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Research Article

The Alternate Modes of Transportation in International Logistics

B. Mariappa Babu[1], P. S. Aithal[2]

[1]The Post Doctoral Research Scholar, Srinivas University, Mangaluru - 575001, India;
[2]The Vice-Chancellor, Srinivas University, Mangaluru - 575001, India

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Corresponding Author
B. Mariappa Babu

Email
emaildrbabu@gmail.com

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Orcid
https://orcid.org/0009-0009-2418-6288

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ABSTRACT

To study the need for alternate modes of transportation in international logistics in general. To analyse the constraints posed by Indian ports and to evaluate the existing modes of transportation other than major ports. To assess the need for an alternative mode of transportation. To discuss the emerging alternate modes of transportation that are in the pipeline. An exploratory research design is used in the research study. A comprehensive literature review of existing literature, such as the Ministry of Shipping in India or port authorities, for the most accurate and up-to-date information on the utilization of capacity in Indian ports, as the latest data on port capacity utilization can provide references or reports to support the claim. Additionally, to review industry reports or publications which may provide insights into the utilization levels of Indian ports. To analyse data released by the Ministry of Commerce, the Director General of Foreign Trade, and the Ministry of Ports, Shipping and Waterways. To analyse logistics and transportation-related journals & newspaper articles relating to emerging transportation. Sea transport through major ports has almost reached its full capacity, air transport though fast is expensive, rail transportation is slow, and road transportation, though offers door-to-door service is unreliable. Further, Indian ports have to overcome 2 main constraints, namely the Port and Vessel Constraints. The recent changes in the international logistics sector include Skylon, Space Elevator, Rope Cars, Metrino Butt, Hyperloop, and UR Air Vehicle. Space ay and Ground Way are viable modes of transportation, but the cost and research interest may delay them. A exploratory study to understand the issues in Indian ports, to analyse the need for other modes of transportation such as air, road, outer habour, inland water connectivity, etc, and to explore the other modes of transportation that are in the pipeline and at the research stage.

Keywords: *alternate modes of transportation, sea & air major ports, minor ports, outer habour, inland connectivity, hyperloop, rope cars, metrino butts, space elevators, space way, ground way*

Introduction

As evidenced from Wikipedia (2023), 95% of the international cargo tariff in India is through the sea. And further, in most cases, the export goods are containerised (25% in India) though the level of containerisation is lower than in many other countries (The Economics Times, 29 May 2022). There are also 205 notified minor and intermediate ports in India. In 2007, major ports handled over 74% of all cargo traffic and in the same period, 26% of maritime traffic was handled by minor ports (Wikipedia, 2010). The share of minor ports is growing steadily. As per the Ministry of

Shipping (2014) report in 2013, the major ports handled about 60% of total seaborne traffic, and 176 Non-Major Ports handled 40 % of total traffic. As per Dun & Bradstreet report (2021), the major ports account for 67% of the maritime traffic. In 2021-22, the share of major ports increased by 7% from the previous years 2000-21 (Nautilus Shipping (2023), The Ministry of Ports, Shipping and Waterways (2023)). Nearly 90% of the minor ports' traffic is handled by minor ports in 3 states, namely Gujarat, Maharashtra, and Andhra Pradesh, and again 67% by the two minor ports in Gujarat, namely Mundra and Pipavav ports in Gujarat (The Load Star, 4 March 2022). By and large, around ¾ of the total traffic is handled by major ports. At present, supposedly around 80% to 90% of the capacity of major Indian ports is utilized, which is far higher than the global standard of 70% (Rengamani &Venkataraman, October 2015). The lesser number of major ports in India is itself a serious constraint posed to Indian exporters. Further, none of the major ports can accommodate container vessels over 4400 TEUs, owing to less draft depth (less than 13 m) in Indian seas.

Problem Statement

International logistics in itself is not a sustainable service with an inadequate and inefficient transportation network - the path of transportation is decided by political scenario rather than by shortness of route, use of non-renewable energy, use of materials (packaging and packing) that are not environmentally friendly throughout the chain of logistics, etc. In the Exim business, international logistics is not making any value addition to the product but rather makes an essential contribution by delivering the product to overseas buyers. It is always considered an overhead cost. There are 12 major ports in India. Currently, the capacities of all Indian ports are insufficient to handle overseas trade volume, and hence, they need to be improvised, or alternate forms of transportation should be looked into.

Research Objective

The overall objective of the research to analyse the different alternative modes of transportation in international logistics.

1. To study the need for alternate modes of transportation to conventional modes of transportation such as sea, and air in international logistics in general around the world.
2. To analyse the constraints posed by Indian ports and to evaluate the existing modes of transportation other than major ports.
3. To assess the need for an alternative mode of transportation.
4. To discuss the emerging alternate modes of transportation that are in the pipeline.

Methodology

An exploratory research design is used in the research study. A comprehensive literature review of existing literature, such as the Ministry of Shipping in India or port authorities, for the most accurate and up-to-date information on the utilization of capacity in Indian ports, as the latest data on port capacity utilization can provide references or reports to support the claim. Additionally, to review industry reports or publications that may provide insights into the utilization levels of Indian ports. To analyse data released by the Ministry of Commerce, the Director General of Foreign Trade, and the Ministry of Ports, Shipping, and Waterways. To analyse logistics and transportation-related journals & newspaper articles relating to emerging transportation.

Literature Review

International business fosters the economic development of a country. International business depends upon the availability of international logistics (Hofman, 2017). Export and Import (EXIM) business is impossible without international logistics. Though international logistics is vital to international business and further to the economic development of a country, it comes with a cost (Marti et al., 2017; Rezaei et al., 2018). As per the research by Rashidi and Cullinane (2019), international logistics consumes huge energy resources and accounts for significantly higher carbon emissions than many other industries. Owing to this alarming situation, various international agencies worldwide

are calling for better carbon management in the logistics industry to address global warming (Herold and Lee, 2017). Rodrigue et al. (2001) emphasised the need for efficient transportation alternatives with less carbon emissions.

Roth and Kaberger (2002) argue that the effective way to address the carbon emission issue in the logistics industry is by aligning the Governments' policies to achieve sustainability in the logistics sector. Lu et al. (2019), too, contend that the Government's environmental policy should be redrafted in such a way that it fosters green transportation. Logistics efficiency of a country is assessed by the Logistics Performance Index (LPI). LPI is the indicator of a country's logistics performance, which is released annually by the World Bank. Governments must address the logistics industry's sustainability issues while attempting to improve this index.

It was found that there is a significant correlation between LPI and carbon emission (Karaduman et al., 2020). LPI depends upon five factors: customs, infrastructure, international shipments, logistics quality and competence, tracking and tracing, and timeliness. Apart from customs and tracking, the other three components, such as infrastructure, international shipments, and logistics quality, largely depend upon the transportation network (Arvis et al., 2016). Jaramillo et al. (2018) argue that LPI itself focuses on achieving sustainability in the logistics industry and not just improving the logistic performance alone. On the other hand, Liu et al. (2018) argue that LPI is, in fact, a green logistics performance index if the environmental indicators are integrated. Rao and Holt (2005) link green logistics with the economic development of a country.

Transportation function is vital to logistics (Martel & Klibi, 2016). Khan et al. (2017) argue that transportation efficiency is measured by factors such as energy consumption, fossil energy consumption, and carbon emission. In a significant study by Zaman and Shamsuddin (2017), when an attempt is made to improve the "logistics quality and competence" factor (one of the five LPI factors), the dependence on fossil fuels is reduced, but carbon emission on the other hand, had significantly increased. This was a trailing observation of the present modes of transportation.

As from various literature, the need for alternate modes of transportation is eminent - to address various issues such as curtailing the devastating impact on the environment owing to higher energy consumption, addressing global warming, bringing down higher costs, delays, and risks owing to lower LPI, imbibing the sustainability values in the policies of the Governments, to address carbon emission issue as attempting to improve "logistics competency" in the traditional modes of transportation negatively impacts on carbon emission, and finally to improve the overall economic performance as contended in many research journal articles. When the present means of transportation cannot achieve a higher LPI, there is a need to look for an alternate mode of transportation.

Need for Alternative Modes of Transportation

For various reasons, there is a critical need for alternate forms of transportation – alternatives to conventional modes of transportation such as sea and air in general around the world. The first reason is that when moving big amounts of products, traditional forms of transportation like air and water can be expensive. For shorter distances or smaller goods, alternative modes of transportation, such as rail or road, can frequently be more affordable. The second reason is in terms of speed. Air travel is typically the quickest form of international logistics, but it can also be highly expensive. For some goods, alternative means of transportation, such as rail or road, might provide quicker travel times than sea shipping and can be more affordable than air transportation. Traditional modes of transportation, including ships and airplanes, have a limited carrying capacity, particularly during times of high shipping demand. Other modes of transportation, like rail or road, can provide more flexibility and capacity to accommodate unforeseen changes in freight volumes. The third reason is that conventional modes of transportation, such as

air and sea travel, can have a substantial negative influence on the environment. For shipping goods, alternative modes of transportation like rail or road can provide more environmentally friendly choices. Overall, having alternative modes of transportation for international logistics can give companies engaged in international trade more flexibility, reduce costs, and help the environment too.

Constraints at Indian Ports

The constraints at Indian ports can be referred to as Constraints in transportation by sea in India. There are two major constraints relating to the container handling capacity of Indian ports:

Port Constraint

The capacity of the major ports in India is subjected to huge limitations such as less draft capacity, small dry dock, and less beam length, and these limitations are referred to as 'Port Constraints'. The parliamentary committee has recommended increasing the draft from 7 meters to 20 meters under Sagarmala program (The Economic Times, 27 March 2023). It is generally contended that a 13-meter draft is considered a reasonable draft, but most Indian ports (major ports) have a natural draft of less than 13 meters. When this was the condition of the major ports in India, most minor ports fell short of the required draft.

Vessel Constraint

Vessel Constraint refers to the restricted vessel handling capacity of Indian ports. In the Indian scenario, this constraint is supposed to pose a huge constriction on the container handling paradigm. None of the Indian ports has sufficient anchor depth (draft), dry dock, or length to accommodate 'mother vessels', which require a wider beam length, deeper draft, and wider length to house those vessels. Hence, only through small feeders/ vessels, the cargoes shipped to countries like Sri Lanka, Singapore, etc., before being transhipped to the actual mother vessel, from where the actual voyage to the destination starts (Ministry of Ports, Shipping & Waterways 2022).

Assessment of the Need for Alternative Modes of Transportation

Transportation by sea is the preferred mode of transportation in international logistics and can be referred to as a traditional mode of transportation. When Indian ports have been constrained with port and vessel constraints, which are hard to overcome, the role of other modes of transportation, such as air, rail, road, minor ports, outer habour, and inland waterways play a significant role in transportation in international logistics. The assessment of these modes of transportation individually may throw light on the pros and cons of such modes and the inherent need for alternate modes of transportation.

Air Transportation

Air Transportation is quick and direct, but it is relatively expensive and may be appropriate only for smaller or high-value items. Air transportation is usually relatively safe, reliable, and convenient to major locations but less so to remote locations. Even in this mode of transportation, ground link transportation also must be arranged. More than 90% of world merchandise trade is carried by sea, and over 50% of that volume is containerized. In developed countries, 75-80 percent of general cargo trade is done through containers (UNCTAD, 2022). India is emerging as a modern economy, and about 95% of India's EXIM cargo trade is by sea and 5% by air (Wikipedia, 2023). Only 25% are containerized whereas the liquid bulk traffic, dry bulk represent, and break bulk represent the other modes of unitisation (The Economic Times, 29 May 2022).

Rail Transportation

Rail Transportation is relatively inexpensive, safe, and reliable. It is slower than air transportation and depends on the availability of rail lines and spurs to serve specific customers. If spurs are unavailable, then road transportation to and from rail lines must be arranged. In many countries, more particularly European countries railway companies have heavily committed themselves to this means of transportation to lower their operational costs (Eurostat, 2023).

Road Transportation

Road or Truck Transportation is versatile and can provide door-to-door pickup and delivery. Trucks can often service locations that cannot be served by other means. Although off-road vehicles and helicopters are available for areas that cannot be reached by road, most truck transportation relies on an adequate system of roads and receiving facilities. So far, only little consideration has been given to improving truck transportation. As 71% of our planet Earth is occupied by sea, the scope for a road link between and among the countries is less. Hence, sea and air modes of transportation are viable alternatives (means) for cross-border trade.

Minor Ports

There are 205 notified minor and intermediate ports in India. Major ports handled over 74% of all cargo traffic in 2007 (Wikipedia, 2010). The contribution of minor ports is growing steadily and is almost 25% of Indian maritime trade. Year after year, the performance of minor ports is becoming increasingly visible. As per the Ministry of Shipping (2014) report in 2013, the major ports handle about 60 % of the total sea-borne traffic, and 176 Non-Major Ports handle 40% of the total traffic. Hence, it is evident that the minor ports are also making significant progress in maritime transport and trade. As the minor ports are growing and started handling cargoes to the tune of 40% of the total traffic, in the Indian scenario, this would pose a constraint on the choice of port – major or minor (particularly in case of large shipment) and such constraint can be referred to as 'Port Choice Constraint'. This is a hard constraint as the vessel handling capacity of the minor ports is subjected to huge limitations owing to their lesser draft, smaller dry dock, and lesser beam length when compared with major ports. Developing small ports is a viable alternative. Some small ports have a draft up to 17m, much higher than the major ports. Mundra Port (in Gujarat), a minor private port, handles Cape-size vessels - the biggest of the dry-bulk cargo carriers - of 18m draft, loaded oil super-tankers requiring 21m draft, container vessels requiring 15.1m draft and roll on-roll off vessels of 230m length (Live Mint, 31 March 2014). Dredging operations can only deepen the draft & can invite mother vessels to Indian shores. Some minor ports, such as Mundra & Krishnapattinam had already smelt success by increasing the draft by dredging operation and such prototypes can be replicated.

Outer Habour

The concept of 'Outer Habour' is picking up in various countries. 'Outer Habour', also referred to as 'Offshore Habour'. Many countries are already using their territorial water to build the 'outer habours'. Currently, small vessels are used for piloting through the Pamban pass at Pamban Port (in Tamil Nadu, India). In Cuddalore and Nagapattinam Ports (in Tamil Nadu), the ships anchor in the midstream, and cargoes are loaded and unloaded through barges.

As per the 'International Sea Law' effected by UNO, the following distances from the shore of a country are marked as guidelines for riparian rights of the country over the water (see Table 1):

Table 1: Scope for Developing 'Outer Habour'

Distance in NM	Control over water	Scope for 'Outer Habour'
Up to 12	Under state jurisdiction. Monitored by Coastal Security Group of the concerned state	Tremendous scope as these zones under of Indian Government or respective coastal State Governments
From 16 to 27	End of the continental shelf. The sea gets deeper than 200 m.	
From 12 to 20	Exclusive Economic Zone (EEZ) is Indian waters. Comes under the Centre's Department of Animal Husbandry, Dairying & Fisheries.	
Beyond 200	International Waters	No scope

Adapted from Source: Reddy, 2011; Note: NM – Nautical miles;

As India is not blessed with deep shores (water at shores are not deep enough to accommodate huge vessels), the concept of 'outer habour' is a viable alternative.

Inland Waterway

A navigable canal utilized for transportation or other commercial purposes that is located inside the boundaries of a nation or region is known as an inland waterway. Rivers, lakes, canals, and other bodies of water fit for vessel movement can be considered among these waterways.

When it comes to moving people and commodities, inland waterways can be a more affordable and sustainable option than road and rail transportation. They are frequently used to move people and smaller loads and transfer bulk commodities like coal, grain, and timber.

Several nations' and regions' economies rely heavily on their inland rivers. They can help trade and commerce, ease access to inaccessible locations, and promote leisure and tourism. Yet, their construction and upkeep can be complex due to things like shifting water levels, hazardous navigation, and environmental issues. Indian Government, under the National Waterways Act, 2016, has declared 111 inbound waterways as national waterways. The national waterways cover a distance of 20,275 Kilometers across 24 states (The Ministry of Ports, Shipping & Waterways, 2020).

Discussion on Alternative Mode of Transportation

Major ports handle over 74% of all cargo traffic, and 176 Non-Major Ports handle 40% of the total traffic. Nearly 1/3 of the EXIM is through the sea in India. Air Transportation is quick and direct but relatively expensive and may be appropriate only for smaller or high-value items. Additionally, conventional modes of transportation, such as sea and air travel, can negatively influence the environment. Rail Transportation is relatively inexpensive, safe, and reliable and depends on the availability of rail lines and spurs to serve specific customers. Road or Truck Transportation is versatile and can provide door-to-door pickup and delivery. As 71% of our planet Earth is occupied by sea, the scope for a road link between and among the countries is less. Outer Harbour is also picking up in various countries. However, Outer Harbour can be a completely near alternative. Using Inland Water streams for transportation may be an alternate mode of transportation but their construction and upkeep can be complex due to shifting water levels, hazardous navigation, and environmental issues.

From the above discussion, there is an eminent need for other modes of transportation other than the traditional ones. The discussion on the alternative modes of transportation is presented under the following headings:

- Emerging new modes of transportation that are in the pipeline;
- Alternate modes of transportation that are in the research stage.

Emerging New Modes of Transportation in the Pipeline

There are some visible changes happening in the 'transportation' sector of international logistics in the recent past. Those are as follows: Skylon, Space Elevator, Rope Cars, Metrino Butt, Hyperloop, UR Air Vehicle. These visible changes happened in the 'transportation' sector of international logistics in the recent past, which are free from traffic congestion bottlenecks. Rope cars and Metrino Bhutts are best suitable for inland transportation.

Skylon

Skylon is a 27 ft long jet-engine plane that runs at five times the speed of sound and can travel anywhere in the world in just 4 hours. These planes cooling system is filled with condensed helium to extract heat from the air and cool it to minus 150 degree Celsius, thereby cooling the engine to -150 degree Celsius. Hence the engine is cooled by more than 100 degree Celsius in 0.01 seconds.

These Skylon planes are to make a significant impact in the transportation of consignments, more particularly of perishable nature (Business Standard, 15 December 2014).

Space Elevator

A Space Elevator is one, which carries people and cargo at a fraction of the cost of rockets. The Space Elevator will reach 96,000 km into space using carbon nanotechnology, and it is an absolute alternative to 'Earth-Based Rockets' (also referred to as 'Space Shuttles') which are more expensive and dangerous. The Space Shuttle costs about $22,000 per kg to take the cargo into space. The Space Elevator costs only about $200 per kg for doing the same job (Times of India, 24 September 2014).

Rope Cars

Rope cars are a sort of transportation system that employs cables or ropes to convey cabins or gondolas along a predetermined route. They are often referred to as cable cars or aerial tramways. They are frequently used to move people or goods through challenging terrain, including mountains or valleys (IJIRT, May 2020).

Rope cars operate by suspending a fixed cable or rope between two or more stations. After that, a grip or clamp is used to secure the cabins or gondolas to the cable, enabling a drive system at one of the stations to draw them along the wire.

Rope cars come in various forms, such as aerial tramways, funiculars, and gondola lifts. Aerial tramways typically have two cabins that move in opposing directions down a single cable. In contrast, funiculars transport a single vehicle up and down a steep incline using two parallel tracks and a cable. Like aerial tramways, gondola lifts often employ more compact, enclosed cabins.

In addition to being employed as a mode of public transit in urban areas, rope cars are popular in hilly areas for skiing and sightseeing. The Roosevelt Island Tramway in New York City and the San Francisco cable cars are two of the most well-known rope cars (The New York Times, 15 January 2008).

Metrino Butt

Metrino Butt is an unmanned, airborne, auto-driven, cabled wagon used in the transportation sector. It can travel at a speed of 60 km in urban areas and at 120 km per hour in rural areas. Each wagon should have a 7-meter separation distance from another. The wagons are carried by a cable, and there is a need for setting concrete beams to a height of 10 m at specific intervals. The establishment of such Metrino Butts is already under the perusal of the Central Government (The Economic Times, 27 February 2018). A Metrino Butt is similar to a 'Rope Car', but the former can carry heavy items as the concrete beam supports are there (whereas in the latter such beams are absent).

Hyperloop

Hyperloop is a mode of transportation in which people or cargo are filled in a capsule and that capsule hovers inside a tube. Inside the tube, a low-pressure environment, very similar to an airplane at a high altitude is created. The capsule inside the tube doesn't encounter much resistance and therefore, the capsule can travel at high speed with very little energy. Further, the whole hyperloop system is powered 100% by solar energy. The low-pressure steel tube can be above or below the ground. The capsule or a couple of capsules are driven by a cushion of air blasted from underlying skis, propelled by a magnetic linear accelerator. Tesla and SpaceX CEO, Elon Musk submitted a 57-page technical specification of the functioning of Hyperloop in August 2013 (Wired, 1 February 2018). Already building of such tubes is on the pipeline in California (USA) and Vienna (Austria). Hyperloop is to offer lightning-fast transport, which is impossible for any land-based vehicle (Reuters., 9 July 2015). India is to introduce Hyperloop in the near future (The Economic Times, 14 March 2023).

UR Air Vehicle

UR Air Vehicle refers to an Ultra-Rapid Air Vehicle which can travel at 4 times the speed of sound. The French aircraft company Airbus invented

and patented a UR Air Vehicle in June 2015 with the US Patent & Trademark Office and named it as CONCORDE 2. CONCORDE 2 can fly at an altitude of 1,00,000 feet and can carry 2-3 tonnes of cargo for 5,500 miles. The travel from London to New York could happen in just 1 hour. Or in the Indian scenario, a round trip from Kashmir to Kanyakumari can be completed in just 1 hour. At take-off, the craft would use a pair of turbojets and a rocket motor. It would climb vertically like a space shuttle. Before reaching the speed of sound, the turbojets shut off. At 1 lakh feet altitude, the rocket motor too retracts, and yet another set of motors, the ramjets, would help to achieve a speed over 4 times that of the sound (Time, 3 August 2015).

Alternate Modes of Transportation that are in the Research Stage

A few modes of transportation such as Space Way and Ground Way, though viable in the near future but still the cost and research interest in those modes of transportation may delay a wee bit.

Space Way by Earth Rotation

The shape of the Earth is spherical. The Earth revolves both on its own axis and around the Sun. The former movement of Earth on its own axis is referred to as rotation, whereas the latter movement of Earth around the Sun in its orbit is referred to as revolution. The Earth takes 1 day or 24 hours (approximately 23 hours, 56 minutes, and 4 seconds) to complete one full rotation on its own axis, and the speed of Earth on its own axis is 460 meters per second (or 1609.34 km/hour or roughly 1,000 miles/hour) (Spohn et al, 2014). The Earth takes one year or precisely 365.242 days to complete one full revolution around the Sun, and the speed of Earth around the Sun is 30 km/second (or 107826.05 km/hour or 64,000 miles/hour).

If a person manages to fly beyond the atmosphere and manages to remain static, then he will be able to reach a different location (destination) without actually traveling, thereby relying solely on the rotation of the Earth.

This mode of transportation is based on the idea that if a person moves at the same speed as the atmosphere (i.e., 1000 miles per hour), the speed of the atmosphere will be zero, and they can move by the rotation of the Earth. It is possible to travel by just going up to space, keep waiting, and landing at the desired location.

This mode of transportation can be better explained with the "relativity theory". Say, for example, a person X starts from his house located at location A at 8 AM and reaches his office located at location B. At 5 PM, X reaches back to his house located at A from his office located at B. From X's frame of reference, he travels the same distance to reach back his house at A from his office at B.

But from the frame of reference of a person Y watching X from outside Earth (assuming, though not strictly that Y is watching from outside Earth standing above the X's house at location A and it is the sight of reference of Y), the distance X has to travel from his Office at new location B' to his House located at original location A (can be referred as A0, which is the original location of X's house at A but over time, that's 9 hours in this case, the X's House has moved to A' but his the place where from above Y is assumed to be watching from his frame of reference standing outside the Earth) is 1609.34x9 = 14,481 km.

Again, from the frame of reference of person Z watching outside the Solar System, then the House at A and Office at B at 8 AM will be at the new location A'' and B'' respectively at 5 PM. From Z's frame of reference (refer to Table 2), the distance X has to travel from his office at new location B' to his house at original location A or A0 is 1,07,826.05x9=9,70,434.45 km.

Where,

1609.34 km/minute is the speed of rotation of Earth around its own axis;

9 is the hours between 8 AM to 5 PM;

A is the original location of X's house at 8 AM;

B is the original location of X's Office at 8

AM;

A' is the new location of X's House at 5 PM;

B' is the new location of Y's Office at 5 PM;

A0 is the virtual original location of X's house at 5 PM, which has subsequently moved to a new location A' at 5 PM and is the sight of reference of Y and Z from which Y & Z are watching X from 8 AM to 5 PM.

Table 2: An Overview of the Frame of Reference of 2 objects (House & Office in this case) of a person on Earth, outside Earth and outside the Solar System & the relative distance, considering the Earth's rotation on its axis & revolution around the Sun

Frame of Reference	House	Office	Travel Distance	Remarks
X	A	B	Same distance from A to B and B to A	
Y (from outside Earth)	The House has moved from A to a new location A'; Original location of House at A can be referred to as A0 (from above, where Y is watching X)	The Office has moved from B to a new location B'	Distance between Office at B' and to house at A0 is 1609.34x9 = 14,481 km	As Earth rotates on its own axis, the location of House at A at 8 AM will be at A' and Office at B will be at B' at 5 PM
Z (from outside Solar System)	- House has moved from A to a new location A''; - Original location of House at A can be referred to as A0 (from above, where Z is watching X)	The Office has moved from B to a new location B''	Distance between Office at B'' and to house at A0 is 1,07,826.05x9 = 9,70,434.45 km	As Earth revolves around the Sun, the location of House at A at 8 AM will be at A'' and Office at B will be at B'' at 5 PM

The diameter of Earth is 12,756 km, and the perimeter is 40,066.596 km ($2\pi r$ = 2x3.141x 12,756/2) or 24,855 miles. Hence, conclusively, a person from outside Earth can move to another part of the Earth by just staying outside the Earth. But, at the same time, the distance covered on Earth by a person staying outside space is merely inert, taking into consideration the perimeter of Earth. Hypothetically, assuming that a person can manage to stand outside the Earth or space as the case may be, these modes of transportation are feasible though achieving such would be an outbreak in the scientific world.

When one is staying at the surface of the Earth, then they are moving with the velocity of the surface of the Earth. This is due to their attachment to the surface of the Earth (Dowling & Showman, 2007). One has the same velocity as they had on the Earth's surface if they simply rise and ascend in a balloon. But as one goes farther from the centre of the Earth, one should have more velocity to have the same angular velocity as the Earth rotates with an inclination of 23.45 degrees from its orbit around the Sun (Dehant & Mathews, 2007).

Angular velocity (ω) is the rate of change of angular displacement(θ) of a body (Ozkaya et al, 2017). Angular velocity is shown in the below formula:

$\omega = rv$

Where,

r denotes the radius

v indicates the magnitude of the linear velocity of a particle travelling in a circle

Hence, in reality, one will move slower than the Earth. As a result, one will be farther away from

Earth and not where one started the voyage when one finally gets on Earth.

Two main things to overcome in this mode of transportation are: one should go very high for the wind not to affect them. Secondly, one won't be able to breathe as the air pressure is very low. Hence, this mode of transportation may be suitable for goods transport.

Ground Way Through Earth's Body/Crest

Ground Way transportation is based on the concept of reaching another part of the Earth by digging a hole across the Earth's body or crest.

The Earth's diameter is approximately 12,742 km, which means that a hole through the Earth would need to be over 12,742 km long. Some of the challenges in this type of transportation are:- the deep of the Earth, extreme heat and pressure at the core of the Earth, difficulty in drilling, etc. Another major constraint that makes this transportation inviable is that any object dropped into the hole (with the perception that the hole across the Earth's body was dug successfully) will tend to move towards the centre of the Earth due to gravity and hence, reaching another end of the Earth may be difficult. But such an issue can be overcome by selecting an appropriate place where the centre of gravity is at the lowest. As per Wion News (30 June 2023), there appears a big hole in the center of the Indian Ocean and the scientist have concluded that the hole was due to weak gravitation force at that site.

Russians made an attempt to establish this mode of transportation, and the project is called the Kola Superdeep Borehole. It was an ambitious project undertaken by the Soviet Union in the 1970s to drill a hole as deep as possible into the Earth's crust. The drilling began in 1970 and continued for over 20 years, reaching a depth of 12,262 meters (about 40,230 feet) in 1989. This hole was the deepest hole ever drilled by humans on Earth (Saikia et al, 2021). The Kola Superdeep Borehole was not dug by hand but rather through a series of drilling operations that involved using a large drill bit. The project was abandoned in 1994 due to a lack of funding and technical difficulties. It also faced criticism for its high cost and the environmental impact of the drilling operations.

China, too, is digging a hole in the desert of Tarim in Xinjiang (The Guardian, 6 June 2023), and the real reason behind such an exercise will be known to the world in years to come.

ABCD Analysis of Alternative Modes of Transportation

ABCD (Advantage, Benefit, Constraint, and Disadvantage) Analysis is carried out to assess the pros and cons of alternate modes of transportation. The advantages of alternate modes of transportation focus on the characteristics that differentiate them from traditional modes of transportation. The benefits are something that the shipper would get when using one of the alternate modes of transportation instead of traditional modes. The constraints focus on the restraints in implementing the alternate modes of transportation and further on the constrictions while using one of the alternate modes as a transportation tool. The first one can be referred to as limitation, and the latter one as restriction. The disadvantages focus on the features of alternate modes of transportation that are absent in alternate modes, which would negatively impact a function or activity when adapted instead of one or other traditional modes.

Advantages of Alternative Modes of Transportation

The biggest advantage of alternate modes of transportation is speed. When many new modes of transportation are available, it will mitigate congestion in the current modes of transportation, thereby decreasing congestion on traditional transportation routes. Though alternate modes of transportation involve a huge initial investment, cost savings associated with using alternate modes of transportation when implemented cannot be ruled out. Alternate transportation modes enhance supply chain resilience. The shippers will have better options to select the mode of transportation

as currently, they have only a limited choice. Global warming issues can be addressed as the alternate modes of transportation are likely to emit less carbon (Peters, 2022). Barnett (2014) and Pachauri & Meyer (2014) argue that in the present modes of transportation, the emission of greenhouse gases (carbon dioxide, methane, nitrous oxide, hydrochlorofluorocarbons (HCCs), hydrofluorocarbons (HFCs), and ozone) is at an alarming level.

Benefits of Alternative Modes of Transportation:

The major transportation mode, sea transportation, is subjected to frequent sea perils, which are beyond the control of human beings. As alternate modes of transportation are based on technological advancements, they would provide better and enhanced freight security. A study by Silverman et al. (2012) reveals that people who are engaged in the road and rail transportation sector for a substantial period of time are exposed to lung cancer risk. On the other hand, alternative transportation modes can help reduce greenhouse gas emissions, thereby reducing the undesirable impact on the environment, society, and humans. Alternate modes can open up new markets and regions. Expanding market reach is possible. Owing to their speed in transportation, the alternate modes of transportation are cost-efficient. More particularly, alternate modes of transportation would be a boon in the case of the transportation of perishable goods. The alternate modes of transportation reduce reliance on a single mode of transportation, thereby paving the way for diversification of transportation options for shippers

Constraints of Alternative Modes of Transportation

Constraints may be the limitations in implementing the alternate modes of transportation or restrictions imposed by those modes when using one or other alternate modes of transportation. Limitations in implementing alternate modes of transportation depend upon feasibility, cost, and Government regulation. The feasibility of implementing alternate modes of transportation again depends upon the technology, topography, technical expertise, time, etc. The cost involved in investment in technological advancements for alternate modes would pose a constraint. Most of the alternate modes of transportation are based on technological advancements. Not all countries can allocate a budget to promote technological advancements. Kola Superdeep Borehole project was called off by Russia owing to financial constraints. As international logistics spans more than one country, usually many countries, there should be regulatory support from Governments worldwide for alternate modes of transportation. Government policies and regulations have to favour alternate modes of transportation. Restrictions on alternate modes of transportation may be quantity restriction and reliability. Skylon and UR Air Vehicles are likely to have quantity or volume restrictions. The reliability of the alternate modes of transportation is yet to be assessed.

Disadvantages of Alternative Modes of Transportation

The cost of implementing the alternate modes of transportation is the first and foremost disadvantage. Secondly, the implementation consumes a significant time. Thirdly, a country should be technologically advanced. Fourthly, a country should have sufficient technical expertise in implementing them. As international logistics spans many countries, not all countries would have the same budget, caliber, expertise, and technological advancement to implement them.

Once implemented too, the alternate modes of transportation are erred with some disadvantages. Freight rates may be costlier (at least at the initial stage) than the traditional modes that are collected to meet the investment cost. As some of the alternate modes of transportation have restricted space, the question of loading voluminous cargo (which is not uncommon in international logistics) cannot be sufficiently answered. Some alternate modes of transportation may have weight restrictions, too. Alternate modes of transportation may be unsuitable for multimodal or intermodal transportation. In multimodal transportation, the

carriage of goods in more than one mode takes place based on a single contract (Elbert & Seikowsky, 2017; Roso, 2008), and likewise, in intermodal transportation, the carriage of goods in more than one mode takes place based on multiple contracts with minimum or no handling in subsequent modes from the first mode of loading (Segui et al. 2016). In both multimodal and intermodal transportation, door-to-door service is possible. Door-to-door service of shipments may be a big question mark in alternate modes of transportation.

Conclusion

International logistics is not a sustainable service with inadequate and inefficient transportation networks; the path of transportation is decided by political scenarios rather than by shortness of route. 95% of the international cargo tariff in India is through the sea, and most export goods are containerized. Major ports handle over 60% of all cargo traffic, and 176 Non-Major Ports handle 40% of the total traffic. Indian ports have to overcome 2 main constraints, namely the Port and Vessel Constraints. Air Transportation is quick and direct but relatively expensive and may be appropriate only for smaller or high-value items. Additionally, conventional modes of transportation, such as air and sea travel, can negatively influence the environment. Rail Transportation is relatively inexpensive, safe, and reliable and depends on the availability of rail lines and spurs to serve specific customers. Road or Truck Transportation is versatile and can provide door-to-door pickup and delivery. As 71% of our planet Earth is occupied by sea, the scope for a road link between and among the countries is less. Outer Harbour is also picking up in various countries. However, Outer Harbour can be a completely near alternative. Using Inland Water streams for transportation may be an alternate mode of transportation, but their construction and upkeep can be complex due to shifting water levels, hazardous navigation, and environmental issues. The recent changes in the international logistics sector include Skylon, Space Elevator, Rope Cars, Metrino Butt, Hyperloop, and UR Air Vehicle. Space Way is based on the idea that if a person moves at the same speed as the atmosphere, the speed of the atmosphere will be zero, and they can move by the rotation of the Earth. Ground Way Through Earth's Body/Crest transportation is based on the concept of reaching another part of the Earth by digging a hole across the Earth's body. Challenges include the deepness of the Earth, extreme heat and pressure, difficulty in drilling, and the tendency of objects dropped into the hole to move towards the Centre of the Earth due to gravity. When the above difficulties are overcome in the future, this mode of transportation will emerge as cheap and fast. Space Way and Ground Way are viable modes of transportation, but the cost and research interest may delay them.

Limitation and Future Work

A detailed study of the factors governing the choice of transportation should be made, as this research conveniently ignores such factors.

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