision/purpose of company
- Sound strategy
- Power to execute objectives
- Effective means of implementation
3 Regulatory Factors

- Minimum fare regulation
- Minimum labour regulation
- Appropriate safety regulation
- Appropriate service level regulation
- Appropriate financial regulation
- Regulation to encourage investment
- Financial support to offset regulatory costs
3 Road v Rail

• Regulations need to be applied equally to different forms of transport
  – Taxpayer-funded national police deal with road accidents but railway staff deal with rail accidents?
  – Roads provided free but rail customers have to pay for track maintenance?
3 Road v Rail

• Railways often come under pressure because their externalities are greater than for road but unpriced e.g.
  – Less pollution
  – Time savings

• Other benefits are of monetary value to Government, but still have to be funded
  – Fewer accidents
3 Road v Rail

- Other subtleties:
  - Private sector (oil/car) companies can lobby for road improvements but nationalised railways often prevented from lobbying
  - If track conditions deteriorate, we stop running (for safety reasons), but this does not stop people using roads with potholes
    - If Governments are not careful, these policies encourage travellers to use less-safe modes
3 Road v Rail

• Other subtleties:
  – Public transport (esp. railways) allow a denser more sustainable urban form
  – Map shows proportion of New York which would have to be car-parks if there were no railways
3 Economics: Operational

• Ensure good terminal location
  – City-centre: nearest most trip ends & easiest for interchange

• Avoid demand peakiness
  – By time of day
  – Geographically (i.e. not branch lines)
3 Economic Principles

✓ Density: more traffic on same railway
?
Scale: more traffic on bigger railway
X Complexity: more types of traffic/assets
3 Short- and Long-run Costs

(a) Costs of Operations

- Fixed Cost
- Variable Cost
- Complexity Cost
- Total Cost

money

traffic
3 Costs and Revenues

(b) Revenue, Total Cost, Efficiency

- Revenue
- Total Cost
- Profit ("Efficiency")

money

traffic
4 Ensuring Long-Term Success
4 Controlling Costs

• Railways have high fixed costs naturally
• But overheads must be controlled
  – e.g. railway running 1 train per week with 750 staff in head office
• If conditions require high railway employment, use it in customer-facing roles e.g. on-train staff, ticket offices
4 Ensuring Long-Term Success

• Fares/charging policy
  – Don’t under-price rail or road
  – Should cover operating costs and make some contribution to long-run costs
4 Ensuring Long-Term Success

• Asset management
  – System to plan & replace assets
  – Stable funding needed from Government
  – Commercial fares/freight rates help to support this approach and encourage managers to consider income and costs
4 Ensuring Long-Term Success

- Systems engineering
  - Everything impacts on everything else
  - Minimising costs in one area may mean spending more elsewhere
- Technology decisions
  - Unsprung loco weight
- Planning decisions
  - Length v frequency
4 Ensuring Long-Term Success

- Operational and safety management
  - Poor safety impacts directly on the bottom line
  - Good operational management is essential if Governments are to trust the railway with mass transportation
4 Management of Stations

• Once demand rises, this is not as easy as it appears; key concerns are
  – Safety
  – Punctuality

• Railways are a system, so need to manage
  – Rolling stock
  – Platform infrastructure
  – Passenger flow
4 Understanding Passenger Flow

- Fruin’s level-of-service categories
  - A to D are OK, E and F aren’t
  - for efficiency as well as safety reasons, plan to avoid congestion
4 Understanding Passenger Flow

• Implications & subtleties often not understood
  – Bottlenecks
  – Edge effects & corners
  – Logical sequence of tasks
  – Clear sightlines
  – Good information
4 The Platform: Train Interface

- The rationale for stations
- Safety-critical

...but also

- Capacity-critical: in urban areas, railway line capacity determined as much by station stop times as by anything else
4 The Platform: Train Interface

- On high-volume passenger railways, detail matters
- Active management is essential – but doesn’t have to be “high-tech”
4 The Platform: Train Interface

- Have research database from a range of urban and metro railways
- 100 datasets, each of around 30 observations
- Record numbers of passengers, passenger time, function time and station characteristics
- …all at the critical door
  - Spreading passengers out is critical
4 The Platform: Train Interface

• Although passengers are timed at a particular door, doors are of different widths
• We therefore use passengers/second/metre of door width as the unit to describe movement

• Most train doors are about 1.2m wide
• Passengers get on/off at ≈1/second
• Average rate ≈ 0.8 pass/s/m
4 Recent Research

• Results from our research demonstrate systems engineering in practice
• Have used multiple linear regression on our dataset to be able to estimate the impact of different input factors
• Now able to report impacts of station factors
4 Recent Research

• Separate platforms for boarding & alighting

• Platform width
4 Recent Research

- Results give us guidance as to good practice:

<table>
<thead>
<tr>
<th>Design Feature</th>
<th>Unit</th>
<th>Parameter</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platform: train gap</td>
<td>10 cms</td>
<td>-0.06 (-8%)</td>
<td>10 cm larger gap leads to 8% reduction in boarding rates</td>
</tr>
<tr>
<td>Separate platforms for boarding &amp; alighting</td>
<td>Yes/no</td>
<td>0.55 (68%)</td>
<td>Availability of separate platform increases alighting rates by 68%</td>
</tr>
<tr>
<td>Platform screen doors</td>
<td>Yes/no</td>
<td>-0.02 (-2%)</td>
<td>Installation of PSDs reduces alighting rates by 2% (although has other benefits)</td>
</tr>
<tr>
<td>Platform width</td>
<td>Metres</td>
<td>0.07 (8%)</td>
<td>1m wider platform increases alighting rates by 8%</td>
</tr>
</tbody>
</table>
5 Conclusions & Recommendations
5 Conclusions

• Basket of factors underlies choice of rail
• Rail is not the appropriate choice for everything
• Range of key factors underlie railway profitability
  – Some are inherent characteristics of the situation
  – Some to be managed by Government
  – Some (e.g. overall speed) a joint decision
  – Others (e.g. asset/station management) by the railway
5 Recommendations

- Target those markets for which rail is appropriate
- Agree objectives
- Sustain stable (high) funding
- Keep costs down, especially overheads
- Ensure a level playing field with other modes