The role of macrologistics in industrial development: Infrastructure and policy
- Jan Havenga
Key messages

• Macrologistics enable systemic choices for infrastructure and policy
• The premise is the same as for micrologistics – without cost data we are blind
• South Africa has macrologistics challenges
• We now have the instrumentation/experiments to assist with these challenges
• This work has been used widely, although sadly so, not much by the DoT
• We’ve exported to India, are working in Vietnam and possibly China soon
• We have illustrative case studies
• Future challenges will require more of macrologistics
Discussion points

The rise of Macrologistics

South Africa’s Macrologistics status

South Africa’s Macrologistics improvement opportunities

Examples of Macrologistics in practice

The future of logistics
The lower level definition of logistics

- Transport
- Storage
- Management and administration
- Opportunity cost of holding inventory

Why?

- Because the fuel is not available where and when needed
- We also talk about a time and place discrepancy

Logistics provide time and place utility
The strategic or firm level view of logistics

<table>
<thead>
<tr>
<th></th>
<th>Ocean delivery</th>
<th>Road delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport</td>
<td>R 3 600 000</td>
<td>R 18 000 000</td>
</tr>
</tbody>
</table>

The transport cost for road delivery is 5 times more, but the total logistics costs only half.
Logistics is an input into a system that produces value

Like all inputs the objective is to minimize

- We want to keep the cost of the ingredients as low as possible
- We want to keep the cost of the other production factors as low as possible

Minimising the cost of each element is not enough. We need to understand costs

This can be done for an entire economy

<table>
<thead>
<tr>
<th>Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flour</td>
</tr>
<tr>
<td>Yeast</td>
</tr>
<tr>
<td>Sugar</td>
</tr>
<tr>
<td>Salt</td>
</tr>
<tr>
<td>Water</td>
</tr>
</tbody>
</table>

By the time that the average product in South Africa is consumed 50% of the cost is logistics
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Logistics costs for South Africa in 1996

- Transport (R42,579m) 56.0%
- Stock Losses (R2,394m) 3.1%
- Warehousing (R9,578m) 12.6%
- Admin & Management (R4,789m) 6.3%
- Inventory Carrying Cost (R14,367m) 18.9%
- Order Processing (R2,394m) 3.1%

Total logistical cost = R76,101m (18% of GDP)
South Africa’s input – output relationship over the last decade

- Logistics costs as a percentage of GDP

Our macrologistics position improved up to 2011, but has since deteriorated
Transport costs is still the biggest contributor.
In 2016 costs will touch a half trillion Rand

But this relationship is still a functional view. Decision informing trade-offs are not possible.
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The future of logistics
Understanding demand and supply. Spatial challenges in all BRICS countries.
What causes high logistics costs?

• High demand for logistics relative to value added
  • Spatial
  • Lack of beneficiation
  • Excessive choice

• Expensive or inefficient supply
  • Modal choice
  • Routing and scheduling
  • Double handling
  • Empty haul
  • Load factors
  • Driver behaviour
  • Inefficient drivetrains

But overall to manage this the logistician needs macro ABC costing. The heart of logistics
To understand what can improve you need to understand demand

- Today
- Forecast for 2040

South Africa’s extensive freight flow model – the start of instrumentation
The model includes 83 commodities

- Processed Foods
- Sugar Cane
- Stone
- Grain

Between ~400 districts, tons, tonkilometres, all modes, costs
And for systemic calculations costs are disaggregated

• Into various segmentation regimes
• Including detailed cost elements

• And various cost drivers

- Load factor
- Empty haul
- Load per trip
- Distance per annum
- Fuel consumption per vehicle
- Driver habits or training
- Vehicle maintenance and compliance

A combination of segmentation, elements and drivers enables systemic trade offs

It is at the heart of logistics. National level instrumentation
One supply side example – note this “train”

This is a tragedy
The typical FMCG long distance supply chain has natural “catchment” areas...
But can we do it differently?
And can we prove why?

<table>
<thead>
<tr>
<th>Volumes and Savings</th>
<th>South Africa</th>
<th>Corridors</th>
<th>2 corridors only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tons (million)</td>
<td>50</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>Tonkilometers (billions)</td>
<td>30</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>Costs (Billion R)</td>
<td>7</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Emmissions (‘000 tons)</td>
<td></td>
<td></td>
<td>400</td>
</tr>
</tbody>
</table>
## Considering a vehicle fleet – for the Natal Corridor

<table>
<thead>
<tr>
<th></th>
<th>Current fleet</th>
<th>Trips per day (laden)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current</strong></td>
<td>3500</td>
<td>2,000</td>
</tr>
<tr>
<td><strong>30 year scenario: Aggressive rail</strong></td>
<td>8,000</td>
<td>4,500</td>
</tr>
<tr>
<td><strong>30 year scenario: Current rail</strong></td>
<td>11,000</td>
<td>6,500</td>
</tr>
<tr>
<td><strong>30 year scenario: Stagnated rail</strong></td>
<td>14,000</td>
<td>8,000</td>
</tr>
</tbody>
</table>
Why do we struggle to do it?

• Micrologistics approach to a macrologistics problem
  • Tragedy of the commons

• The failure of infrastructure – we don’t know what we need and how to prioritise
  • On a micro level:
    • Capital projects prioritisation
    • CBA per project

• The failure of policy – we don’t know why we regulate
  • On a micro level:
    • Specific positioning criteria
    • Measureable strategies

• The failure of logistics as a discipline
  • The absence of:
    • Instrumentation
    • Link with Macroeconomics
Effects of Industrialisation?

22 Scenarios already considered

- Ferromanganese smelter at Coega
- OEM vehicle plant in the Nelson Mandela Bay Metro
- Crude and gas refinery at Coega
- Copper and cobalt beneficiation in Limpopo
- Tshiame logistics hub in Harrismith
- Fracking in Karoo
- Nuclear power stations
- Deep Sea Ship repair facility at Mtunzini
- Titatium & zircon plant at Saldanha
- Biofuels refinery at Coega
- Ekurhuleni aerotropolis aviation facility at OR Tambo
- Dube Trade port outside Durban
- Tswane autotropolis vehicle hub at Pretoria
- Saldanha steel mill increased capacity
- Limpopo steel mill creation
- Saldanha liquid fuels
- Cement plant at Coega
- Blue metals steel mill at Germiston
- Soda Ash manufacturing at Durban
- Zirconium beneficiation at Mtunzini
- Titanium Oxide beneficiation at Mtunzini

Effects

- Freight flows
- Induced industries
- Transport costs
- Externality costs
- Logistics hubs
- Port system reconfiguration
As researchers in the absence of a SA appetite we’ve expanded our horizons

South Africa

Sub-Saharan Africa

India

Vietnam (in progress)

China (in discussion)

Turkey (possible)
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Examples of Macrologistics in practice

The future of logistics
Examples of macrologistics in practice

Trade and cluster example

Policy example

Infrastructure example – lessons from our work in India

Humanitarian logistics question
South Africa’s logistics costs for 2014 were R429 billion. This includes costs up to the quay wall, but excludes the port and liner costs.
Of the R429 billion, R101 billion were inland trade logistics costs.
Of the R429 billion, R101 billion were inland trade logistics costs
Trade logistics costs

- Inland trade logistics costs: R101bn
- Direct port charge: R23bn
- Total: R95bn
But R23 billion of this costs is “induced”. It is overspend or waste, due to the nature of trade supply chains.
This figure could be as high as R28 billion.
Examples of macrologistics in practice

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Externality costs in South Africa

- Accidents: External costs significantly higher than transport costs.
- Emissions: Similar pattern to Accidents.
- Noise: Lower in comparison to Accidents and Emissions.
- Congestion: Lesser compared to Accidents, Emissions, and Noise.
- Land use: Minimal compared to other categories.
- Policing: Least among all categories.
Externality costs in South Africa – rates per mode

- Emissions
- Accidents
- Congestion
- Noise
- Landway
- Policing

Cent per tonne/km

Road vs. Rail
The full results of internalising South Africa’s freight externalities

![Diagram showing comparison between current and rail-friendly freight switch to rail, with categories for Rail, Road, and Externality.]
Examples of macrologistics in practice

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Humanitarian logistics question
Why India? 50% of the world population lives on 1% of the surface
46% of the world population lives in the yellow area
The number of people living in the blue and red areas are the same.
Two macrologistics business cases

<table>
<thead>
<tr>
<th>Balagarh</th>
<th>Varanasi</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Investment in DFC</strong></td>
<td><strong>Expected return to logistics savings per annum</strong></td>
</tr>
<tr>
<td>$4 billion</td>
<td>$1 billion</td>
</tr>
<tr>
<td><strong>Macrologistics issues</strong></td>
<td></td>
</tr>
<tr>
<td>Connectivity to the port/Kolkata city logistics/Congestion/Alternative port use</td>
<td></td>
</tr>
<tr>
<td><strong>Investment in an extended gate/hub</strong></td>
<td><strong>Additional expected return to logistics savings per annum</strong></td>
</tr>
<tr>
<td>$0.5 billion</td>
<td>$2 billion</td>
</tr>
</tbody>
</table>

- **Design of a 0.5 million ton facility**

- **Varanasi at the confluence of the Ganga and all modes**

- To maximize logistics savings a 39 million ton design is needed
Examples of macrologistics in practice

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Policy example

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Humanitarian logistics question
World population and food production

World Meters - [http://www.worldometers.info/world-population/](http://www.worldometers.info/world-population/)
World population and food production

Source: Hunger Notes - http://www.worldhunger.org/
Food and Agriculture Organisation of United States - http://www.fao.org
World Meters - http://www.worldometers.info/world-population/
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So is infrastructure a problem? Consider hard and soft infrastructure.
So is infrastructure a problem? Consider hard and soft infrastructure.
A lot of hype on supply side

- Physical internet
- 3 D printing
- Driverless trucks
- Electric road trains
- Drones
- Catenary supported highways

This is all micro logistics technology. The biggest change will be the rise of macrologistics

We need changes on the macro level
The new world order – the biosphere will drive logistics’ future

- Biosphere (environmental)
- Socio-sphere (social)
- Econosphere (economic)
Emerging – the bulls-eye model

Biosphere (environmental)

Sociosphere (social)

Econosphere (economic)
The current problem – The Mickey Mouse Model

Social

Environmental

Economic

(Business as usual)

Strong sustainability for New Zealand: Principles and Scenarios (2009) Sustainable Aotearoa New Zealand inc (SANZ)
A thought on demand side – from the engine of growth to degrowth

I was born
University
First job
Relocalisation is real – the speed and disaggregation is still unsure
If logistics as an input needs to maximise output. How do we measure output? The emerging role of macrologistics

<table>
<thead>
<tr>
<th><strong>Econo-sphere</strong></th>
<th><strong>Socio-sphere</strong></th>
<th><strong>Bio-sphere</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Does not distinguish between speculation and real growth</td>
<td>Growth at household level is not measured</td>
<td>Wellness of the environment ignored</td>
</tr>
<tr>
<td>Does not measure non-market activities that contribute to growth</td>
<td>Measures Quantity and not Quality</td>
<td>Encourages natural resource depletion</td>
</tr>
<tr>
<td></td>
<td>Effects of poverty, illiteracy and life expectancy ignored</td>
<td></td>
</tr>
</tbody>
</table>
Thank You