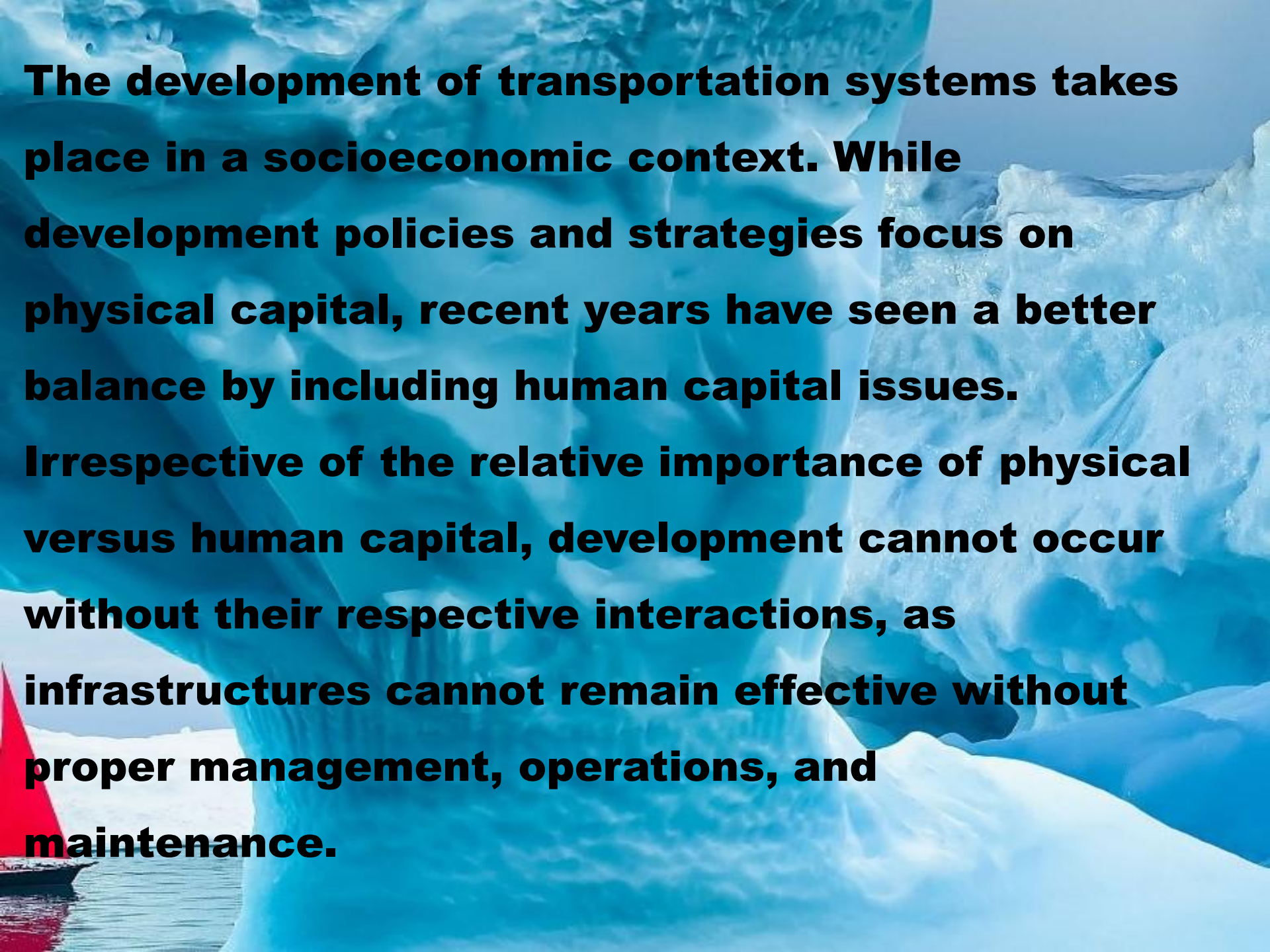
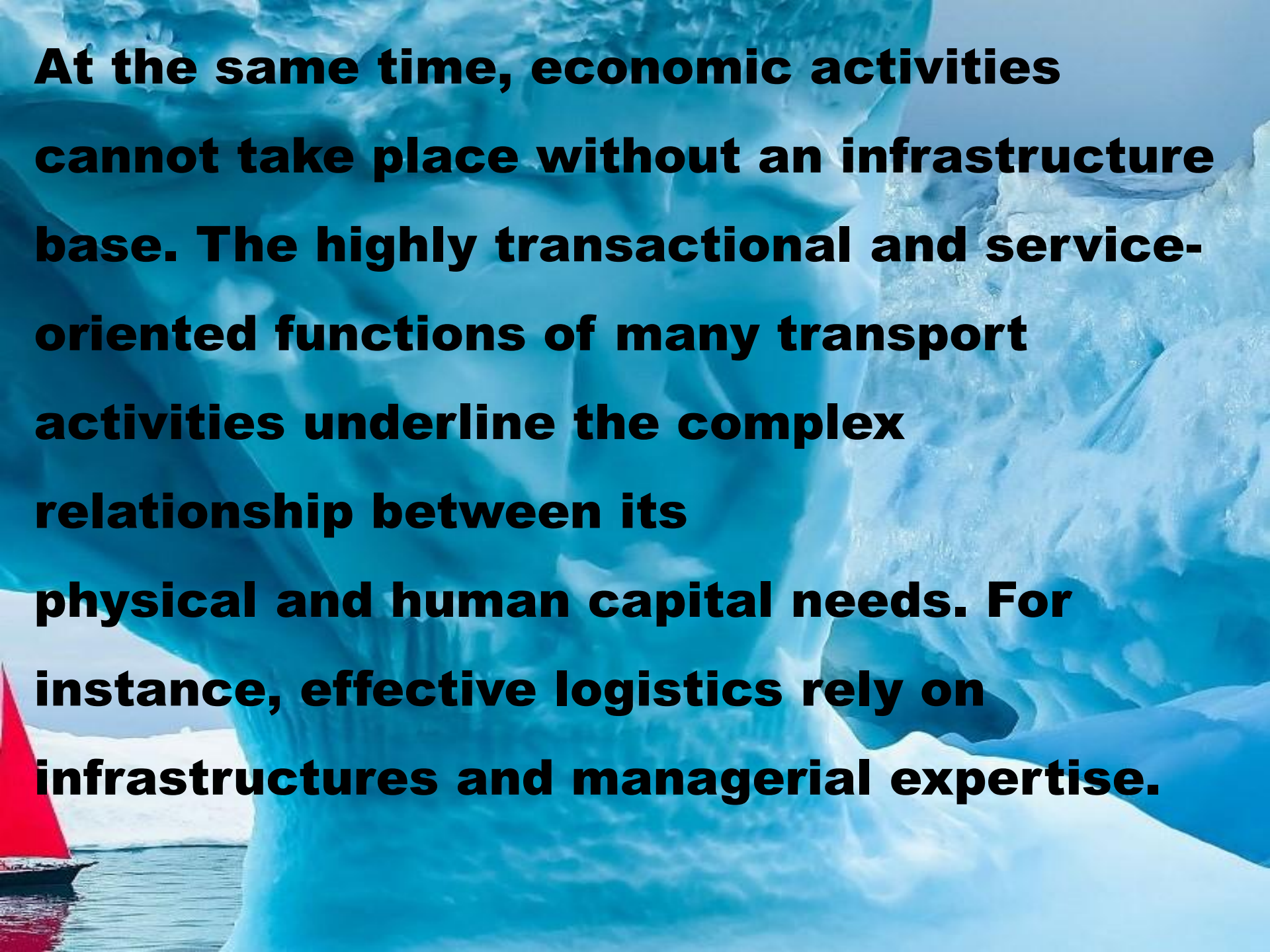


The Economic Importance of Transportation

Development can be defined as improving the welfare of a society through appropriate social, political, and economic conditions. The expected outcomes are quantitative and qualitative improvements in human capital (e.g. income and education levels) as well as physical capital such as infrastructures (utilities, transport, communications System technology's).

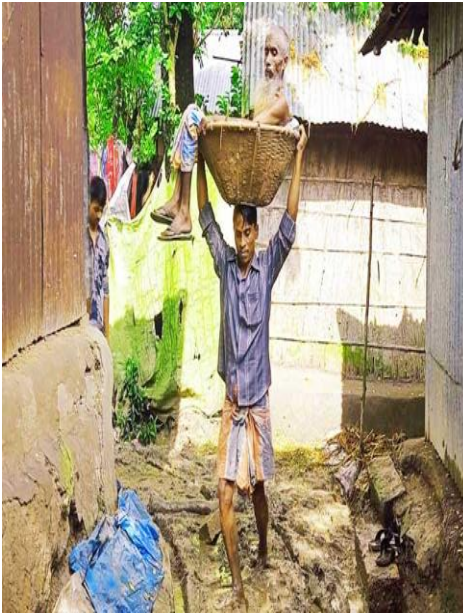
The background of the slide is a photograph of a massive iceberg in the ocean. The iceberg is a deep blue color and has a jagged, textured surface. In the bottom left corner, a small portion of a red sailboat is visible. The text is overlaid on the image in a bold, black, sans-serif font.

The development of transportation systems takes place in a socioeconomic context. While development policies and strategies focus on physical capital, recent years have seen a better balance by including human capital issues. Irrespective of the relative importance of physical versus human capital, development cannot occur without their respective interactions, as infrastructures cannot remain effective without proper management, operations, and maintenance.

A large, jagged iceberg floats in the ocean, its surface textured with various shades of blue and white. In the bottom left corner, the red sail of a sailboat is visible against the dark water. The background shows a clear blue sky and a distant horizon line.

At the same time, economic activities cannot take place without an infrastructure base. The highly transactional and service-oriented functions of many transport activities underline the complex relationship between its physical and human capital needs. For instance, effective logistics rely on infrastructures and managerial expertise.

Chronological Evolution of Transport System in the World



 Boat	 Cruise Ship	 Submarine	 Steam boat
 Cargo Ship	 Motorboat	 Hovercraft	 Sailboat
 Jet scooter	 Warship	 Houseboat	 Raft
 Yacht	 Pirate ship	 Bulk Carrier	 Catamaran



Bicycle

Van

Truck



Tractor

Motorcycle

Train



27 SEPTEMBER 1825

train passes through dragonfruit fields in south central Vietnam. Photo courtesy of Saigonairways

The background of the slide is a blue-tinted photograph of a sailboat on the water. The sailboat is the central focus, with its mast and rigging visible. The water is a deep blue, and the sky is a lighter blue. The overall tone is professional and modern.

High density transport infrastructure and highly connected networks are commonly associated with high levels of development.

When transport systems are efficient, they provide economic and social opportunities and benefits that result in positive multiplier effects, such as better accessibility to markets, employment, and additional investments. When transport systems are deficient in terms of capacity or reliability, they can have an economic cost, such as reduced or missed opportunities and lower quality of life.





A large, jagged iceberg with a deep blue hue dominates the foreground. In the background, a small red sailboat is visible on the water under a clear sky. The text is overlaid on the upper portion of the iceberg.

At the aggregate level, efficient transportation reduces costs in many economic sectors, while inefficient transportation increases these costs. Besides, the impacts of transportation are not always intended and can have unforeseen or unintended consequences.

A large, jagged iceberg floats in the ocean, its surface textured with various shades of blue and white. In the bottom left corner, the red sail of a sailboat is visible against the dark water. The background is a clear, light blue sky.

For instance, congestion is often an unintended consequence of providing users with free or low-cost transport infrastructure. However, congestion also indicates a growing economy where capacity and infrastructure have difficulties keeping up with the rising mobility demands. Transport carries an important social and environmental load, which cannot be neglected. *Jean-Paul Rodrigue (2024).*

Factors behind the Development of Transport Systems

Scale	Environmental	Historical	Technological	Political	Economic
 Local	Hydrography and geomorphology	Culture and settlement patterns	Roads	Zoning	Employment and distribution
 Regional	Climate	Urban system	Railways and canals	Taxation and regulations	Modal competition and complementarity
 National / Transnational	Distance	Nation state / Colonialism / Imperialism	Corridors and sea routes	Trade agreements	Markets
 Global	Oceanic masses	Globalization	Air transport and tele-communications	Multilateral agreements (WTO)	Interdependency and comparative advantages



Environmental.

At the local scale, existing hydrographical and geomorphological characteristics are strong factors in transport development, particularly in terms of the technical challenges (bridge, gradients) they present to construct and maintain infrastructure. Climate, which is more a regional attribute, also conditions transportation construction and operations.

Historical.

Settlement patterns, which are influenced by cultural attributes, strongly influence local transport development, such as street grids. At the regional level, the structure of an urban system. It is also a historical process such as colonialism and forms of imperialism that have shaped aspects of national transport developments, particularly in areas of the world that were colonized. However, it is the process of globalization that had one of the most enduring influences in recent decades in shaping global transport systems.

Technological.

Each transportation technology has a matching scale of development. Corridors, which are mainly Local Area , long-distance rail and highway networks, are transport constructs built to connect at the national or continental level. The technologies that have supported the most transport development at the global level are mainly air transportation and telecommunications. Paradoxically, these technologies are mostly used at the regional (air) and local (telecommunications) levels.








Political.

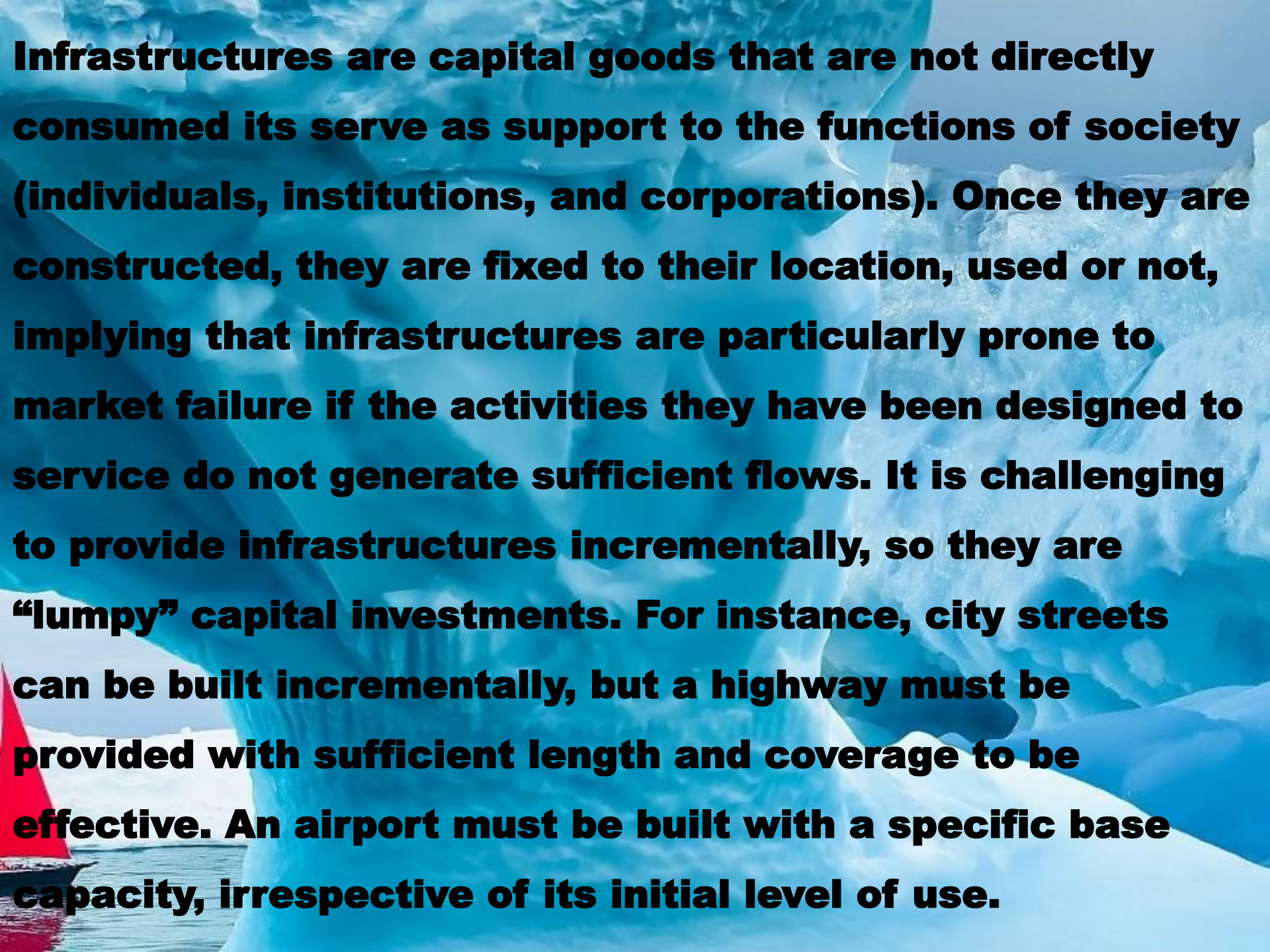
Transportation development is a process that is managed and regulated and it dictates what is allowed to be built, including the function of what is being built. Forms of taxation and regulations such as safety and operating conditions are political aspects that play at the regional (most transport regulations are at the state / provincial level) and the national levels. Trade agreements have an important transnational implication, linking neighboring economic entities, which has influenced transportation development with an attempt to coordinate physical and trade networks. Multilateral Trade Agreement favoring specific transnational connectivity.

Economic.

Economic processes shape transportation development and their interactions. The more advanced an economy is, the more intensive and efficient transportation systems are. At the local level, employment and distribution are key drivers focusing on transit systems as well as the freight distribution of final goods. Transportation modes compete to service markets, a process that mainly takes place at the regional level. Markets are increasingly perceived as transnational, requiring coordinated supply strategies. Competition between major economic actors at the global level, often the outcome of comparative advantages, influences major freight flows and the transport systems supporting them.

Basic Services and their Associated Infrastructures

SERVICE	SUPPORTING INFRASTRUCTURES
 Transportation	Roads, bridges, tunnels, rail tracks, ports, harbors, airports, distribution centers.
 Water supply	Dams, reservoirs, pipes, treatment plants.
 Water disposal	Sewers, used water treatment plants.
 Irrigation	Dams, reservoirs, canals, sprinkling systems.
 Waste disposal	Landfills, incinerators, recycling facilities, compost units.
 Telecommunications	Telephone exchanges, telephone and cable lines, oceanic cables, cellular towers, fiber optic cables, web servers.
 Power	Power plants, transmission & distribution lines, pipelines.

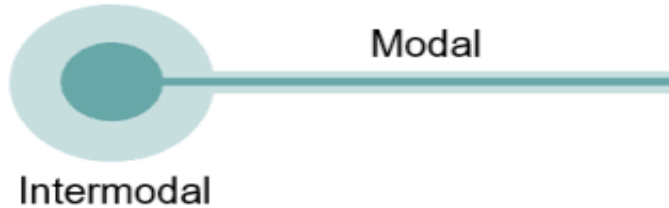


Infrastructures are capital goods that are not directly consumed but serve as support to the functions of society (individuals, institutions, and corporations). Once they are constructed, they are fixed to their location, used or not, implying that infrastructures are particularly prone to market failure if the activities they have been designed to service do not generate sufficient flows. It is challenging to provide infrastructures incrementally, so they are “lumpy” capital investments. For instance, city streets can be built incrementally, but a highway must be provided with sufficient length and coverage to be effective. An airport must be built with a specific base capacity, irrespective of its initial level of use.

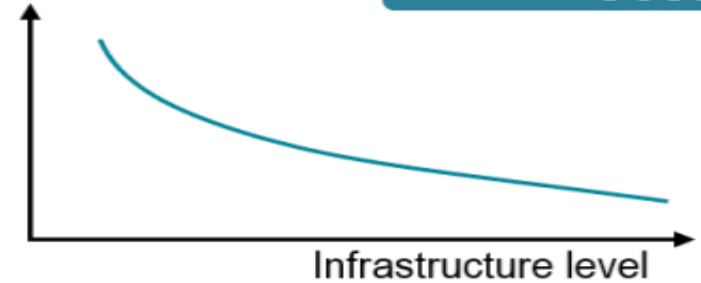
Economic Impacts of Transportation Infrastructure

CORE

Capacity

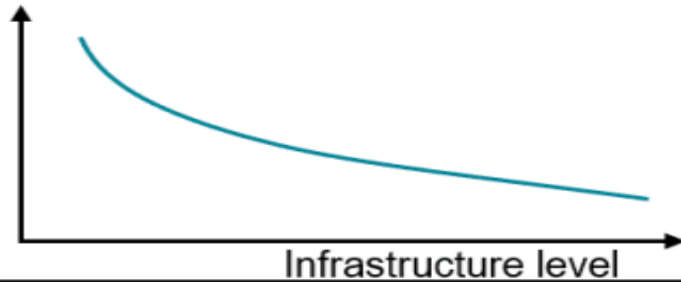


Costs

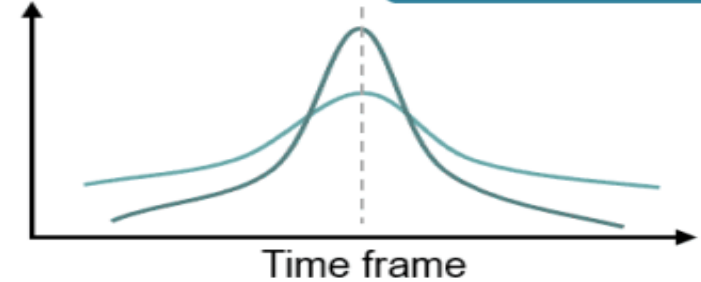


OPERATIONAL

Time



Reliability



GEOGRAPHICAL

Accessibility



Location



Capacity (core).

Improving intermodal (terminals) and modal capacity through infrastructure investments is a core strategy to promote economic opportunities. An economy has a greater capacity to move passengers and freight, which conveys economic of scale and higher economic output levels.

Costs (core).

Transport developments are commonly associated with lower unit transport costs, implying that mobility becomes more affordable. Alternatively, additional volumes can be carried at a similar cost. Overall, the share of transportation costs in the final costs of goods declines.

Time (operational).

The economic benefits of time improvements are multi-dimensional. First, passengers and freight will arrive at their destinations faster, which is convenient and has economic value. Second, time gains result in better inventory management levels and better utilization of transport assets (infrastructure, terminals, vehicles, containers, etc.).

Reliability (operational).

Commonly involves a higher probability that a passenger or cargo unit will reach its intended destination within a scheduled timeframe and without loss, spoilage, or damage (for cargo). Reliability enables economic systems to synchronize their activities better, which, like time benefits, enables better utilization of transport assets.

Accessibility (geographical).

The capability to access a wider market base is a common economic benefit for firms. Inputs such as raw materials, parts, energy, or labor become more readily available for an economy. At the same time, outputs such as finished goods have access to a wider market base. Greater accessibility to regional and global passenger markets also has economic impacts linked with commercial transactions and tourism.

Location (geographical).

An important impact of transportation concerns influencing the location of economic activities. Specific sites in proximity to modal or intermodal infrastructure are likely to generate higher value than less accessible sites. This is often referred to as the clustering effect. Thus, through Location decisions involving commercial, residential, or manufacturing activities, the economic landscape is modified. Improvements in one or more of these characteristics usually result in improvements in the competitiveness level of an area, such as a region.

Basic Location Factors

FACTOR

SCALE

CRITERIA

Suitability 
High Low

SOCIOECONOMIC ENVIRONMENT

Macro (national)

- Capital
- Subsidies
- Regulations
- Taxation
- Technology

Global expansion

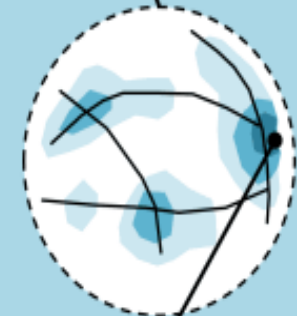


ACCESSIBILITY

Meso (regional)

- Labor
- Materials
- Energy
- Markets
- Suppliers / customers

National expansion



SITE

Micro (local)

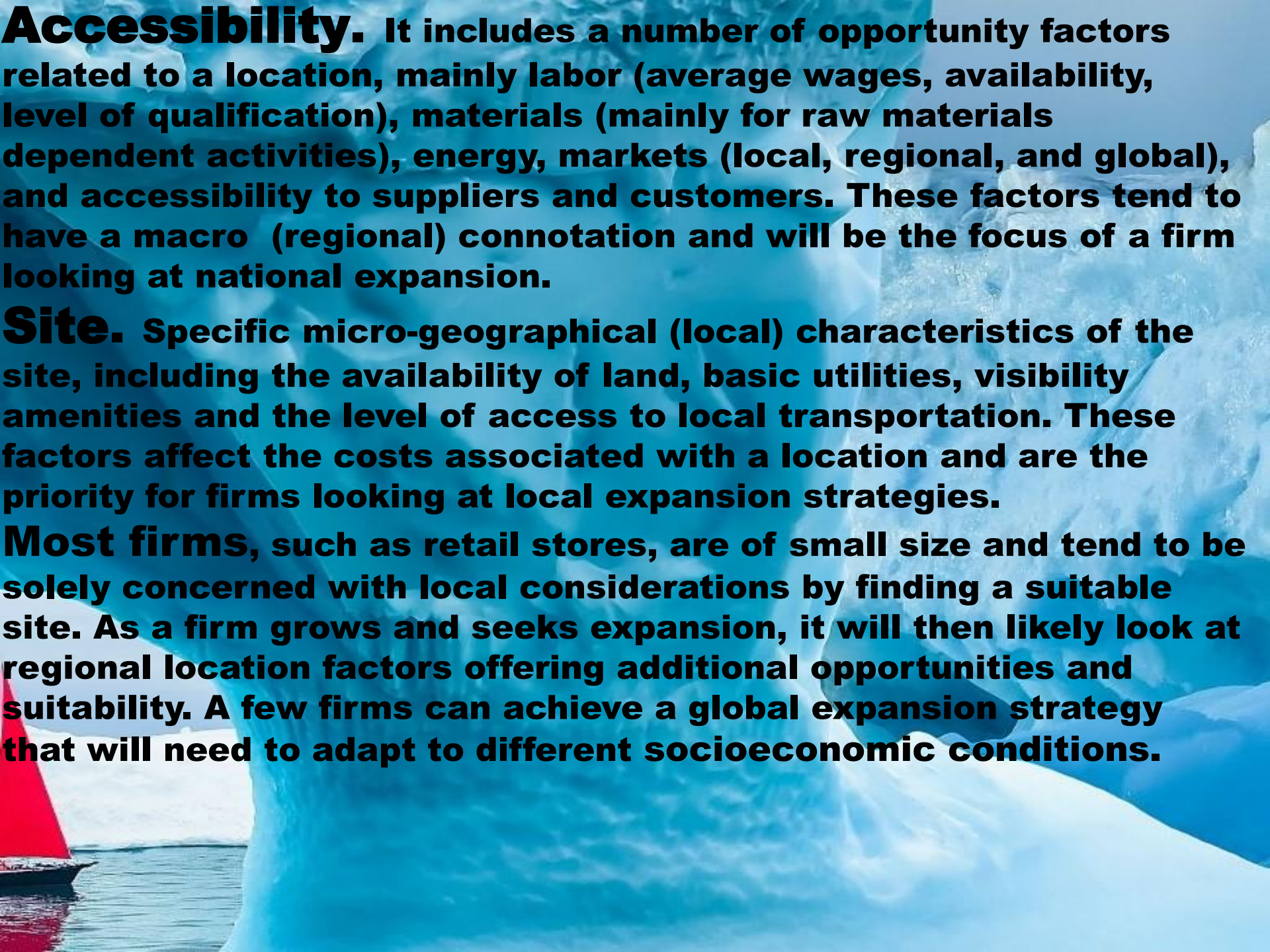
- Land
- Utilities
- Visibility
- Transportation
- Amenities

Local expansion



Socioeconomic environment.

Specific macro-geographical characteristics that can apply to jurisdictional units, such as the nation-state, the state/province, or the municipality. The nation-state is the most common unit that offers consistency in the socioeconomic environment. The location factors consider capital availability, subsidies and incentives, regulations, taxation, and available technology. A firm looking at global expansion is evolving at this scale of analysis to seek suitable locations to allocate its production and distribution assets as well as the potential demand for its output.

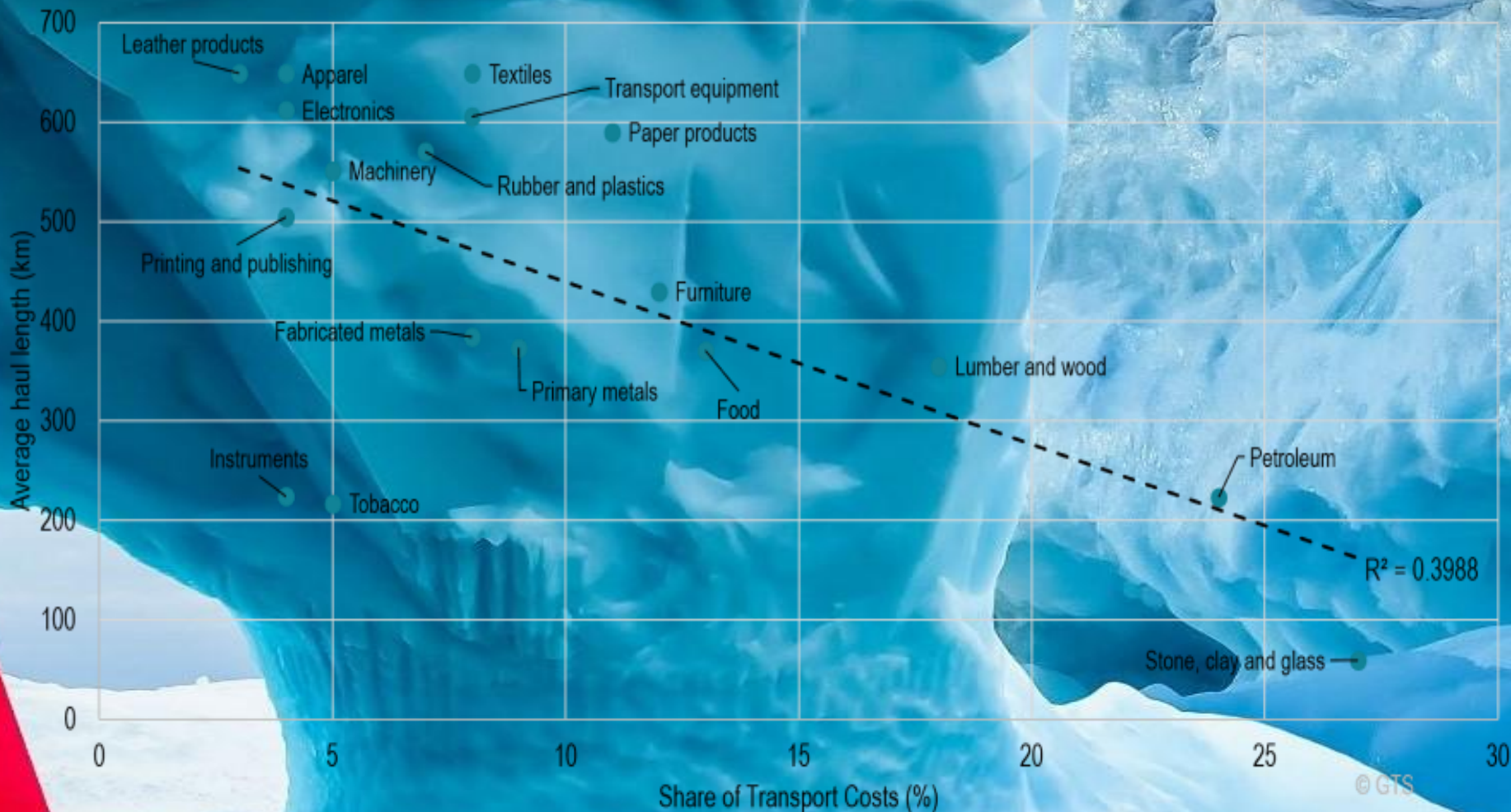


Accessibility. It includes a number of opportunity factors related to a location, mainly labor (average wages, availability, level of qualification), materials (mainly for raw materials dependent activities), energy, markets (local, regional, and global), and accessibility to suppliers and customers. These factors tend to have a macro (regional) connotation and will be the focus of a firm looking at national expansion.

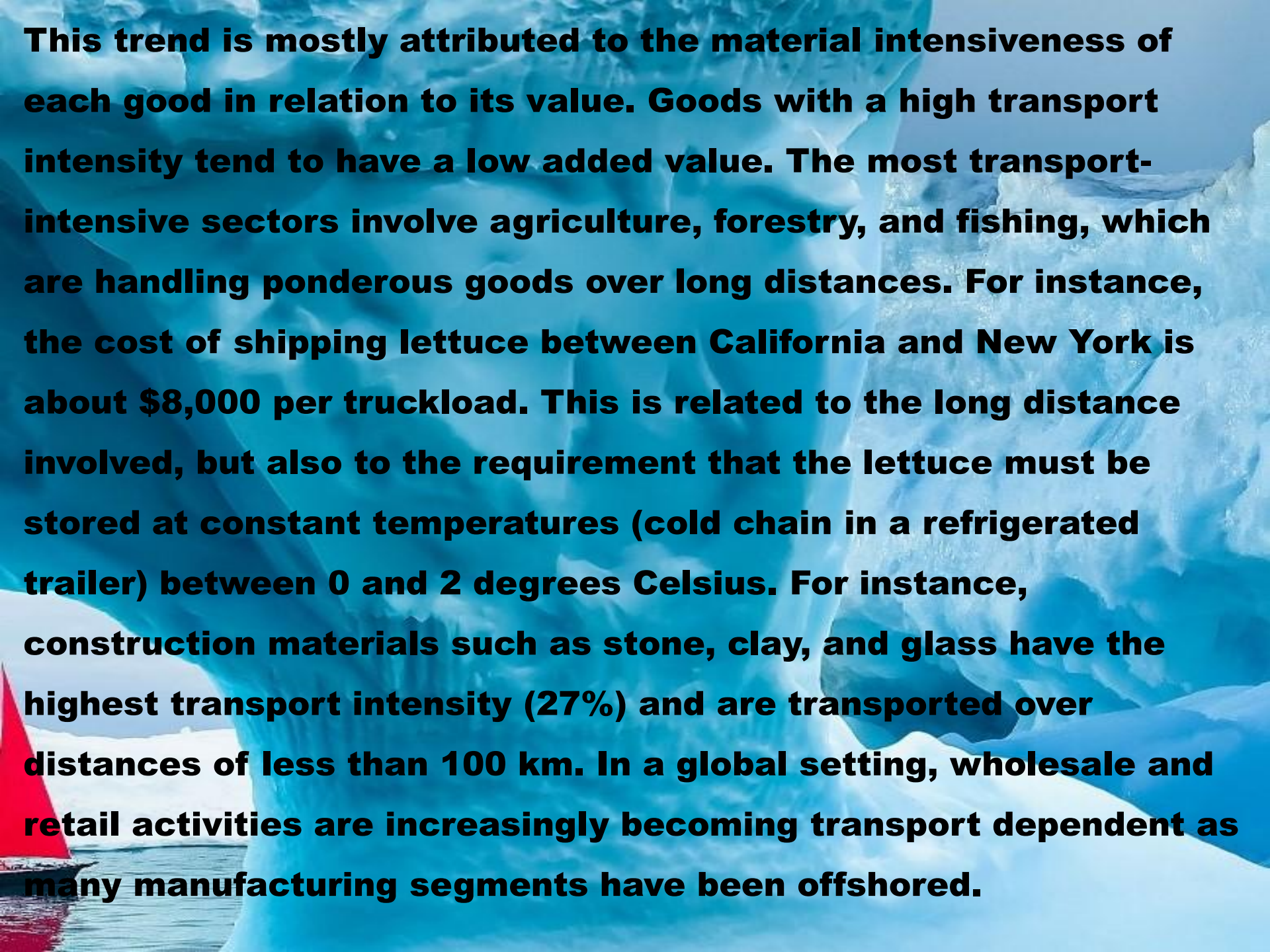
Site. Specific micro-geographical (local) characteristics of the site, including the availability of land, basic utilities, visibility amenities and the level of access to local transportation. These factors affect the costs associated with a location and are the priority for firms looking at local expansion strategies.

Most firms, such as retail stores, are of small size and tend to be solely concerned with local considerations by finding a suitable site. As a firm grows and seeks expansion, it will then likely look at regional location factors offering additional opportunities and suitability. A few firms can achieve a global expansion strategy that will need to adapt to different socioeconomic conditions.

Share of Transport Costs in Product Prices and Average Domestic Haul Length

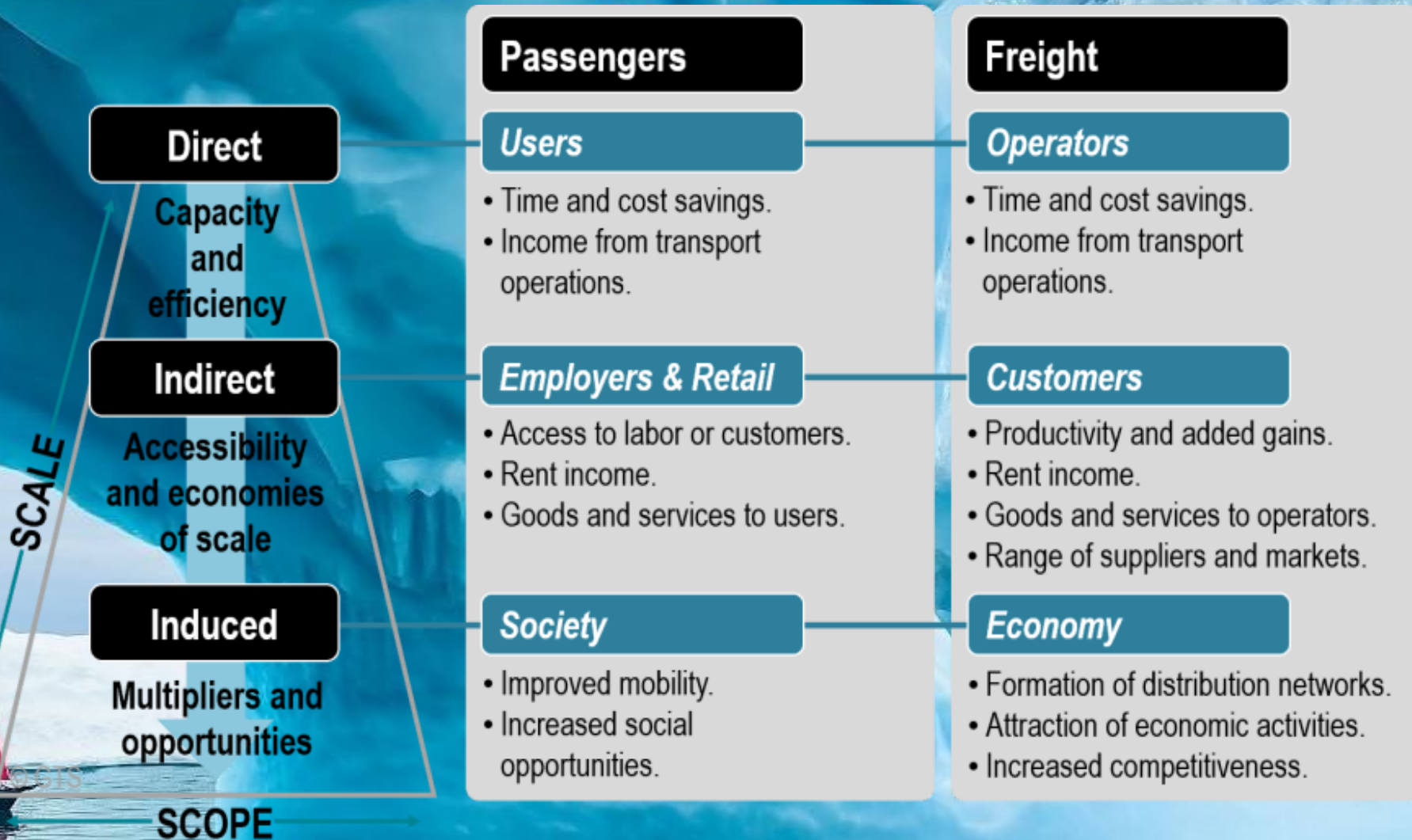


Source: Adapted from US Department of Commerce.

The background of the slide features a large, jagged iceberg in the foreground, partially obscuring a sailboat on the water. The sky is a clear, bright blue. The text is overlaid on this scene in a bold, black, sans-serif font.

This trend is mostly attributed to the material intensiveness of each good in relation to its value. Goods with a high transport intensity tend to have a low added value. The most transport-intensive sectors involve agriculture, forestry, and fishing, which are handling ponderous goods over long distances. For instance, the cost of shipping lettuce between California and New York is about \$8,000 per truckload. This is related to the long distance involved, but also to the requirement that the lettuce must be stored at constant temperatures (cold chain in a refrigerated trailer) between 0 and 2 degrees Celsius. For instance, construction materials such as stone, clay, and glass have the highest transport intensity (27%) and are transported over distances of less than 100 km. In a global setting, wholesale and retail activities are increasingly becoming transport dependent as many manufacturing segments have been offshored.

Socioeconomic Benefits of Transportation





Direct Impacts. The direct benefits are mostly related to capacity and efficiency improvements that impact users and operators, particularly in terms of time and cost savings.

Indirect Impacts. The indirect benefits mostly relate to accessibility gains and better economies of scale. While employers and the retail sector (as well as other activities such as institutions) gain better access to labor or customers, the customers of freight transport services. Both passenger and freight traffic also convey additional demands for goods and services (e.g. fuel, maintenance, repairs, insurance). Freight-related activities also benefit from a wider range of suppliers for their inputs and markets for their outputs.

Induced Impacts. The induced benefits are mostly related to economic multipliers and increased opportunities. Society benefits from increased mobility since individuals have a wider range of options for their activities and the associated social opportunities (education, social interactions, leisure).

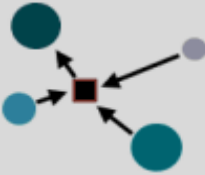
Types of Economies in Production, Distribution and Consumption

Production

Distribution

Consumption

Economies of transportation

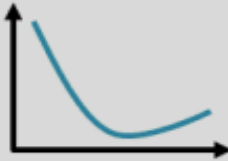


Lower unit costs through accessibility to suppliers and customers

Lower unit distribution costs through transport chains management

Lower unit output costs through accessibility to suppliers and customers

Economies of scale



Lower unit costs with larger plants

Lower unit transport costs through larger modes and terminals

Lower unit costs with larger retail outlets

Economies of scope



Lower unit output costs with more product types

Lower transport costs with bundling of different loads

Product diversification attracts more customers

Economies of agglomeration

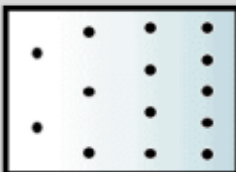


Industrial and service linkages with manufacturing clusters

Lower input costs with clustering of distribution activities

Lower input costs with clustering of retail activities

Economies of density

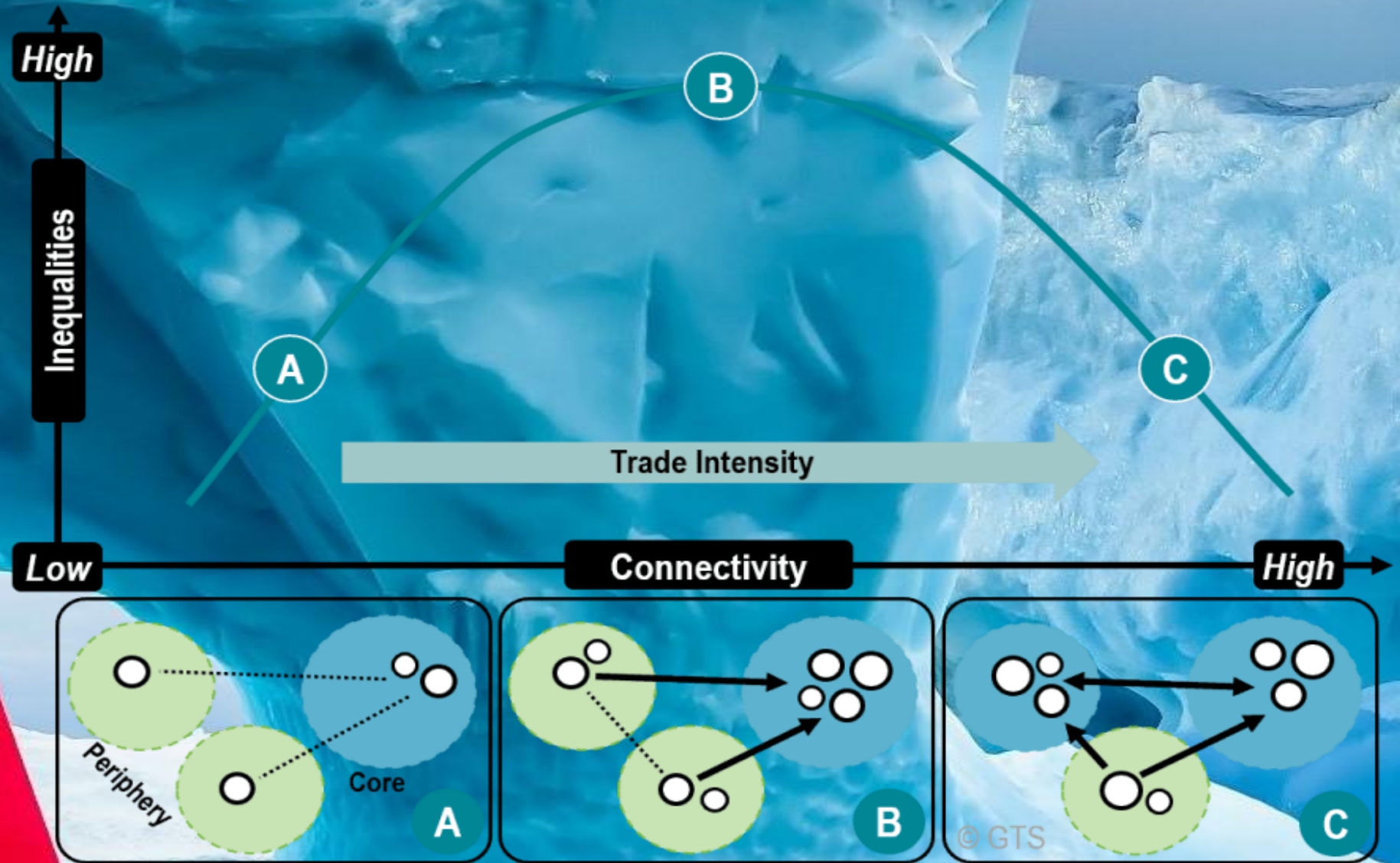


Increased accessibility to labor (skills) with higher densities

Lower unit distribution costs with higher densities

Increased accessibility to goods and services with higher densities

Trade, Connectivity and Spatial Inequalities



Transport Economic Indicators

Type	Measures	Relevance
Transportation Prices	Aggregate price of transportation services by mode or commodity.	Input costs by economic sector. Market competitiveness.
Transportation Productivity	Labor productivity and total-factor productivity (labor and assets).	Level of return on investment. Economic impacts by sector.
Logistics Costs	Supply-chain distribution cost relative to GDP or total costs.	Efficiency by logistics function.
Transport Capacity Utilization	Share of modal (vehicles and links) and intermodal (terminals) capacity.	Assessment of investment needs for maintenance, upgrade and expansion.

Transportation prices. The cost that users pay for transportation services is indicative of the input costs that transportation conveys for economic sectors. Comparative prices are reflective of the competitiveness of each transportation option. Subsidies can be a factor of distortion since it conveys policy preferences for specific modes.

Transportation productivity. The capacity to carry specific quantities of people or freight per unit of input (e.g. labor and capital costs); how much output is derived per any given unit of input. Productivity measures are useful to assess the level of return on investment.

Logistics costs. The burden that each segment of the supply chain imposes on the economy indicates how efficient logistics are. High logistics costs are usually associated with resource-intensive economies.

Transportation capacity utilization. The closer a transport system is to its design capacity, the more congested it is, but the more profitable it is. As capacity utilization rises, there is a need to provide additional capital for maintenance and, eventually, transport infrastructure expansion.

A Multi-Layer Perspective about Transport and Economic Development

Demand Pull

Transport Chain Organization

Organization of the (multimodal) routing of passengers and freight through the transport system using a mix of transport services and transport infrastructures.

Transport Service Operations

Bus services, rail services, barge services, maritime transport services, trucking, airline services, etc. Freight and passenger handling in transport nodes.

Transport Infrastructure

Transport nodes (e.g. airport, seaport, railway station, intermodal terminal, etc.) and transport links (highways, waterways, rail tracks, pipelines, etc.)

Location

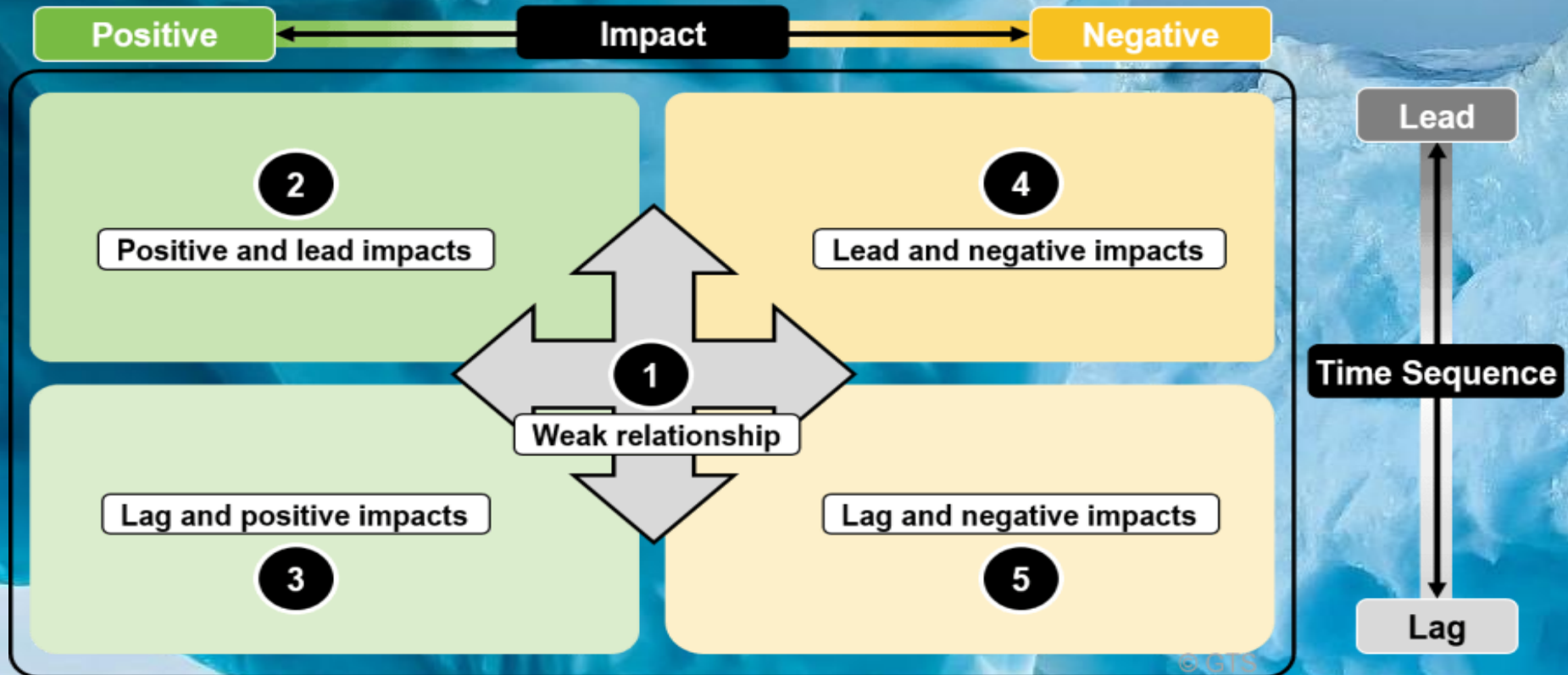
Geographical location of origin and destination of movements (multimodal transport chain).

Valorization

© GTS

Source: adapted from Notteboom, T. and J-P Rodrigue (2007)

Time Sequence and Nature of Impacts of Transport Investments

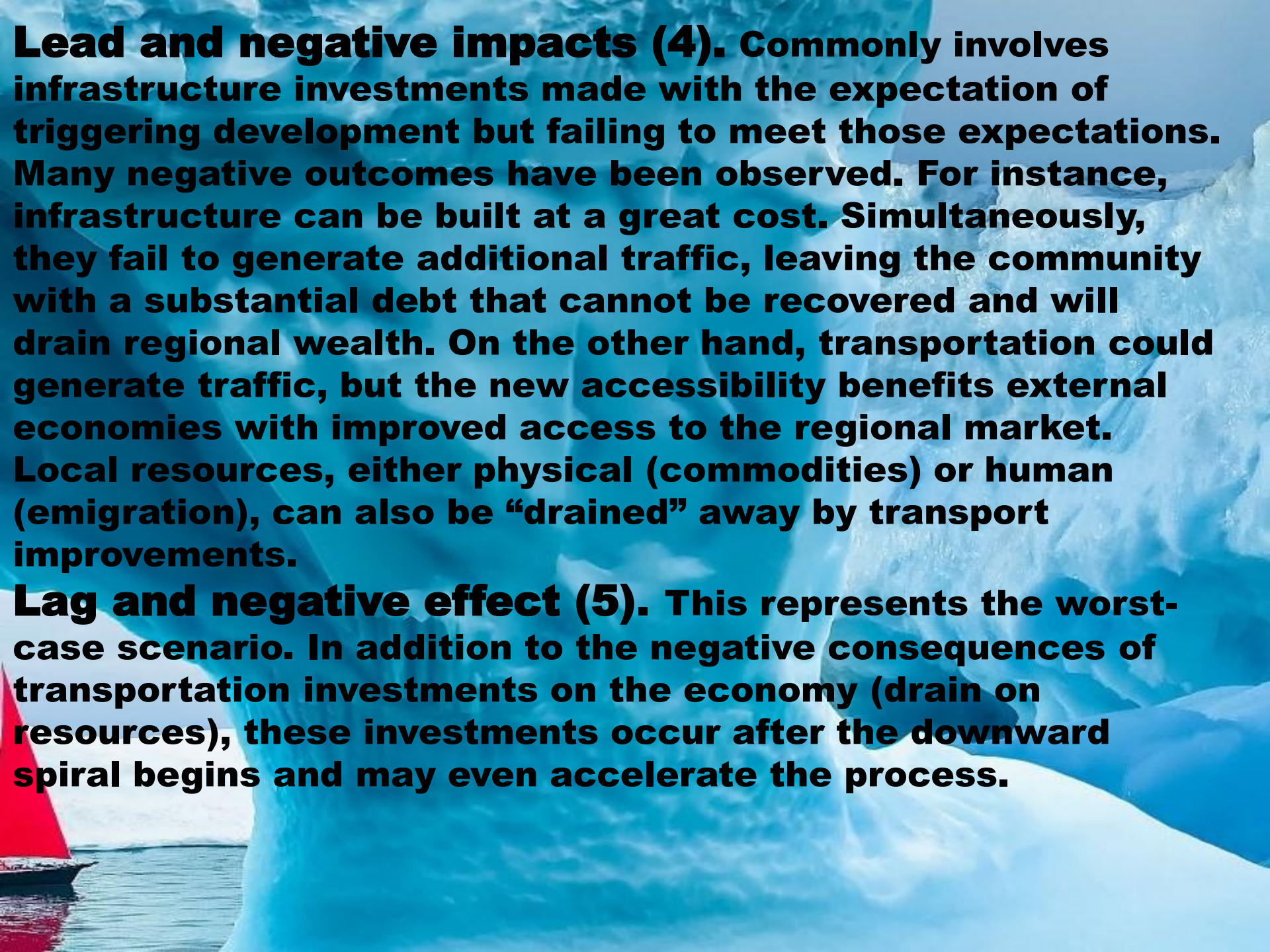


There is no straightforward relationship between transport and economic development as the level of impact and its time sequence can vary based on location and socioeconomic characteristics. This leads to five potential relationships:

Weak relationship (1). Although transportation supports economic and social activities, no specific causality can be expressed. This is particularly the case for infrastructures that were implemented a while ago, and becoming embedded in the regional economy. Their lead role can no longer be asserted, but it does not mean that transportation is not important, as it is still a fundamental component supporting mobility within the economy.

Positive and lead impacts (2). Represents the best-case scenario where investments and the presence of infrastructures triggers economic growth for a region, namely the expansion of production and consumption. This process commonly occurs when new infrastructures are built to access resources or new markets, triggering a wave of investments.

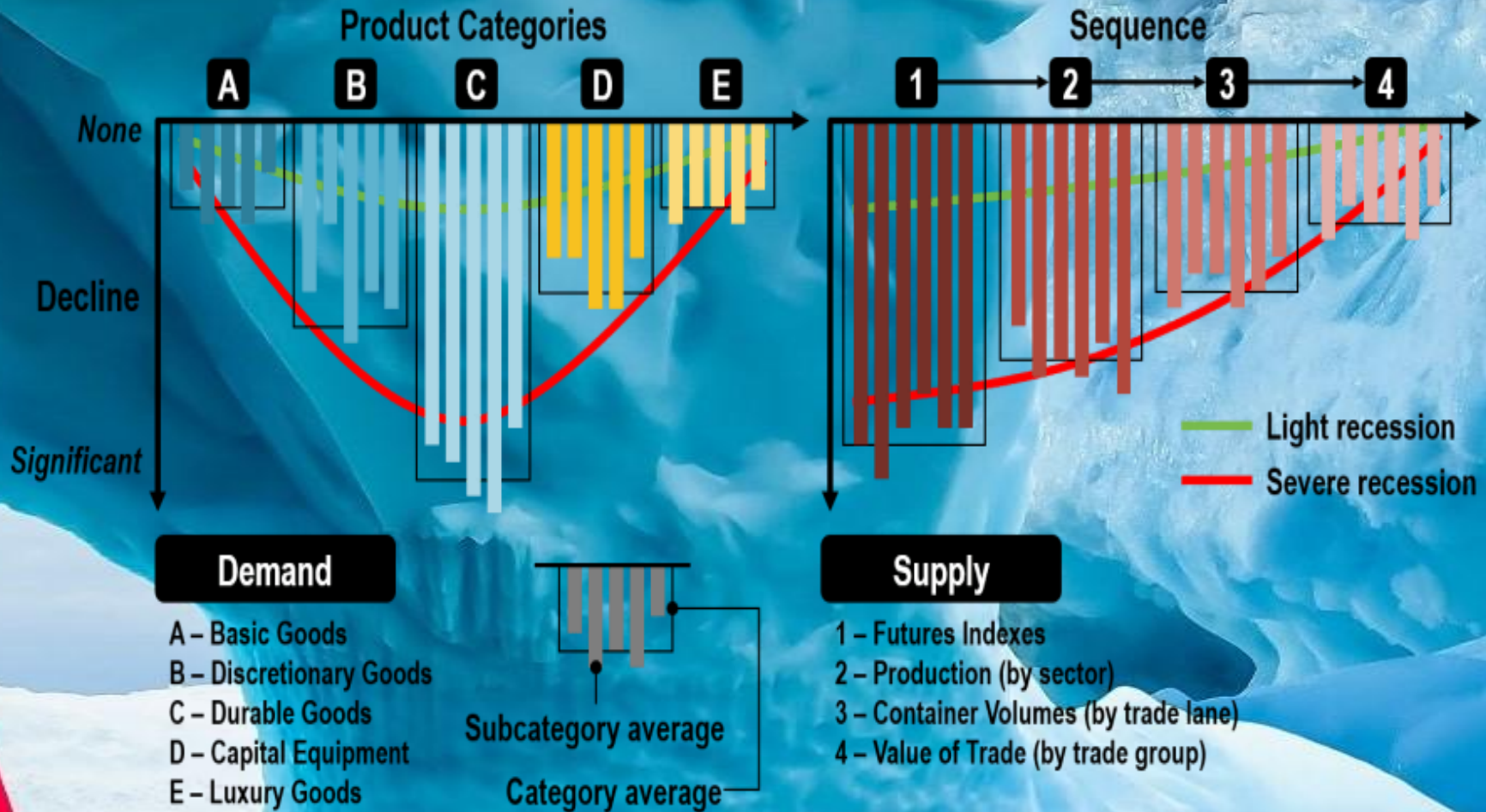
Lag and positive impacts (3). The development of transport infrastructures follows economic development by trying to add capacity to meet additional demands. A good example would be fast-paced growth, as seen in Pacific Asia (notably China), where investments in transport infrastructure do not keep up with the substantial traffic growth generated by rising mobility and new globally linked manufacturing functions. This situation could eventually impair future growth prospects as the existing infrastructure can no longer satisfy the demand.



Lead and negative impacts (4). Commonly involves infrastructure investments made with the expectation of triggering development but failing to meet those expectations. Many negative outcomes have been observed. For instance, infrastructure can be built at a great cost. Simultaneously, they fail to generate additional traffic, leaving the community with a substantial debt that cannot be recovered and will drain regional wealth. On the other hand, transportation could generate traffic, but the new accessibility benefits external economies with improved access to the regional market. Local resources, either physical (commodities) or human (emigration), can also be “drained” away by transport improvements.

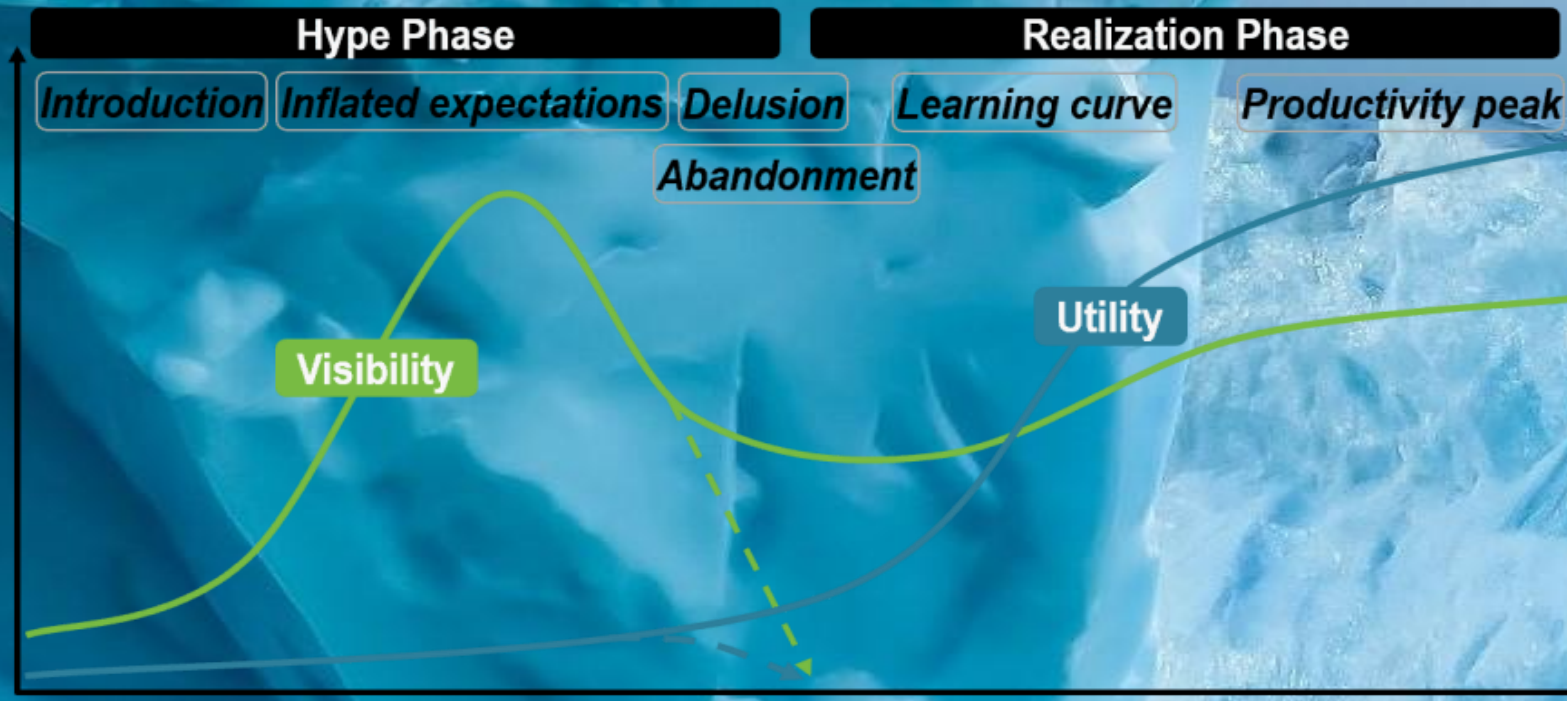
Lag and negative effect (5). This represents the worst-case scenario. In addition to the negative consequences of transportation investments on the economy (drain on resources), these investments occur after the downward spiral begins and may even accelerate the process.

Impact of Recessions on Consumption, Production, and Trade



Source: Adapted from Notteboom, T., A. Pallis and J-P Rodrigue (2021)

Technology Hype Cycle



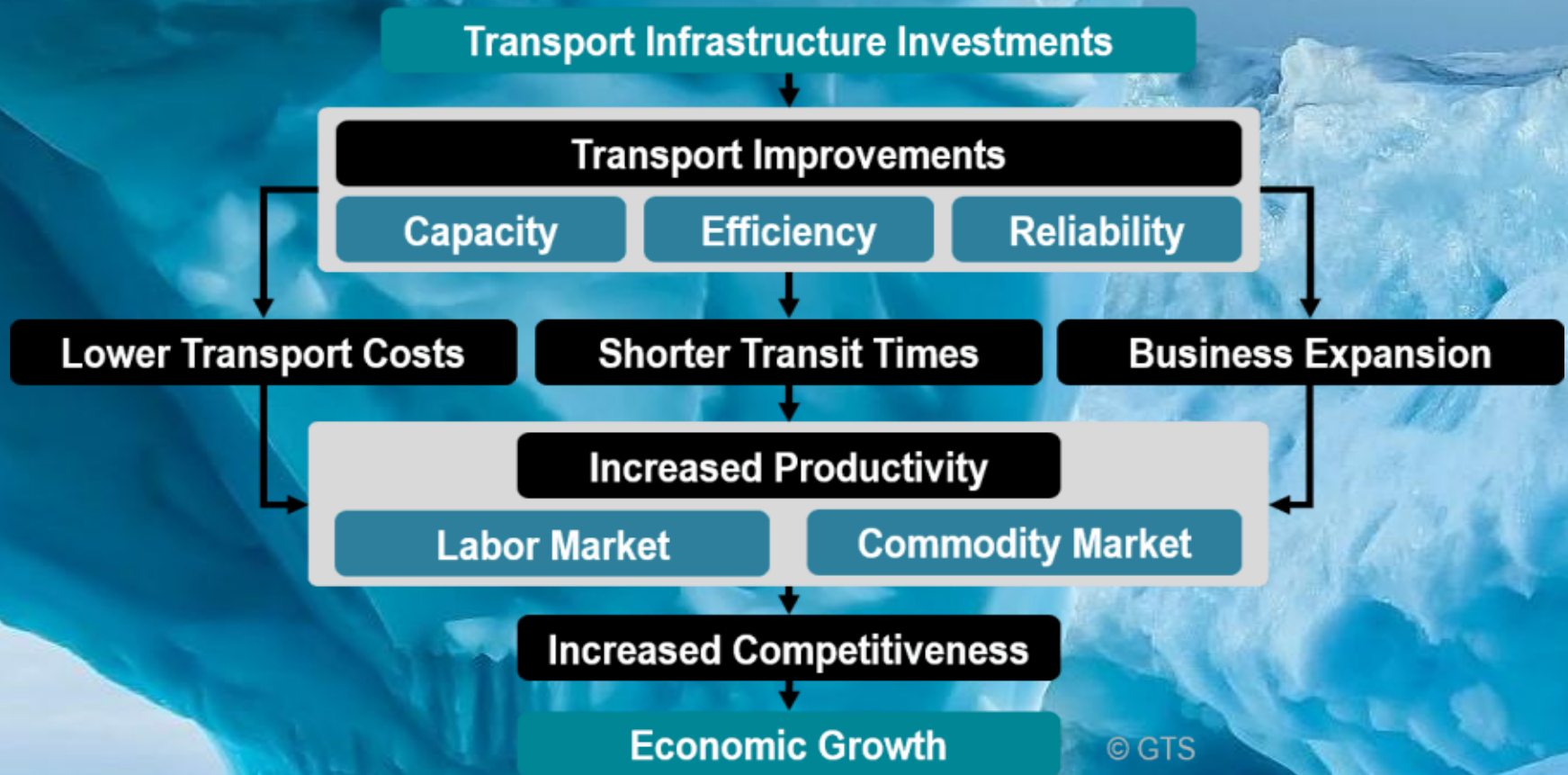
Source: adapted from Gartner Inc.

Technology has the potential to disrupt markets, a fact underlined since the industrial revolution, when several key technologies created new markets and new economic opportunities. This is also the case for the transport sector. However, the impacts of technological innovation are usually not a linear process. On several occasions, a new technology goes through a set of stages before its potential can be realized. Two major phases can be identified:

Hype phase. Once a new technology (or product) is introduced, its real potential is fairly unknown and subject to much speculation and exaggeration. There are thus many expectations, and the corporation introducing new technology will obviously do its utmost to ensure it receives the highest visibility possible and even promotes the “hype”. The utility of the technology has not yet been formally demonstrated. What often happens is after a stage of inflated expectations (e.g. “world-changing / disruptive” technology), the realization comes about that those expectations cannot be reconciled with the reality (low utility and market potential). In some cases, the new technology can be abandoned altogether.

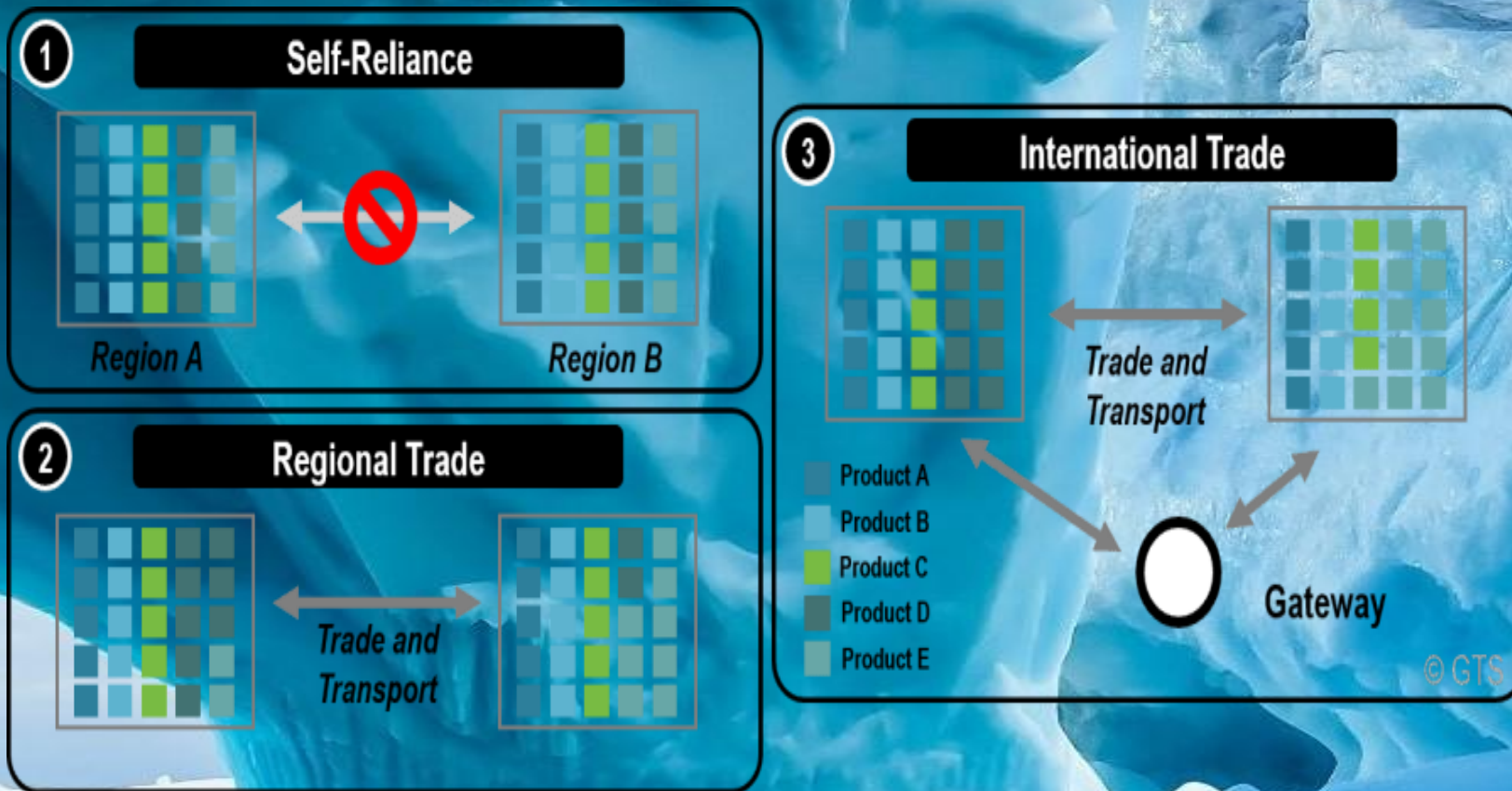
Realization phase. Once the hype phase is over, then the real potential of the technology can be realized after a learning and adaptation period. The utility of the technology improves greatly as a larger number of applications are found (sometimes different from those believed to be possible during the hype phase). At some point, the technology has reached its potential (maximum utility).

Transport Impacts on Economic Opportunities



The expectation is that transport infrastructure investments will result in transport improvements in terms of capacity, efficiency, and reliability. The related lower transport costs, shorter transit times, and business expansion make economic activities more productive and competitive.

Trade, Transportation and Geographic Specialization



Source: Adapted from: E. J., Gauthier H. L. and M. E. O'Kelly (1996) *Geography of Transportation*

Components of Transport Cost



- Legal
- Insurance
- Customs

Transaction Costs

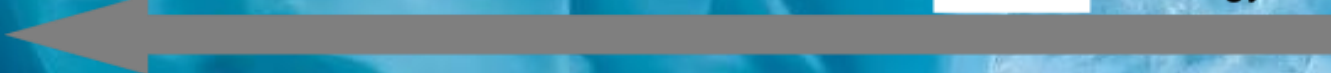
Friction of Distance



- Time
- Energy

A

B



Shipment

- Load unit
- Massification
- Packaging



A movement between locations A and B involves three cost components in the assessment of the related transport costs: Transactions costs are related to resolving the setting of the movement, including legal costs and insurance. For international movements, they can be significant as issues related to currency exchange as well as customs duties have to be considered.

The friction of distance represents how many units of distance can be traded per unit of cost, which indicates how much effort (time, energy, etc.) must be made to ensure that a movement takes place. Distance is considered to be the simplest attribute for such a purpose. Still, when international transportation is involved, the change in the jurisdiction is also an important component of the transport cost.

Shipment implies the physical characteristics of the transportation process and the efforts that must be made to make a passenger or freight unit transportable. The higher the level of massification of the units, the lower the transport costs (economies of scale). Additionally, freight must be prepared for transport, such as packaging, palletizing, or stuffing into a container.

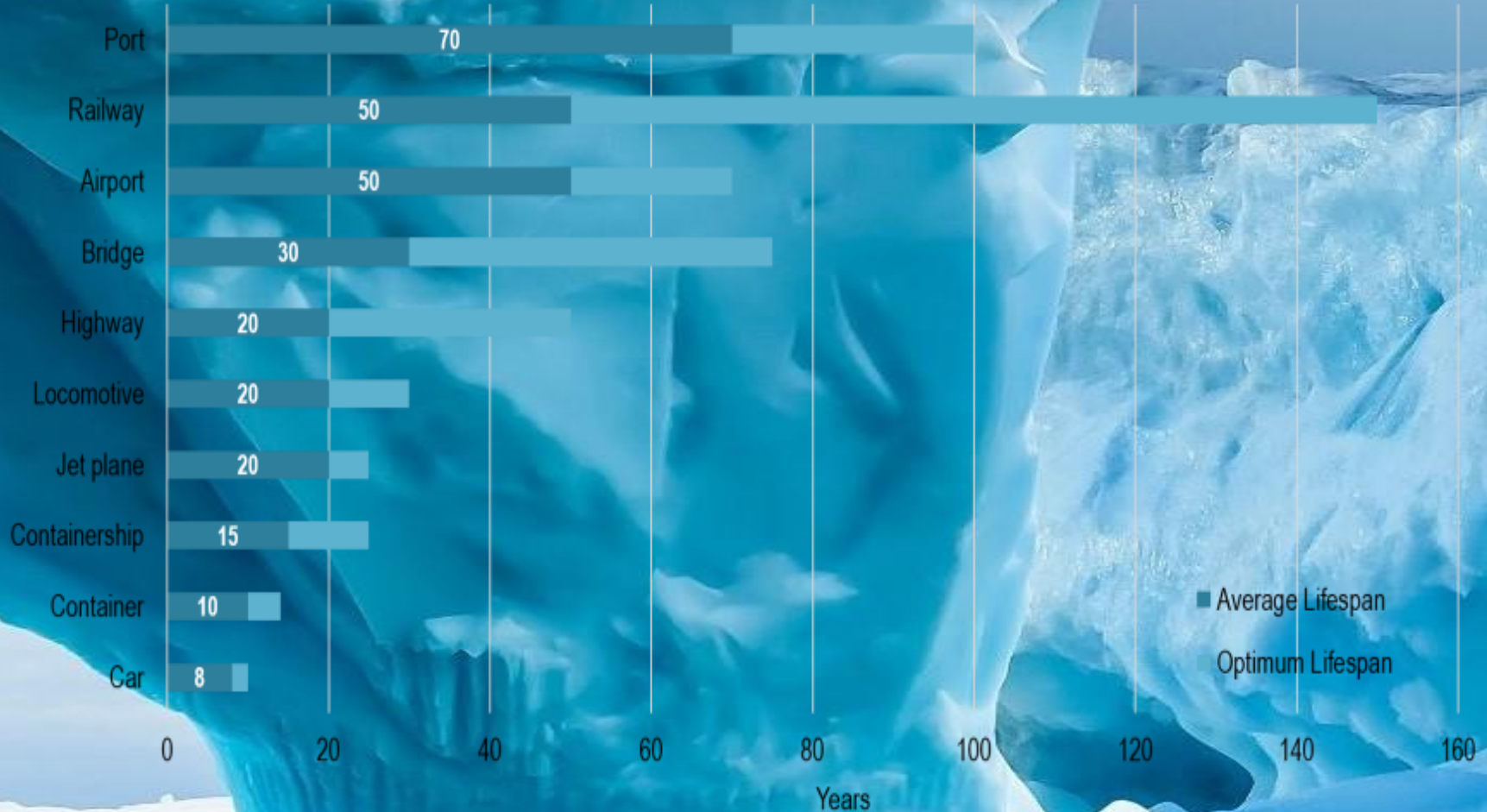
Fixed and Operating Transport Costs

MODE	FIXED & CAPITAL COSTS	OPERATING COSTS
Road	<ul style="list-style-type: none">• Land, Roads, Parking, Ramps, Bridges, Tunnels, Signalization• Vehicles and trailers	<ul style="list-style-type: none">• Maintenance, Labor, Fuel
Rail	<ul style="list-style-type: none">• Land, Tracks, Bridges, Tunnels, Signalization• Locomotives and Wagons• Rail yards and Terminals	<ul style="list-style-type: none">• Maintenance, Labor, Fuel
Pipeline	<ul style="list-style-type: none">• Land, Pipes• Pumping stations and Tanks	<ul style="list-style-type: none">• Maintenance, Energy
Air	<ul style="list-style-type: none">• Land, Field, Terminal• Aircraft	<ul style="list-style-type: none">• Maintenance, Fuel, Labor, Airport charges
Maritime	<ul style="list-style-type: none">• Land for port terminals• Cargo handling equipment• Ships	<ul style="list-style-type: none">• Maintenance, Fuel, Labor, Port Charges
Telecommunications	<ul style="list-style-type: none">• Towers, Hubs, Poles, Cables• Exchanges, Servers	<ul style="list-style-type: none">• Maintenance, Energy

Fixed costs are incurred to make transportation services available and involve the provision of infrastructure, rights of way, terminals, and the control equipment for their operations. They do not change with the level of traffic but provide a level of capacity.








Operating costs (or variable) are incurred when traffic takes place and are a function of its intensity. They mainly include labor, fuel (or energy), and maintenance.

The lifespan of Main Transport Assets

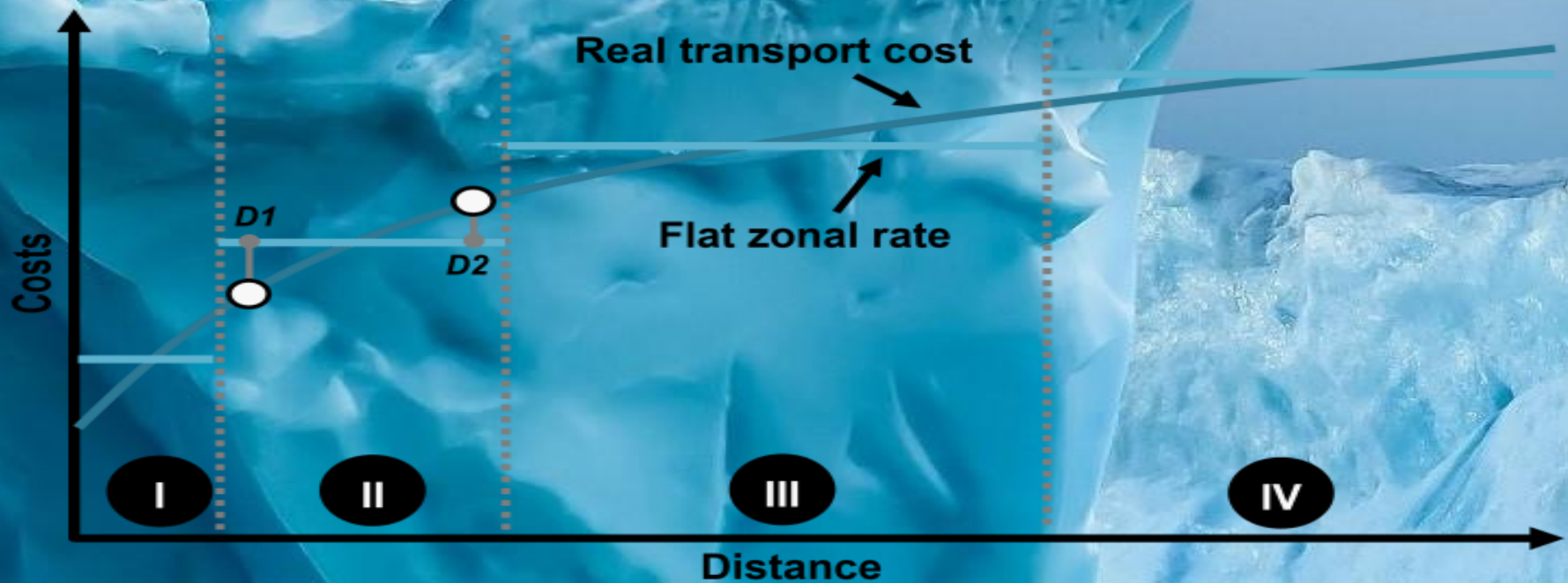


Source: some data from Living Planet Report , Eurostat 2003, 2006

Conditions Affecting Transport Costs

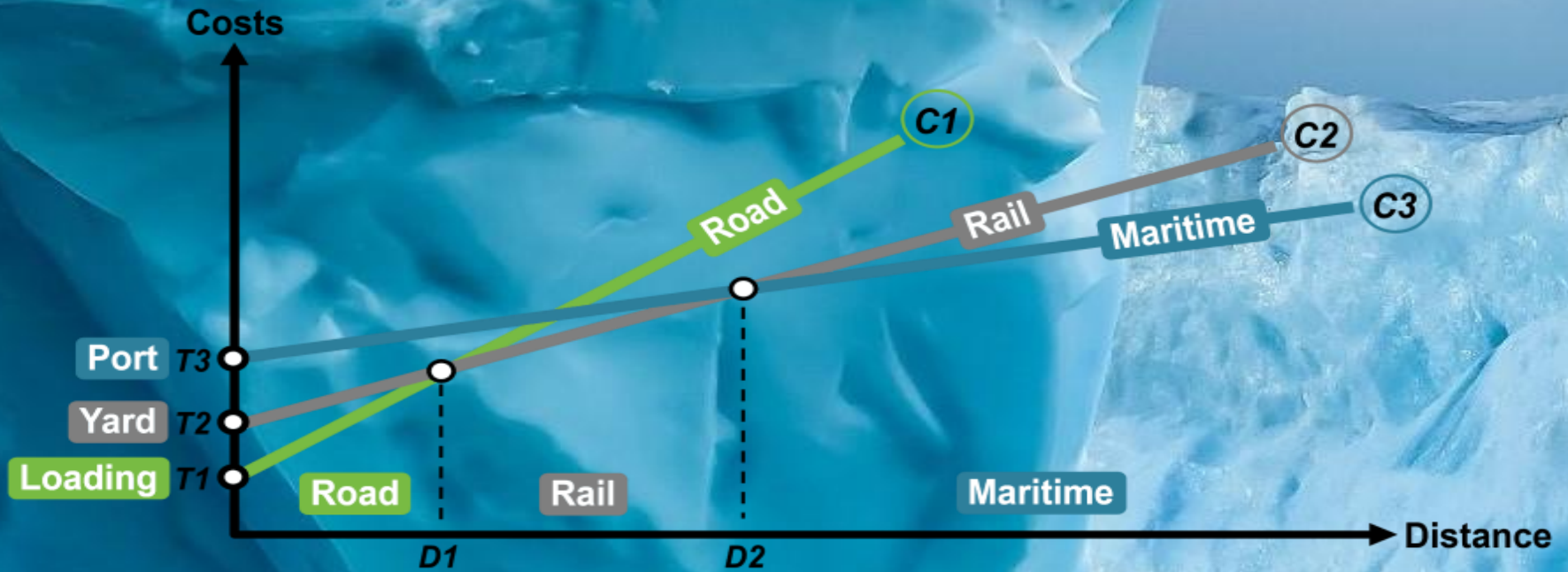
	CONDITIONS	FACTORS	EXAMPLES
	Geography	<ul style="list-style-type: none">Distance, physiography, accessibility	<ul style="list-style-type: none">Shipping between France and England vs. shipping between France and the Netherlands
	Type of Product	<ul style="list-style-type: none">Amenities, packaging, density, weight, perishability	<ul style="list-style-type: none">Business vs economy classShipping coal, flowers or wine
	Economies of Scale	<ul style="list-style-type: none">Shipment size	<ul style="list-style-type: none">Narrow-body vs. a wide-body flight (passengers)Post-Panamax vs. to Panamax (freight)
	Imbalances	<ul style="list-style-type: none">Empty travel	<ul style="list-style-type: none">CommutingTrade between China and the United States
	Infrastructure	<ul style="list-style-type: none">Capacity, operational conditions	<ul style="list-style-type: none">The Interstate
	Mode	<ul style="list-style-type: none">Capacity, operational conditions	<ul style="list-style-type: none">A bus vs. a carA bulk ship vs. a containership
	Regulations	<ul style="list-style-type: none">Tariffs, operational restrictions, safety, ownership	<ul style="list-style-type: none">Anti-trust regulationsThe Jones Act

Transport Rates

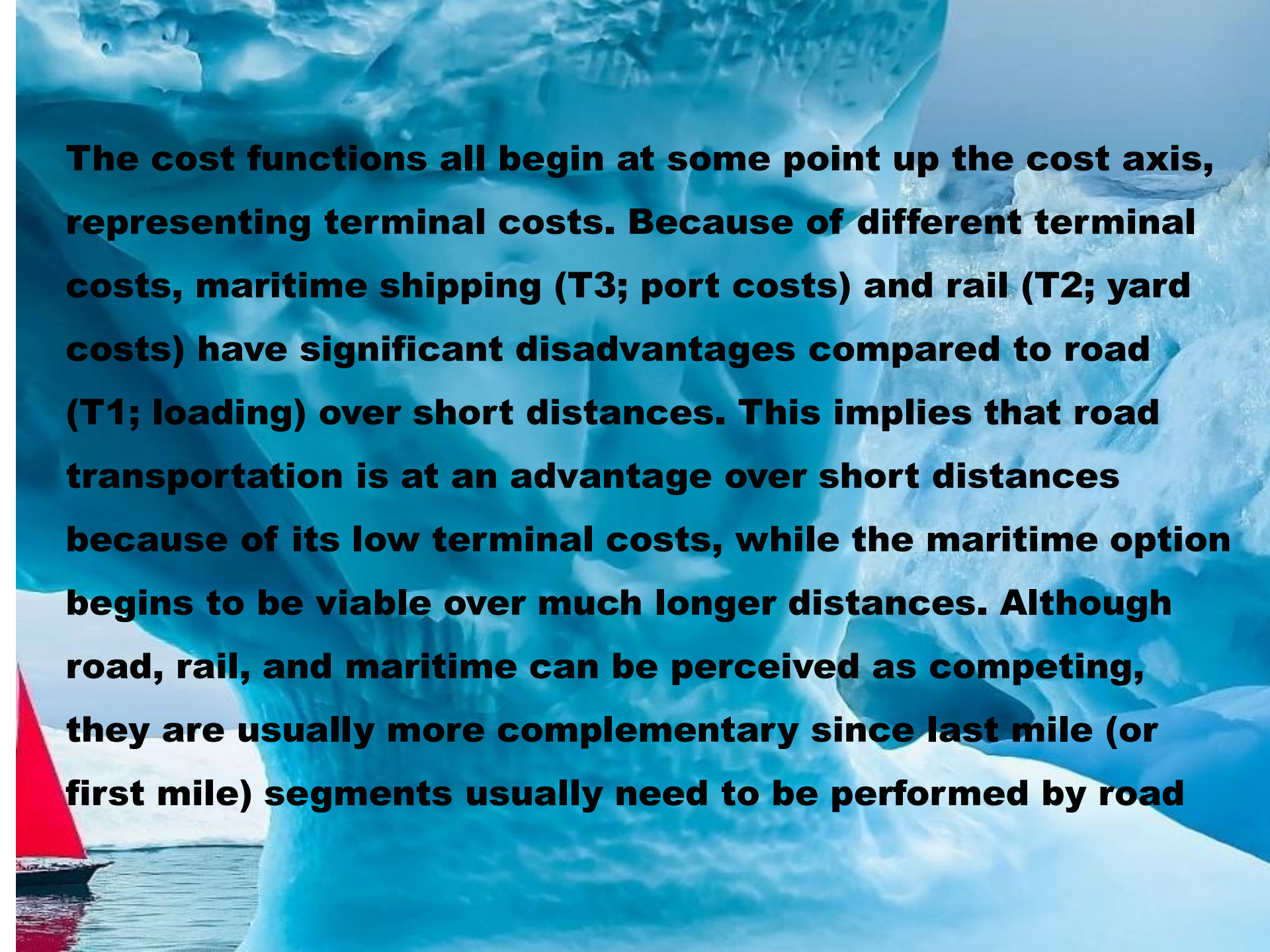


Real freight rates can be complicated to calculate for a transport company, especially when there are a large number of customers. A common answer to this problem is establishing a set of geographic zones where freight rates are equal. The rate is commonly set through the principle where the closest customers in a zone partially subsidize the furthest customers. For instance, under a zonal rate system, a customer located at D1 pays the same rate as a customer located at D2. Under a distance-based system, the customer at D1 would have paid a lower rate than a customer located at D2. Many transit systems also use a zonal rate structure organized around concentric rings from the city center.

Terminal Costs



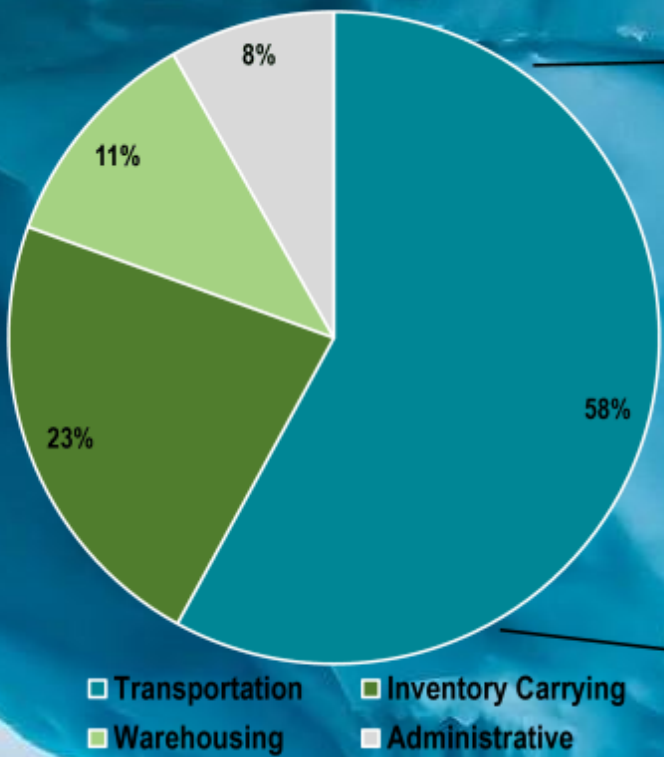
Transport Costs can be simplified as a linear function for three modes; road, rail, and maritime. This function only considers the cost of loading and transport to the destination, but not unloading and backhaul moves. It notably applies to freight, but passenger transportation depicts similar patterns, although maritime is not a common option outside ferries



The cost functions all begin at some point up the cost axis, representing terminal costs. Because of different terminal costs, maritime shipping (T3; port costs) and rail (T2; yard costs) have significant disadvantages compared to road (T1; loading) over short distances. This implies that road transportation is at an advantage over short distances because of its low terminal costs, while the maritime option begins to be viable over much longer distances. Although road, rail, and maritime can be perceived as competing, they are usually more complementary since last mile (or first mile) segments usually need to be performed by road

Global Logistics Costs by Function and Mode, 2018

Logistics Costs by Function

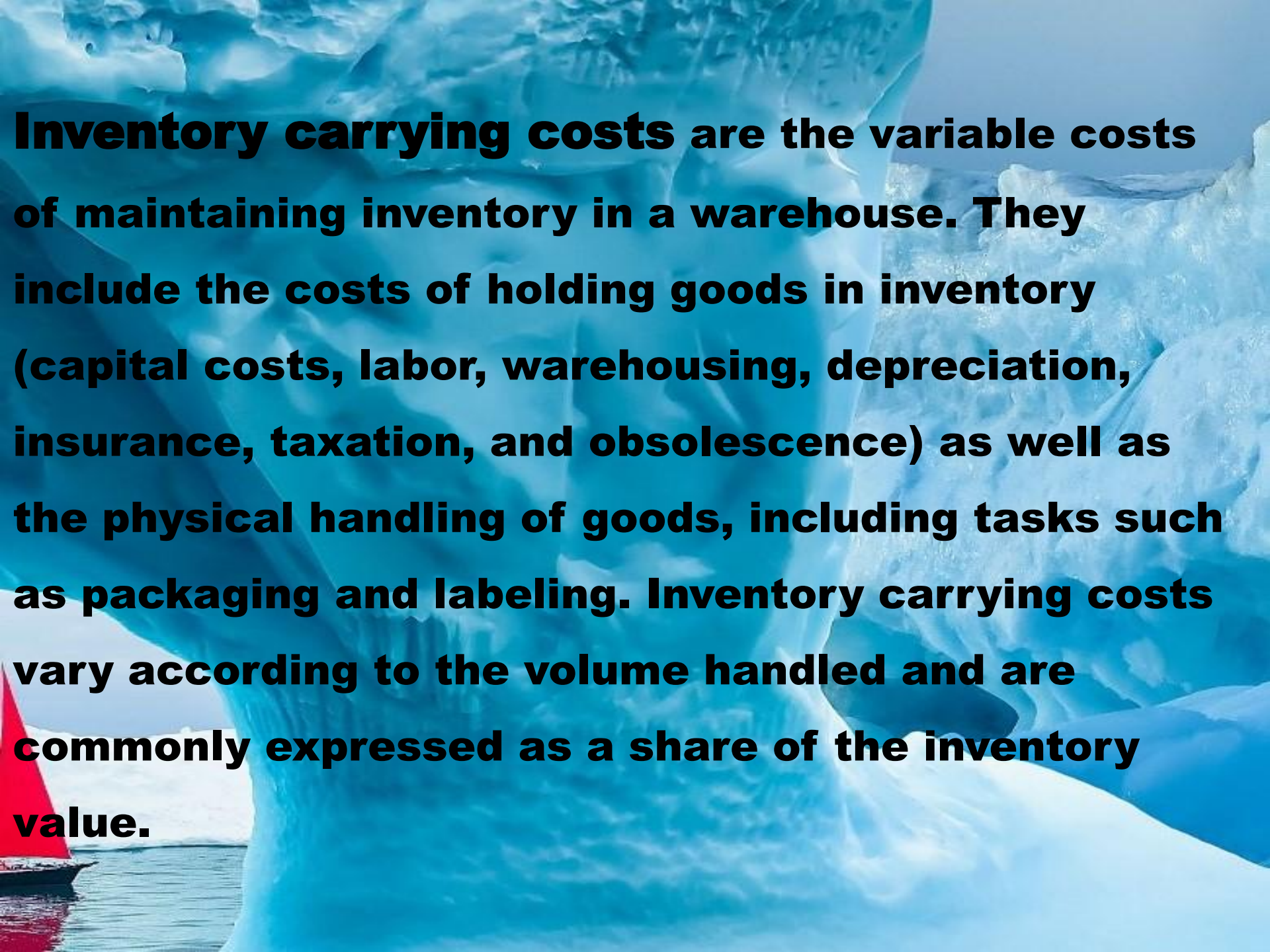


Logistics Costs by Mode (billions USD)

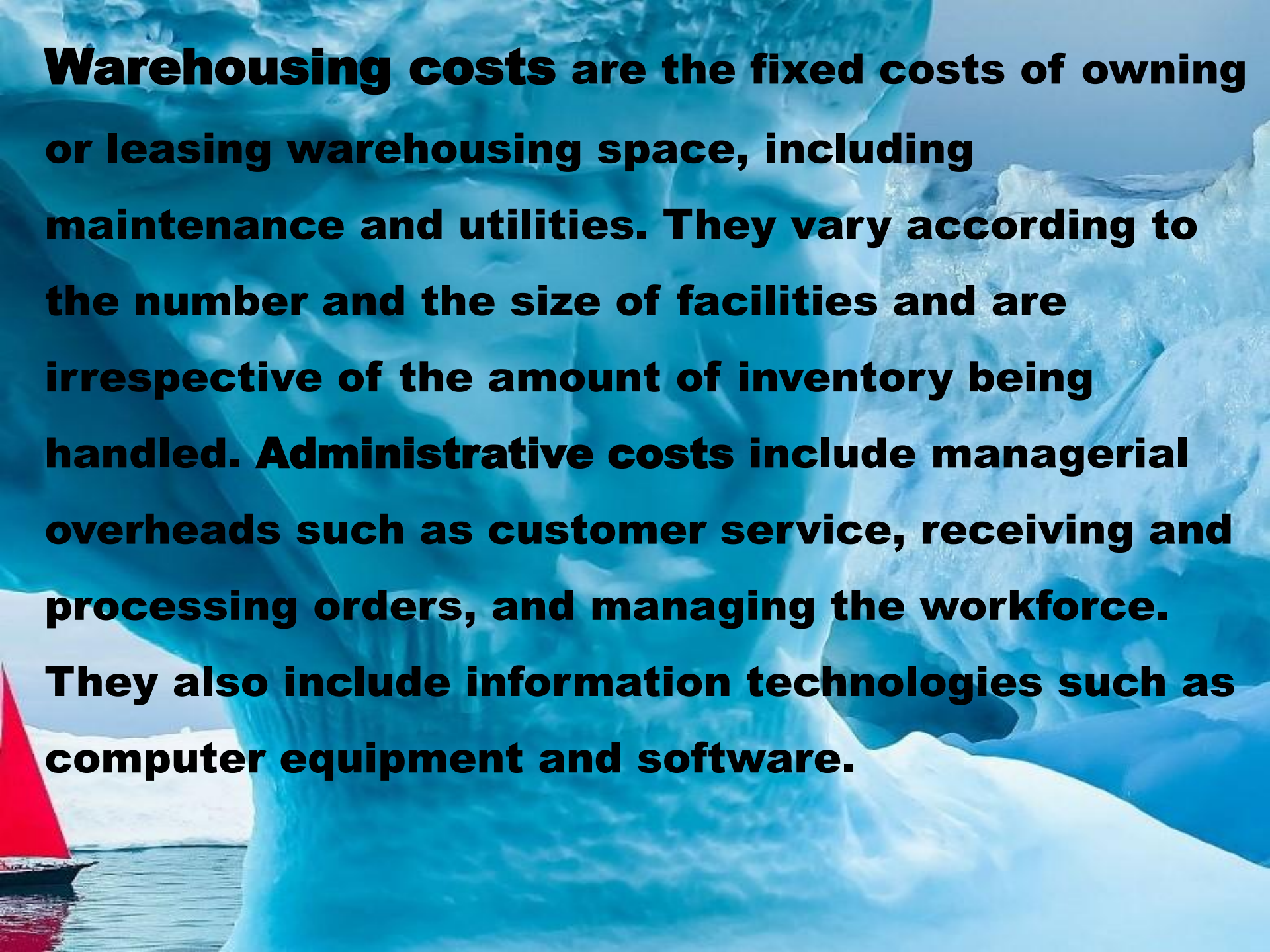


Transportation costs remain the dominant consideration as they account for more than half of the logistic costs. They include the costs related to the operation and maintenance of transportation modes and terminals used in the supply chain. They are the costs related to moving goods between where they are manufactured and where they are distributed and consumed.

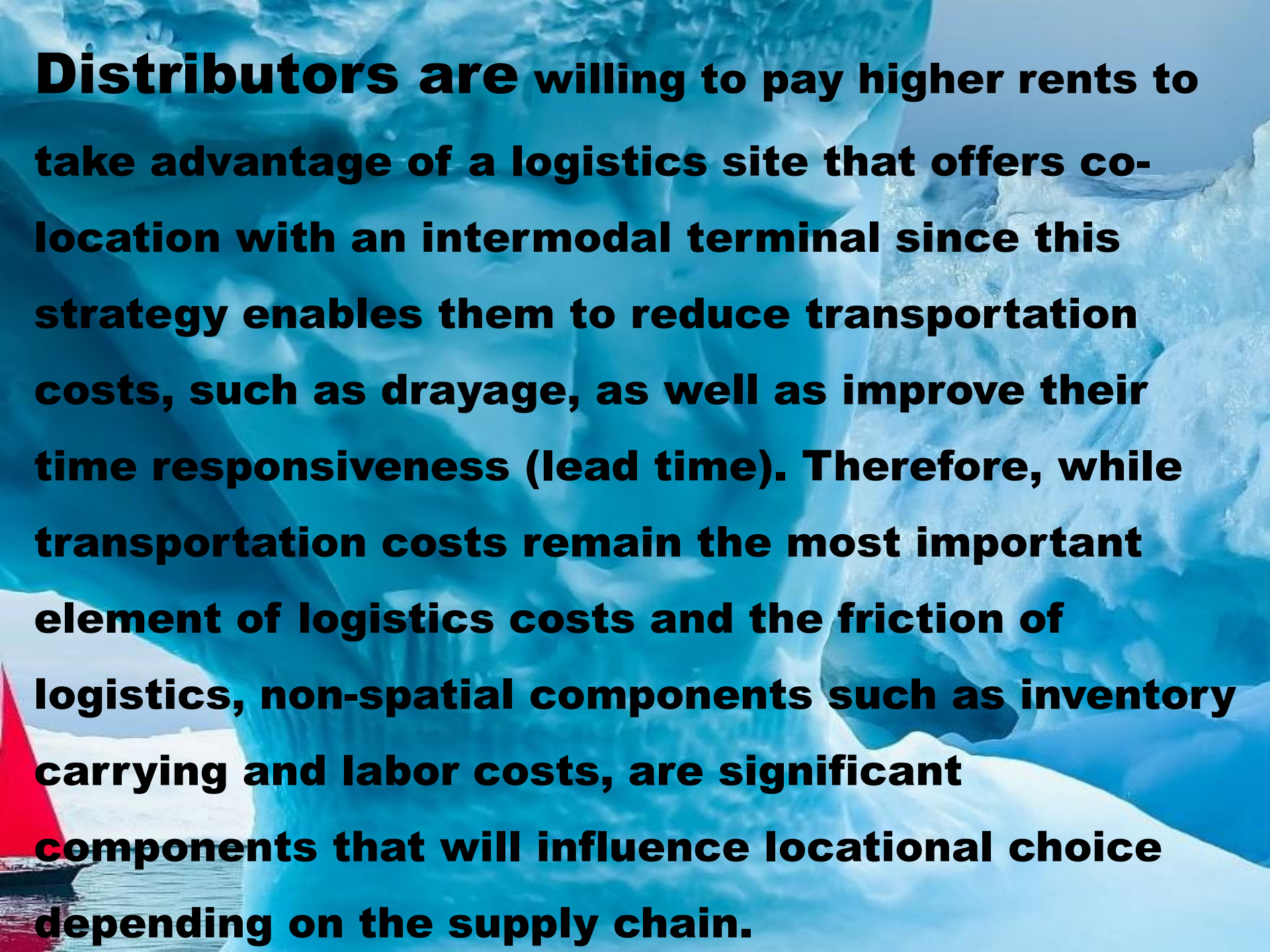
Source: Adapted from Armstrong & Associates Inc.

A large, jagged iceberg floats in the ocean, its surface textured with various shades of blue and white. In the bottom left corner, a small red sailboat is visible on the water. The background is a clear blue sky.

Inventory carrying costs are the variable costs of maintaining inventory in a warehouse. They include the costs of holding goods in inventory (capital costs, labor, warehousing, depreciation, insurance, taxation, and obsolescence) as well as the physical handling of goods, including tasks such as packaging and labeling. Inventory carrying costs vary according to the volume handled and are commonly expressed as a share of the inventory value.

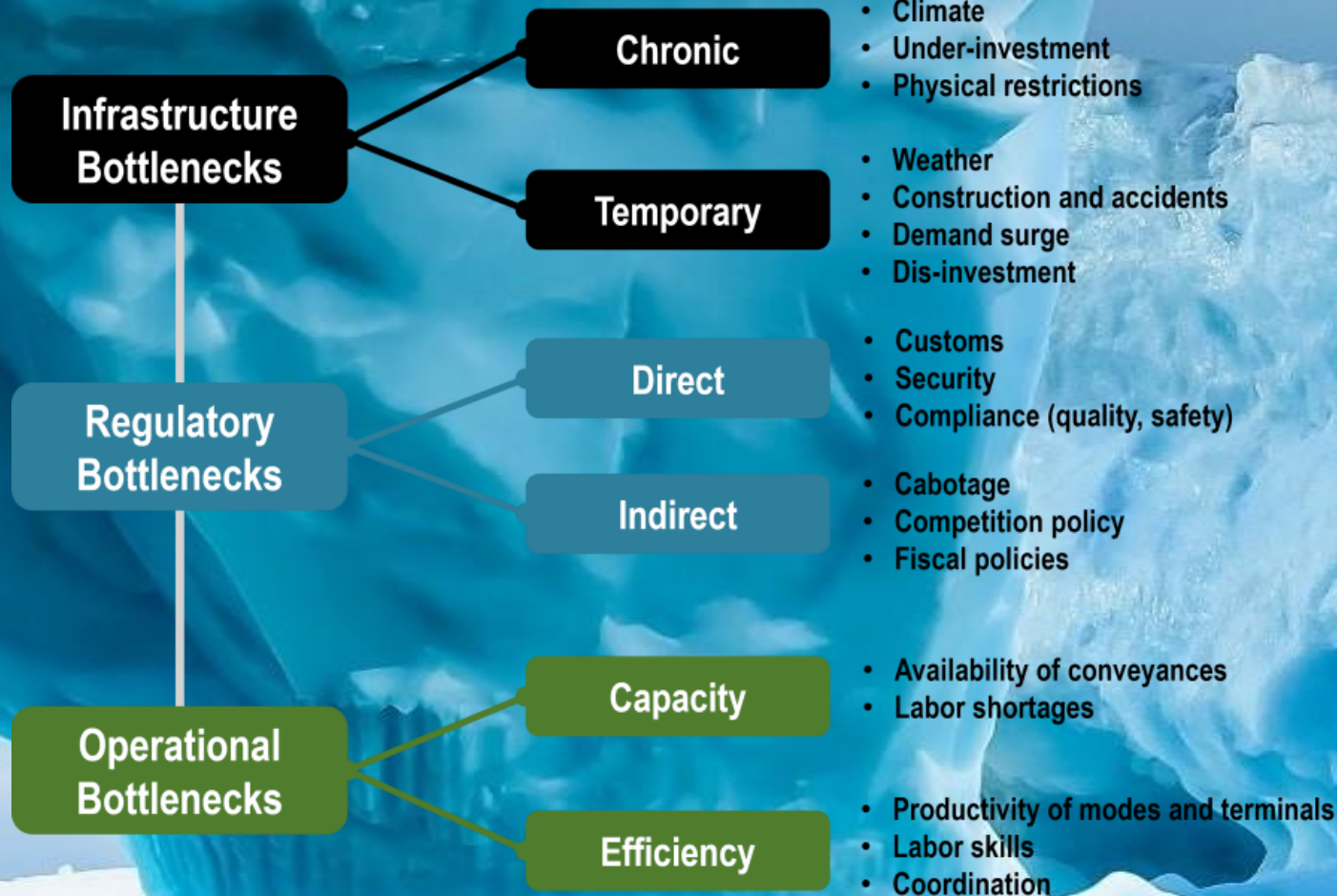
A large, jagged iceberg floats in the ocean, its surface textured with various shades of blue and white. In the bottom left corner, a small red sailboat is visible on the water. The background is a clear blue sky.

Warehousing costs are the fixed costs of owning or leasing warehousing space, including maintenance and utilities. They vary according to the number and the size of facilities and are irrespective of the amount of inventory being handled. **Administrative costs** include managerial overheads such as customer service, receiving and processing orders, and managing the workforce. They also include information technologies such as computer equipment and software.



Distributors are willing to pay higher rents to take advantage of a logistics site that offers co-location with an intermodal terminal since this strategy enables them to reduce transportation costs, such as drayage, as well as improve their time responsiveness (lead time). Therefore, while transportation costs remain the most important element of logistics costs and the friction of logistics, non-spatial components such as inventory carrying and labor costs, are significant components that will influence locational choice depending on the supply chain.

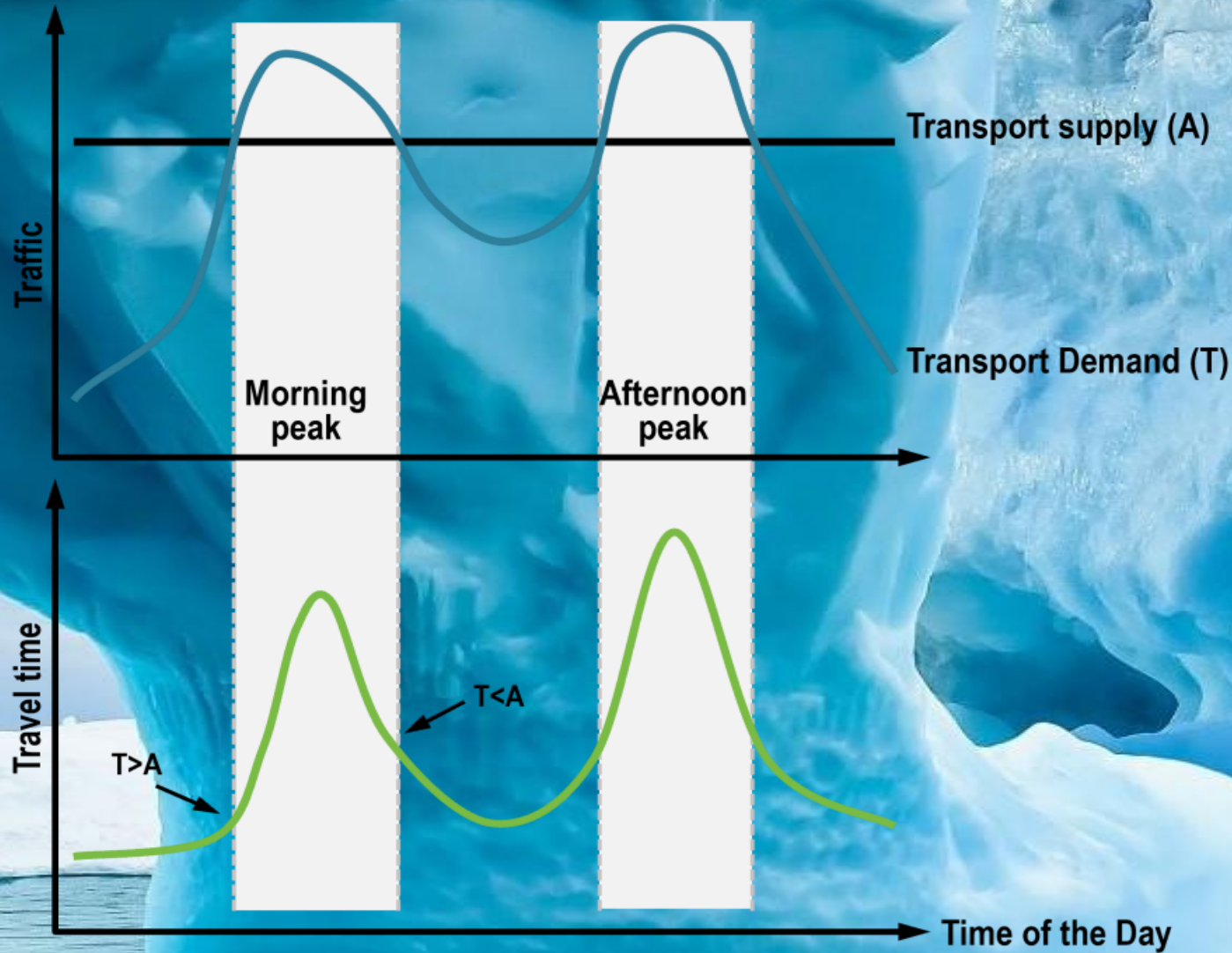
Types of Transportation Bottlenecks



Major Supply Variables for Transportation Modes

	ROAD	RAIL	AIR	MARITIME
ROUTES	<ul style="list-style-type: none">•Lanes•Width•Speed limit	<ul style="list-style-type: none">•Tracks•Grade	<ul style="list-style-type: none">•Corridors•Air control	<ul style="list-style-type: none">•Canals•Locks
TERMINALS	<ul style="list-style-type: none">•Parking	<ul style="list-style-type: none">•Yards•Transshipment	<ul style="list-style-type: none">•Runways•Gates	<ul style="list-style-type: none">•Docks•Transshipment
VEHICLES	<ul style="list-style-type: none">•Speed•Capacity	<ul style="list-style-type: none">•Speed•Capacity	<ul style="list-style-type: none">•Speed•Capacity	<ul style="list-style-type: none">•Speed•Capacity

Transport Supply, Demand and Travel Time



Economic Rationale of Rail Transportation



MARKET AREA

- Longest service area for inland transport (average length of 1,300 km).
- Service passengers and freight markets.
- Intermodal integration favored market segmentation and specialization.



CAPACITY

- A wagon can carry 50 to 100 tons of freight.
- Unit specialization (intermodal, liquids, grains, minerals, vehicles).
- Economies of scale (unit trains and double-stacking).



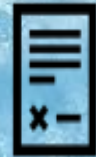
COSTS

- High construction and maintenance costs.
- High operating costs: labor (60%), locomotives (15%) and fuel & equipment (25%).
- Shipping costs decrease with distance and load.
- Transshipments and train assembly increase costs.



BENEFITS

- Accelerated industrialization.
- Support agricultural and energy supply systems.
- Intermodal connectivity with international trade.



REGULATION

- Conventionally highly dependent on government subsidies.
- Government financing, mainly for national economic strategy.
- From regulation to deregulation.
- Private ownership and operations.



**Thanks to all
for Active
Participation
with me**