Railway Freight Transport in Brazil

Dr Cassiano Augusto Isler
Mobility Engineering Department | Joinville Technological Center
Agenda

- About the speaker
- UFSC–Joinville
- Railway Freight Transport in Brazil
  - A bit of History
  - Concession Model
  - Pos-Concession Results
  - Pos-concession Challenges and Perspectives
About the speaker
About the speaker

♦ 2010

Master Dissertation
Railway Network Capacity Model for Freight Transport

♦ 2013

PhD Visiting Researcher – ITS/University of Leeds
Professor Chris Nash and Professor Mark Wadman

♦ 2015

PhD Thesis
Socioeconomic assessment of a regional railway network for passenger transport in Brazil

Faculty Member – Transport Engineering and Logistics
UFSC – Joinville
About the speaker

- LOGISTICS
  Applied mathematical modeling
  Solution algorithms and computational tools

- RAILWAY PASSENGER TRANSPORT
  Demand modelling
  Socioeconomic assessment
  Mathematical modelling applied to network planning
UFSC – Joinville
UFSC – Joinville
UFSC – Joinville

- Federal University of Santa Catarina
- Joinville Technological Center
- Engineering Mobility Department
UFSC – Joinville

- Naval Engineering
- Aerospace Engineering
- Automotive Engineering
- Mechatronics Engineering
- Infrastructure Engineering
- Interdisciplinary Bachelor
- Railway and Metro Engineering
- Transport Engineering and Logistics
UFSC – Joinville
Railway and Metro Engineering

- Railway and subway dynamics
- Design and maintenance of rolling stock
- Maintenance and installation of pathways
- Materials for rail transportation systems and underground
UFSC – Joinville
Railway and Metro Engineering

♦ Communication systems
♦ Signaling and operation
♦ Infrastructure
♦ Prevention and investigation of accidents
♦ Legislation
♦ Management of metro-rail projects
UFSC – Joinville
Transport Engineering and Logistics

Transport Engineering
- Planning and Operation
- Traffic Engineering
- Economics
- Infrastructure
- Operations Research

Logistics
- Supply Chain Management
- Strategic Planning
- Operations Research
The graduate in Transport Engineering and Logistics is able to:

- propose the layout of terminals and estimate their capacity;
- solve problems regarding the operation of different modes of transport;
- model transport and logistics problems mathematically and solve them with different algorithms;
- model problems of logistics and transport applying queuing theory and simulation models.
Railway Freight Transport in Brazil

A bit of History
Railway Freight Transport in Brazil
A bit of History

- **1854 – 1930**
  First railway/Brazilian and British Companies (29,000 km)

- **1930-1940**
  Electric Traction/Nationalization (37,000 km)

- **1992**
  Concession (28,000 km)

- **2012**
  New concession model proposed
Railway Freight Transport in Brazil
A bit of History

Source: "O Desenvolvimento de Infraestrutura de Transportes Contribuições do TCU" - Ministro Augusto Nardes – March 2012
http://pt.slideshare.net/editoraforum/apresentao-min-nardes
Railway Freight Transport in Brazil
A bit of History

Productivity
(Million Net Ton Kilometers per employee)

Source: Pesquisa CNT/Coppead 2011: Transporte de Cargas no Brasil – Brasília
Railway Freight Transport in Brazil

Concession Model
Railway Freight Transport in Brazil
Concession Model

♦ National Land Transport Agency
  (Agência Nacional de Transporte Terrestre - ANTT)
# Railway Freight Transport in Brazil: Concession Model

<table>
<thead>
<tr>
<th>Developed markets with significant participation of railways in the transport matrix</th>
<th>Cargo for exportation</th>
<th>Emerging markets</th>
<th>Fragmented markets with high participation of passengers</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>Canada</td>
<td>South Africa</td>
<td>Australia</td>
</tr>
<tr>
<td>5 (Class I)</td>
<td>2</td>
<td>1</td>
<td>~10</td>
</tr>
</tbody>
</table>

### Number of operators

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>1.652</td>
<td>45%</td>
<td>Mostly closed</td>
<td>Mostly private</td>
<td>Private</td>
<td>Public and private</td>
</tr>
<tr>
<td>Canada</td>
<td>370</td>
<td>46%</td>
<td>Mostly closed</td>
<td>Mostly private</td>
<td>Private</td>
<td>Public and private</td>
</tr>
<tr>
<td>South Africa</td>
<td>180</td>
<td>34%</td>
<td>Closed</td>
<td>Public</td>
<td>Mostly public</td>
<td>Public and private</td>
</tr>
<tr>
<td>Australia</td>
<td>599</td>
<td>53%</td>
<td>Depends on the railway</td>
<td>Depends on the railway</td>
<td>Depends on the railway</td>
<td>Public and private</td>
</tr>
<tr>
<td>Brazil</td>
<td>380</td>
<td>25%</td>
<td>Closed</td>
<td>Public and private (concessions)</td>
<td>Private</td>
<td>Public and private</td>
</tr>
<tr>
<td>Russia</td>
<td>1.151</td>
<td>88%</td>
<td>Mostly closed</td>
<td>Public</td>
<td>Public</td>
<td>Public and private</td>
</tr>
<tr>
<td>China</td>
<td>2.200</td>
<td>60%</td>
<td>Closed</td>
<td>Public</td>
<td>Public</td>
<td>Public</td>
</tr>
<tr>
<td>India</td>
<td>560</td>
<td>39%</td>
<td>Closed</td>
<td>Public</td>
<td>Public</td>
<td>Public</td>
</tr>
<tr>
<td>Germany</td>
<td>330</td>
<td>22%</td>
<td>Open</td>
<td>Public</td>
<td>Public</td>
<td>Public and 80% public</td>
</tr>
<tr>
<td>UK</td>
<td>121</td>
<td>13%</td>
<td>Open</td>
<td>Public</td>
<td>Public</td>
<td>Private</td>
</tr>
<tr>
<td>Spain</td>
<td>27</td>
<td>5%</td>
<td>Open</td>
<td>Public</td>
<td>Public</td>
<td>90% public</td>
</tr>
</tbody>
</table>

Source: ANTF; UIC; ANTT; AAR; AUB; EUROSTAT; China Transp; Yearbook; Controller and Auditor General of India; Transport Canada.
### Railway Freight Transport in Brazil

**Concession Model**

<table>
<thead>
<tr>
<th>Developed markets with significant participation of railways in the transport matrix</th>
<th>Cargo for exportation</th>
<th>Emerging markets</th>
<th>Fragmented markets with high participation of passengers</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>Canada</td>
<td>South Africa</td>
<td>Australia</td>
</tr>
<tr>
<td>5 (Class I)</td>
<td>2</td>
<td>1</td>
<td>-10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of operators</th>
<th>Transported cargo 2005, TUm</th>
<th>Participation of the railway network in the transport matrix</th>
<th>Access to the railway network</th>
<th>Propriety Structure</th>
<th>Rolling Stock</th>
<th>Responsibility of investments</th>
</tr>
</thead>
<tbody>
<tr>
<td>45%</td>
<td>46%</td>
<td>34%</td>
<td>25%</td>
<td>88%</td>
<td>60%</td>
<td>39%</td>
</tr>
</tbody>
</table>

- **Recently attempts to open access in Brazil**
- **Open access basically in Europe (focused on railway passenger)**

Source: ANTF; UIC; ANTT; AAR; AUB; EUROSTAT; China Transp; Yearbook; Controller and Auditor General of India; Transport Canada.
Railway Freight Transport in Brazil
Concession Model

### Developed markets with significant participation of railways in the transport matrix

<table>
<thead>
<tr>
<th>Country</th>
<th>Cargo for export</th>
<th>Emerging markets</th>
<th>Fragmented markets with high participation of passengers</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>5</td>
<td>5</td>
<td>~300</td>
</tr>
<tr>
<td>Canada</td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>South Africa</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Australia</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Brazil</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Russia</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>China</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>India</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Germany</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>UK</td>
<td>5</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Spain</td>
<td>10</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

### Recent attempts to open access in Brazil

- **Number of operators**
  - USA: 5 (Class I)
  - Canada: 2
  - South Africa: 1
  - Australia: 10
  - Brazil: 2
  - Russia: 1
  - China: 1
  - India: 1
  - Germany: 1
  - UK: 5
  - Spain: 10

- **Transported cargo 2005, TU Mn**
  - USA: 1,652
  - Canada: 380
  - South Africa: 2,200
  - Australia: 560
  - Brazil: 1,151
  - Russia: 330
  - China: 121
  - India: 27

- **Participation of the railway network in the transport matrix**
  - USA: 45%
  - Canada: 46%
  - South Africa: 34%
  - Australia: 25%
  - Brazil: 88%
  - Russia: 60%
  - China: 39%
  - India: 22%
  - Germany: 13%
  - UK: 5%
  - Spain: 5%

### Access to the railway network
- Mostly closed
- Mostly closed
- Closed
- Depends on the railway
- Closed
- Mostly closed
- Closed
- Closed
- Open
- Open
- Open

### Propriety Structure
- Mostly private
- Mostly private
- Public
- Depends on the railway
- Public
- Public
- Public
- Public
- Public
- Public
- Public

### Rolling Stock
- Private
- Public and private
- Public
- Public and private
- Public and private
- Public
- Public
- Public
- Public
- Public
- Public

### Responsibility of investments
- Public and private
- Public and private
- Public
- Public and private
- Public and private
- Public
- Public
- Public
- Public
- Public
- Public

Source: ANTF; UIC; ANTT; AAR; AUB; EUROSTAT; China Transp; Yearbook; Controller and Auditor General of India; Transport Canada.
Railway Freight Transport in Brazil
Concession Model
Railway Freight Transport in Brazil
Concession Model

♦ RUMO
Malha Norte

“Northern Network”
Railway Freight Transport in Brazil
Concession Model

♦ RUMO
Malha Oeste

“Western Network”
Railway Freight Transport in Brazil
Concession Model

- **RUMO**
  - Malha Paulista

  “São Paulo State Network”
Railway Freight Transport in Brazil
Concession Model

♦ RUMO
  Malha Sul

“Southern Network”
Railway Freight Transport in Brazil
Concession Model

♦ EFC
Estrada de Ferro Carajás

“Carajás Railway”
Railway Freight Transport in Brazil
Concession Model

♦ EFPO
Estrada de Ferro Paraná Oeste

“Western Paraná State Railway”

<table>
<thead>
<tr>
<th>EFPO</th>
<th>Full/Empty Container</th>
<th>Soy Bean</th>
<th>Corn</th>
<th>Vegetable oil</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Railway Freight Transport in Brazil
Concession Model

♦ EFVM
Estrada de Ferro Vitória-Minas

“Vitória-Minas Gerais State Railway”

<table>
<thead>
<tr>
<th>EFVM</th>
<th>Iron Ore</th>
<th>Mineral Coal</th>
<th>Siderurgical Products</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

© Cassiano Augusto Isler, 2017
Railway Freight Transport in Brazil
Concession Model

♦ **FCA**
Ferrovia Centro-Atlântica

“Mid-Atlantic Railway”
Railway Freight Transport in Brazil
Concession Model

- **FNS**

  Ferrovia Norte-Sul

  “North-South Railway”

<table>
<thead>
<tr>
<th>FNS (Tramo Norte)</th>
<th>Soy Bean</th>
<th>Corn</th>
<th>Cellulose</th>
<th>Diesel Oil</th>
<th>Iron Ore</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The table above represents the commodities transported by different railway segments. For example, FNS (Tramo Norte) transports Soy Bean, Corn, Cellulose, Diesel Oil, and Iron Ore.
Railway Freight Transport in Brazil
Concession Model

♦ FTC

Ferrovia Teresa-Cristina

“Teresa-Cristina Railway”
Railway Freight Transport in Brazil
Concession Model

- MRS
  - Ferrovia MRS
  - “MRS Railway”

<table>
<thead>
<tr>
<th></th>
<th>Iron Ore</th>
<th>Sugar</th>
<th>Cement</th>
<th>Siderurgical Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Railway Freight Transport in Brazil

### Concession Model

- **FTL**
  - Ferrovia Transnordestina Logística
  - “Transnordestina Railway”

<table>
<thead>
<tr>
<th></th>
<th>FTL</th>
<th>Diesel Oil</th>
<th>Cement</th>
<th>Gasoline</th>
<th>Siderurgical Products</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Map showing railway transport in Brazil](image-url)
Railway Freight Transport in Brazil
Pos-Concession Results
Railway Freight Transport in Brazil
Pos-Concession Results

Investments in Existing Network Public and/or Private
(million Brazilian reais)

Total in 19,5 years - 55 billion Brazilian reais

Source: ANTT; *Until August, 2016
# Railway Freight Transport in Brazil

## Concession Model

<table>
<thead>
<tr>
<th>Year</th>
<th>Rolling Stock</th>
<th>Infrastructure</th>
<th>Superstructure</th>
<th>Communication</th>
<th>Signaling</th>
<th>Maintenance</th>
<th>Staff</th>
<th>Road Vehicles</th>
<th>Other (informatics, marketing etc.)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>1,039.7</td>
<td>362.3</td>
<td>2.3</td>
<td>16.6</td>
<td>57.3</td>
<td>60.4</td>
<td>14.9</td>
<td>2.7</td>
<td>230.5</td>
<td>3,792.7</td>
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<tr>
<td>2007</td>
<td>1,075.5</td>
<td>347.0</td>
<td>85.8</td>
<td>8.1</td>
<td>81.5</td>
<td>64.7</td>
<td>18.3</td>
<td>0.9</td>
<td>338.8</td>
<td>4,027.6</td>
</tr>
<tr>
<td>2008</td>
<td>2,031.9</td>
<td>525.4</td>
<td>161.2</td>
<td>6.9</td>
<td>89.2</td>
<td>186.4</td>
<td>21.1</td>
<td>4.4</td>
<td>336.4</td>
<td>5,370.9</td>
</tr>
<tr>
<td>2009</td>
<td>829.2</td>
<td>426.1</td>
<td>127.4</td>
<td>10.2</td>
<td>115.6</td>
<td>75.8</td>
<td>18.0</td>
<td>0.9</td>
<td>294.8</td>
<td>3,907.0</td>
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<tr>
<td>2010</td>
<td>765.7</td>
<td>1,024.2</td>
<td>730.2</td>
<td>11.1</td>
<td>75.0</td>
<td>74.1</td>
<td>26.5</td>
<td>4.4</td>
<td>523.7</td>
<td>5,244.9</td>
</tr>
<tr>
<td>2011</td>
<td>1,534.1</td>
<td>1,523.1</td>
<td>715.4</td>
<td>33.7</td>
<td>167.2</td>
<td>85.7</td>
<td>26.0</td>
<td>3.5</td>
<td>838.0</td>
<td>6,937.7</td>
</tr>
<tr>
<td>2012</td>
<td>929.1</td>
<td>1,388.0</td>
<td>1,047.8</td>
<td>54.3</td>
<td>193.7</td>
<td>127.5</td>
<td>32.4</td>
<td>4.8</td>
<td>1,100.0</td>
<td>6,889.6</td>
</tr>
<tr>
<td>2013</td>
<td>873.3</td>
<td>1,714.0</td>
<td>494.7</td>
<td>42.1</td>
<td>160.2</td>
<td>121.7</td>
<td>25.1</td>
<td>10.6</td>
<td>1,871.8</td>
<td>7,326.5</td>
</tr>
<tr>
<td>2014</td>
<td>1,170.1</td>
<td>2,160.2</td>
<td>669.2</td>
<td>70.8</td>
<td>315.5</td>
<td>40.2</td>
<td>18.7</td>
<td>52.4</td>
<td>1,585.5</td>
<td>8,096.6</td>
</tr>
<tr>
<td>2015</td>
<td>556.0</td>
<td>3,114.4</td>
<td>1,191.9</td>
<td>29.7</td>
<td>271.3</td>
<td>81.3</td>
<td>11.8</td>
<td>0.1</td>
<td>1,246.4</td>
<td>8,517.9</td>
</tr>
<tr>
<td>2016*</td>
<td>642.5</td>
<td>1,229.6</td>
<td>574.6</td>
<td>9.8</td>
<td>254.9</td>
<td>80.6</td>
<td>5.7</td>
<td>-</td>
<td>840.5</td>
<td>3,638.2</td>
</tr>
</tbody>
</table>

Source: ANTT; *Until August, 2016
Railway Freight Transport in Brazil
Pos-Concession Results

**Railway Production**
(million Net Ton Kilometers)

**Total in 19,5 years** - 4,5 billion Net Ton Kilometers

Source: ANTT; *Until August, 2016
Railway Freight Transport in Brazil
Pos-Concession Results

Accident Rate
(accidents per million train-kilometers)

International Reference
8 to 13 accidents per million train-kilometers

Source: ANTT; *Until August, 2016
Railway Freight Transport in Brazil
Pos-Concession Results

Direct and Indirect Jobs in the Existing Network

Source: ANTT; *Until August, 2016
Railway Freight Transport in Brazil
Pos-Concession Results

Number of containers

Source: ANTF Associates
Railway Freight Transport in Brazil

Pos-Concession Challenges and Perspectives
Railway Freight Transport in Brazil
Pos-Concession Challenges and Perspectives

- The operator does not need to invest in network expansion
- Closed access and attempt to open access
- The investments in infrastructure previously shown are not to “correct” the alignments
- High tonnage per axis (average of 30 tons) running on an infrastructure of more than 100 years
- The network is not ready to the increasing movement given the lack of strategical investments, e.g., for double stack container trains
Railway Freight Transport in Brazil
Pos-Concession Challenges and Perspectives

Railway Freight Transport in Brazil
Pos-Concession Challenges and Perspectives

Source: http://www.amantesdaferrovia.com.br/photo/esta-o-de-s-o-carlos-sp
The average commercial speed very low

Source: SAFF/ANTT
Railway Freight Transport in Brazil
Pos-Concession Challenges and Perspectives

♦ The stations once highly used for passenger transport are deprecated

Railway Freight Transport in Brazil
Pos-Concession Challenges and Perspectives

Source: ANTF: Annual Railway Magazine – 2011 (Source of map)
Railway Freight Transport in Brazil
A bit of History

Infrastructure Investment (2015-2018)

- Rail
  - R$ 86.4 billion
  - 43.5%
- Ports
  - R$ 37.4 billion
  - 18.9%
- Road
  - R$ 66.1 billion
  - 33.3%
- Airports
  - R$ 8.5 billion
  - 4.3%

Thank you!
cassiano.isler@ufsc.br
We want to hear you!

<table>
<thead>
<tr>
<th>NAME</th>
<th>GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Drake</td>
<td>1</td>
</tr>
<tr>
<td>Luis Oliveira</td>
<td>1</td>
</tr>
<tr>
<td>Rômulo César Carvalho de Araújo</td>
<td>1</td>
</tr>
<tr>
<td>Fernando Paulo Caneschi</td>
<td>1</td>
</tr>
<tr>
<td>Rodrigo Alvarenga Rosa</td>
<td>1</td>
</tr>
<tr>
<td>Jonathan Powell</td>
<td>2</td>
</tr>
<tr>
<td>Nicholas Gould</td>
<td>2</td>
</tr>
<tr>
<td>Bruno Vieira Bertoncini</td>
<td>2</td>
</tr>
<tr>
<td>Igor Baria</td>
<td>2</td>
</tr>
<tr>
<td>Yesid Assaf</td>
<td>2</td>
</tr>
<tr>
<td>Tianni Wang</td>
<td>3</td>
</tr>
<tr>
<td>Maria Triantafyllou</td>
<td>3</td>
</tr>
<tr>
<td>Francisco Gildemir Ferreira da Silva</td>
<td>3</td>
</tr>
<tr>
<td>José João Pires de Oliveira Filho</td>
<td>3</td>
</tr>
<tr>
<td>Acires Dias</td>
<td>3</td>
</tr>
<tr>
<td>Marcelo Blumenfeld</td>
<td>4</td>
</tr>
<tr>
<td>Marin Marinov</td>
<td>4</td>
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<tr>
<td>Verônica Teixeira Franco Castelo Branco</td>
<td>4</td>
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<tr>
<td>Vinicius Kaster Marini</td>
<td>4</td>
</tr>
<tr>
<td>Elisete Zagheni</td>
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<td>Paola Gonzalez Ramos</td>
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<td>Andréa Pfutzenreuter</td>
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We want to hear you!

- What did you know about railway freight transport in Brazil before this presentation?

- What do you know about the theme that was not told in the presentation?

- What is your opinion about the current situation of railway freight transport in Brazil?

- What is your opinion about the future of railway freight transport in Brazil, given the current scenario?

Suggestion: each element of the group may answer the first two questions individually and the remaining questions may be answered together.