A concise introduction to
Transport Geography

by
Fanny
SARUCHERA
Contents

Transport Geography

Part I  -  A theoretical approach

Part II - A practical approach

Part III - A short view at Namibia’s (transport) geography
WHAT is transportation?
- In simpler terms, Transportation is the act of moving people, items and information from a point A to a point B.

This can be
- carrying a plate from the kitchen to the living room
- moving furniture from one flat to another
- sending any goods from a seller / shipper to a buyer
- bringing supplies from earth to the International Space Station in orbit

Etc.....etc.....
The following information refers to the transportation of freight (cargo, goods, commodities), as this is the connecting factor with the forwarding business, and the relevant physical-geographic aspects of transportation.
HOW ABOUT Transport geography?

Transport geography is

- a sub-discipline of geography
- concerned about the mobility
- of people, freight and information.

Transport geo seeks to understand:

- the spatial organization of mobility
- by considering its attributes and constraints
- as they relate to the origin, destination, extent, nature and purpose of movements.
Transport Geography

1. Transportation is the spatial linking of derived demand

2. Distance is a relative concept involving space, time and effort

3. Space is at the same time a facilitator and a constraint for mobility

4. The relationship between space and time can converge or diverge

5. A location can be a central or an intermediate element of mobility

6. To overcome geography, transportation must consume space

7. Transportation seeks massification but is constrained by atomization

8. Velocity is a modal, intermodal and managerial effort
Transportation is the spatial linking of a derived demand:

- preceding economic activities (original demand)
- linking the spatial components of this demand.

Transport business is derived demand. It is not performed for its own sake.

“A market economy could not function without the capacity of transportation to link supply and demand.” (Jean, Comtois, and Slack, 2013).
**Distance**

is a relative concept involving space, time and effort.

How distance is perceived is a function of the amount of effort made to overcome it.

These efforts can be assessed in terms of

- spatial distance
- time distance
- or other effort measures such as cost or energy spent to overcome distance.
Space

- *as well a support as a constraint for mobility*
- provides room for transport infrastructure
- yet sometimes is an obstacle for transport flow e. g.  
  - *river* >>>
    - constraint for land transport systems
    - support for fluvial transportation
  - *atmosphere* >>>
    - spatial support for air transport operations
    - weather can be a constraining factor (e.g. ...storms)
The relation between space and time can converge ...

- transport involves the consumption of a unit of time in exchange of a given amount of space
- this process has mostly converged (a greater amount of space can be reached with the same amount of time or the same amount of space can be reached with a lesser amount of time)

Reasons:
- technological improvements
- better capacity and
- extent of transport infrastructures
The relation between space and time, however, can diverge ... 

- when *congestion* starts to be *significant*
- each additional unit of movement results in additional delays.
Location

 quán central (“... they act as generators [origins] or attractors [destinations] of movements.”)

 or

 quán intermediate (“... when movements are passing [transiting] through them on their way to another location”, e. g. hubs)
To **overcome geography**

- in its physical / topographical sense,
- **transportation must consume space.**
- Transportation infrastructures are consumers of space e. g. pathways, terminals

“The more extensive a transport system and the higher the level of mobility, the more extensive its consumption of space.”
Transportation

- seeks massification, i.e. conveyances with higher capacity and supported by larger terminals
- economies of scale (particularly in terms of the loads (...) they can carry
- is constrained by atomization, i.e. loads being consolidated and deconsolidated in some segments of the transportation process
**Velocity** is seen as

妮 the **time required to cover the whole transport process** from the moment a consignment is put in transport circulation to the moment of arrival at its final destination. Thus, speed itself is just one criterion of velocity.

妮 “*Therefore, the velocity of (...) freight is a joint consideration of the effectiveness of the respective modes involved, as well as that of the intermodal operations connecting the modes.*”
Transportability

- **ease of movement** of passengers, freight or information

- **transport costs** (absolute and relative)

- **attributes** of what is being transported (fragility, perishable, price ...)

- **Political factors** (laws, regulations, borders, tariffs ...)

- **When transportability is high, activities are less constrained by distance.**
Transportability – influencing factors

**Weight** - indicator of the amount of energy that must be spend to carry the cargo

**Storage** - complexity related to hold the cargo in inventory before it can be used

**Fragility** - ease at which the cargo can be damaged during transport

**Perishable** - degree of degradation after being harvested or manufactured, influences commercial value of goods
The concept of “flow” in Transport Management

The concept of “flow” has four major components:

1. **Geographical**
   
   origin >>>
   
   <<< (spatial and/or organizational) separation* >>>
   
   >>> destination

   * high degree of separation limits flows

2. **Physical**

   * specific physical characteristics >>>
   
   type of load units and physical conditions of carriage

   * flows can be *atomized* or *massified* (as outlined above)
3. *Transactional*
   * negotiations between contracting partners, e.g.
     * booking a slot on a containership
   * monetary exchange between provider of transportation and user

4. *Distribution*
   * flows are organized in sequences
   * more complex flows involve different modes/terminals
   * (often) transport flows are scheduled and routed
   * in order to minimize costs or maximize efficiency
Importance of transportation: contemporary trends

1. **Growth of the demand** related to (...) freight mobility [is the] **result of:**

- larger quantities of (...) freight being moved
- longer distances over which they are carried
- ongoing process of mobility growth >> multiplication of the number of journeys
- a wide variety of modes that service transport demands.
2. Reduction of costs

- costs per unit transported have dropped significantly
- makes it possible to overcome larger distances
- exploit the comparative advantages of space
3. **Expansion of infrastructures**

- above trends have extended the **demand** for **transport infrastructures quantitatively** and **qualitatively**
- to service **new areas** and
- **adding capacity** to existing networks
Core components of transportation systems

a. Transportation nodes

- Transportation primarily links locations >>> nodes
- Nodes serve as
  - access points to a distribution system or as
  - transshipment / intermediary locations within a transport network.
- Transport terminals where flows
  - originate,
  - end or
  - are being transshipped from one mode to the other.
b. Transportation networks

- spatial structure and organization of transport infrastructures and terminals
- structures (routes and infrastructures) supporting and shaping movements
c. Transportation demand

- *demand for transport services*
- *demand modes used to support movements*
- *results in an interaction which flows through a transport network*
Fallacies of transportation systems

1. Access and accessibility

⇒ *access to transportation systems is usually open to anyone (exemptions may apply)*

⇒ *accessibility varies according to one's location within the transport system: a, b and c have access to the system. b appears to be the most accessible due to its central location in relation to the network.*

(Source: Rodrigue et al., 2013)
Fallacies of transportation systems – 2

2. Distance and time

- While distance remains constant, time can vary due to improvements in transport technology (positive effect), because of congestion (negative effect) or regulations such as speed limits.

- Speed = the unit of distance traveled per unit of time

(Source: Rodrigue et al., 2013)
A practical approach to Transport Geography
The global perspective

http://www.nasa.gov/images/content/49259main_flat_earth_nightm.jpg
The global perspective – elevation

The global perspective – mountains / slopes

The global perspective – ocean currents

http://www.physicalgeography.net/fundamentals/images/oceancurrents.gif
The global perspective – distribution of lakes and other water bodies

The global perspective – distribution of rivers

The global perspective – urban areas

http://bioval.jrc.ec.europa.eu/products/gam/images/large/urban_areas.png
The global perspective – distribution of railways

The global perspective – distribution of roads

Sea transport geography - the global perspective

Joint Research Centre – Land Resource Management Unit (European Commission)
Sea transport geography - the global perspective

Sea transport geography - the global perspective

http://static5.businessinsider.com/image/528267c3ecad04901f9f9e8f-960/tumblr_mw4i1zke0c1s3dn7vo1_1280.png
Sea transport geography - the global perspective

(a) The trajectories of all cargo ships bigger than 10 000 GT during 2007 (colour scale indicates number of journeys along each route. Ships are assumed to travel along the shortest (geodesic) paths on water.

(b) A map of the 50 ports of highest betweenness centrality and a ranked list of the 20 most central ports. 

From: The complex network of global cargo ship movements; Pablo Kaluza, Andrea Kölsch, Michael T. Gastner, Bernd Blasius; DOI: 10.1098/rsif.2009.0495Published 19 January 2010
Sea transport geography – major canals

- Global sea transports have to pass bottlenecks (chokepoints);
- **four** of which are (artificial) **canals**:

  ➤ Panama Canal
  ➤ Suez Canal
  ➤ St. Lawrence Seaway
  ➤ Kiel Canal
Sea transport geography – Panama Canal

Quite tight: Panama Canal passage today
Sea transport geography – Panama Canal
Sea transport geography – Panama Canal

Panama Canal crosssection
(http://educatoral.com/panama_canal_crosssections.jpg)

Panama Canal – saving miles
(source: as shown in picture)
Sea transport geography – Panama Canal

Panama Canal Expansion

- new lane of traffic along the Canal
- new (third) set of locks up to 13,000 TEU
  (existing locks allow up to 5,000 TEU vessels)
- doubling the waterway’s capacity
  and
- Pacific Access Channel
- Improvement of Navigational Channels (Dredging)
- Improvements to Water Supply
- works began on Sep 2007 at a total cost of US$ 5.2 bn
  (http://micanaldepanama.com/expansion/)
http://micanaldepanama.com/expansion/faq/#prettyPhoto

THIRD SET OF LOCKS

The white line indicates the path that ships will take through the locks.

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Sea transport geography – St. Lawrence Seaway
Sea transport geography – St. Lawrence Seaway

Great Lakes / St. Lawrence Seaway (Highway H2O) Facts

➡️ Lock systems:
   6 U.S. (incl. 4 parallel locks at St. Mary’s River,
   13 Canadian an one transit (Army Corps of Engineers)

➡️ Vessel maximum:
   225.5 m (740 ft.) length; 23.77 m (78 ft.) beam;
   8.08 m (26 ft., 6 in.) draft; 35.5 m (116.5 ft.) height
   above water.

➡️ Channels maintained at 8.2 m (27 ft.) minimum depth.

Sea transport geography – St. Lawrence Seaway

Great Lakes / St. Lawrence Seaway (Highway H2O) Facts

 distância
Atlantic Ocean to Duluth, Minnesota on Lake Superior = 2,038 nautical miles (3,700 kilometres), 8.5 sailing days.

Includes some 245,750 square kilometres (95,000 square miles) of navigable waters.

Sea transport geography – St. Lawrence Seaway

(Video: 05-02-The Great Lakes St. Lawrence Seaway System - A Vital Waterway)
Sea transport geography – Suez (Sues) Canal

Geographical location of Suez (Sues) Canal
Sea transport geography – Suez (Sues) Canal

Suez Canal shortens travel distance
A few examples (distance in nautical miles):

<table>
<thead>
<tr>
<th>Journey</th>
<th>via Suez Canal</th>
<th>via Cape Town</th>
<th>saving</th>
<th>in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ras Tanura – Rotterdam</td>
<td>6.436</td>
<td>11.169</td>
<td>4.733</td>
<td>42 %</td>
</tr>
<tr>
<td>Ras Tanura – New York City</td>
<td>8.281</td>
<td>11.794</td>
<td>3.513</td>
<td>30 %</td>
</tr>
<tr>
<td>Singapur – Rotterdam</td>
<td>8.281</td>
<td>11.755</td>
<td>3.647</td>
<td>30 %</td>
</tr>
</tbody>
</table>
Sea transport geography – Suez (Sues) Canal

El Ferdan Railway Bridge

(commons.wikimedia.org/wiki/Suez_Canal?uselang=de#mediaviewer/File:El_Ferdan_Railway_Bridge.jpg)
Sea transport geography – Suez (Sues) Canal

Dimensions and routing

Length

**Total length (land-crossing): 162,25 km**

(Port Said to Ismailia: 78,5 km; Ismailia to Port Taufiq: 83,75 km; plus a bulwark of 2,4 km length from into the MedSea to prevent sand deposits from River Nile)

Nautical beginning of Suez Canal: buoy 22 km ahead of Port Said marking the entrance channel and waiting zones

Nautical ending of Suez Canal: 9 km south of Port Taufiq, resulting in a **total nautical length of 193,30 km.**
Sea transport geography – Suez (Sues) Canal
Dimensions and routing

Passing places (by-pass)
➡ the passage is „single-lane“
➡ and usually takes place in convoys

Therefore three passing places with a total length of 78 km exist:
➡ Port Said Eastern Entrance
➡ Ballah By-Pass
➡ Great Bitter Lake (with waiting zones)
Sea transport geography – Suez (Sues) Canal

Depth:
24 m (since 2010) with a vessels max. draft of 20,1 m (66 ft)

Width:
North: water level 345 m / floor bed 215 m
South water level 280 m / floor bed 195 m

Cross section
North: 4.800 m² / South: 4.350 m²

Tides
Tidal amplitude 0,5 to 0,7 m in Port Said and 0,8 m to 1,4 m (2 m acc. to other sources) in Sues
Sea transport geography – Suez (Sues) Canal

Maximum dimensions of vessels

- Length: no limit
- Height: max. 68 m
- Width: 64,0 m (no restrictions; width >64 m depending on wind velocity and special regulations)
- Draft: max. 20,1 m (66 ft) – the wider the vessel the lesser the draft!

- maximum tonnage: 240 000 DWT
- vessels too big for Suez Canal are called “Capesize”
Sea transport geography – Suez (Sues) Canal

Southern exit of Suez Canal
(http://commons.wikimedia.org/wiki/Suez_Canal?uselang=de#mediaviewer/File:Port_Suez.jpg)

Southern exit, Port Taufiq, Suez (satellite view)
(http://commons.wikimedia.org/wiki/Suez_Canal?uselang=)
Sea transport geography – Kiel Canal

Satellite photo of Kiel Canal (location marked red) (NASA)

# Sea transport geography – Kiel Canal

## Technical data - 1

<table>
<thead>
<tr>
<th>Dimensions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>length:</strong></td>
<td>98.637 km</td>
</tr>
<tr>
<td><strong>width at the waterline:</strong></td>
<td>162 m (partly 102.5 m)</td>
</tr>
<tr>
<td><strong>width at the bottom:</strong></td>
<td>90 m (partly 44 m)</td>
</tr>
<tr>
<td><strong>water depth:</strong></td>
<td>11 m</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Locks</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>old locks</strong></td>
<td></td>
</tr>
<tr>
<td><strong>usable length:</strong></td>
<td>125 m</td>
</tr>
<tr>
<td><strong>usable width:</strong></td>
<td>22 m</td>
</tr>
<tr>
<td><strong>lock sill depth:</strong></td>
<td>in Brunsbüttel NN-10.20 m</td>
</tr>
<tr>
<td></td>
<td>in Kiel-Holtenau NN-9.80 m</td>
</tr>
</tbody>
</table>

| **mitred lock gates:** | 2 ebb tide and 2 flood tide doors per chamber |
| **filling:**           | through 2 side channels each with 12 branch channels |
| **lock transit time:** | 30 minutes |
## Sea transport geography – Kiel Canal

**Technical data - 2**

<table>
<thead>
<tr>
<th>new locks</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>usable length:</strong></td>
<td>310 m</td>
</tr>
<tr>
<td><strong>usable width:</strong></td>
<td>42 m</td>
</tr>
<tr>
<td><strong>depth:</strong></td>
<td>NN-14.00 m</td>
</tr>
<tr>
<td><strong>lift gates:</strong></td>
<td>each chamber 3 gates</td>
</tr>
<tr>
<td></td>
<td>the middle lock gate - which is also the reserve gate - makes it possible to transit the lock more quickly in a shortened chamber</td>
</tr>
<tr>
<td><strong>filling:</strong></td>
<td>in Brunsbüttel by revolving lock gates</td>
</tr>
<tr>
<td></td>
<td>in Holtenau through 2 side channels each with 29 branch channels</td>
</tr>
<tr>
<td><strong>lock transit time:</strong></td>
<td>45 minutes</td>
</tr>
</tbody>
</table>
### Sea transport geography – Kiel Canal

<table>
<thead>
<tr>
<th>year</th>
<th>number of ships</th>
<th>Total number of ships that passed through the KIEL-CANAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>33 522</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>34 879</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>30 948</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>year</th>
<th>gross tonnage</th>
<th>Total gross tonnage of the ships that passed through the KIEL-CANAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>154 488 820</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>166 134 880</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>149 618 384</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>year</th>
<th>total cargo in tons</th>
<th>Total cargo of the ships that passed through the KIEL-CANAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>98 036 571</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>104 038 522</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>94 630 321</td>
<td></td>
</tr>
</tbody>
</table>
Sea transport geography – Kiel Canal

Comparison of total cost for one vessel passage:
Kiel Canal, Panamakanal and Suezkanal in 2009 (in Euro)
Sea transport geography – major straits/narrows

Global sea transports have to pass bottlenecks (chokepoints), five of which – at least – are natural straits (narrows):

- Strait of Dover
- Strait of Gibraltar
- Bab-el-Mandab
- Strait of Hormuz
- Strait of Malacca
Sea transport geography – major straits/narrows

Strait of Dover

English Channel = arm of the Atlantic Ocean
* between southern England / northern France,
* joins the North Sea to the Atlantic.
* about 560 km (350 mi) long and
* varies in width from 240 km (150 mi)
  at its widest, to only 34 km (21 mi) in
  the Strait of Dover.
* over 400 commercial vessels p/day

Pictures / text, see http://www.eosnap.com/tag/strait-of-dover/
Sea transport geography – major straits/narrows

Strait of Gibraltar

- joins Atlantic Ocean to Mediterranean Sea between Spain and Morocco
  - width between 14 and 44 km
  - length about 60 km
  - water depth 300 m to 900 m (below water level)
  - passage of approx. 300 merchant vessels per day
Sea transport geography – major straits/narrows

Bab-el-Mandab

27 kilometers of water separate the Arabian peninsula and Africa and join the Red Sea to the Gulf of Aden / Arabian Sea, of utmost strategic importance
Sea transport geography – major straits/narrows

Strait of Hormuz

Strait of Hormus (Hormuz) joins Persian Gulf to Arabian Sea / Indian Ocean
min width 55 km

(http://upload.wikimedia.org/wikipedia/commons/c/cf/Stra%C3%9Fe_von_Hormuz.jpg)
Sea transport geography – major straits/narrows

[Image: Strait of Malacca]

Strait of Malacca – geographical location

Sea transport geography – major straits/narrows

Strait of Malacca

“Photo of the Day: Winging it Over the Strait of Malacca”
January 22nd, 2013
by Tahiat Mahboob
(Asia Blog)
(http://asiasociety.org/files/130121_POD_malacca.jpg)
Sea transport geography – major straits/narrows

Strait of Malacca

Key facts about the Malacca Strait (abridged, full text see slides after the next) (http://www.straitstimes.com/ - Published on Mar 12, 2014 4:38 PM)

- **800 km long** waterway connects Andaman Sea // South China Sea
- about 65 km-wide in south, broadening in north to some 250 km
- at **narrowest point** only **2.7 km wide**
- in **southern part** depth rarely beyond **36m**, usually only **27m**
  in the north-west, it deepens gradually to about **200m**
- numerous islets, reefs and sand ridges hinder passage at the southern entrance to the strait
Sea transport geography – major straits/narrows

主力军 Strait of Malacca

Key facts about the Malacca Strait (cont’d)
(abridged, full text see next 3 slides)
(http://www.straitstimes.com/ - Published on Mar 12, 2014 4:38 PM)

主力军 one of the most important shipping lanes in the world
主力军 shortest sea route between the markets of Asia and Middle
主力军 East/Europe
主力军 more than 50,000 merchant ships passing every year
主力军 ca. 1/3 of all seaborne oil - 15 mio barrels p/day (end of 2011)
主力军 nearly 80 % of China's crude oil imports passing through it
主力军 a natural bottleneck, potential for collisions, grounding
主力军 or oil spills
Sea transport geography – major straits/narrows

�ん Strait of Malacca (background information / own reading)

Key facts about the Malacca Strait
(http://www.straitstimes.com/ - Published on Mar 12, 2014 4:38 PM)

1. The 800km-long waterway connects the Andaman Sea with the South China Sea. It is about 65km-wide in the south, broadening northwards to some 250km. At its narrowest point, it is only 2.7 km wide. In its southern part, its depth is rarely beyond 36m and usually only 27m. In the north-west, it deepens gradually to about 200m as it merges with the Andaman basin. Numerous islets, some fringed by reefs and sand ridges, hinder passage at the southern entrance to the strait.

2. The narrow stretch of water is one of the most important shipping lanes in the world, as it is the shortest sea route between the growing markets of Asia and the Middle East and beyond. More than 50,000 merchant ships ply its waters every year.
Sea transport geography – major straits/narrows

† Strait of Malacca (background information / own reading)

Key facts about the Malacca Strait (cont’d)
(http://www.straitstimes.com/ - Published on Mar 12, 2014 4:38 PM)

3. The strait is also critical to global energy security. About one-third of all seaborne oil – 15 million barrels per day of oil and petroleum products - was transported through the strait at the end of 2011. But the United States Energy Information Administration says it is one of the world’s two "most strategic chokepoints" for oil trade, along with the Strait of Hormuz in the Persian Gulf. The Malacca Strait's narrowest point, at only 2.7km wide, not only creates a natural bottleneck, but also potential for collisions, grounding or oil spills.

4. The congested waterway is becoming increasingly important strategically to Beijing, with nearly 80 per cent of China's crude oil imports passing through it from the Middle East and Africa in 2011.
Sea transport geography – major straits/narrows

Strait of Malacca (background information / own reading)

Key facts about the Malacca Strait (cont’d)
(http://www.straitstimes.com/ - Published on Mar 12, 2014 4:38 PM)

5. Piracy has been a problem in the Malacca Strait, but there has been a steep decline in pirate attacks and armed robbery in recent years, partly as a result of intensified surveillance and coordinated patrols by littoral states since 2005. There was one pirate attack in the Malacca Strait from January to June in 2013, one in 2012 and none in 2011, according to the International Maritime Bureau.
Sea transport geography – more hot spots

🌊 Cape Horn

[Map of Cape Horn]

[Image: Satellite image of southern Patagonia with Punta Arenas indicated]

[Image: South America Blue Marble orthographic]

[Map of Cape Horn, Chile, with coordinates and data]

[Map of Cape Horn, Chile, with coordinates and data]

[Map of Cape Horn, Chile, with coordinates and data]
Sea transport geography – more hot spots

cury Cape of Good Hope

both pic above:
http://www.eosnap.com/?s=cape+of+good+hope
Air transport geography - the global perspective

http://routesmap.blogspot.com
Air transport geography - the global perspective

Air streams supporting and constraining air traffic

Above: Wind velocity at 10,500 meters against a Winkel tripel projection

Atmospheric circulation
http://0.tqn.com/y/weather/1/S/b/C/-/-/AtmosphCirc2.png
<table>
<thead>
<tr>
<th>RANK</th>
<th>AIRPORT</th>
<th>CARGO (Metric tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Loaded and unloaded Percent change</td>
</tr>
<tr>
<td>1</td>
<td>HONG KONG, HK (HKG)</td>
<td>4161718 2.3</td>
</tr>
<tr>
<td>2</td>
<td>MEMPHIS TN, US (MEM)</td>
<td>4137801 3.0</td>
</tr>
<tr>
<td>3</td>
<td>SHANGHAI, CN (PVG)</td>
<td>2928527 -0.3</td>
</tr>
<tr>
<td>4</td>
<td>INCHEON, KR (ICN)</td>
<td>2464384 0.3</td>
</tr>
<tr>
<td>5</td>
<td>DUBAI, AE (DXB)</td>
<td>2435567 6.8</td>
</tr>
<tr>
<td>6</td>
<td>ANCHORAGE AK, US (ANC)</td>
<td>2421145 -1.7</td>
</tr>
<tr>
<td>7</td>
<td>LOUISVILLE KY, US (SDF)</td>
<td>2216079 2.2</td>
</tr>
<tr>
<td>8</td>
<td>FRANKFURT, DE (FRA)</td>
<td>2094453 1.4</td>
</tr>
<tr>
<td>9</td>
<td>PARIS, FR (CDG)</td>
<td>2059200 -3.8</td>
</tr>
<tr>
<td>10</td>
<td>TOKYO, JP (NRT)</td>
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<td>COLOGNE, DE (CGN)</td>
<td>717146 -1.8</td>
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<td>28</td>
<td>KUALA LUMPUR, MY (KUL)</td>
<td>713254 1.6</td>
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<td>ABU DHABI, AE (AUH)</td>
<td>712488 24.1</td>
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<td>OSAKA, JP (KIX)</td>
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</tr>
</tbody>
</table>

TOTAL CARGO TRAFFIC 2013
(http://www.aci.aero/News/Releases/Most-Recent/2014/03/31/Preliminary-World-Airport-Traffic-and-Rankings-2013--High-Growth-Dubai-Moves-Up-to-7th-Busiest-Airport-)
External constraints of an international airport

Motorways, railways and settlements (Frankfurt Airport, Germany)
Internal constraints of an international airport: Chicago O‘Hare, USA

http://upload.wikimedia.org/wikipedia/commons/f/f4/O'Hare_International_Airport_(USGS).png
Hub function of an international airport: Haneda Airport, Tokyo / Japan

Discussion: How do international airports in Namibia serve the “hub” function?
A short view at
NAMIBIA’S (transport) geography
(SEE separate handout)
Thank you!!

Special thanks to
Uwe Schick (A
Germany colleague
& mentor)