CHAPTER 2

Transportation and the Spatial Structure

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The Geography of Transportation Networks

Chapter 2.1
### Types of Networks and Flows (under construction)

<table>
<thead>
<tr>
<th>Physical / structural</th>
<th>Continuous / Discontinuous</th>
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<tr>
<td>Relational / virtual</td>
<td>Symmetrical / Asymmetrical</td>
</tr>
<tr>
<td>Distribution</td>
<td>Balanced / Imbalanced</td>
</tr>
</tbody>
</table>
Network Options

LEAST COST TO USE

LEAST COST TO BUILD

HYBRID

Maximum connectivity

High travel costs: AC, BD

Compromise
Network Structures

- **Centralized**
- **Decentralized**
- **Distributed**
Structural Components of Transport Networks

Flow

NODE

Link

FEEDER

HUB

CORRIDOR

Mode B

GATEWAY

Mode A

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Centrifugal and Centripetal Networks

[Diagram showing the difference between centrifugal and centripetal networks]
Point-to-Point and Hub-and-Spoke Networks
Detour Level in a Hub-and-Spoke Network
Impacts of Integration Processes on Networks and Flows

**BEFORE INTEGRATION**

**AFTER INTEGRATION**

<table>
<thead>
<tr>
<th>NETWORK</th>
<th>INTERNATIONAL BORDER</th>
<th>FLOWS</th>
</tr>
</thead>
</table>

**NETWORK**

**FLOWS**

International border
Transportation Network Efficiency and Resilience
Cost, Revenue and Level of Network Coverage

A
- Cost: 10
- Revenue: 15
- Benefit: 5

B
- Cost: 12
- Revenue: 18
- Benefit: 6

C
- Cost: 14
- Revenue: 25
- Benefit: 11

D
- Cost: 19
- Revenue: 29
- Benefit: 10
Transport Rates and Network Structure

DIFFUSED

CENTRALIZED

Rate
- Low
- High
Cost Structure of Point-to-Point and Hub-and-Spoke Networks

Point-to-Point Total Costs: Total: 15,000

Hub-and-Spoke Total Costs: Total: 5,850
Topology of a Network

Unidirectional link

Bi-directional link
Network Topologies

- **Mesh**
- **Hub-and-Spoke**
- **Linear**
- **Tree**
Network Geometry and Number of Links

### For each node to be linked to another node

- **Even number of nodes**
  - $n/2 = 2$

- **Odd number of nodes**
  - $(n+1)/2 = 3$

### For all the nodes to be linked together

- $n-1 = 5$

### For each node to be linked to all other nodes

- $n(n-1)/2 = 10$

### Number of possible combinations

- $2^{n(n-1)/2} = 8$
Topology and Network Connectivity

- Average Path Length
- Minimum Network
  - Geographic Barrier
- Network Length
  - Fully Connected Network

A
B
C
D
**Typology of Transportation Networks**

<table>
<thead>
<tr>
<th>Abstraction level</th>
<th>Concrete</th>
<th>Abstract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative location</td>
<td><img src="image1" alt="Concrete Relative Location" /></td>
<td><img src="image2" alt="Abstract Relative Location" /></td>
</tr>
<tr>
<td>Number of edges and nodes</td>
<td><img src="image3" alt="Number of Edges and Nodes" /></td>
<td><img src="image4" alt="Number of Edges and Nodes" /></td>
</tr>
<tr>
<td>Types of traffic</td>
<td>Continuous</td>
<td>Divided</td>
</tr>
<tr>
<td>Volume and direction</td>
<td><img src="image5" alt="Volume and Direction" /></td>
<td><img src="image6" alt="Volume and Direction" /></td>
</tr>
<tr>
<td>Orientation and extent</td>
<td><img src="image7" alt="Orientation and Extent" /></td>
<td><img src="image8" alt="Orientation and Extent" /></td>
</tr>
<tr>
<td>Type of traffic</td>
<td><img src="image9" alt="Type of Traffic" /></td>
<td><img src="image10" alt="Type of Traffic" /></td>
</tr>
<tr>
<td>Volume and direction</td>
<td><img src="image11" alt="Volume and Direction" /></td>
<td><img src="image12" alt="Volume and Direction" /></td>
</tr>
<tr>
<td>Number of edges and nodes</td>
<td><img src="image13" alt="Number of Edges and Nodes" /></td>
<td><img src="image14" alt="Number of Edges and Nodes" /></td>
</tr>
<tr>
<td>Load and capacity</td>
<td><img src="image15" alt="Load and Capacity" /></td>
<td><img src="image16" alt="Load and Capacity" /></td>
</tr>
<tr>
<td>Type of correspondence</td>
<td>Hierarchical</td>
<td>Non-hierarchical</td>
</tr>
<tr>
<td>Distance, road type and control</td>
<td>Highway 125 km, Secondary road 90 km</td>
<td><img src="image17" alt="Distance and Control" /></td>
</tr>
<tr>
<td>Pattern</td>
<td>Linear</td>
<td>Random</td>
</tr>
<tr>
<td>Change (dynamics)</td>
<td><img src="image18" alt="Change Dynamics" /></td>
<td><img src="image19" alt="Change Dynamics" /></td>
</tr>
</tbody>
</table>
Transport Networks and Space

Transport Network

Space

Accessibility

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Mode of Territorial Occupation by Transport Networks

- **Road**: Clearly defined
- **Rail**: Vaguely defined
- **Cellular coverage**: Without definition

Overlap

"No service"
Network Strategies to Service a Set of Locations
Absolute and Relative Distance in a Network

**Absolute Distance**

10 km

**Relative Distance**

30 minutes
Networks and Spatial Continuity

Diagram A

Diagram B

Diagram C
# Spatial Continuity by Transportation Mode

<table>
<thead>
<tr>
<th></th>
<th>Ubiquity</th>
<th>Fractionalization</th>
<th>Instantaneity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automobile</td>
<td>High (road coverage the most extensive)</td>
<td>None (1 passenger = 1 movement)</td>
<td>High (available on demand)</td>
</tr>
<tr>
<td>Transit</td>
<td>Average (within metropolitan areas)</td>
<td>Average (bus loads or train loads)</td>
<td>Average to high (fixed high frequency schedules)</td>
</tr>
<tr>
<td>Air transport</td>
<td>Limited to airports (common)</td>
<td>Average (plane loads from 50 to 500 passengers)</td>
<td>Average (fixed schedules and connections)</td>
</tr>
<tr>
<td>Maritime</td>
<td>Limited to ports (rare)</td>
<td>High (ship loads, reinforced by economies of scale)</td>
<td>Low (fixed schedules and connections)</td>
</tr>
<tr>
<td>Rail</td>
<td>Limited to rail terminals (common)</td>
<td>Average (train loads)</td>
<td>Average (fixed schedule)</td>
</tr>
<tr>
<td>Pipeline</td>
<td>Limited to network</td>
<td>Low (continuous flow)</td>
<td>High (continuous flow)</td>
</tr>
</tbody>
</table>
## Networks as Tools of Spatial Cohesion (Control)

<table>
<thead>
<tr>
<th>Period</th>
<th>Emerging Network</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-colonial</td>
<td>Fluvial, coastal and road</td>
<td>Empire building</td>
</tr>
<tr>
<td>Colonial Era</td>
<td>Maritime</td>
<td>Trade, exploitation and political control</td>
</tr>
<tr>
<td>19\textsuperscript{th} Century</td>
<td>Canal and rail</td>
<td>Nation building, commerce and political control</td>
</tr>
<tr>
<td>20\textsuperscript{th} Century</td>
<td>Highways and air</td>
<td>National and transnational integration</td>
</tr>
<tr>
<td>21\textsuperscript{st} Century</td>
<td>Telecommunication</td>
<td>Global supply chains</td>
</tr>
</tbody>
</table>
Transport and Spatial Organization

Chapter 2.2
Transportation Infrastructures and their Constraints

**Physical and Environmental**
- Conventional physical constraints impacting transport infrastructure.
- Climate constraints and weather disruptions.

**Demand**
- Transport infrastructure designed to meet a specific demand level.
- Variations in the demand and accidents can create bottlenecks.

**Financing**
- Transportation infrastructure is capital intensive.
- Securing financing can constrain infrastructure development.

**Construction and Maintenance**
- Construction and maintenance of infrastructure create disruptions in existing operations.

**Regulations**
- Restrictions about how transport infrastructure can be developed, owned and operated.
- Pressures from advocacy groups.
Scales of Spatial Organization for Transportation

**GLOBAL**
- **Nodes**: Gateways and hubs (airports and ports)
- **Links**: Air and maritime routes
- **Relations**: Investment, trade and supply chains

**REGIONAL**
- **Nodes**: Metropolitan areas
- **Links**: Corridors (rail lines, highways, canals)
- **Relations**: Urban system and hinterland

**LOCAL**
- **Nodes**: Employment and commercial activities
- **Links**: Roads and transit systems
- **Relations**: Commuting and distribution
Forces of Geographical Concentration and Dispersion

- **Centrifugal**
  - Immobile factors
  - Land rent
  - External diseconomies

- **Centripetal**
  - Location
  - Attributes
  - Accessibility
  - Market size
  - Labor market
  - External economies

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Factors of Polarization (under construction)

<table>
<thead>
<tr>
<th>Network</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load break</td>
</tr>
<tr>
<td>Competition</td>
</tr>
<tr>
<td>Services</td>
</tr>
<tr>
<td>Agglomeration economies</td>
</tr>
</tbody>
</table>

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Poles of the Global Economy
The Layers of Connectivity

Locational
Infrastructural
Transport
Valorization

Demand Pull

Functional

Shipper
Customer

Locational
Infrastructural
Logistical

Accessibility
Fluidity
Links
Networks
Flows
Efficiency

Relations

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The Relevance of Connectivity

- **Effect**
  - Economic
  - Network
  - Spatial

- **Issue**
  - Interactions, Costs, Opportunities
  - Capacity, Reliability, Resilience
  - Hinterlands, Policy, Development, Inequalities

- **Stakeholders**
  - BCO (importers and exporters), Producers, Retailers, Wholesalers
  - Terminals, Modes, Shippers, Logistics service providers, Infrastructure managers
  - Civil society, Governments

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Accessibility and Connectivity

Accessibility

- Traffic potential (passengers and freight)
- Market / Hinterland
- Space / Time
- Trade or commercial policy

Connectivity

- Transportation network (modes and terminals)
- Gateways, hubs and links
- Capacity, reliability, resilience
- Logistics (transport) policy

Focus

- Structure
- Performance
- Governance
The Components of Nodal Connectivity

Gateway or Hub

Hinterland Connectivity
Regional corridors (rail, road, fluvial)

Foreland Connectivity
Global air and maritime shipping networks
The Three Tiers of Connectivity

Terminals (networks)

Distribution (supply chains)

Production and consumption (trade)
Gateways and Hubs

Intermodal

Gateways

Mode A

Mode B

Corridor

Transmodal

Hubs

Mode A

Mode B
## The Three Main Gateways of North America

<table>
<thead>
<tr>
<th>Gateway System</th>
<th>Gateways</th>
<th>Total share (%)</th>
<th>Imports / Exports ($ billions) 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southern California</td>
<td>Port of Los Angeles, Port of Long Beach, Los Angeles International Airport, Otay Mesa (Port of Entry)</td>
<td>17.4%</td>
<td>$329.5 $108.1</td>
</tr>
<tr>
<td>New York / New Jersey</td>
<td>JFK International Airport, Newark Liberty International Airport, Port of New York / New Jersey</td>
<td>13.5%</td>
<td>$219.2 $121.3</td>
</tr>
<tr>
<td>Detroit</td>
<td>Detroit (Port of Entry), Huron (Port of Entry)</td>
<td>8.5%</td>
<td>$109.6 $104.1</td>
</tr>
</tbody>
</table>
Types of Hinterland Connectivity

Inland Center

Gateway

A

B

C
Types of Bottlenecks

Infrastructure Bottlenecks
- Chronic
  - Climate
  - Under-investment
  - Physical restrictions
- Temporary
  - Weather
  - Construction and accidents
  - Demand surge
  - Dis-investment

Regulatory Bottlenecks
- Direct
  - Customs
  - Security
  - Compliance (quality, safety)
- Indirect
  - Cabotage
  - Competition policy
  - Fiscal policies

Operational Bottlenecks
- Capacity
  - Availability of conveyances
  - Labor shortages
- Efficiency
  - Productivity of modes and terminals
  - Labor skills
  - Coordination
Main Transportation Bottlenecks

Capacity Bottlenecks
- Lack of terminal or connector capacity.
- Lack or absence of intermodal options.

Operational Bottlenecks
- Lack of logistical services.
- Lack of logistical performance (cost, time and reliability).

Institutional Bottlenecks
- Lack of clear mandate and jurisdiction.
- Lack of coordination and cooperation.

Skills Bottlenecks
- Lack of labor flexibility.
- Lack of qualified labor.
- Lack of training programs.

Integration-Based Bottlenecks
- Customs clearance delays.
- Cabotage restrictions.
- Competition and fiscal policies.
- Lack of clear mandate and jurisdiction.
- Lack of coordination and cooperation.

Distribution-Based Bottlenecks
- Lack of terminal or connector capacity.
- Lack or absence of intermodal options.
- Lack of qualified labor.
- Natural or man-made disruptions.
- Lack of investment and maintenance.

Transaction-Based Bottlenecks
- Lack of logistical services.
- Lack of logistical performance (cost, time and reliability).
World Cities, 2012

World City Index (2012)

- Fourth Tier (Less than 1.25)
- Third Tier (1.25 to 2.5)
- Second Tier (2.5 to 3.5)
- First Tier (3.5 and above)
<table>
<thead>
<tr>
<th>Criteria to be a World City (Foreign Policy)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recognition</strong></td>
</tr>
<tr>
<td>First-name familiarity; a city is recognized without the need for a political subdivision (e.g. London, UK or Paris, France).</td>
</tr>
<tr>
<td><strong>Influence in international affairs</strong></td>
</tr>
<tr>
<td><strong>Large population</strong></td>
</tr>
<tr>
<td>Population of at least one million, typically several million.</td>
</tr>
<tr>
<td><strong>Transport hub</strong></td>
</tr>
<tr>
<td>Major port and/or airport facilities. Several highways and/or a large mass transit network (rapid transit, light rail, regional rail, ferry, or bus).</td>
</tr>
<tr>
<td><strong>Large cultural communities</strong></td>
</tr>
<tr>
<td>Several international cultural groups and/or expatriate communities.</td>
</tr>
<tr>
<td><strong>International institutions</strong></td>
</tr>
<tr>
<td>Financial institutions, law firms, corporate headquarters, international conglomerates, and stock exchanges (influence on the global economy). Cultural institutions (museums and universities).</td>
</tr>
<tr>
<td><strong>Media and telecommunications</strong></td>
</tr>
<tr>
<td>Several powerful and influential media outlets with an international reach. Advanced communications infrastructure (fiber optics, Wi-Fi networks, cellular phone services).</td>
</tr>
<tr>
<td><strong>International events</strong></td>
</tr>
<tr>
<td>An active cultural scene (film festivals, music or theatre scene, an orchestra, an opera company, art galleries). Major sport events (e.g. Olympics, World Cup).</td>
</tr>
<tr>
<td>Criteria to be a World City (AT Kearney)</td>
</tr>
<tr>
<td>-----------------------------------------</td>
</tr>
<tr>
<td><strong>Business activity</strong></td>
</tr>
<tr>
<td>The economic weight of the city; headquarters of major multinational corporations, locations of top business services firms, the value of capital (stock) markets, the number of international conferences, and the flow of goods through ports and airports.</td>
</tr>
<tr>
<td><strong>Human capital</strong></td>
</tr>
<tr>
<td>Capacity to attract and train talent; size of foreign-born population, quality of universities, number of international schools, international student population, and number of residents with university degrees.</td>
</tr>
<tr>
<td><strong>Information exchange</strong></td>
</tr>
<tr>
<td>The effectiveness of information flows; accessibility to major TV news channels, internet presence, number of international news bureaus, level of censorship and broadband subscriber rate.</td>
</tr>
<tr>
<td><strong>Cultural influence</strong></td>
</tr>
<tr>
<td>The cultural weight of the city; number of major sporting events, number of museums, performing-arts venues, culinary establishments, number of international travelers and number of sister-city relationships.</td>
</tr>
<tr>
<td><strong>Political engagement</strong></td>
</tr>
<tr>
<td>The level of influence on global politics; number of embassies and consulates, major think tanks, international organizations and local institutions with international reach, and the number of political conferences.</td>
</tr>
</tbody>
</table>
The Spatial Setting of Market Areas

Radial Market Areas

Optimal Coverage with Radial Market Areas

From Radial into Hexagonal Market Area

Optimal Coverage with Hexagonal Market Areas
# Market Size / Area Relationships in the Central Places Theory

## Diagram

The diagram illustrates the relationship between market area radius and market size (population) for different order towns in the central places theory. The x-axis represents the market area radius (km), while the y-axis represents the population of the market area (millions). The different order towns are represented by different symbols and are labeled as follows:

- **M** (Marktort)
- **A** (Amtsort)
- **K** (Kreisstadt)
- **B** (Bezirkstadt)
- **G** (Gaustadt)
- **P** (Provinzstadt)
- **L** (Landstadt)

## Table

<table>
<thead>
<tr>
<th>Order</th>
<th>Radius (km)</th>
<th>Town Population</th>
<th>Market Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>M (Marktort)</td>
<td>4</td>
<td>1,000</td>
<td>3,500</td>
</tr>
<tr>
<td>A (Amtsort)</td>
<td>6.9</td>
<td>2,000</td>
<td>11,000</td>
</tr>
<tr>
<td>K (Kreisstadt)</td>
<td>12</td>
<td>4,000</td>
<td>35,000</td>
</tr>
<tr>
<td>B (Bezirkstadt)</td>
<td>20.7</td>
<td>10,000</td>
<td>100,000</td>
</tr>
<tr>
<td>G (Gaustadt)</td>
<td>36</td>
<td>30,000</td>
<td>350,000</td>
</tr>
<tr>
<td>P (Provinzstadt)</td>
<td>62.1</td>
<td>100,000</td>
<td>1,000,000</td>
</tr>
<tr>
<td>L (Landstadt)</td>
<td>108</td>
<td>500,000</td>
<td>3,500,000</td>
</tr>
</tbody>
</table>

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Variations of the Central Places Theory

**Marketing Principle**

**Transport Principle**

**Administrative Principle**

K=3  

K=4  

K=7
Growth Poles Theory

The Setting of a Growth Pole

Emergence of a Secondary Growth Pole

Core Industry
- Linked to core industry

Secondary Industry
- Linked to secondary Industry

Suppliers
- Upstream linked industries

Customers
- Downstream linked industries
Core-Periphery Stages of Development in an Urban System

1. Initial stage: Core and Periphery

2. Development stage: Core gaining influence on Periphery

3. Integration stage: Core and Periphery integrated

4. Advanced stage: Core and Periphery fully integrated
Conceptual Corridor Development

A

B

C

D

E

F
Transport Corridors and the Regional Spatial Structure
Main North American Gateways, Corridors and Inland Freight Clusters

[Map of North America showing various gateways, corridors, and freight clusters.]

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Land Use Value by Activity Sector in Function of the Distance from the CBD
Central Places in Urban Areas

1) CBD
2) Regional Center
3) Neighborhood Center
4) Local Center

Major axis
Minor axis
Transportation and Location

Chapter 2.3
Strategic Decision Making in Location

PRODUCT
What to produce or sell?

INPUTS
How to produce?

MARKETS
For whom and in what quantity?

SPACE
Where to produce?
<table>
<thead>
<tr>
<th><strong>Traditions in Location Theories</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Neo-classical</strong></td>
</tr>
<tr>
<td><strong>Behavioral</strong></td>
</tr>
<tr>
<td><strong>Institutional</strong></td>
</tr>
<tr>
<td><strong>Economic base</strong></td>
</tr>
<tr>
<td><strong>Location factors</strong></td>
</tr>
<tr>
<td><strong>Cumulative causation</strong></td>
</tr>
<tr>
<td><strong>Core-periphery</strong></td>
</tr>
<tr>
<td><strong>Industrial district</strong></td>
</tr>
<tr>
<td><strong>Innovative milieu</strong></td>
</tr>
<tr>
<td><strong>Competitive advantage</strong></td>
</tr>
</tbody>
</table>
Historical Urban Location Factors

### Defense
- River-meander site
- River-island site
- Peninsula site (or offshore island)
- Sheltered harbor site

### Commerce
- Bridge-point site
- Confluence site
- Portage site
- Head of navigation site

**City**  \**Fortifications**  \**Road**
Factors in Urban Location

Connectivity

Proximity

Accessibility
The Location Spectrum

Non-material inputs

(Location factors)

Material Inputs

(Outputs)

- (Labor, Capital, Technology, Policies, Regulations)
- (Resources, Parts, Energy, Land)
- (Markets, Customers)
Behavioral Approach to Location

Information

Availability

Capacity to Use

Homo oeconomicus

Territory

Spatial margins of profitability

Profitability

Costs

Revenue

C11

C22

C35

Cn1

Cnn

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Basic Location Factors

- **Micro (local):** Land, utilities, visibility, transportation (local access), amenities
- **Meso (regional):** Labor, materials, energy, markets, suppliers / customers
- **Macro (national):** Capital, subsidies, regulations, taxation, technology

**Scale:**
- **Site:** Land, utilities, visibility, transportation (local access), amenities
- **Accessibility:** Labor, materials, energy, markets, suppliers / customers
- **Socioeconomic Environment:** Capital, subsidies, regulations, taxation, technology

**Location:**
<table>
<thead>
<tr>
<th>Country Factors</th>
<th>Region Factors</th>
<th>Local Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Government rules, attitudes, political risk, incentives</td>
<td>• Attractiveness of region (culture, taxes, climate, etc.)</td>
<td>• Site size and cost</td>
</tr>
<tr>
<td>• Culture &amp; economy</td>
<td>• Labor, availability &amp; costs</td>
<td>• Air, rail, highway, and waterway systems</td>
</tr>
<tr>
<td>• Market location</td>
<td>• Costs and availability of utilities</td>
<td>• Zoning restrictions</td>
</tr>
<tr>
<td>• Labor availability, attitudes, productivity, and cost</td>
<td>• Environmental regulations of state and town</td>
<td>• Nearness of services / supplies needed</td>
</tr>
<tr>
<td>• Availability of supplies, communications, energy</td>
<td>• Government incentives</td>
<td>• Environmental impact issues</td>
</tr>
<tr>
<td>• Exchange rates and currency risks</td>
<td>• Proximity to raw materials &amp; customers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Land/construction costs</td>
<td></td>
</tr>
</tbody>
</table>
**Locational Changes in Manufacturing**

1. **Intensification**
   - Production
   - Employment

2. **Specialization**
   - Product A
   - Product B
   - Product C
   - Product D
   - Closing

3. **Concentration**
   - X

4. **Rationalization and relocation**
   - X
   - X
   - X

---

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Main Types of Economies in Production, Distribution and Consumption

<table>
<thead>
<tr>
<th>Economies of Transportation</th>
<th>Economies of Scale</th>
<th>Economies of Scope</th>
<th>Economies of Agglomeration</th>
<th>Economies of Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower unit costs through accessibility to suppliers and customers</td>
<td>Lower unit costs with larger plants</td>
<td>Lower unit output costs with more product types</td>
<td>Industrial and service linkages with manufacturing clusters</td>
<td>Increased accessibility to labor (skills) with higher densities</td>
</tr>
<tr>
<td>Lower unit distribution costs through transport chains management</td>
<td>Lower unit transport costs through larger modes and terminals</td>
<td>Lower transport costs with bundling of different loads</td>
<td>Lower input costs with clustering of distribution activities</td>
<td>Lower unit distribution costs with higher densities</td>
</tr>
<tr>
<td>Lower unit output costs through accessibility to suppliers and customers</td>
<td>Lower unit costs with larger retail outlets</td>
<td>Product diversification attracts more customers</td>
<td>Lower input costs with clustering of retail activities</td>
<td>Increased accessibility to goods and services with higher densities</td>
</tr>
</tbody>
</table>

© GTS
# Main Location Factors for Distribution Activities

<table>
<thead>
<tr>
<th>Influences</th>
<th>Factors</th>
</tr>
</thead>
</table>
| **Production and transport economics** | • Relative availability and cost of land and labour at port or inland location  
• Danger of diminishing returns such as congestion, energy and empty movements.  |
| **Capacity and congestion**        | • Congestion in the port and access infrastructure.  
• Quality and capacity of hinterland connections.  
• Availability of inland distribution centres, custom clearance, container depots and logistics facilities.  |
| **Market structure and trade strategy** | • Trade structure of the region: physical geography, resource endowment, centrality/intermediacy, mix of foreign and locally sourced inputs, regional specialisations, history of the region.  
• Degree of vertical cooperation and integration between port and inland transport operators  
• Strong port competition driving new initiatives to extend their cargo base, either by securing hinterlands or by anchoring tenants at the port.  |
| **Supply chain management**        | • Supply chain strategy of local shippers and distributors (e.g. push vs pull, high or low inventory, primary/secondary distribution needs). Integration of inland terminals within supply chain management practices (e.g. acting as stock buffers).  
• Dominance of merchant vs carrier haulage in the region.  |
| **Policy and regulation**          | • Economic development strategies of public sector agencies leading to favourable land use policy, zoning, financial incentives.  
• Policies related to foreign trade zones and customs procedures.  
• Cargo safety and security procedures. |
Basic Location Strategies

**Costs Minimization**

- Revenue
- Costs
- Profits
- Points: A, O1, B

**Profit Maximization**

- Revenue
- Profits
- Costs
- Points: A, O3, B

**Revenue Maximization**

- Revenue
- Profits
- Costs
- Points: A, O2, B
Accessibility and Location

Concentric Circles

Linear Buffers

Accessibility Requirement

Site Accessibility

Accessibility Requirement

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The Four Main Locational Influences of Transportation

- Transport Costs
- Agglomeration Economies
- Economies of Density
- Co-Location
Resource and Market Orientation

Resource Orientation

- Heavier input, shorter distance to assembly
- Raw materials → Manufacturing

Market Orientation

- Lighter input, longer distance to assembly
- Lighter output, longer distance to market
- Heavier output, shorter distance to market
Types of Manufacturing Clusters

- **Marshallian Industrial Cluster**
  - Suppliers
  - Customers
  - Small local firm

- **Hub-and-Spoke Cluster**
  - Large firm

- **Satellite Platform Cluster**
  - Branch plant
Transport and Co-Location

Co-Location Zone

Terminal

Activity
Information Technologies and Mobility

Chapter 2.4
Organizational Forms in Human Societies

- **Agricultural (First Wave)**
  - Hierarchy based on heredity
  - Feudal structures

- **Industrial (Second Wave)**
  - Vertically oriented bureaucracies
  - Democratic representation

- **Information (Third Wave)**
  - Networked bureaucracies
  - Multilateral consensus
<table>
<thead>
<tr>
<th>Media Type</th>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newspapers</td>
<td>1630s</td>
<td>Emerged with the printing press and movable types (17th century). Many specializations (general and financial).</td>
</tr>
<tr>
<td>Magazines</td>
<td>1730</td>
<td>Periodicals (weekly, monthly) focusing on specific topics (events, politics, people, fashion, technology).</td>
</tr>
<tr>
<td>News agencies</td>
<td>1835</td>
<td>Provide news to the media (Reuters, Bloomberg, Associated Press, Agence France Presse).</td>
</tr>
<tr>
<td>TV / Cable</td>
<td>1945 / 1980</td>
<td>Visual access to the private home. Richer content. Specialization of channels (cable).</td>
</tr>
<tr>
<td>Mobile phones / Smartphones</td>
<td>1983 / 2001</td>
<td>Portable telecommunication / Portable media access. Multifunctional device (camera, recorder, GPS).</td>
</tr>
</tbody>
</table>
The Myth of the Dematerialization of the Economy

Platform Corporation
- Focus on core competencies
- Outsourcing low added value activities

Apple focuses on product design and retailing (Apple Store). Relies on a massive network of original equipment manufacturers.

E-Commerce
- Lessen the footprint of retail stores
- Developing a network of distribution centers

Amazon owns a network of e-fulfillment centers (distribution centers) processing large volumes of cargo (orders). It also operates parcel delivery services.

Asset Management
- Manage existing assets more efficiently.
- Developing platforms connecting the supply and demand of services.

Uber links users with individual car owners willing to provide a taxi service.
Airbnb links users with property owners.
# The Substitution and Generation Effects of Information Technologies on Mobility

<table>
<thead>
<tr>
<th>Virtual Activity</th>
<th>Substitution</th>
<th>Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telecommuting</td>
<td>Commuting trips</td>
<td>New discretional trips due to time savings</td>
</tr>
<tr>
<td>Distance Learning</td>
<td>Trips to educational institutions</td>
<td></td>
</tr>
<tr>
<td>Online Banking</td>
<td>Trips to financial institutions</td>
<td></td>
</tr>
<tr>
<td>Social Media</td>
<td>Trips to social events</td>
<td></td>
</tr>
<tr>
<td>Teleconferencing</td>
<td>Trips to conference venues</td>
<td></td>
</tr>
<tr>
<td>Virtual Entertainment</td>
<td>Trips to event venues</td>
<td></td>
</tr>
<tr>
<td>E-commerce</td>
<td>Trips to stores</td>
<td></td>
</tr>
<tr>
<td>Electronic Documents</td>
<td>Courier trips, Mail deliveries</td>
<td></td>
</tr>
<tr>
<td>Monitoring</td>
<td>Professional and work trips</td>
<td></td>
</tr>
</tbody>
</table>

**Flows**
- **Passengers**
- **Freight**

**Logistics and deliveries to new destinations**
Mail Carried by USPS and Parcels Carried by Major Carriers, United States, 2004-2020 (in billion units)
Possible Impacts of ICT on Mobility (under construction)
### Factors behind the Impacts of ICT on Mobility Mitigation

<table>
<thead>
<tr>
<th>No ICT counterpart</th>
<th>Mobility cannot be substituted. Mandatory co-location.</th>
</tr>
</thead>
<tbody>
<tr>
<td>No practical or desirable ICT counterpart</td>
<td>Mobility can be substituted, but outcome much less practical.</td>
</tr>
<tr>
<td>Positive utility of mobility</td>
<td></td>
</tr>
<tr>
<td>ICT not a replacement for travel</td>
<td></td>
</tr>
<tr>
<td>Time and cost substitution</td>
<td></td>
</tr>
<tr>
<td>Cheaper mobility</td>
<td></td>
</tr>
<tr>
<td>Efficiency improvements</td>
<td></td>
</tr>
<tr>
<td>Travel productivity</td>
<td></td>
</tr>
<tr>
<td>Additional travel demand</td>
<td></td>
</tr>
<tr>
<td>Globalization</td>
<td></td>
</tr>
<tr>
<td>Decentralization</td>
<td></td>
</tr>
</tbody>
</table>
The Digitalization of Mobility

Digital Services
- Access Devices: Entry and interaction with information systems
- Geospatial Services: Real-time locational information
- Connectivity Networks: Communication between elements of the information system
- Open Data Exchanges: Data exchange between elements of the information system
- Integrated Payments: System to settle transactions
- Cloud Services: Receive, store and retrieve large databases
- Blockchain: Encrypt transactions and events in a ledger

Physical Services
- Access Devices
- Geospatial Services
- Connectivity Networks
- Open Data Exchanges
- Integrated Payments
- Cloud Services
- Blockchain
<table>
<thead>
<tr>
<th>“X-pooling”</th>
<th>“X-hailing”</th>
<th>“X-sharing”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus-pooling</td>
<td>Ride-hailing/Ride-sourcing</td>
<td>Sharing of vehicles</td>
</tr>
<tr>
<td>Vanpooling</td>
<td>e-hailing</td>
<td>Ride sharing</td>
</tr>
</tbody>
</table>

- **On-demand operation of bus-like services but using dynamic routing in buses or vans owned by the platform with sharing of the space inside the vehicle by passengers.**
- **On-demand operation of taxi-like personal transport directly from origin to destination. The service comes with a driver, either through privately-owned vehicles that connect to the platform (ride-hailing/ride-sourcing), or through official taxi services that are enabled by digital platforms (e-hailing).**
- **Shared access to vehicles which can either be owned by the platform, or by individual owners that share such assets. In addition, “rides” can also be shared, wherein vehicle trips (activity-based) which would have happened anyway (i.e. from A to B) are shared with other users (thus making use of latent vehicle capacity).**
Forms of Digitalization in Freight Transportation

- **Goods**
  - RFID.
  - Sensors.
- **Conveyances**
  - Sensors.
  - Navigation.
  - Routing.
  - Vehicle automation.
- **Infrastructure**
  - Sensors.
  - Traffic management.
  - Terminal automation.
- **Business process**
  - Electronic data exchange.
  - Blockchain.
Digital Freight Platform

Transportation Service Providers

ICT Service Providers

Freight Platform

Operators

BCO

Public Authorities
**Freight Visibility (Tracking)**
- Improve the reliability of supply chain management.
- Status and locations of shipments (vehicles, rail cars, containers and individual loads).
- Mobile communications and Global positioning systems (GPS).
- Radio-frequency identification (RFID) tags and bar codes.

**Asset Management**
- Maximize equipment utilization.
- Equipment location (tractors, trailers, rail cars, containers, ships).
- Real Time Locating Systems (GPS and RFID tags).
- Status monitoring of vehicle and cargo conditions.

**Efficiency Improvements**
- Improve productivity and reduce data errors.
- Verification and exchange of shipment information.
- Non-intrusive inspection and information technologies such as optical character readers (OCR), RFID tags and bio-metrics (to identify drivers).

**Freight Information Exchange**
- Information exchange using web-based technologies and electronic data interchange (EDI).
- Real-time terminal information systems.
- Blockchains.

**Regulatory Compliance**
- Pre-screen shipments and direct low-risk freight to quick clearance.
- Enhance security at international borders.
- Electronic pre-notification of shipment information.