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The Need for Inland Shipping and its Viability in India: Opportunities and Challenges

by

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“Sure I am this day we are masters of our own fate, that the task which has been set before us is not above our strength; that its pangs and toils are not beyond our endurance. As long as we have faith in our own cause and an unconquerable will to win, victory will not be denied to us.”
-Winston Churchill

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Abstract

Logistics is regarded as the backbone and one of the key enablers of India's economic growth, which helps move goods in the country on which major commercial sectors thrive on. However, India's logistics sector is infamous for its inefficiencies and obsolete techniques all of which contribute towards the high logistical costs of as much as 13 to 14 percent of the GDP rendering the logistical costs of India among the highest in the world. With India's tremendous economic growth over the past decade and the prospects of it only increasing in the foreseeable future, there exists the critical need to address the various inefficiencies and bottlenecks in the sector to create a sustainable logistics network which addresses the issue of the much needed integration of transport network effectively. At the centre of such an attempt towards sustainable transport development of a system capable of handling future freight volume increases, and a move towards a balanced network design, is the revival of the Inland Shipping sector in India. India is well endowed with an extensive network of navigable waterways totalling around 14,500 kilometres. Yet, this sector has remained neglected and under-utilized for all these years. India's current transport modal mix is dominated by rail and road with the modal share of Inland waterways being only a miniscule 0.2 percent relative to countries like China, USA, and Europe where the modal share of inland shipping is 8.7%, 8.3%, and 7% respectively. However, the Government of India has now implemented a series of projects to revive the Inland waterways of the country making them adept for freight transportation, a step that holds great importance for the development of Intermodal and Multimodal transport systems in the country; it is one step that has the potential to transform the logistical network of the country. Inland shipping is considered one of the most sustainable ways of transportation being environmental friendly with very low transportation costs. Our thesis is motivated by the fact that though there is unanimity for the vast potential for the application of Inland shipping, there are a wide variety of challenges that its application in an effective Intermodal and Multimodal transport network brings with itself which need to be solved effectively. Also there are doubts about whether Inland shipping can really lead to costs advantages in the case of India in the sense and investments in this regard are justified. With all this it there exists a golden opportunity for India to redefine its logistics sector but there is a pressing need for adoption of the right measures and learning from the global best practices such as that of Europe or the other developing countries to encourage the development of an Intermodal and Multimodal transport network integrating Inland shipping and the other two modes namely roadways and railways best utilizing the transport infrastructure of the country.

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1. Introduction

1.1. Background and Motivation of the Thesis

The logistics industry in India has been one which has managed to gain a lot of attention from the public and private entities in recent years. India started out with a transportation handicap having none of the essential infrastructure but over the years the logistics sector transformed itself tremendously into an industry becoming one of the key enablers for India's economic success. However, the pace at which India is growing, the current logistics infrastructure of India is over stretched and is not in a position to handle the future demands; even at conservative annual growth rate of 7.5 per cent, India's freight traffic is likely to more than double from current level by 2020 and the present infrastructure is inadequate and inefficient to handle it.

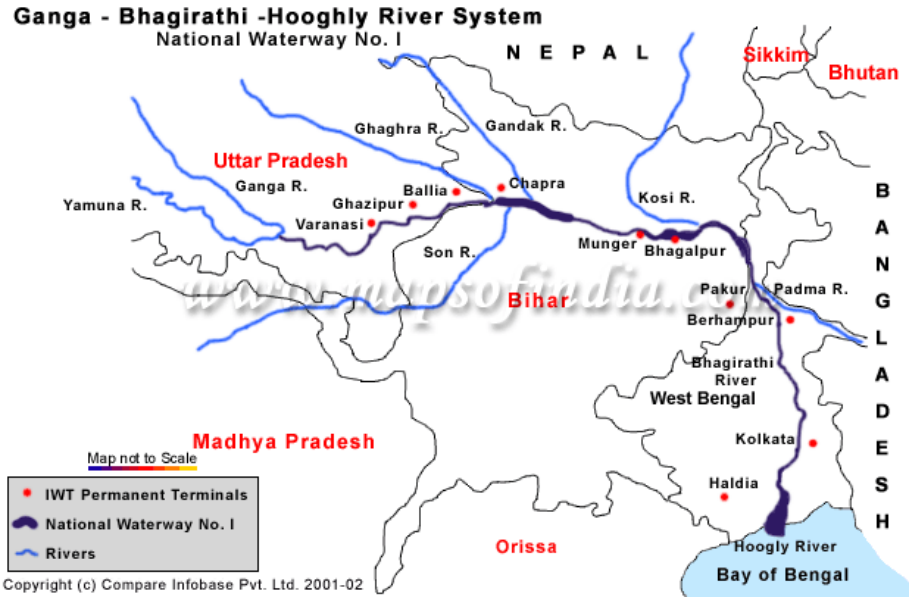
Based on the nature of India's freight flows, what it needs is a systematic and efficient shift towards a balanced network design. Presently, the freight movement in India is highly dependent on transportation by road compared to other continental sized countries like the US and China (McKinsey & Company, 2009). In the past, the policies and funding by the Indian government have ignored other transport modes like railways and inland shipping even though the capacity on such modes remains inadequate. However, to meet the sky rocketing demands for the growing freight volumes, a shift towards a more economically viable and environmental friendly way is required. Achieving this will require building an extensive well integrated network and also ensuring that the right flows are on the right mode. Furthermore, utilising the existing infrastructure and integrating them fully and efficiently into the expansion plans will also go a long way in reducing the economic waste.

The government in recent years has been trying to come up with and implement an effective national level policy by defining a blueprint of infrastructure development to encourage adequate linkages of different modes of transportation. This will help in achieving a holistic and balanced multimodal mix. In such attempts one key step by the Government of India is the reviving inland shipping sector in India which has for all these years been neglected. The Inland Waterways Authority India, under the Ministry of Shipping has implemented projects to develop the National waterways in India to make them adept for inland transportation.

As part of this vast project, The Government of India has implemented a plan for reviving the Ganga watercourse also known as the National Waterway 1 or NW-1 (SEE FIGURE 1) to ferry cargo to and from the eastern seaports of Haldia and Calcutta, two of India's major sea ports to Varanasi in Northern India connecting the Industrial hubs in the north to the one's in the

west. The project is being implemented with the World Bank financing the development of the Ganga waterway with a loan of USD 375 million.

Figure 1: National Waterway 1



Source: mapsofindia.com

Almost 40% of all India's traded goods either originate from this resource-rich region in the north which is a centre for a lot of industrial activities or are destined for its bustling markets. Currently, freight from the Gangetic states in the North take the longer land routes to reach sea ports in the West of either Mumbai in Maharashtra or Kandla in Gujrat (SEE FIGURE 2), rather than going to the much closer port of Kolkata. However, with the development of the NW-1, shippers in the North can directly ship their cargo to the Kolkata-Haldia complex reducing transportation costs immensely with a help of a cheaper, more environmental friendly way of transportation. Also, once operational, this waterway will be integrated into the larger multi-modal transport network linking the Eastern Dedicated Rail Freight Corridor and also northern network of highways in the country.

Figure 2: The Western ports of JNPT and Kandla in India

Source: agrixchange.apeda.gov.in

The development inland waterways in India with this first step has the potential to change the logistics infrastructure of the country. However, the advantages offered by inland shipping are restricted to the manifestation of certain specific conditions and circumstances. For instance, the total cost advantage of inland shipping is dependant heavily on the length of transport on waterways and the distance of the consignee to or from the transfer point. Our thesis will study the effect of NW-1 on the freight movement in the North trying to assess and predict the economic benefits that can follow; Our Research will have an qualitative assessment of why is inland shipping needed in India and whether the outcomes that are being predicted and promised can actually be achieved keeping in mind not only the advantages but the limitations of its application in the Indian scenario and whether Inland Shipping with the present plans of the Government of India has to potential to change the logistical network of India.

1.2. Research Objectives, Questions, and Methodology

The role played by rivers in trade, commerce, and logistics and its potential is undeniable. To tap into this resource is one of the strategic objectives of the Indian government which not only includes the revival of just the inland waterways sector but also an attempt to modernise the entire logistics network of the country and build efficient systems of road, rail, inland, and coastal waterways and their effective integration for seamless transportation.

For centuries, river networks used to be the main channels of inland trade, and even today inland waterways continue to remain popular in many parts of the world. In this context, it is the potential of Inland shipping in India which triggers this research. India is well endowed with a good density of rivers and other waterways. Development of Inland shipping can be huge step towards not only the socio-economic development but also in providing a sustainable transport which fully utilises all the different modes- rail, roads, and waterways to their full potential i.e. moves India towards intermodal and multimodal transportation which is the need of the hour.

The purpose of this thesis is to assess the need for and viability of Inland Shipping in India taking into account the opportunities and challenges that are present for its application in India. For this purpose, our research will be guided by the following main research question:

What are the opportunities and difficulties for the application of Inland shipping in India?

Answering this research question will entail a lot of different aspects. It will assess whether there is in fact a need for inland shipping and if so why. We will take into account what are the problems with Inland shipping in other countries where it is fully developed such as Europe and use that as an example to learn from for the Indian scenario. We will further the assess the current state of the logistics sector of India which will not only give us reasons for development of an alternate mode of transport but also give way for the discussion on the application of Intermodal and Multimodal transportation systems. In the context of this, the above main question can be split into five sub questions, discussions on which will provide us with the answers needed which will ultimately conclude our stance in the face of our main research question. The five sub questions are: -

1. ***Why is Inland shipping needed and how will it contribute towards the development of sustainable transport systems?***
2. ***What is the current state of the Indian logistics sector?***
3. ***What can be done for the effective development of an effective intermodal and multimodal transport system incorporating inland shipping?***
4. ***What is the current state of the Inland waterways transport sector of India?***
5. ***What are expected reductions in transportation costs?***

1.2.1. Methodology

Our research will primarily be a theoretical research incorporating a qualitative methodology. The reason for this is the fact that the first four research sub questions are more empirical in nature i.e. they are concerned with observations on and experiences with inland shipping. Addressing the research questions will be best done by an extensive literature review incorporating integrative review of the different concepts surrounding inland shipping adoption, the various trends and concepts in the logistics sector, the experiences of different countries with inland shipping, all of which is more on the qualitative side relative to the quantitative side. This will help our research address the different reviews on the various concerned topics in an integrated way such that different frameworks or perspectives can be best applied to our case.

The first four questions will be answered based on a qualitative analysis of the literature that is present on the relevant topics for our research such as 'sustainable transportation', 'development of sustainable transport systems', 'intermodal and multimodal transport systems', 'supply chain and logistics development', 'inland transportation', 'inland waterway transportation', 'the role of inland waterway transportation in sustainable transportation' to describe a few. Our literature review is of course not limited to just these topics and will also be based on the relevant studies surrounding the other different relevant concepts.

However, though the empirical findings will provide for a strong stance on the adoption of IWT, we will incorporate a case study research methodology that will move us towards a more quantitative approach which will give further insights into the arguments presented; The fifth question will be answered based on a case study approach adopted that will involve a quantitative analysis of transportation costs incurred when transporting a container via the different modes in the context of the case study description. This will essentially help broaden

the view of the research after the qualitative discussions for the first four research sub questions and help make our research more reliable and objective. The aim of the case study is to compare the findings on transportation costs and which will indicate whether transportation by inland waterways will in fact lead to reduced costs. For the purpose of our case study we further adopt a scenario methodology by introducing two scenarios. This will essentially help us incorporate the existing assumptions, challenges, and uncertainty surrounding the success of inland shipping in India; The results from the two scenarios will not only help answer the fifth sub research question but also address the primary research question more effectively providing insight on both the 'challenges' as well as the 'potential' of Inland shipping thus providing for a solid base to conclude our research with.

2. Literature Review

2.1. The Need for Inland Shipping- The Role of Inland Shipping in Sustainable Transportation

Inland Shipping or Inland Waterway Transport (IWT) finds its place in a logistics network as one of the most sustainable transport modes and has been the topic of conversation becoming widely adopted by countries which are increasing concerned about the topic of sustainability and progressing towards sustainable supply chain management. Sustainable supply chain management includes all the processes of supply chain management such as procurement, production, distribution, and the reverse logistics with the right steps taken towards ensuring a socio-economically and an ecologically sustainable recovery (Bloemhof & Van Nunen, 2005). This gives way to the topic of sustainable development. Sustainable development is development that meets the need of the present without compromising the ability of future generations to meet their own needs (Brundtland, 1987). In context of sustainable development, the topic of sustainable transportation becomes important with transportation's considerable effect on the environment and society. The need for inland shipping can be found in the definition of a sustainable transport system. A sustainable transport system includes three requirements (Rohacs & Simongati, 2007)-

1. It keeps at the forefront the health of the humans and the ecosystem while meeting the basic needs of the participant including the individuals, companies, and the societies while promoting equity within and between successive generations.
2. Is economically viable in the sense that it is affordable, fair, and efficient, offers choice of transport modes, promotes competition and development.
3. Limits emissions and waste as much as possible, uses renewable energy at or below their rates of generation, and uses renewable resources at or below the rates of development of renewable substitutes while minimizing the impact on the environment.

From the above definition, it becomes clear that two aspects need to be addressed for the effective development of the sustainable transport system. One is in economic in nature while the other has to do more with the natural environment but the two are somewhat interconnected. The economic use of natural resources in the context of transportation depends greatly on the built systems and on the applied technology (Rohacs, Hadhazi, Simongati, & Hargitai, 2005). Our thesis is more economic in nature and thus we will only judge IWT's economic performance. Therefore, on an economic front we can analyse IWT considering broadly the

transportation prices, infrastructure cost, external costs, final energy consumption, and energy efficiency looking at examples from Europe and other parts of the world.

The different modes of transportation in the past have managed to reduced their prices over the last 20 years. There have been reductions up to 36%, 45%, and 52% in road transport, railways, and water transport respectively with water transport achieving the largest reduction and has managed to become the cheapest on account of increased competition with road transportation (Rohacs & Simongati, 2007). Taking the example of Europe, IWT had to reduce its costs in order to maintain its market share in the face of roadways gaining the larger chunk of it, by focussing on high volume markets over large distances. IWT is considered the cheapest mode of transport; it fulfils the requirements of bulk goods as well as containerised freight best while being cost inelastic and thus earning considerable revenues (Blaauw, Van Windrum, & De Vries, 2003).

The infrastructure costs are related to provide for the mode of transportation for instance, highways in the case of road transport, tracks in the case of railways, and terminals and ports in the case of waterways. One huge advantage that IWT has over other transport modes is that waterways are natural and thus the only costs related to infrastructure are the costs of inland navigation which is rather small. However, it does need maintenance in the form dredging and providing locks etc. The costs of infrastructure depend a lot on the different material and labour prices and taxation systems of a country. However, examples from countries like China and Europe point towards them being lesser than what can be expected in the provision for infrastructure for other modes as the utilization of natural infrastructure available and the possibility to expand it, there are considerable costs advantages which can be achieved. The external costs of a transportation mode are very large and uncertain which includes various aspects like accidents and congestion; In Europe, it accounts for 8% of the GDP (INFRAS, 2000). The external costs of IWT when considering the absolute costs per year to the yearly transported volume are quite less and thus has a far good position in sustainability criterion relative to the other two modes (Rohacs, Hadhazi, Simongati, & Hargitai, 2005). Energy consumption is an important topic for transportation sector with it being responsible for around 40 to 50 percent of total energy consumption on an average. IWT has very less energy requirements due to the favourable ratio between loading capacity and net weight of the ship (Schilperood, 2004).

2.2. The Potential of Inland Shipping- The case of the Netherlands and the rest of Europe

As we will discuss later, Europe too suffers from the problem of over dependence of trucking as a transportation mode which leads to a not so efficient logistics network. However, unlike India it has a well-functioning IWT system. Therefore, transporting goods by IWT can prove to be advantageous for Europe and its member states as barges can transport more goods per distance kilometre, having loading capacities being equal to hundreds of trucks, adoption of which can help reduce not only the transportation costs, emissions, but also curb the road congestion (European Court of Auditors, 2015).

With the economic growth of EU member states and also with its enlargement, there is considerable increase in trade and thus the demand for the movement of freight. With the concept of sustainable development at the heart of Europe's transport development plans, EU realising the potential of IWT has identified key areas as the main challenges among which limited and poor availability of infrastructure are a big concern. It is taking several steps to respond to the situation it finds itself in. It is focussing most importantly on providing for equal and fair competition among all the transport modes. It is also focussing on harmonisation of framework conditions focussing on fiscal and legal regimes, and developing adequate infrastructure of waterways and ports to help IWT compete in terms of costs. It is also focussing on innovation and cooperation within the sector and with other modes.

We will be Considering Europe's example along with that of the Netherlands which can help point out the potential IWT system has and what the Netherlands and the rest of Europe doing for its integration into an intricate logistics chain for sustainable development of its transportation sector.

2.2.1. The IWT Sector in Europe- Structure, Problems, and Potential

In Europe, IWT represents a 3.5% market share in volume and ranks third in inland freight transport after the other two competing modes namely rail and road contributing significantly to cope with the rising traffic volumes. A major threat for IWT sector in Europe is its inability to keep up with roadways with the latter capturing the larger part of the modal share since 1973. IWT in Europe is dominated by the presence of private players. There are two types of service providers namely 'IWT operators' and 'single-vessel operators'. There are essentially four corridors that IWT sector has to service- the Rhine corridor (Netherlands, mid-western Germany, Poland, and the Czech Republic) the North-South corridor (parts of the Netherlands and Belgium, and France), the East- West corridor (northern and eastern Germany, Poland and

Czech Republic), and the Danube corridor (south-eastern Germany, Austria, Slovakia, Hungry, Romania, Bulgaria) with the Rhine corridor being the most important one. In Western Europe, is mainly made of up of the IWT operators who only arrange for the transportation of the freight whereas the it is the single vessel operators who actually haul the freight. In places where IWT is widely used and well developed such as Germany, Belgium, France, and the Netherlands, it is the single vessel operators who are mostly family owned companies who dominate the market relying on freight forwarders to obtain cargo from shippers for transportation (European Court of Auditors, 2015).

Coming to infrastructure, the European IWT sector is characterised by vessels of a large variety with differing technology and differing variations which can essentially be categorised into two groups namely- single self-propelled vessels and push boat technology with the former being the one that is used majorly; Self-propelled vessels amount to approximately 7.5 million deadweight tonnes in the four corridors (Buck Consultants International, 2004).

Infrastructure of IWT is the most important topic which has direct bearing on its competitiveness; It has been observed that missing links and bottlenecks limit the overall efficiency of IWT. In places where the necessary infrastructure is not available or cannot be used effectively, IWT cannot compete with the other two modes. The infrastructure of IWT varies greatly when taking into account all of Europe. If we consider the high-volume corridors like that of Rhine, it is backed up by an excellent intricate networks with links to the major seaports. The IWT network covers almost all of Western Europe linking the important economic areas. In places where the infrastructure is developed IWT has considerable advantages over the other two modes. There are four competitive advantages reported in the report 'prospects of inland navigation Europe' relating to this (ProgTrans, 2004): -

1. Having a lowest line cost per tonne kilometre between ports
2. IWT services are reliable in the sense of meeting the established deadlines not taking into account the cases of extreme weather
3. Has a high level of safety which are necessary conditions for the movement of dangerous goods
4. Is linked on average to the lowest external costs relative to railways and trucking

One advantage that the IWT in Europe has is that many industrial and population centres lie along the inland waterways. In the case of Europe, one necessary precondition that has been identified for an excellent seamless IWT transportation is the adoption of uniform construction standards which are not fulfilled due to certain bottlenecks. Essentially this leads to the problem where there is lack of integration of IWT in the sense that many waterways in Europe are not

connected or inadequately connected with each other which restricts the IWT's competitiveness with other modes. Thus, there is a pressing need for the adoption of uniform construction standards.

One important concept implemented in the IWT sector in Europe is that of the 'tri-modal hubs' with many ports transforming themselves into pure transfer facilities and logistics centres providing high value-added services. This concept has helped curb the cost of transhipment, which is one major contributing factor towards the competitiveness of IWT sector (VBD Germany, 2004).

Infrastructure not only involves the ports and the vessels but also the necessary adoption and dissemination of the important information and communication technologies; In Europe, the adoption of the various technology aids towards achieving four types of strategic benefits namely- increased competitiveness of IWT, optimised use of infrastructure and the funds available, improved safety, and increased environmental protection. There is one major technology adopted in the European IWT sector namely, the River Information Services (RIS) which aids the operational services of the sector all over Europe and has been seen a major step towards transforming inland navigation into a transparent, reliable, flexible, and easy to access transport mode.

One important issue involving IWT in Europe is the issue pertaining to the intermodal competition and intra modal competition. In the context of this concepts such as liberalisation and deregulation become important. This has to do directly with the legislation and policies which govern the operations of IWT. IWT sector in Europe operates within the political and legislative framework set by the EU including the international agreements. Liberalisation of the transport markets in the EU is considered quite unequal which distorts the competition between the different modes; With the involvement of many state entities of the many countries of Europe, there exist significant difference in taxation for instance between Germany and the Netherlands affecting IWT companies. Also, in many of the EU member states service providers may operate with direct or hidden subsidies. Therefore, there is a need enforcement of tax regulation. There is also need to regulate the market structure which has an important bearing on the intermodal competition. It has been pointed out that the single vessel operators are at an disadvantage without having direct link to shippers and having to rely of forwarders for freight while railway in EU owns large rolling stocks and has its own affiliated sales organisations which allows them to operate on lower prices on certain routes (Buck Consultants International, 2004).

Taking into account everything, EU is realizing the missed opportunities and is incorporating changes into its policies and legislations for development of IWT and for it to contribute towards, smart, sustainable, and inclusive growth of the European economy. It is essentially focussing on ten key development areas namely legislation, waterway infrastructure, enhancing the performance of transhipment interfaces, improving information services, improvement in human resources, modernisation of the supply side i.e. fleets, integration of IWT in the logistics chains, innovation, marketing of IWT, and creating a reliable knowledge base of IWT (Wiegmans & Konings, 2016).

Improving the legislation has to do with essentially addressing the market structure and to make sure the necessary measures are in place for fair competition among the different modes. For fair competition, the improvement and harmonisation of the legislative framework which is directly related to the various facets such as manning requirements, technical regulations of barges, social standards, licenses to operate, and the more important fiscal aspects is crucial (ProgTrans, 2004). There needs to be level field established in the context of monitoring and control of existing regulations and addressing the intermodal competition effectively having transparency in infrastructure budgets, subsidies for ships or for rolling stocks in the case of railways. Improving the legislation also has to do with curbing the bureaucracy that exists with so many member states involved which lead to implementation delays due to lengthy administrative procedures (European Court of Auditors, 2015).

Improving the waterway infrastructure has to directly with improving the waterways and extending them effectively. As we discussed, there are certain regions where the inefficient connections in the network hinder the effective use of IWT network and this has a direct bearing on its competitiveness. Thus, the main policy objective in this regard is to improve the waterway infrastructure by incorporating proper maintenance, removing the bottlenecks, and wherever necessary improving the infrastructure by extending the waterways. This has to do with improvement in locks where lock capacities lead to prolonged travel times, improving the width and shape of the navigable waterways which essentially determine whether upstream and downstream vessel can navigate their ways simultaneously, ensuring the appropriate depths in the waterways which determine how many tonnes of goods can be carried on a barge. An extended version of this step is the enhancement of the infrastructure of the ports which will help provide an effective network aiding the transhipments for the intermodal integration of IWT in the logistics chain. For instance, a relevant missing link which is being addressed presently is that of the Seine-Scheldt connection between France and Belgium being worked upon by member states (European Court of Auditors, 2015). Bringing down the costs of

transhipments which include the transport costs of pre-haulage and end-haulage is essential in order for IWT to be competitive with the other modes. One obvious solution to this the strategic placement of industrial hubs close to waterways. Europe already is endowed with this advantage as many industrial hubs relocated close to the waterways during the industrial revolution and have remained in such locations. What the legislative plans are doing is that they are adopting a coordinated spatial planning policy in favour of IWT while also improving hinterland connections (European Court of Auditors, 2015).

In the context of improving information services, there is more attention being given to increasing the safety and efficiency of IWT. For this, additional attention is being given to the framework of technical conditions, interfaces with external systems, applications and acceptance of user/ system operators as well as implementation support. There are also attempts being made for the cooperation of entities outside the sector (VBD Germany, 2004). The increased use of effective ICTs will also promote the intermodal integration with increased cooperation among logistics service providers. Effective and efficient ICTs also have to do the modernisation of the fleet and improving cooperation and innovation of enterprises. Innovation is the IWT sector is linked to the development of R&D programmes for development of technologies that curb operational costs, incorporate automation, and are essentially targeted towards developments which lead to efficient propulsion technologies which help reduced the emissions and make IWT even more sustainable. There have been financial incentives given for the adoption of such technologies as well (VBD Germany, 2004).

One major impediment in the adoption of IWT in Europe to a large extent is a strong and negative preconceived notions that exist in the minds of logistics service providers about the performance and advantages of IWT (Wiegmans & Konings, 2016). This issue is being addressed with the help of better professional processed information. Linked to this is the idea of creating a knowledge base with all the essential facts and figures of the IWT sector which are important for the different stakeholder of the transport industry and which will influence their decision-making process. There is an absence of up to date, compatible, and reliable data of the IWT sector in all the main four corridors (VBD Germany, 2004). This was causing EU strategies for IWT to not be based on comprehensive and robust analysis (European Court of Auditors, 2015). Thus, attempts have been made towards the development of a central IWT statistics database for better knowledge to be presently available.

2.2.2. IWT in the Netherlands- Structure, Problems, and Potential

Considering the particular case of Netherlands, IWT is very well-developed mode in the Netherlands. The Netherlands along with Germany and Belgium on their own provide 90 percent of the IWT performance in the EU with its modal share in the Netherlands being close to 40 percent (ProgTrans, 2004) with the most important hub of activity for it being the Rhine corridor. Its strong presence in most areas contributes for its large share in freight transportation and is used mainly for three things namely transport of bulk goods, international transport over long distances greater than 120 kilometres, and for cargo flows connected with seaports (Beijer, 2009). According to the Dutch Central Bureau of Statistics IWT having a market share of over 60 percent in total transported weight, leads in the international transportation market having the largest market share in the segment of chemical products, coal, sand, gravel, and ores with most of such industries being located close to waterways. (Policy Research Corporation, 2007). However, this can also be considered a limitation for IWT considering the limited potential for growth in bulk goods transport with no growth in segments such as sand and oil. Another aspect which acts an advantage for IWT in the Netherlands is its strong interconnectivity with deep sea ports.

Like in India, trucking is the dominant mode for transportation in the Netherlands but statistics figures suggest that IWT is catching up fast with its market share growing with each passing year. According to the Central Commission for the Rhine and European Commission though from the years of 1994 to 2004, the market share grew from 15 to 33 percent.

Beijer in his paper provides a well explained comparison of IWT with road and rail transport which points towards the fact that the position of IWT in the Netherlands depends on the type of transportation in question based on the three types transportation (Policy Research Corporation, 2007): -

1. Transportation from one location on the waterway to another location on the waterway
2. Transport with one transhipment and one other mode of transport to or from a location not situated on the waterside
3. Transport that includes transportation by another mode to a location situated on the waterside and a second transport by another mode from a location situated at the waterside

IWT's advantages can be identified by taking into account the nature of the three types of transportation listed above. Beijer points out that IWT is the most effective for transportation in the first situation as it is the cheapest transport routes on all modes; although transhipment costs are high for IWT relative to what is incurred when using roadways, the low costs of

transportation more than negate the high costs of transportation and render IWT as the better way to transport with roadways becoming efficient only on very small distance. (Beijer, 2009). In the second type of transportation listed, we need to take into account that fact that the fixed costs of IWT is significantly higher than road transport which include the costs of loading and unloading of the freight and waiting times. Thus, if the entire transportation does not take place on the water length, the transportation leg which needs to be serviced by trucking tends to increase the transportation costs taking into account the transhipment from truck to barge and thus in such a situation IWT as an option becomes viable and competitive only when the transportation involves longer distances. For shorter routes, IWT is highly competitive for container transportation involving distances of 60 to 100 kilometres. In the third type of transportation, there are two additional transportation legs which will be fulfilled by another mode, IWT becomes competitive with road on longer distances of 180 kilometres or more (Beijer, 2009). Thus, the example of the Netherlands shows that IWT has a dominant market share for transportation on longer routes. However, in the Netherlands, as Beijer points out, road transport dominates over IWT sometimes even on longer routes when there is poor connectivity to the waterways on the route involved, due to the poor connectivity of waterways to the origin and destination and in the cases which involve the transportation to small fragmented destinations and exclusive goods which need to be delivered in a certain time frame. However, there are certain key trends which benefit IWT sector and shall make it more competitive in the near future and make its prospects even more viable than they already are (Rohacs & Simongati, 2007). Firstly, there is the increase of trade which will require the freight transportation to expand. The second trend is the scalability of transportation which involves the move of the industry towards transportation of larger volumes with every movement (economies of scale) as can be seen by the move away from smaller sized vessels. However, this scalability issue can also be considered a threat with the improvements in barge sizes being restricted to certain sizes depending on the waterways. The third trend is the growth of containerisation, transportation of which is the cheapest by IWT. Containerization is perhaps the biggest potential for IWT being suitable for inland waterways and its infrastructure. Thus, these trends which benefit the IWT sector are something even India should keep an eye on. Such prospects with their strong developments in India as we will discuss later, give way to an argument which validates the government's proposition of reviving the IWT sector.

According to the Policy Research Corporation, the step towards developing IWT further in the Netherlands should focus on three primary development areas namely- improvements in IWT

rates compared to other modes particularly roadways, improving accessibility to waterways, and improving the infrastructure (Policy Research Corporation, 2007).

The case of the Netherlands and the rest of Europe points out several factors which can be taken into account for IWT application in India considering its similarities in the overall nature of the logistics industry with India.

2.3. An Overview of the Logistics Industry in India- Why it needs a change

India started liberalizing its economy in 1991 which brought International trade and economics to a forefront having a huge impact on the daily lives of the Indian Population. The Indian Economy today has reached a level where it has managed to grab the attention of the world's leading super powers by becoming one of the fastest growing economies in the world and this growth is predicted to rise at an even faster pace in the near future. In just a decade India has seen its economic size more than double to $1.37 trillion (TCI, 2016). One of the drivers of this economic development has been India's logistics infrastructure. It has been the backbone for the success of many key sectors like retail, automobiles, pharmaceuticals and many others. India's current logistic was worth USD 110 billion in 2014 and was reported to be growing with CAGR of over 16 percent. (IBEF, 2013).

Although the logistics sector in India has come a long way, it still has a lot more to achieve to stand out in the global market. Service reliability of the logistics industry the emerging markets of India has been referred to as slow and requiring high engagement of time of the customers, thereby, incurring high indirect costs (Nikolai, Neumann, & Markus, 2005). The key problems that plague the logistics industry of the country today include poor infrastructure, trade regulations and complex tax regimes, untrained manpower, use of obsolete information and communication technologies, and low rates of technology adoption. Furthermore, the industry as a whole is one which is not very well organised. Consequentially, all of these problems translate into increased logistical costs in India; the logistical cost in India is about 13-14% of the GDP, as against 7-8 % in developed countries with transport and warehousing in India accounting for 63% and 29% respectively. (JLL, 2015).

Industry experts believe that the Indian logistics industry is at a turning point in its development (Agarwal, 2015). There no doubt about the fact that India lacks critically in the logistics infrastructure; There much work to be done learning from the global best practices for the betterment of it and India is still somewhat of a greenfield in Shipping and Logistics. This can

be considered a blessing in disguise. India as a huge opportunity ahead of itself; with a large part of India's future logistics network yet to be built, India has the opportunity to build this infrastructure optimally. With the pace at which India is growing and with the freight movement expected to increase 2.5 folds in the coming years, it needs considerable investments in this sector to accommodate for it, shortfall of which shall put India's growth at risk. Presently the country's network of roads, railways, and waterways and its condition is insufficient to handle the future growth. Making it adept for the future freight movement growth requires an integrated and coordinated approach wherein every mode of transport namely roads, railways, waterways, and air is developed appropriately to match to the future needs and where existing assets are used better (Sawant, 2013). Recognizing the sector's pivotal role in India's economic development, the Government of India has tripled the annual spending on logistics infrastructure over the past few years. It has announced many major development projects and adopted a newer policy regime with the aim to make the sector more competitive and at par with the international standards (TCI, 2016). Also, there are several models which are emerging as a solution to the present critical needs of this sector which have proven to be successful in mitigating similar problems with their application in other major global economies. With all that is happening, the logistics market in India is expected to be worth $307 Billion by 2020.

There are essentially two key areas that need attention managing the logistics chains across India logistics industry- costs and reliable value-added services (Chandra & Sastry, 2002). Thus, the task of improving Indian logistical practices to a level at par with the global best practices will have to start with the gradual improvement of these two main segments in terms of reducing costs and improving the services.

2.4. What is Logistics- What do you pay for?

According to the US Council of Supply Chain Management Professionals, logistics is the process of planning, implementing, and controlling the efficient, cost-effective flow and storage of raw materials, in process inventory, finished goods, and related information from point to point of origin to point of consumption for the purpose of meeting the customer requirements; It can be categorized into 3 activities namely (CSCMP, 2013): -

1. Core Logistics Service- which involves the activities like the line haul pick-up and distribution, storage, loading/unloading, stuffing/ stripping, load consolidation

2. Value Adding Service- packaging, quality control, product testing/ repair, assembly, installation, information and maintenance, sanitary services, trade insurance and finance.

Logistics can be considered the most important aspect for assessing a particular market as it affects the volumes as well as the value of any internationally traded goods (Kumar, 2014).

2.5. Logistics Services Organisation in India

In India, the multinational logistics service providers like DHL, UPS, and the other Liner companies operate together with a few privately-owned companies. While the larger companies own the advanced logistics knowledge, capabilities, and IT systems, their market share is significantly small to be able to drive the market. What can be noticed, observing the clientele of such multinational companies is that most often they collaborate closely with the other local logistics providers not having being able to break through the latter's local presence and knowledge of the industry who have been operating since a long time; In this way large, multinational companies are being able to provide services without owning a significant amount of assets. Major state-owned enterprises like CONCOR and Central Warehousing Corporation play a significant role in the sector too.

In India, it is the small-sized and medium-sized companies that handle most of the freight volume traded providing low-cost services to countless small and medium-sized manufacturers. The market is dominated by the abundance of freight forwarders and truck brokers providing local warehousing, distribution, less-than-truckload transport, and express parcel services also providing low value-added point to point transport (Kumar, 2014). The question which arises then is how are such players with their obsolete logistics systems are still able to gain a significant market share to the point where even the multinationals have to collaborate with them. The answer lies in the way the manufacturing and trade sector in India is organised. The manufacturing landscape of India is dominated with small and medium sized firms which because their size and inadequate management capabilities do not require the high-end services offered by sophisticated logistics services provided. The choice of carrier selection is driven mainly by price which is the reason why service providers focus a lot on price cutting rather than service quality; This is another reason for the lack of technology adoption in this sector too.

2.6. Freight Transportation with the different modes

There are predominantly three types of modes used for freight transportation in India for the inland movement of goods or the movement of goods to and fro between the many major ports in the West, East, or the South namely- Roadways, Railways, and Inland Shipping. Coastal Shipping or Short Sea shipping is also used for the movement of freight. For the purpose of our thesis we will stick to Roadways, Railways, and Inland Shipping for our discussions on the transportation modes and their competitiveness.

2.6.1. Roadways in India

Road transport is the most basic and is most vital for the development of the economy, trade, and social integration, all of which depends on the conveyance of people and goods; It is the most common and the most popular mode of transport in terms of number of cargoes carried per annum (Bardi, Coycle, & Novack, 2006). India's road network is the second largest in the world and the densest among countries of similar size with over 5.23 million kilometres of roads and highways. Over the past the Government of India has paid special attention to the development of the road infrastructure to improve connectivity and accessibility across the country; It has spent over USD 8.7 billion in the last year alone and had also authorized the National Highway Association of India (NHAI) to generate Internal and Extra Budgetary Resource (IEBR) to USD 8.5 billion. Also, over the past 6 years the government has extended a budgetary support of USD 22.6 Billion. The aim is to expand the National Highway network to 0.2 million kilometres over the next 4-5 years. (TCI, 2016).

In India, easy accessibility and flexibility has rendered roadways as the preferred mode of transport and has helped it gain a larger share in terms of volume of goods transported as compared to the other modes of transportation with implications on the transfer quality, the flexibility and timelessness of delivery (roadways has the option of door to door delivery, which today has become an important aspect to differentiate one's transportation services), and consequently costs except for commodities which over long distances, predominantly move through the extensive rail network; 60 percent of the freight in India is transported by roads.

However, the extensive network and good connectivity is one side of the story when it comes to roadways as a transportation mode. The road network in India is plagued by numerous problems and is a mode which is much less energy efficient and environmental friendly besides being more unsafe. The has to do partly with the poor infrastructure of the roads. With the poor quality of roads which have been built, it places additional burden on the government budgets

to repair them regularly and delays the already slow implementation of new projects to add infrastructure. Analysis of the transport budgets of some states in India shows that the amount of money allocated to the sustenance of the existing road network far surpasses the allocation to the new road development (Sawant, 2013). The poor quality of roads and their inefficient network leads to an impairment of freight transportation as they can never move as per their design speed, which in turn leads to a wastage of fuel ultimately making the higher than average freight movement costs even more expensive. Furthermore, the competence of ports and airports is diminished greatly because of the quality of the connecting road network being poor. On top of this the pricing of the numerous poorly administered tolls on the roads has had a negative effect on the business operations. The cumbersome documentation, detention at check posts, and the bureaucratic hassled have adversely affected the productivity of the trucking industry; a truck on an Indian highway clocks only 300-500 km per day while trucks in the developed countries cover double this distance. (NTDPC, 2014). The other problems have to do with the way the road transportation sector is organised. This sector in one which is disintegrated and highly unorganised. There are many players offering to carry freight differing in their sizes, the quality, and level of service. The transportation providers can be differentiated based on their geographical presence with the small players having regional or national permits with a small fleet of one or two single axle trucks usually being present in the rural parts of the countries while the medium and big players having their presence in both the rural and urban major cities. This leads to the absence of a competitive market structure because of which freight rates are not determined by market forces due each player engaging in price cutting at razor cut margins. This further leads to overloading of vehicles by the small truckers in order to maintain their profits margins. It is reported by the National Transport Association of India that trucks here are overloaded to the factors of 2-3 times with it happening so predominantly that it has somewhat become the norm of the industry with service providers not engaging in adopting security measures due to cost reasons and the lack of appropriate law implementation for the same. Also, there is shortage of skilled manpower in this sector with the service providers having no specialised training or education needed for efficient operations; truck drivers often face difficulty in simple day to day business activities like logging delivery records, understanding delivery documents, and handling queries. Another problem is the lack of technology adoption in this sector. Majority of the transportation in the country is carried out the same way it was carried out years back with the service providers adopting inefficient operational practices, employing uneducated labour which works on lower wages, using obsolete vehicles with poor maintenance of equipment as a means to reduce costs.

Implementation of technology in this sector needs a quantum jump which will facilitate faster more efficient movement of goods. (NTDPC, 2014).

In keeping up with the increasing demand of road transportation, the National Highway Authority of India (NHAI) has been strengthening and widening national highways in multiple phases and at the same time announcing many major projects to add infrastructure. For instance, as part of the National Development Projects, the development of the Golden Quadrilateral connecting the major cities of India namely New Delhi, Mumbai, Chennai, and Kolkata and the North-South and East- West links both financially and structurally was finished in 2012 making it the fifth largest highway in the world. Furthermore, the Government of India has been investing heavily in the development of an Intelligent Transport System (ITS) which will enrich the roadways as a transportation mode. For the future development, the Government of India has already cleared 16 highway projects worth USD 1.1 billion and plans to invest USD 15 billion for developing 35,0000 km of roads across the country of which 21,000 will be dedicated economic corridors with the aim to improve freight movement, ease traffic bottlenecks and improve the overall connectivity in the country. Furthermore, the Government of India targets to secure 33% funding for the total investments in road infrastructure with the help of the private players in business (TCI, 2016).

2.6.2. Railways in India

The Indian railways (IR) network is considered one of the largest and the busiest rail networks in the world; Indian railways is the fourth largest freight carrier in the world and has the largest passenger carrier spanning over more than 66030 km. It is major source of revenue generation for the Government of India as the freight segment of Indian Railway is a profit- making business, contributing 70% to the total railway earnings carrying around 32.1 % of the freight generated playing a critical role in the integration of markets rightly being referred to as 'the lifeline of the Indian economy'. Presently it transports 1900 trains a day with freight trains making up approximately 35% of the it, transporting 2.65 million tonnes of freight traffic. (TCI, 2016).

The IR compares really well on an absolute perspective and relative to its largest peers across the world. However, when adjusted for the Indian scale, the inadequacy of the network which has continually worsened over the past 60 years comes forward. Over the years the share of railways in freight transportation has declined with roadways emerging as the more predominant mode for freight transportation. This can be blamed on a number of things. Firstly, obviously there has been huge developments of the motorised road transport for freight

movement with its inherent advantages in terms of accessibility, convenience, and door to door delivery. Secondly, the railway sector suffers badly from huge underinvestment with budget allocation in rail, at just 20% of the roads, is significantly lower than global standards. Then there is the poor utilization of funds made available; It is reported that 60 percent of funds are allocated to projects with a negative rate of return with the railways being choked off internal funding too. Furthermore, there is the issue of cross subsidisation between passenger and freight wherein passenger fares have moved up just 28 percent while there has been a 91 percent increase in the freight rates, with passenger losses being compensated by squeezing out revenues from the freight customers. There is inadequate network capacity too in terms of the speed of the trains in the context that the average speed of the freight trains is 20-24 kilometres per hour as against the requirement of 60 kilometres per hour which leads to greater turn around and lead times. On top of this, both freight and passenger trains share the same track capacity; The continuous addition of passenger trains has resulted in route congestion and further reduction in the average speed of the freight trains. The plans implemented to benefit the Railway sector have not worked out well too. For instance, the government in 2013 launched the 'Policy for participative models in rail connectivity and capacity augmentation projects', to attract capital and enhance competition got accelerated construction of rail infrastructure wherein private players are allowed to construct and own private rail lines connecting ports, large mines, logistics parks or similar industries or cluster of industries. It also opened the containerised cargo sector to private sector prior to which it was the exclusive monopoly of the Container Corporation of India (CONCOR). However, this did not result it in what was being expected due to the lack of a level playing field. Private container train operators (CTOs) face major problems with the lack of accessibility to the existing terminals which are mostly owned by CONCOR. Also, the CTOs report that handling the major inland container traffic is a big issue where majority of the terminals along the railway network are owned by CONCOR. This eventually has led to the private players incurring losses and exiting the domain due to the absence of a level playing field (NCAER, 2016).

With all this, IR is continuously losing market share to trucking for the movement of freight even though it is the transport mode which is considered the cheapest, most reliable, and has the least emissions considering the higher rate of utilisation.

Indian railways this has a tremendous potential for growth. Realising the opportunities that are being lost and opportunity to generate high revenues, the Ministry of Railways in India has been taking many measures to expand the rail connectivity and recapture its market share in the movement of freight. It is focussing on growth strategies which include increasing the speed

of the trains, development of freight corridors, modernization of wagons, faster turnaround time and provisions of adequate environment for private players. Indian government plans to invest around USD 51 billion for setting up three news arms of dedicated freight corridors crisscrossing the length and breadth of the country in the next eight years. Furthermore, it has implemented projects to increase the freight train speeds to up to 100 km per hour. It also has made investments totalling 1 billion USD in five railway projects to double and triple the existing lines for the decongesting them; It has also rolled out freight related software for rationalisation of freight rate determination. (TCI, 2016).

2.6.3. Inland Shipping in India

Inland Shipping in India is at a very nascent stage. India boasts of an extensive network of inland navigable waterways stretching across the length and breadth of the country totalling around 14,500 km. Yet, this sector remained neglected despite the universal acceptance for transportation through this mode considering it is a cheaper more environmental friendly way than rail or road for transportation with operations in India being restricted to only a few stretches. Only about 0.5% of the freight is transported via this mode with annual cargo movement of 7 million mega tonnes which is miniscule compared to the average of 1 billion mega ton of port volumes and even poorer when compared to countries like China, USA, and Europe where the modal share of inland shipping is 8.7%, 8.3%, and 7% respectively (The World Bank, 2017).

It was only 40 years after the Independence of India that the Inland Waterways Authority of India (IWAI) was established on October 27th, 1986 for the development and regulation of inland waterways under the Ministry of Shipping, Government of India. with the IWAI in its responsibility as a provider, facilitator, and regulator of the inland water transport sector is mandated to take up infrastructure development and regulations on NWs, conduct techno-economic feasibility studies, advise the Central Government of India on IWT matters, and provide assistance to the various states in IWT development.

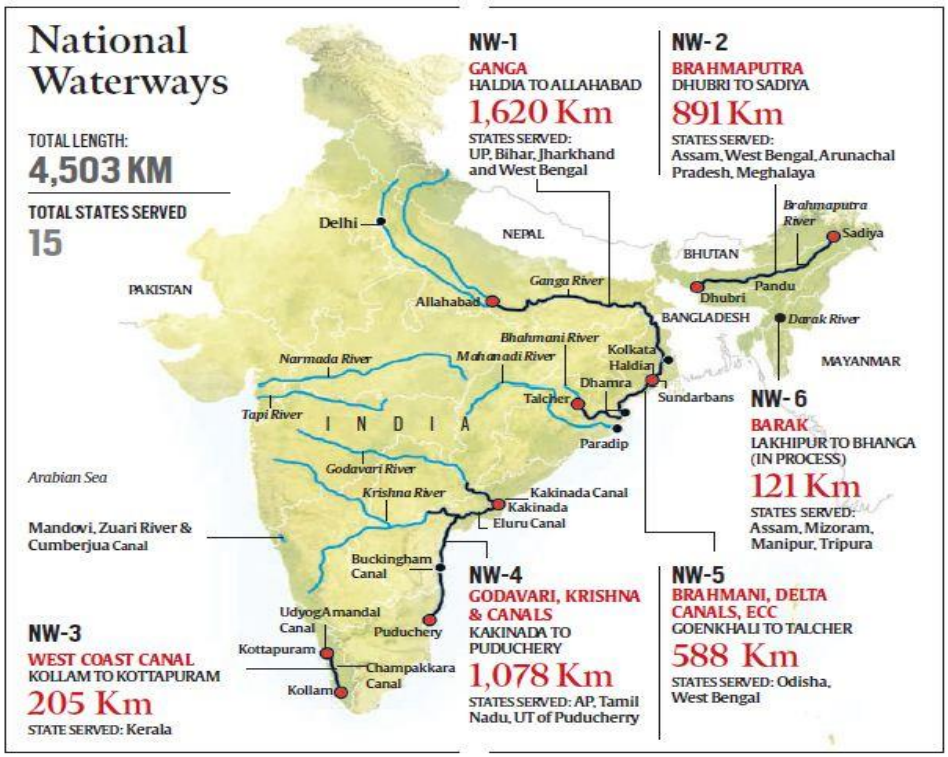
India until 9th March 2016 consisted of five main national waterways (SEE FIGURE 3) namely-

1. National Waterway 1 (NW1): The Ganga-Bhagathi-Hooghly river system from Allahbad to Haldia (1620 kms)- declared as national waterway in 1986
2. National Waterway 2 (NW2): The Brahmaputra river from Sadiya to Dhubri (891kms)- declared as national waterway in 1988.

3. National Waterway 3: The West Coast Canal from Kottappuram to Kollam along with Champalara and Udyogmandal canals (205 kms)- declared as national waterway in 1993
4. National Waterway 4 (NW4): The Kakinanda- Puducherry canal along with the rivers Godavri and Krishna (1095 kms)- declared as national waterway in 2008.
5. National Waterway 5 (NW5): The East Coast Canal integrated with Brahmani and Mahandi delta river system (623 kms)- declared national waterway in 2008.

The government over the past decade had been planning a vast expansion of the waterways and on 9TH March 2016, the National Waterways Act was passed in the Indian Parliament, coming into effect on 12th April 2016. The act declared an additional of 106 waterways; There are now 111 national waterways in the country.

Figure 3: National Waterways Network



Source: indianexpress.com

Historically, the rivers have served as an effective waterway, carrying people and goods over long distances. Even today many countries depend heavily on inland waterway transport, especially for large and bulky cargo. The clustering of industrial activities in the past was influenced by the logistical convenience of riverine possibilities, when rail and road were transport modes which were not so conveniently available and well developed. In India, inland water transport on the river Ganga can be considered one of the earliest organised transport movement over larger than normal distances, before rail and road networks were so developed. Studied show that the movement and export of commodities like tea, jute, and spices in the eastern sector, connected to the riverine port in Kolkata have been among the early commercial drivers of the pre-independence sub-continent. Until today, rivers in urban centres and rural areas of India constitute of small, mechanized country boards often used for the transportation, trading, and sustaining livelihoods with the waterways being a major contributor to the way of life and economy of a household.

There exists tremendous opportunity for inland shipping to India as developing it will only reduce the burden and overdependence of freight movement by roads but also result in significant economic and environmental benefits taking the logistics industry in India towards having more balanced modal split. The government of India has now given the major task of reviving the sector of inland shipping by infrastructure upgradation, expanding the required facilities needed taking suitable policy measures by channelizing the available funds effectively. One major objective of IWAI in this revival plan is the task of interlinking inland waterways with coastal shipping since such links have appeared to hold good prospects in respect of several river systems in India. More specifically, the Ganga-Brahmaputra-Sunderbands river system offers potential if integrated with the Paradip Port, Krishna-Godavri-Buckingham Canal with Chennai port, West Cost Canal with the Cochin Port, and the Madovi-Zuari-Camberjua Waterways with the Momugao port. Furthermore, the government is encouraging the private sector for its active participation in the development of river ports, multimodal terminals, construction and repair facilities, and operation of barges on rivers (Sriraman, 2010).

2.7. Composition of Freight and its implications on transport costs and modal split

As discussed earlier, India's trade is dominated by transportation by road but due to inefficiencies of the country's road infrastructure, India's cargo transportation costs rank amongst the highest in the world. A Total Transport System Study (TSS) conducted by RITES for the Planning Commission in the year 2007-08 reported that road freight in that year was about 706 billion tonne km while the total transport sector freight was estimated around 1409 billion tonne km, rendering road transport's share to be around 50%. The results of the study are summarised in the table below: -

Table 2.1. Inter-regional freight flows by the respective transportation modes

Interregional Freight Flows		
Mode	Million Tonnes	Billion Tonnes km
Rail	768.72	508.10
Road	1558.87	706.16
Coastal Shipping	59.10	85.70
Airways	0.28	0.29
IWT	54.88	3.38
Pipelines	113.99	105.45
Total	2555.35	1409.08

Source: TSS-RITES

Transport costs are the largest costs and accounts for more than one third of the total logistics costs (Agarwal, 2015).

Thus, the most important factor which has a huge influence on the choice of transportation mode thus becomes the cost of the chosen mode and also the alternative transport modes available.

3. Assessing the Viability of Inland Shipping in India

Inland water transport (IWT) mode is one mode which is globally accepted as an environmental friendly and fuel efficient. In India, it was an important mode for transportation during the pre-independence period becoming the lifeline for trade. With the economic developments that followed after the Independence and the development of the other modes such as roadways and railways, IWT's growth in India stagnated due to various socio-economic, environmental, and infrastructural factors such as deforestation in catchment area, siltation of rivers, diversion of water for irrigation, construction of cross structures like bridges with inadequate air clearances. As discussed earlier, the clustering of industrial activities in the past was influenced by the logistical convenience of riverine possibilities, when rail and road were transport modes which were not so conveniently available and well developed. Therefore, industrial centres which were otherwise in the past located close to the waterways for the logistical convenience they offered, shifted away and no new industrial centres came up in the same locations. This further shifted the focus away from the development of IWTs (IWAI , 2005).

As discussed above, there is no doubt about the fact that Water based transport is a very effective mode of transportation considering the low operating costs, the environmental friendly advantage with the pollution being lower than what it is when the transportation is carried out by road, rail, or air. Furthermore, being naturally endowed with a rich waterway network, the resource and the sector just need to be upgraded, trained, and maintained.

However, taking into account everything, the advantages and the benefits of IWT are by no means automatic and certain. These advantages vary from waterway to waterway and also depend crucially on the how well the projects are implemented. These waterways not only require huge financial investments but are also likely to have adverse social and environment impacts involving sensitive ecosystems that need to be first thoroughly discussed and debated, and the advantages and disadvantages for such projects be examined in detail. (Dhamadhikary & Sanbhor, 2017).

3.1. Major Considerations of Inland Waterways in India

In its application in India, research suggests that in inland waterways unlike other form of transportation in India, the usage of IWT often vary from state to state, depending on the economic, technical, social, and political considerations. The global considerations for IWT in support of its adoption include the following facets (S & J, 2015): -

- Fuel efficiency

- Cost-effectiveness/ Technical effectiveness
- Low GHG emissions
- Low developmental costs
- Decongestion
- Ideal for transportation of hazardous cargo
- All weather mode
- Minimal land acquisition

However, the importance of the above considerations could vary from country to country and also from one-time period to another. For instance, while the developmental costs of IWT in developed countries like the Netherlands would be low where it accounts for a large share for transportation. However, in a country like India, where it is just being revived, the developmental costs for the same, accounts for a major chunk of the project implementation. In fact, funding for IWAI is a one of the biggest concerns.

The available literature assessing the need for IWT in India suggests that there are essentially five major considerations for using the IWT in India: -

i. Economic Efficiency: -

Economic Efficiency gains are subject to the total costs which include capital, labour, and other operating costs. While it IWT of cargo may be cheaper/ economic it may not be efficient on the productive side; The productive side of it will depend on the system used and the extent of mechanisation, the use of latest technology and overall management (S & J, 2015). According to a study carried out by the NTDPC, the cost of operation of IWT for a 500 tonne self-propelled unit vessel working at 75% load factor for 300 days a year is very much lower than that of rail and road transportation for similar commodities. The cost advantages increase with the increase in the size of the vessels used; A 1500 tonne vessel operates at less than half the operating costs of rail transportation and less than one-third of operating costs of road transportation.

ii. Employment Potential: -

India is plagued with a serious problem of unemployment and underemployment. One of the major objectives of the National Transportation Policy is that of job creation (TCI, 2016). The criterion of job creation would not be the reason for the adoption of a particular mode of transport by the users. The sole use of the employment maximization criterion could lead to a transportation mode which is most labour intensive per unit of investment but inefficient in terms of costs, time, and service. Such a situation could be a threat to India's transport system

(S & J, 2015). However, in the case of India, employment generation in the IWT sector is concerned more with the revival aspect of the sector in the context of the construction and maintenance. NTDPCC reports that at least 13.2 persons-year of employment were generated for the construction and maintenance of the navigational channels and terminal facilities in addition to operational activities.

iii. Energy Use: -

The energy consumption on various modes of transportation has been an important issue in India since 1972 with the impact of the imports of energy material on an oil importing country such as India.

iv. Environmental Factors: -

IWT has important environmental advantages when compared to other modes of transportation. Firstly, the land use in IWT is minimal as no additional land is needed for laying down of tracks or roads with the transportation happening mostly through water. One could argue that the IWT in itself cannot be considered a total transportation solution as it will always need to be integrated with other transportation modes at the transfer nodes or to support it. However, it does lead to a situation where the over dependence on railways and roadways is lessened and the capacity enhancement which requires more land use is reduced. This also reduced the congestion on the roads and the noise is almost non-existent for waterways. However, there are important environmental implications of reviving the IWT which are discussed briefly later such as disturbing the ecosystem of the waterways due to dredging. However, IWT does not have any noticeable impact on the environment relatively.

v. Socio-economic Requirements: -

Though logistics network developed till now can be considered one that connected various parts of the country well, increasing/ developing the connectivity is still an important objective of the National Transport Policy. The NTDPC reports that out of a total of 575,936 villages in India, 407,297 are still to be connected by roads and for most of these villages IWT is an important mode of transport.

We will now discuss three of the national waterways i.e. NW-1, NW-2, and NW-3 briefly discussing their extent and status and the opportunities they offer. We will then discuss the technological and physical viability assessing the infrastructure of IWT in India which will essentially give us an idea about the viability of moving goods using IWT.

3.2. Demand for Inland Shipping in India and the Commercial Opportunities

Under the National Waterways Act, 2016, there are 6 inland waterways in India that have been declared National Waterways (NWs) in addition to the existing to the existing NWs we discussed above. These inland waterways cover 24 states which plan to utilize them. The sector, though not very active is operational in some states like Goa, Kerala, North- East and West Bengal where it is an indispensable part of the logistical infrastructure. Out of the 111 inland waterways, there are six of them operational. These are: -

1. NW-1: Ganga-Bhagirathi-Hooghly river system (Allahbad-Haldia)
2. NW-2: River Brahmapurta
3. NW-3: West Coast Canal (Kottapuram-Kollam) along with Udyogmandal and Champakara Canals
4. NW-68: Mandovi
5. NW-97: Sunderbans waterways
6. NW-111: Zuari

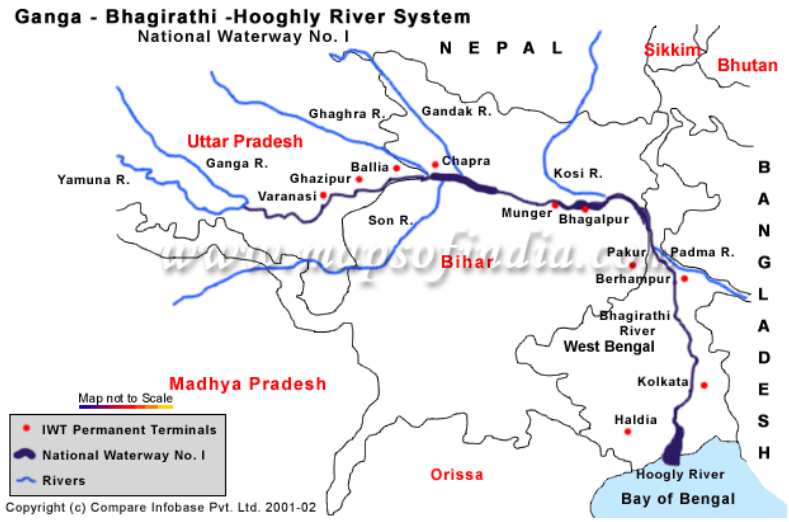
The stretch on NW-1 is used for transporting coal and fly ash. The stretch on NW-2 has Roll On-Roll Off (Ro-Ro) services. The stretch on NW-68 and NW-111 is used majorly for transporting iron ore (Ministry of Shipping, 2016).

In the year 2003-04 the total cargo movement through the inland waterways was about 32.48 million tonnes which increased to 55.82 million tonnes in 2007-08. The total distance that through which cargo weight was carried (ton-km) was reported to be 1.922 billion tons-km of cargo. This is very low when compared to the total cargo that was traded in India through its major ports in that year which was around 288 million tonnes (NDTPC, 2012).

Handling freight through IWT involves not only the movement to and fro from the water mode, it also includes the transportation of freight to the transfer nodes, loading and unloading of the freight and storage. IWT offers medium sized batch opportunities, slow but secure movement, limited door-to-door opportunities almost always requiring first and last mile transportation as bridge between the user premises and transfer nodes, and cheap rates. The geographical advantage of the freight transport is the strongest if the entire movement is across a river. The next level of advantage comes with one or both terminals are near a river. (Rangaraj & Raghuram, 2007) . In this regard, NW-1 from Allahabad to Kolkata on the Ganga-Bhagirathi-Hooghly River system is uniquely endowed with a strategic location. With the Ganga river

stretching across from Allahabad right up till Kolkata and Haldia. Both Kolkata and Haldia are major shipping ports of India (SEE FIGURE 4).

Figure 4: National Waterway-1



Source: mapsofindia.com

Furthermore, this waterway brings the Port of Paradip in Odisha closer in the context of transportation needed for the freight. Currently, freight from the Gangetic states in the North take the longer land routes to reach sea ports in the West of either Mumbai in Maharashtra or Kandla in Gujrat, rather than going to the much closer port of Kolkata. However, with the development of the NW-1, shippers in the North than directly ship their cargo the Kolkata-Haldia complex reducing transportation costs immensely with a help of a cheaper, more environmental friendly way of transportation. One such other waterway that has this geographical advantage, is NW-2 stretching from Sadiya to Dhubri in the North- Eastern region of India. External trade through seagoing lines becomes a good candidate for IWT here. At Haldia port as the river system is connected to the port operation, barges can directly unload the freight directly onto the seagoing vessels, if custom formalities can be completed without entering the port.

Figure 5: National Waterway-2

Source: Ministry of Development of North Eastern Region, India

The North-Eastern region has 7 states which are together known as the Seven Sisters. These regions are a hub of economic activities and trade for instance they hold quarter of the country's oil reserves and produce 12% of its petroleum. The state of Assam in this region is a producer of crude oil and it accounts for 15% of India's crude output and natural gas. Furthermore, the agricultural and textile imports from this region is a lot. Assam produces more than half of India's tea and is famous around the world for its tea exported. With no port present in the North East, trade there is conducted either through rail, road, or air. The two inland waterways namely NW-1 and NW-2 are integrated through the Sunderbans River and Canal system and the Jamuna River flowing in Bangladesh. Bangladesh's inland waterways can be used by India for facilitating the movement of cargo from the North-East to ports in Bangladesh or port of Kolkata with the 'Indo-Bangladesh Protocol on Inland Water Transit and Trade' being in place under which vessels of one country can transit through specified routes of the other country. Also, a variety of cargo moves by road and rail to Assam from locations other than those in West Bengal. With IWT there exists an opportunity for achieving a modal shift. The North-East being a hub of agricultural activities has a lot of demand for Fertiliser from Paradip and Soda Ash from Gujarat. Such cargo can be diverted from railways to waterways. Dr. S. Sriraman, Professor of Transport Economics at the University of Mumbai suggested that despite the cost of two long sea voyages and two river navigations, with vessels steaming one

way laden and the return in ballast, the transportation for such commodities is financially viable and compares favourably with rail transport with transport costs per tonne km for coastal shipping and IWT being 0.30 while that from rail being 0.65. Similarly, the geographical location of the state of Cochin which is another major sea port having exclusive berths to handle coastal cargo and inland cargo with its connection to NW-3 is unique; it is located where the West Coast canal (from Kottapuram to Kollam) and the two canals (Champakara and Udyogamandal) meet offering an inland channel to all parts of the NW-3 (SEE FIGURE 6). The Cochin Port Trust realizing the potential here has been actively trying to develop the traffic on NW-3 and has even carried out studies for the transportation of containers. In 2002 when the study was carried out, it was found that there were 14163 containers that were moved between the Kochi Port and Cochin Special Economic Zone (CSEZ), Alappuzha, Kollam, Kayamkulam, which are declared minor ports of Kerala. With the materializing of the proposed extension of NW-3 other ports such as Vizhinjham, Ponnani, Azhikkal, Beypore also become potential locations for the integration of IWT and coastal shipping (Sriraman, 2010).

Figure 6: National Waterway 3

Source: mapsofindia.com

3.2.1 Cargo Movement and Divertible Traffic

According to the IWAI reports that the total cargo moved on the three national waterways i.e. NW-1, NW-2, and NW-3 in the year 2013-14 was estimated to be 6.89 million tons. The figures of the freight flows over the past few years (2009-2014) are summarised in the table below; According the reports available on the present freight movements in the three waterways i.e. NW-1, NW-2, and NW-3, freight has only increased since 2009.

Table 3.1. Total yearly cargo transported from the year 2009 to 2014

Total yearly freight cargo transported by the waterways (MMT), 2009-14					
Waterway	2009-10	2010-11	2011-12	2012-13	2013-14
NW-1	1.81	1.87	3.31	2.71	3.34
NW-2	2.11	2.16	2.40	2.42	2.48
NW-3	0.67	0.89	1.34	1.24	1.07
Total	4.59	4.92	7.05	6.37	6.89

Source: - IWAI

The IWT sector has experienced high growth over the last decade with the figures reporting a slow and gradual modal shift towards IWT with the development of the waterways. The cargo movement has reached 8.38 MMT in the year 2014-15, with a growth of 181.20 percent. The major commodities moved through NW-1 are coal, fertilizers, edible oils, cement; Majority of these industries are clustered in close proximity to NW-1 and thus it becomes viable for them to use IWT for transportation of cargo. The National Thermal Power Corporation (NTPC) which is an India public sector company under the Ministry of Power uses NW-1 majorly, for the transportation of coal and has reportedly transports close to 3 million metric tonnes per annum from Haldia to Farakka (Dhamadhikary & Sanbhor, 2017). In the west, the NW-2 is has important pilot projects underway to transport food grains, coal for NTPC, pipes and other cargo for Oil India Ltd from Kolkata and containers between Kolkata and Pandu. The NW-3 with its close proximity to the major port of Cochin is being used widely for container transportation.

An extensive study conducted by Rail India Technical and Economic Services (RITES) for IWAI during the initial stages of the project implementations reported that a total of 77.22 million tons of cargo in the year 2021-22 could be diverted from rail and road respectively onto

IWT on NW-1, NW-2, and NW-3, if the implementation of plans and infrastructure needed were well in place by then. The results are summarized in the table below: -

Table 3.2. Divertible Traffic in Million Tonnes forecasted for the year 2021-22

Estimated Divertible Traffic in Million Tonnes in year 2021-22			
	From Rail	From Road	Total
NW1	25.90	17.44	43.34
NW2	2.31	19.48	21.79
NW3	0.91	11.18	12.09
Total	29.12	48.1	77.22

Source: - IWAI

The potential for traffic for on NW-1 and NW-2 comes from places like Numaligarh, Dibrugarh, and Digboi with their oil refineries in the north-east, and oil refineries elsewhere on the river bank locations such as Haldia in the North. Furthermore, the agriculture and manufacturing trade there in the north and North-Eastern regions is only increasing and thus can benefit significantly from IWT.

3.3. Supply side of Inland Shipping in India

3.3.1. Role of Agencies and Regulating Policies- Improving the Institutional Framework

The Inland Waterways Authority of India Act, 1985 provides for "the constitution of an Authority for the regulation and development of inland waterways for purposes of shipping and navigation and for matters connected therewith or incidental thereto". This is the Inland Waterways Authority of India (IWAI) which came into existence on 27th October 1986 for the development and regulation of IWT. The Authority primarily undertakes projects for development and maintenance of IWT infrastructure on national waterways through the funds provided by the Ministry of Shipping (IWAI, 2016). IWAI is the most important nodal body for the national waterways in the country.

The Inland Waterways Authority of India Rules 1986 and a series of regulations have been drawn out under the Inland Waterways Authority of India Act, including the 'Prevention of Collision on National Waterways Regulations, 2002', 'Safety of Navigation and Shipping Regulations, 2002', and 'Inland Waterways Authority of India (Classification of Inland Waterways in India) Regulations of 2006'. The last set provides a system of classification of waterways and related technical parameters for each class of waterway. Then we have the

'Inland Vessels Act of 1917, Amended in 2007' which deals with the infrastructural assets of IWT such as the survey and registration of inland vessels, removal of obstructions in navigation, carriage of goods and passengers, prevention and control of pollution. This act vests the power of such regulation under the Central and State Government of India to regulate these various facets. Furthermore, laws like the 'Indian Ports Act 1908 and the 'Major Port Trusts Act, 1963' would govern the planning and operation of inland waterways (IWAI, 2016).

One important policy that this sector has is the 'Inland Water Transport Policy' which is the only formal policy drafted in 2002 that deals with IWT. It talks about IWT being economic, fuel-efficient, and environmental friendly mode of transport estimating that the total potential for cargo movement by national and other waterways at 50 billion tonne per km (which also raises questions about the overall role IWT can play in the transport sector considering that total potential o cargo movement is only 50 billion ton per km). It discusses the challenges from navigational hazards like shallow waters and narrow width of the channel during dry weather and things like absence of infrastructure facilities like terminals ad inadequacy of navigational aids. One important thing that needs to be pointed out here is that the Policy calls for "large-scale private sector participation both for creation of infrastructure and for fleet operation" and proposes a number of support measures like bonds by IWAI, joint ventures by IWAI and equity participation by Government in private BOT (Build, Own, Transfer) projects, tax exemptions, subsidies on vessels, enhances depreciation rates, custom duty concessions. However, this policy dates back to 2002 and there is a need for the government to adopt a more updated version of this document.

As can be seen, In India, the inland waterways are controlled/ governed by a number of central and state agencies for its regulation, operation and sustenance. Some actors are: -

1. Inland Waterway Authority of India (IWAI)
2. Central Inland Water Transport Corporation (CIWTC) and other operators
3. Customers
4. State Governments
5. Port Authorities
6. Transport development agencies

With so many agencies and bureaucratic procedures involved, it is crucial that these agencies work smoothly without any hindrance which is a complex issue in the country (Rangaraj & Raghuram, 2007). The IWAI is the regulatory and infrastructure provider and therefore takes the decisions keeping in mind the operational aspects of this sector. Its main role is the provision of at least one effective waterway on the National Waterway system.

CIWTC, has been a loss making organisation and is being considered for privatisation. Taking into consideration the declining financial and operational viability of CIWTC its presence is not critical for IWT and can be done away with reducing the bureaucracy.

Taking into consideration that the development of IWT is a capital and scale intensive activity, the traditional framework that is usually in place when discussing the development of IWT are no longer relevant. In India, there is a lack of a system that involves extracting reasonable operational charges for various services thereby ensuring a level of service on the infrastructure. The roadways and railways in India have two drastically different operating and regulatory models and a suitable model needs to be evolved for IWT as well (Sriraman, 2010). With its development inland water transportation will also need to involve the incorporation of coastal or deep-sea movements at some points. While the deep-sea shipping is guided by a mix of national and international laws, coastal shipping is within the ambit of the central government control and an attempt to incorporate IWT activities in it can be thought of for successful smooth operations. However, being under two completely different governing bodies adds to problems associated with bureaucracy, scope of governance, and fund allocation. Also, major issue in this context relate to the different operating standards which include various aspects like vessel certification, safety, and personnel related issues.

Furthermore, with the inland waterways run through more than state it becomes really important to have a uniformity in the realm of various operational aspects of IWT throughout the country which can be a problem when issues between state governments arise.

The key issues in the context of policies relates IWT in India are pertaining to the investments in waterways and the associated infrastructure. Statistics show that the proportion of freight volume transported by IWT is very small with railways and roadways being the preferred over it as was discussed earlier. But, one can also argue that IWT has been neglected over the years and with the low investments made in it with the other two transport sectors being injected with huge cash flows. Worldwide experience suggests that strategic investments in some modes of transport can impact shares of movement significantly and with the resulting impact on overall costs and competitiveness. The possibility of private sector participation for the development, maintenance, and regulation of this sector is one thing that authorities are depending on critically, but it will still need considerable investments and efforts from the regulatory authorities to make up for the underinvestment in this sector for all these years and to stoke the interest of the private players to ultimately invest in the sector.

3.3.2. Infrastructure Supply

Just the mere presence of a river or a canal is not enough for the operational viability IWT. An inland waterway needs several other things to make it functional such as the existence of a water body (river, estuary, canal) with appropriate depth, appropriate width, which has sufficient water throughout the year; The depth of the waterway determines the appropriate size/ tonnage of the vessel operational on it. In operational context, the channel is termed as 'fairway' and its depth is referred to as 'least available depth'. The appropriate tonnage of the vessel is given by the 'dead weight tonnage' (DWT) which is the weight that the vessel can carry and does not include the weight of the vessel itself. According to the Planning Commission of India there are three basic IWT related infrastructure needed for the development of waterways which are: -

1. Fairway or navigational channel with the desired width and depth.
2. Terminals for berthing of vessels, loading/unloading of cargo and for providing interface with road and rail.
3. Navigational aid for safe navigation.

It is expected that once the appropriate infrastructure is in the place covering the three components to a satisfactory level, the private sector will invest in acquiring and operating the inland vessels reducing the gestation period for setting up of new facilities and bring in latest technology and improved management techniques (Sriraman, 2010).

There is also the added responsibility of the concerned stakeholders of maintaining the waterway. Dr. S. Sriraman in this context identifies 7 impediments to the growth of IWT in India which are: -

1. Insufficient depths throughout the stretch of navigable waters
2. Excessive siltation in major rivers from erosion of uplands and deforestation
3. Navigation in the waterways being relegated due to priorities given to drinking water, irrigation and power hydel sectors which results in reduced draft.
4. Non-availability of low draft high technology vessels.
5. Non-availability of adequate navigational aids resulting in restricted sailing over long periods of time.
6. Non-availability of permanent terminals with adequate infrastructure for loading/ unloading and storage activities.
7. Non-availability of bulk commodities along the water front.
8. Non-availability of return cargo on most of the routes.

Essentially, the general key issues and challenges in IWT sector can be classified as technical, regulatory, geo-political, financial, and integrated development approach issues (S & J, 2015). One huge constraint for the viability of IWT in India is the availability of minimum depth in the waterways. The Regulations of 2006 require that the "minimum depth of a channel should normally be available for about 330 days of the year" (Dhamadhikary & Sanbhor, 2017). However, the waterways in India are subject to seasonality and often have varying levels of depth which is often not in line with the required depth depending upon the season. Also, the increase in usage of water arising from habitation, industrial, and agricultural needs, and the impact of dams on river streams can be considered as factors contributing towards the decreased water flow on the main waterways. Here the operations of dredging and cutting become important to create depth; building barrages to elevate the water level may also work. Dredging involves the removal of sediments and debris from the bottom of lakes, rivers, harbours, and other water bodies; It is routine necessity in waterways around the world because of sedimentation-the natural process of sand and silt washing downstream-gradually fills channels and harbours. Capital dredging is used to create a channel in the river bed of the required depth while maintenance dredging is used to clear the channel of the silt and sediments that continue to be deposited by the river flow (NOAA, 2012). This brings the added social costs of altering the ecosystem of the rivers. Apart from dredging, another way of adding depth to the is to construct barrages on the rivers which create a sharp change in the water level and therefore require a system of locks and gates to allow vessels to navigate with the sudden change of water level.

NW-1 and NW-2 in this context are typical alluvial rivers having characteristics of braiding, meandering having sediment load and high-water level fluctuation during summer and monsoon seasons. In India, IWAI, in principle, commits to maintaining to a year-round depth of 2 meters (Planning Commission, 2012) but this not found to be true in practice. However, in these rivers several shallow areas which are called shoals come up during the seasons where availability of water is not much and thus maintaining the LAD of 2 meters becomes a problem and is not possible particularly in upper reaches. Therefore, one option that is strategically justified is to provide the required draft on appropriate channels, by an assessment of the traffic potential on each of the respective waterways. The other thing that can be done is to provide and maintain an average draft of 1.5 m and then assess if that would be operationally viable. On the other hand, NW-3 in this context is a tidal canal where the water flow is uniform and predictable and thus the requirement of intensive maintenance activities is low relative to that of NW-1 and NW-2.

Added to the problem of depth is the problem of inadequate air draft with multiple bridges with low vertical clearances obstructing the passage of inland vessels on waterways such as NW-3; There are several navigable canals in the states of Uttar Pradesh, Bihar, West Bengal, Tamil Nadu, and Andhra Pradesh which cannot be utilised presently due to air draft restrictions.

One other issue brought up Dr. S. Sriraman in his paper is related to the navigation in the waterways. The requirements for navigation on a waterway include channel markings, night navigational aids, including the possible deployment of GPS and river maps and charts for navigation. The problem of non-availability of the waterway round the year combined with that of rudimentary infrastructure with not up to the mark navigational facilities is one of the major roadblocks in the successful operation in the waterways. However, with the development being in the initial phases, there is an advantage and opportunity to research, develop, and deploy the most advanced navigational technology and infrastructure like for instance the RIS in Europe. At the same time, one related problem which the lack of Maintenance, Repair, and Overhaul (MRO) facilities which are severely in shortage needs to be tackled.

There are various developmental activities which have been undertaken for the development of fairways, navigational aids, and terminals discussed in detail in the report provided by the Planning Commission of India under each of the National Waterways. For NW-1 a target of providing LAD of 2 meters between Haldia and Varanasi was kept and a LAD of 1.5 meter was set for the waterway stretching between Varanasi and Allahbad for 330 days in a year as per the Regulations of 2006; Bandalling and dredging activities for this purpose were taken on a year to year basis. However, the plan was only successful to a certain extent. The LAD of 2 m could be maintained on only a part of the stretch between Haldia and Varanasi; it was achieved only up till Patna which is 363 km away from Varanasi with a depth of 1.5 m being maintained for the remaining part of the distance. The stretch between Varanasi and Allahabad had a depth of 1.5 m only for about 4-5 monsoon months in a year. This was blamed on IWAI not having the required number of dredgers. For the development of navigational aids river notices and pilotage services were provided to vessels that operated on this waterway with navigational marks for day being provided all year long. There was also a project which was undertaken to for the extension night navigational facilities from Farakka to Patna (460 km). In the development of terminals, there were a number of activities taken up. Throughout NW-1 fixed concrete terminals already exist at Kolkata, Pakur, and Farakkah. The terminal at Kolkata belongs to CIWTC while terminals at Pakur and Farakka belong to Farakka Barrage Project Authorities. All these terminals were used for cargo transportation. Furthermore, plans for the construction of a permanent terminal at Patna, Haldia, BISN Kolkata and Varanasi were

sanctioned and progressed. For NW-2, the target was to provide a LAD of 2 m between Dhubri and Dibrugarh (768 km) and 1.5 m between Dibrugarh and Sadiya (123 km). The plan was successful, however for the stretch between Dibrugarh and Sadiya, LAD of 1.5 m could be maintained only during the monsoon season due to the low discharge in this upper reach of the waterway. In the context of development of terminals, a project for the construction of a fixed Reinforced Cement Concrete (RCC) terminal at Pandu is in progress; At present, there is no fixed terminals on this stretch. For NW-3, the target is to provide LAD of 2 in the entire waterway. However, due to various problems like disposal of dredged material opposed by environmental authorities, the presence of fishing nets in the waterway, land acquisition for widening of canals and court cases in respect to land acquisitions, contractual litigations, capital dredging could not be completed in the entire waterway except between Kochi and Thakazhi jetty and most of the proportion between Kochi and Kottapuram. As far as terminals are concerned for this waterway, fixed terminals at 7 locations- Kottapuram, Alluva, Kayamkulam, Viakom, Tannermukkham, Trikkunnapuzha, Maradu were completed.

3.3.3. Fleet Availability and Operations

Given the lack of development and the recent revival of IWT in India there is critical shortage of IWT vessels in the sector with only a limited availability of IWT vessels suitable for operations on the National Waterways. There needs to a substantial provisions in the next few years alongside infrastructure development such as development of terminals and modal links which would encourage the participation of private sector which is the need of the hour. Provision also need to be made in procuring appropriate vessels of the appropriate capacity. Presently, private operators do have moderately sized fleets but have not been investing in new vessels in the last decade; Service providers due to the inability of generating profits have been scrapping vessels off late. It is here that the role of government owned shipyards in India like the Rajabagan Dock Yard owned and operated by CIWTC in Kolkata becomes important, and can be seen as a catalyst to revive their trust and encourage them to invest in procuring new vessels. Furthermore, to encourage investments from the private sector to increase the capacity, the Government of India announced many subsidies for instance the ‘Inland Vessel Building Subsidy Scheme’ (IVBSS) under which 30% subsidy is payable to the entrepreneurs for construction of inland vessels built in India for operations in the national waterways,

Sunderbans and Indo Bangladesh Protocol routes (Planning Commission, 2012). The scheme was quite successful in encouraging investment and lead to orders for 33 vessels.

There are also the operational limitations which restrict players from investing in this sector. Barge economics like deep sea vessels rely on economies of scale. The fixed and operational costs of operating a barge are quite high and can be negated by transporting large volumes (higher revenues). However, larger barges require more draft and need a larger water depth. With the present infrastructural constraints in the waterways of India, such barges cannot be operated. Therefore, it will take some time for the private sector to become interested and start investing in creating additional capacity by purchasing barges; a large part of this depends on the quality of infrastructural supply and more importantly its maintenance. This can be supported by the example of the waterways in Goa. In Goa, there is a quite well functioning industry for the manufacture, maintenance, and repair of barges many of which are operated by the mining companies operating there which used IWT for iron ore and coal transportation. IWT as we discussed above is quite a well-maintained activity in that side of the country and if fully operation. This goes to show that with the current developments if IWT through the other waterways becomes viable, the opportunities which will unveil shall lead to private players entering that space over time enhancing the capacity of the sector which is what the IWAI should be focussing on. Once, the IWT infrastructure is fully functional and the sector develops to reach a threshold level, it can be expected that the funds from the private sector will start flowing automatically.

The proposed movement of coal and petroleum products on NW-1 and NW-2 under the projects undertaken to promote IWT is estimated to add 6000 tonnes of barge capacity. Also, it is expected with the NW-2 being operational and similar projects in North-Eastern States for the planned movement of steel, cement, edible oils will lead to the addition of more barge capacity; The government has taken up a project for the modernisation of the fleet that is already available on the North-Eastern waterways to increase the efficient, add employment opportunities, and enhance the IWT sector as a whole.

Once the IWT operations take off it may become necessary to develop vessel building capability within the country by providing necessary incentives (Sriraman, 2010). At present the vessels are imported from countries like Bangladesh and Myanmar at low costs which aids taking the sector forward.

4. The Answer to India's Logistics Problems- Intermodal Transport (IMT) and Multimodal Transport (MMT)

The United Nations Economic Commission for Europe (UNECE) defines multimodality as the carriage of goods by two or more modes of transport and intermodality as the movement of goods in one and the same loading unit or road vehicle, which successively uses two or mode modes of transport without handling the goods themselves in changing modes (UNECE, 2009). Essentially the difference between the two is that in intermodality, since there is non-handling of goods at the transfer points, therefore there needs to be some sort of uniform packing such as containers which would not require direct handling while multimodality is not concerned with the means of obtaining the modal combination. IMT can be applied to containerized cargo while MMT will apply to bulk materials with the service provider taking full responsibility of the transport, handling, and storage of goods from the origin to the destination under a single multimodal contract. Intermodality is coordinated, seamless, flexible, and continuous from door to door on two or more transportation modes and usually concentrates on operational aspects (Muller, 1999). Also, for effective application of a transport infrastructure a conducive administrative and legal environment and efficient change of information is needed (D'Este, 1996).

The productivity of road transport and railways is severely hampered because of the industry organisation. In the case of India, over the years to make up for the lack of infrastructure, the industry and all of it stakeholder have organised themselves around the inefficiencies that plague the industry. The plans for infrastructure expansion are implemented without considering the present structure and the stakeholders are expected to arrange themselves and adapt their services around what is implemented rather than being implemented with a clear blueprint to best use the infrastructure already present and integrate the modes so that services are linked to increase the efficiency of their operations. All this leads to the overdependence on any one mode- roadways in the case of India. IMT and MMT offer a solution to this problem and have a high potential for application in India to provide a logistics system that is efficient and sustainable making better use of the resources already present.

Some advantages associated with MMT can be listed as follows: -

1. It is a more efficient way of getting goods to the market
2. Container and ICT applications
3. Using the existing capacity to its full potential

4. Helps provide faster transit times of goods while reducing the disadvantage of distance from markets and the typing up of capital
5. Reduces the burden of documentation involved in issuing multiple documents connected to each segment of the transport chain
6. Single Window Interaction: - Establishes only one agency for the consignor to deal with

Similarly, IMT has a lot to offer as well offering the potential to transfer the freight flows form the different modes like rail and road to inland waterways and to coastal shipping offering en route changes from a given mode to other modes which has substantial advantages while carrying large volumes in one transport operation (Kumar, 2014).

The economies of IMT involve: -

1. A pick-up operation
2. A terminal transfer
3. A line haul
4. 2nd terminal transfer
5. Final delivery operation

While IMT may offer benefits in terms of efficiency gains it might also lead to additional costs incurred. For instance, if we talk about road transport and IMT as its efficient alternative, the line haul of the IMT operation must be cheaper than the line haul of the road transport. Also, one needs to keep in mind that the 2nd terminal transfer will generate additional costs and also that the final delivery operation may be costlier than the direct delivery that road or rail transport offers. However, such costs are a small proportion in the face of the gains which stand to be made by transporting goods on modes that they are actually suited for. In the context of these problems, all potential savings related to IMT have to do with the line haul, which increase with the distance over which freight is transported and thus, IMT is viable only after a certain minimum distance; the minimum distance for IMT to be viable is in the range of beyond 400 km with distances being in the range of 250-300 kilometres if the operations start at a seaport as loading units in such a case are concentrated on one end of the haul and the costs of assembling them into larger units can be saved (Kumar, 2014). The choice and cost effectiveness also have a connection to the commodity being transported which needs to be considered before deciding the appropriate modal mix for transportation. The breakeven distance of Rail and Road were estimated in a report by Rites: -

Table 4.1 The break-even distance for transportation of different commodities by rail and road

Commodity	Break- Even Distance (KM)	Commodity	Break- Even Distance (KM)
Food Grain	222	Cement	160
Fruit and Vegetables	313	Livestock	162
Coal and Other Minerals	188	Iron and Steel	173
Fertilisers	167	Containers	307
Sugar	372	Other	307
Petroleum	126		

Source: RITES

4.1. The many agents of logistics and the need for integration- Development of IMT and MMT

The basic need for IMT or MMT application is the changing nature of the logistics and supply chain management over the past years. Walter describes supply chain management as the integration on the various individual functions of logistics which involve a variety of activities such as procurement, inventory management, transportation. This eventually leads to formation of what Hewitt describes as new logistical relationships called 'nets', 'webs', 'virtual organisations' and 'demand satisfaction networks' (Hewitt, 2002). Over the years the nature and landscape of supply chain management has changed with the responsibilities of the various stakeholders increasing. For instance, earlier a shippers and owners were only responsible for the production, however with the advent globalisation and with the opportunity of cutting costs to increase margins, the responsibilities changed drastically with shippers bringing in supply chain managers who are responsible for everything from procurement to transportation. The new landscape and way of things essentially involves the coordination among a wide variety of stakeholders and thus requires joint problem solving because virtually all stakeholders add to the cost component and thus the final price paid by the consumer (Bowersox & Closs, 1996). In contrast to what used to happen, tasks are now shared between firms with the goods flowing between and the risks being shared by different stakeholders for the final price optimisation. Planning now involves supply chain teams adopting a systems approach, and inter-organisational relationships to be formed where each service provider focusses on providing a low cost service with the essential need of linking all activities of various agents like the

suppliers, manufacturers, retailers, logistics service providers coordinating an efficient flow of goods and information; Service providers must endure the best possible customer oriented service for a well-balanced price/ quality ratio (Wiegmans, Nijkamp, & Masurel, 2001). With so many agents coordinating their activities to serve the customer, the roles become mixed and often indistinguishable, with their roles extending beyond what they are originally intended to do, and the management of a sophisticated and expensive goods flow creates high demand for quality transport services (UNCTAD, 1990). Such intermediaries with the aim of adding value and integrating the supply chain throughout combine themselves to provide 3PL services typically providing transportation services and warehousing activities, innovating new ways of transportation focussing on reduced costs and high-quality services, who work together with non-vessel operating common carriers, freight forwarders, and the liner companies. There is a niche operation that each agent in the supply chain is an expert while there are activities which an agent cannot provide not having the required expertise or infrastructure giving way to IMT or MMT. Transport mode choice includes cost, transit time, reliability, distance, shipment size, value of cargo, volume-weight ratio, time constraints, product fragility and perishability which are best served by the medium of IMT and MMT transport which helps meet every need of the shipper (Coyle, Bardi, & Langley, 2003). These transport modes offer shippers greater choice of cost control, flexibility, reliability, and most importantly a one stop service. The aims of supply integration are met effectively with costs being reduced down with the selection of a combination of transport modes with companies having more managerial control with structured cargo flow (Muller G. , 1999). Moreover, IMT and MMT act as a catalyst for any countries economic growth guiding freight efficiently and cost effectively across oceans, along coastal and inland waterways, through ports and terminals, on rail and by trucks (OECD, 2001). In other words, IMT and MMT is the solution for obtaining decreased logistics costs while maintaining the service levels required by shifting consolidated flows to modes that are best capable of handling large volumes enabling economies of scale.

4.2. Impediments and Requirements for IMT and MMT Application in India

An effective IMT and MMT transport system and its potential to stimulate development requires a clear role of the government, use of modern logistics concepts and practice, acceptance of globalisation, competition, and standardisation (Zahurul, Dinwoodie, & Roe,

2005); It requires flexibility, reliability, cost-effectiveness and an extensive collection and dissemination of information (NTDPC, 2013).

De-regulation needs to be at the heart of any efforts towards IMT and MMT infrastructure building which essentially promotes public-private partnerships, which are often associated with successful IMT and MMT developments in Europe and other developed Economies.

India has a lot of problems which severely hamper the application of IMT and MMT in the country which include the general business practices, knowledge and skill of logistics in the country, and unsophisticated ICT infrastructure (Agarwal, 2015).

The different forms of ownership and charges for the use of the respective infrastructure and terminals poses as a hindrance for the application of a transparent and coordinated infrastructure plan. For instance, consider the case of railways in India. CONCOR has the monopoly for freight transportation in India. While the sector is open for private players to enter, the vast network CONCOR make it impossible for private players to make profits. With CONCOR there is a there is the issue of schedule reliability issue with services being offered to and from certain locations on only certain fixed times and days. Logistics service provides thus have no option but to arrange their operations around such problems, for instance, a shipper might expect a minimum number of departures per week to a certain location in the absence of which he has no option but to wait or route the cargo in a less efficient manner. Added to this are the various problems of unavailability of wagons, and non-availability of proper handling equipment. Expanding on the issue of reliability, though road transport has the ability to contribute towards providing an integrated and efficient door-to-door service, its development still lacks in the sense that many feeder networks are not well connected to service locations away from the dedicated freight corridors. Also, while roadways seem like a fast mode, the operations involved in a transit add to significant time costs. This is because of the poor conditions of roads and the multiple posts/ check points which do not allow a seamless flow of freight. Also, transporters also face the problem of corruption at toll booths. In this context, the infrastructural constraint becomes important too. The missing stretches of nodal points for modal transfers however small they may be, prevent effective IMT application which in fact leads to more handling, and transfer and friction costs. There is also inadequate access by rail, road, or IWT and coastal shipping to existing transfer points which do not allow the hassle-free integration of the modes. Obviously with no integration between the existing mode, linking them to provide a sustainable an efficient IMT becomes difficult. There is a lack of cooperation with so many modes and service providers involved with unclear responsibilities and liabilities. To add to the organisational barriers, there are technical problems such as lack

of standardisation such as the use of certain loading units, way of packaging, communication and documentation techniques, and the use of certain equipment makes necessary cumbersome and run of the mill handling procedures and transhipment procedures. The lack of standardisation and compatibility within a logistics chain and between the modes is a severe problem.

The ICDs and dry ports developed in India have been too close to the load centres which constrain the ability of service providers to provide door to door services. In countries like Europe and North America, dry ports offer positions for modal interchanges and act as storage locations located close to the rail and road hubs of the country. In Europe, the concept of dry port has been transformed into what is called freight village for clustering of logistics activities. The freight villages with centralized management and ownership there have two things central to it. Firstly, the connections to major freight corridors and a nearby seaport and the shared access to other facilities, equipment, and common user services. Such freight villages forming an efficient synergy of all modes have contributed significantly to reduce cargo handling costs and time, and reduce the over use of roads. Similarly, in the Asia Pacific region, there is similar concept of distriparks (Kumar, 2014). These act as value added logistics centres offering storage and distribution services in one location. India could learn from such examples and perhaps such concepts can be applied on the country's landscape which can benefit the logistics industry immensely and help support the application of IMT and MMT systems in India.

Another problem is the lack of information about the available service and the possibilities of IMT and problems integrating IMT in the logistics chains of companies.

Even though IMT offers huge advantages, its application also comes with a lot of problems. Intermodal transport requires flexibility, reliability, cost-effectiveness and an extensive collection and dissemination of information (NTDPC, 2013). One shortcoming of IMT application in India have to directly with the kind of operations IMT involves. Since IMT involves modal haulages, transhipments and terminals, and thus requires the involvement of many stakeholders whose roles may overlap and compete; the different forms ownership and charges for the use of the respective infrastructure and terminals poses as a hindrance for the application of a transparent and coordinated infrastructure plan. The other problems have to do with the quality, price, and the coverage. The quality of IMT operations have to do with the schedule reliability, service frequency, and speed. In the case of India, schedule reliability of trucking and railing operations are of substandard.

Another problem is the lack of information about the available service and the possibilities of IMT and problems integrating IMT in the logistics chains of companies.

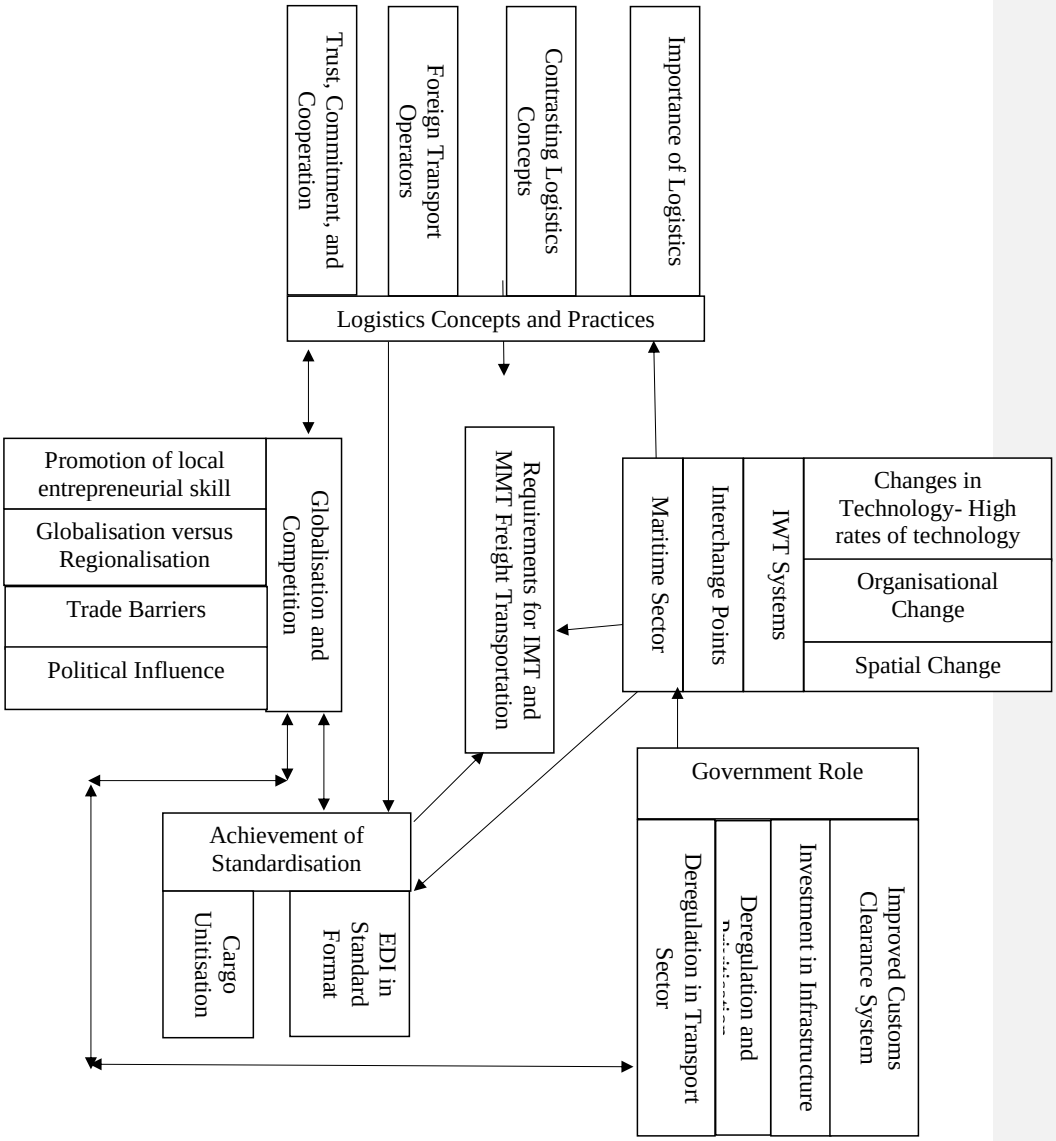
Such problems can only be solved by capacity upgrades to the infrastructure and policy changes There is a need for Intermodal and Logistics National Plan to help outline the intermodal network and provide a framework for the introduction of IMT and logistics. This is what the Government of India has been trying to achieve in the past decade developing logistics parks and corridors which are linked with IMT covering all objectives for modal shifts to improve efficiency. The revival of IWT and linking it to the coastal shipping is also one such step in that direction.

India's economic growth can be sustained and in fact developing an effective IMT and MMT transport network will act as a catalyst for its future growth; The role of an effective transport system for a country's growth cannot be ignored as any logistics system and its quality influences the demand for products and service as well as delivery cost of time. (Hayuth, 1987).

4.3. IMT and MMT for Economic Growth

The problems discussed above can only be solved by capacity upgrades to the infrastructure and policy changes. In an ideal IMT and MMT system there is clear role of the government. As discussed earlier India's logistics industry is quite fragmented and there is a need for supply chain integration. IMT and MMT have the potential to radically transform the economic front as can be seen by the examples of countries like South Korea and Malaysia which have done away with their fragmented systems and have adopted IMT and MMT systems based on US practices. Islam et al in their paper which discusses application of IMT and MMT systems in developing countries give the framework for multimodal development in developing countries with the interventions by national government, and in inland and maritime transport. The framework is given below: -

Figure 7: Freight Transport Multimodal Development in Developing Countries (Zahurul, Dinwoodie, & Roe, 2005)



India has recognized the potential and the need for IMT and MMT system development. It is following the example of China with the aim for the development and integration of dedicated freight corridors, multimodal services, high speed services for freight service, and integration of the overall logistics sector (NTDPC, 2013). The revival of the IWT sector is a step towards this direction as well.

Based on the experiences of developing countries in the development of an efficient IMT and MMT system, the requirements for IMT and MMT application in India can be broadly classifies under the following heads: -

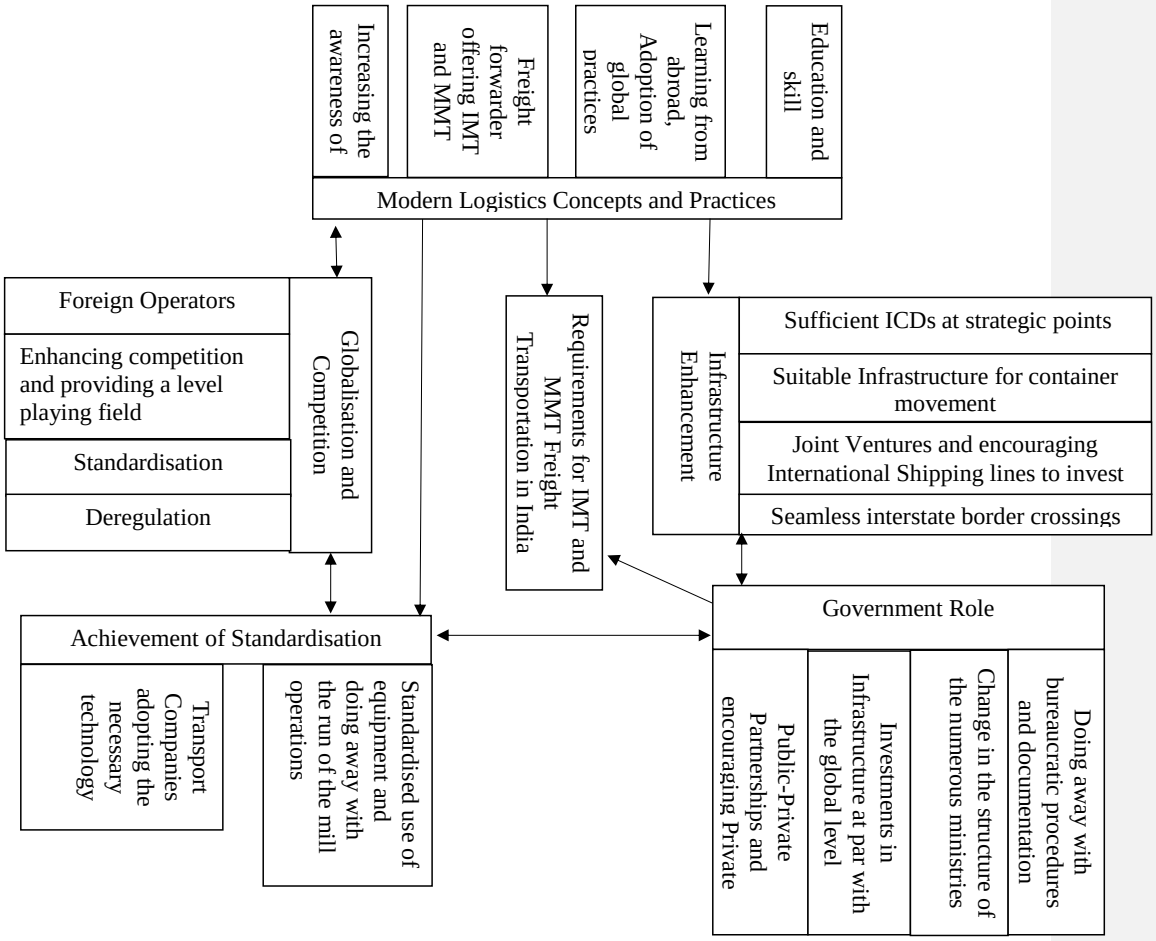
- Improved coordination within the country: - The development of an efficient transport system is not enough, there also exists the requirement to put in place the necessary arrangements for the effective operation of transport systems. It needs to be a consistent, and to the extent possible, harmonized legal regime for transit transport across the region (ESCAP, 2005).
- Changes in present policy structures: - In the case of India, it needs to perhaps consider drastic policy measures and changes to them in order for it to be able to improve the transit process by adopting a clear, well thought out national policy focussed on integration of the logistics sector. There needs to steps taken towards efficient containerisation and IMT and MMT system development which right now is constrained with the multiple ministries involved in the transport sector which lack coordination.
- Measures to improve the overall transportation process: - It is important that there is a simplification of the many bureaucratic procedures involved in the transportation in India. This also has to do with the documentation and procedural inefficiencies of such government bodies which adds to the procedural constraints.
- Infrastructure improvement and development of human resources for the logistics industry: - India is in critical need for international developments in the logistics sector with it still relying on old obsolete methods for transportation. There is also need for skilled personnel in the industry who understand the changing environment and the needs of the same.
- Better Monitoring: - The ESCAP case studies on international experiences in moving towards a integrated transport times point have cost/ time diagrams can help give policy makers an idea about the various problems facing the transit transportation and also give an idea for the methodology that needs to be adopted for efficiency improvements

(ESCAP, 2005). There also needs to be better regulation mechanism for governing things such as freight forwarder operations who operate sometimes below industry standards.

- Dissemination of ICT technologies: - There needs to be a drastic increase in the rate of technology adoption which can help increase efficiency in the sector and help in the move towards supply chain integration. Presently, in most cases shippers are not able to find any information about their freight; There is no transparency due to the lack of inadequate technologies.

Consequently, we can come up with the following framework similar to what Zahrul et al pointed out in their paper: -

Figure 8: - Requirements/ Framework for IMT and MMT transport network in India



4.4. IMT and Inland Shipping- Intermodal Hub Network

In the context of IMT and MMT application and Inland Shipping the application of collaborative hub networks can help decreasing logistics costs; Through collaboration the necessary synchronisation between the different modes can be combined in an intermodal hub network.

The concept of an intermodal hub network in the context of IWT is to consolidate palletized flows between manufacturers and retailers, using inland barges and form collaborative hub network (Vermont, 1999) designed to solve the many to many distribution problems reducing

logistics costs considerably (Danganzo, 1999). Such a network basically contributes towards achieving economies of scale with frequent shipping of consolidated large volumes of freight. Designing a hub network requires the strategic selection of a location for a hub facility, connecting it efficiently with non-hub locations and determining the appropriate linkages using the right modes between these hub and non-hub points fully. These steps are then extended to create a seamless intricate network of hubs which run across the length and breadth of a country and are fully interconnected. The main motivation and concept behind such hub networks is the collaboration between partners in the logistics networks which helps achieve supply chain integration (Zinn & Parasuraman, 1997) with the possibility to share costs and information as activities become combined.

In Europe with the increase the containerized volume and shipping network increasing, there has been key developments in such intermodal hub networks with the adoption of the hub and spoke methods where freight is carried from inland smaller ports to be loaded onto mainline vessels. However, such a network brings with itself additional costs such the costs of feeder services and handling charges for the transportation of freight to the hub port. In India, the absence of hub ports is a critical drawback considering the potential of such networks taking into account the significant share of containers which utilises the feeder, transhipment, and mainline movement. Having hub ports would essentially reduce the feedering time to other ports and will also make the marine side traffic from and to the hub port faster and cheaper.

4.5. Inland Shipping and IMT and MMT network integration

The case of IMT and MMT transport must basically do one thing, demonstrate its ability to compete with the reliance on any one mode, which in our case would be roadways. However, road transport cannot be compared directly to an IMT or MMT chain as they do not offer the same physical transport service (Fremont & Franc, 2009). Therefore, we can perhaps make comparisons based on what the organisational patters of road and IMT and MMT transport can offer to prove that the price competitiveness in the case of IMT and MMT transport is much greater than what roadways can offer alone.

We will now take Europe's example to help understand what can be done in India by the many stakeholders involved for successful IWT operations. In Europe, port hinterland services mostly rely on transport (Fremont & Franc, 2009). This is similar to the case of India where hinterland traffic is moved mostly by tucking and railing with trucking gaining the larger percentage of freight in this regard. In determining the competitiveness of any transport mode

be it IMT, MMT, or using one mode, reliability and the possibility for transportation of greater volumes in one voyage i.e. the possibility for economies of scale is the what convinces shippers to use a particular transport plan. However, price still remains the defining factor for the final decision (Plats & Tilman, 2009). In the case study by Fremont and Franc who looked at the pricing data for river services from the port of Le Havre to Paris, they found that the rail-road combined transport or the use of any one transport fails to meet the reliability standards of the customers and lose out on the cost advantage compared to movement by integration of IWT. This case study is rather interesting for our thesis and points out reasons and arrangements for NW-1 to become successful due to its similarity to the India scenario; IMT application in Le Havre offers prices much lower than the application of individual transport modes even though high volume flows involve a very short distance and which becomes rather adverse in the case of IMT similar to the case of NW-1.

The most important thing that was pointed out was the IWT's ability to extend the economies of scale achieved on the sea by deep sea vessels. Another important aspect to the competitiveness of IWT was that ability to provide value added services as price in itself did not enough to convince shippers to abandon their over reliance on trucking; It becomes necessary to provide additional services that the shipper cannot avail from trucking alone. For instance, in our case study example, there are many additional services provided by the agents operating in that corridor. One kind of service involves providing more flexibility in regard to dwelling time with lengthening of the dwell time for the containers during which shippers pay no additional fees. For terminals at Le Havre, storage is free for 4-5 days in most terminals beyond which shippers pay additional storage fees. In case of shippers who combine barge-road transport, they enjoy extra free dwelling time at Le Havre, 2 days of waterway transport, and 8 more days of free dwell time at Gennevilliers. The other kind of services have to do with offering custom facilities. For instance, in the Le Havre and Paris stretch, the French customs has put signed agreements to set up simplified Community transit procedures which allows storing import containers in warehouses in the Gennevilliers and Bonneuil-sur-Marne inland terminals for up to 45 days after their departure from Le havre at costs as low as 20 to 30 euros per container. This additional time is very attractive to the shippers keeping in mind the high customs clearance costs for a container. With all this, the shippers have the experience more flexibility with the delivery day and can perhaps also use this opportunity to store their goods as many in that region do. All this contributes to adding at least 20 extra days to a shipper's schedule before it becomes necessary for them to declare their freight. This is particularly attractive to large scale distributors as they can wait until the products to be sold are on display

at their retailer's shops where the consumers pay almost at the same time when the distributor pays the charges levied for the custom services. Furthermore, the government authorities in the particular region promoted transportation by IWT on account of it being environmentally friendly with the French Transport Ministry subsidizing cargo handling operations by IMT which amounts to amount 12 euros per container and also encourage it by levying a 'waterway package' which subsidises the rent a shipper or forwarder pays on account for the more water borne transport used. Companies like Schenker take advantage of this arrangement to the best of their ability.

Even though if IMT and MMT transport arrangement seems complex and is harder to execute with many interests of many stake holders and all the complexities of IMT discussed previously, the volumes handled by IMT reduce costs on the inland transport leg. In Europe, economies of scale are smaller on the largest block trains which have the capacity of only 80-95 TEUs while on the waterways, depending on the quality of infrastructure, volumes carried are upwards of 500 TEUs in one voyage on the Rhine with cost savings depending on the length of barge haul, pre-and post-road distance, balance of traffics, and location of inland terminals (Nierat, 1997). The cost savings are even greater in the case of FCL containers as shippers in such a case need a service focussed on door to door delivery with which integration of IWT into an IMT service takes an important part of the door to door costs. In Europe, the private sector i.e. liner companies or NVOCC companies or forwarders have had an important role in generating cost savings for in the inland leg of an IMT operation. For such agents, organising effective IMT operations helps attract and guarantee volumes to fill their vessels. Government interests are also satisfied with IMT operations with possibility of a port to extend its connection further inland allowing to compete with another port immediate hinterland and such a case only leads to more competition and keeps the prices market driven with the neighbouring ports responding in a similar manner (Rodrigue & Notteboom, 2009). Coming to reliability, IMT operations offer services providers to be flexible with their services This has to do with the traffic volumes expected at ports. When traffic at a port increases, there is a risk for some of the traffic to be diverted to secondary ports which are less congested as a result of peripheral port challenge (ECMT, 2006). Agents offering a IMT services using a variety of transport chains and handing higher volumes than is possible by road alone, can improve their services diverting the freight between different ports efficiently to the extent of them offering just in time services in the face of congestion.

There is no doubt IMT and MMT systems add immense value to the logistics chain of a country aiding every stake holder; It becomes a significant prerequisite for a country's economic

growth. Adopting a similar framework of operations will help in the effective development combined transport systems i.e. the development of IMT and MMT infrastructure whose aim of developing an intermodal freight transport which is optimally integrates most effectively all the different transport modes thus resulting in the possibility of efficient and cost-effective transport systems best servicing the customer needs while encouraging competition between service providers. Looking at what has been done in similar countries will help underpin what India can learn from the application of such a policy to make sure the best arrangements are in place to combat the physical and institutional challenges with regards to upgrading the existing infrastructure or creating new capacity and almost all of them lack critically in planning effectively taking into account the future.

5. Case Study

5.1. Revisiting NW-1 for the Case Study

We will now begin with our quantitative analysis of the effect on transportation costs due to IWT with our analysis of the scenario where NW-1 can be used for the transportation of containerized cargo between New-Delhi and Kolkata. NW-1 is the first waterway targeted for the purpose of infrastructure development connecting the Gangetic cities in the North like Allahabad and Varanasi in the state of Uttar Pradesh to the major East coast seaports of Kolkata and Haldia; It connects to the the Port of Paradip via IMT infrastructure/ network and it shall be accessible via roadways, railways, short-sea shipping.

The development of NW-1 may in fact lead to the transformation of the logistical network in the North and ultimately with its success the logistical network of India showcasing the possibilities with IWT. The densely populated regions of the North that the NW-1 stretches across and will serve are ones with essentially a lot of potential and opportunities for trading activities. This region contributes to 40% of the all India's traded goods as it is the hub for major industries like pharmaceuticals and agriculture as well as other manufacturing activities for many fast-moving consumer goods (FMCG). Being in a landlocked region, shippers only have the option of transportation by roadways and railways. As discussed earlier, the problem that we are going to investigate is that presently the freight from these Northern states take the longer routes to reach sea ports in the West being either Mumbai or Kandla; Even though the cargo is bound for the eastern countries it needs to travel in the opposite direction and then head for the destined port. Once NW-1 becomes adept at handling the container traffic, and if IWT provides an opportunity for substantial cost savings, the cargo transported via railways and taking the longer routes will shift onto IWT which will essentially transform the logistical network of India with its proven viability contributing towards the development of a competitive and viable IMT network in India which is what is really needed presently in India for it to respond to the global changes swiftly.

5.2. Factors Affecting Modal Choice

While deciding the transportation modes and routes, the decision makers are faced with a number of different aspects to make decisions. The most important criterion to base their decision are based on the attempts at cost minimization and the freight transportation choice is based mainly on the rates/ prices rendering the economic aspect more dominating relative to other factors (Vannieuwenhuyse, Gerlders, & Pintelon, 2003). Beijer discusses the work of McGinnis on modal choice in detail listing out primarily four models on modal choice namely

the classic economic mode, the inventory theoretical model, the trade-off model, and the constrained optimization model (Beijer, 2009). The classical model takes into account the fixed and variable costs of a transportation mode and at argues that that distance of the freight transportation becomes important for a choice of a particular mode; Certain transportation modes are preferred over the others up until a certain distance while others are considered beyond a particular distance. The inventory theoretic model is based on freight rates and takes into account their trade off with speed and reliability. The third model, the trade-off model is based on minimization of transportation costs taking into account several transport and non-transport costs and choosing the lowest cost option. The constrained optimization modal is built on the trade-off model and mainly theorises a cost minimisation problem based on several variables (McGinnis, 1989). The work of McGinnis is quite relevant in the field of modal choice though it has been critiqued by many theorists who have theorised that modal choice is not purely an economic aspect but rather based on a number of other factors such as shippers satisfaction based on previous experience with different modes, shippers perspective on the competitive level of the different modes. For instance, Cunningham further built upon the four models discussed by McGinnis by incorporating data of competing modes. In his work, he theorises that modal choice depends essentially on three factors namely costs incurred when using competing modes, shipper's perspective on competitive modes, and the transportation costs (Cunningham, 1982). Another important theory in the context of modal choice is that of Gibson, Sink, and Mundy who rank transportation modes on five aspects namely customer service, rates and discounts, availability of equipment, quality, and performance. They also concluded that even though a mode may score optimally and meet all the criterions, it may still not be chosen thus pointing out the fact that the choice of a particular transport mode may not always be rational (Gibson, Sink, & Mundy, 1993).

Taking into account whatever's that been written about modal choice and factors influencing a shipper's decision, it can be said that though there are many factors that can be taken into account while discussing what ultimately dictates the choice of a particular mode, costs can be considered a very important factor in the context of modal choice (Beijer, 2009).

As discussed, in India, the modal choice will essentially depend on the choice at the freight forwarding companies with their strong presence in the Indian market. What shippers or the forwarders are concerned with ultimately is the availability of a door to door service at the least cost (Platz & Hersfeld, 2008). In the context of IWT, literature points out that the location of the origin and destination of the terminals which influence the transhipment costs are the most relevant costs. Added to these factors is the reliability of the service, flexibility which in the

case of IWT would mean the ability to carry varying freight sizes and frequent departures of vessels. The effect of transit time on modal choice is not clear. Reduced prices for transportation tend to make up for the trade off with longer transit times while transport safety tends to be only a decisive factor when the transportation of dangerous goods is involved (Berufsakademie Nordhessen, 2008). The biggest hindrance in the adoption of the IWT is perhaps the mental barrier resulting in many shippers and forwarders neglecting the IWT sector for transportation as had happened in the case of Europe which has changed over the past decade. (Wiegmans & Konings, 2016). In this context, knowledge about IWT, promotional policies of IWT, awareness of intermodal transport services become very important and the necessary steps need to be taken with regard to ensure all the criterions are met for decision makers to get convinced about the concept of IWT and the overall intermodal and multimodal systems and their success factors.

5.3. Case Study- Transportation from ICD/ CFS, New Delhi to JNPT, Mumbai

5.3.1. Overview

We will now model the transportation costs of one 40 feet container from ICD/ CFS, New Delhi to JNPT, Mumbai by road as well as rail.

The scope of our thesis starts at one of the many Inland Container Depots (ICDs) or Container Freight Stations (CFS) present in the Northern region of India where the cargo is consolidated under the supervision of the Central Board of Excise and Customs. For simplification purposes, we will choose the dry ports in New Delhi as our origin of cargo. Our choice of New Delhi in the North is motivated by the fact it is one the eight primary warehousing hubs in Northern India and is considered a major growth corridor (JLL, 2015). The numerous manufacturers in the north from major industrial cities mostly direct their cargo to one of the two major inland terminals in Delhi, namely the CFS under the Container Warehousing Corporation India and the ICD under the Container Corporation of India.

The concept of CFS and ICDs play a very crucial role in the logistical operations and infrastructure in India. An ICD or CFS is located inland offering transportation services to the sea ports. It also offers all other typical transportation services such as container handling and storage, bulk-cargo handling, and customs inspection and clearance. The transportation through such facilities involves mostly trucks but in some cases, may involve rail services as well; Transportation from CFS in New Delhi involves only trucking while the ICD present there provides only railing services to other ICD facilities in its network.

For the purpose of our thesis, we will consider the case of 40 feet Ex-Works (EXW) container with stuffing taking place in the premises of the shipper. We choose a 40 feet EXW container because of two reasons. Firstly, majority of the quote requests that the forwarder receives and almost all of the containers that the forwarder handles on this corridor, are related to 40 feet EXW containers. Secondly, over the past decade there has been a shift towards usage of 40-foot-containers with shippers taking orders only for 40-feet containers as minimum order requirements and also because of advantage of economies of scale. This has led to a situation where due to low demand for the movement of a 20 feet container, most transporters operating in this region have discarded and now do not have the 20 feet trailers. Therefore, a shipper transporting a 20 feet container pays for the transportation of a 40 feet container irrespective of his choice. Therefore, also for the purpose of simplification, we take the example of a 40 feet EXW container.

The process firstly involves acquiring a container from the dedicated liner company and consolidation/ stuffing at the seller's place of business. The container is then transported to the ICD premises for the custom inspection and other formalities. Once the formalities the Container Warehousing Corporation assumes the responsibility of transporting the container to JNPT. One important point to note here is that even though the shipper transports a 20 feet container, he/she will have to pay the same cost as that for the transportation of a 40 feet containers as most transporters operating in this region do not have the 20 feet trailers.

The inputs for the transport cost model were found taking into consideration the cost sheet of one major freight forwarding company operating in the region which outsources the transportation of the container to an independent transporter. The costs can be considered a reliable representation of the true costs of transporting a EXW 40 feet container in this corridor for two reasons. Firstly, as discussed previously, the logistics competitive map of India is such that it is dominated by freight forwarders while independent truck operators are present in very small numbers and are also not preferred due to their inexperienced nature. Secondly, building on the first reason, there are 4 major forwarders operating in this region who have leased out spaces at ICD and CFS, New Delhi. The fierce competition among the forwarders has lead a situation where a price war ensures that the prices offered by one is not higher than the other and thus prices quoted for transportation are more or less similar with shippers sticking to a particular forwarder out of loyalty to the business-client relationship.

Also, the figures were taken as they were and were not adjusted to not take into account the forwarders commission. This want done so that our results fit the purpose of our analysis. As discussed earlier, the logistics industry of India is such that most work is carried out by

forwarders who dominate the industry. Taking into account the costs of transportation (what the forwarder actually charges) will give us the right cost figure for our analysis. Comparing this cost figure to any cost reductions will give us an idea about whether in fact there can be a modal shift that occur towards IWT because what the shipper will care about ultimately is a reduction in the costs of transportation services.

5.3.2. Cost Model

The cost model which we use for the calculation of the transport costs are based on literature from Lingaitiene (2008) and Butler et al (1996); It is also based on the calculations used by Inmuang (2010) who modified the equations to model transport costs and modal shifts in freight transport.

The equations used for the transport calculations purpose are listed below: -

$$Capital\ Cost = Depreciation + Rent + Interest\ Payments \quad \textbf{(5.1)}$$

$$\begin{aligned} Operating\ Costs &= Labour + Maintenance\ and\ Repair\ Costs + Fuel\ Costs \\ &+ Traffic\ Costs + Taxes + Insurance\ Costs + Overhead\ Costs \\ &+ Miscellneous\ Costs \end{aligned} \quad \textbf{(5.2)}$$

With the above input variables, we can calculate the Total Transport Cost per unit per km can be calculate as follows: -

$$Total\ Transport\ Costs\ (TTC) = Capital\ Costs\ (CC) + Operating\ Costs\ (OC) \quad \textbf{(5.3)}$$

From equation 4.3, the average transport cost can be calculated as follows: -

$$Average\ Transport\ Costs\ per\ km\ (ATCperkm) = \frac{Total\ Transport\ Cost\ (TTC)}{Total\ Kilometers\ \ per\ annum} \quad \textbf{(5.4)}$$

Based on the equation 4.4 we can calculate the Average Transport Cost per unit per km as follows: -

$$Average\ Transport\ Cost\ per\ unit\ per\ km = \frac{Average\ Transport\ Costs\ per\ km}{Number\ of\ units\ per\ haul}$$

The units in the above equation can be altered to fit the above equation. In our case the unit of transportation becomes TEU. Therefore, the above equation can be rewritten as: -

$$Average\ Transport\ Cost\ per\ TEU\ per\ km\ (ATCteukm) = \frac{Average\ Transport\ Costs\ per\ km\ (ATCkm)}{Number\ of\ TEUs\ per\ haul}$$

5.4. Trucking Transport Process and Costs

The transportation process for a 40 feet EXW container described here is on the basis of the procedures followed by the forwarder who assumes responsibility for the transportation of the container and can be summarised as follows: -

1. Generation of the invoice/ packing list and other required documents: -
   Most forwarders operating in India, generate a separate Bill of Lading (B/L) and term it as 'House B/L' for which they charge the shipper. The shipper maybe charged for other documents as well.
2. Custom Processing- Documents filling in the Custom and Excise Department
3. Booking placement with the concerned carrier for an empty container
4. Allotment of empty container from carrier and its transportation to the shipper's premises
5. Stuffing/ Stowing of goods in the container
6. Excise sealing process by the concerned custom officer
7. Container transportation to the CFS, New Delhi for further custom clearance and other operation such as Verified Gross Mass (VGM)
8. Container handover process to the carrier: -
   The CWC allows the movement of container by road only after the shipper signs a bond which releases CWC from any liability/ responsibility of the container once it is outside the premises of the CFS and is being transported to the JNPT, Mumbai. Thus, the liability and risk which the transportation involves is borne entirely by the forwarder who transports the container on behalf of the shipper.
9. Container gate in procedure at JNPT, Mumbai

It becomes important here to mention every step involved as most steps in the process mentioned above involve some sort of cost to be borne by the shipper which add to the overall costs of transportation. Such costs will be included under operational costs in the model.

The inputs required for cost calculation are summarised in the table below: -

Table 5.1 Capital Costs and Operating Costs for Transportation of a 40-foot-container by Truck

Price of Trailer Truck	INR 30 lakhs or USD 46783
Price of Container Trailer	INR 30 lakhs or USD 46783
Economic Life of Trailer Truck	10 years
Economic Life of Trailer	10 years
Number of TEUs per haul	1 TEU for our case study
Utilization Rate	80%
Fuel Consumption Rate	INR 2,5 per km or USD 0,04 per km
Interest	12%
Depreciation	30% on Written Down Value =1470000 INR or USD 22915
Operation Expenses	80% out of cost
Labour	Included in the operating expenses
Fuel	45% out of cost
Taxes	7% out of cost
Insurance	3% out of cost
Maintenance and Repair	INR 2,5 per km or USD 0,04 per km = INR 3750
Overhead Costs	Nil
Miscellaneous	Nil

Source: - Forwarding company considered for the case study

$$Transport\ Cost\ (TTC) = Total\ Capital\ Cost\ (CC) + Total\ Operating\ Cost\ (OC)$$

CC = 1470000 + 12264 = INR 1482264

OC = 81760 + 3750 + 45990 + 7154 + 3066 = INR 138654

TTC = 1482264 + 138654 = INR 1620918

$$Average\ Transport\ Cost\ per\ km\ (ATCkm) = \frac{Total\ Tansport\ Cost\ (TTC)}{Total\ Kilometers\ per\ annum}$$

The approximate distance between CFS, New Delhi and JNPT Mumbai is 1500 km. Thus, assuming transportation of one container per month and assuming all haulages are laden, the total kilometres travelled per annum is 1500*12= 18000 km

Therefore, ATCkm = 1620918/ 18000 = INR 90.051

The formula for Average Transport Cost per unit km is: -

$$Average\ Transport\ Cost\ per\ unit\ km = \frac{Average\ transport\ cost\ per\ KM}{Number\ of\ units\ per\ haul}$$

The unit of transport that is required for the calculation of the average transport cost per unit kilometre, can be altered for the concerned purpose; For the purpose of our thesis, the unit used will be TEU.

Therefore,

$$Average\ Transport\ Cost\ per\ TEU\ km\ (ATCteukm) = \frac{Average\ Transport\ Cost\ per\ km}{Number\ of\ TEU\ carried\ per\ haul}$$

We assume 100% utilization, therefore, number of TEU carried per haul is 2.

Thus, ATCteukm = 90.051/ 2 = INR 45.02 ≈ INR 45

5.5. Railing Process and Transportation Costs

The Railing process of the container is similar to that of the trucking. The only difference is that once Container transportation is carried out to the ICD, New Delhi for further custom clearance and other operation such as Verified Gross Mass (VGM) like in the case of Trucking, the container is then transported to JNPT via a train operated by CONCOR.

Assumptions for the transportation by railways are similar to the assumptions taken in the case for transportation by truck.

In the case of railways, the inputs needed for the cost calculation were subject to availability of data as the Railways Authority of India does not openly disclose the operational or capital costs. However, CONCOR recently published the tariff for freight transportation to and from many of the ICDs that are under it. The tariffs can be found in the table below: -

Table 5.2 Railing Tariff of CONCOR from ICD, New Delhi to JNPT, Mumbai

Railing costs from ICD, TKD, New Delhi to JNPT, Mumbai per ton for 20' and 40' containers	
20'	
Upto 10 T	INR 25000
>10 T – 20 T	INR 31000
>20 T – 26 T	INR 36500
>26 T – 31 MT	INR 42500
>31 MT	INR 46000
40'	
Upto 20 T	INR 44500
>20 T	INR 55500

Source: - CONCOR

Also, from the cost sheet of the forwarder consulted for the purpose of our case study revealed a total cost of INR 84000 as the total transportation cost of a 40' container including the trucking length from the shipper's factory and the transportation of the container by train to JNPT, Mumbai.

Based on the above information and on the information provided by few of the CONCOR officials who were interviewed for obtaining their view for the purpose of our thesis, a figure for the average transport cost per TEU per Kilometre (ATCteukm) which will be used for the comparison with the trucking transportation costs.

Therefore, ATCteukm for railways = INR 23

5.6. Inland Shipping Process and Transportation Costs

In the context of our case study, if inland shipping were to be used for the purpose of container transportation, the containers will be directly routed towards Calcutta for oceanic vessels to then transport them to their destination port in any of the far-eastern countries.

We assume that once NW-1 becomes adept for container transportation, forwarders will begin routing the cargo by IWT. Since at present such a service does not exist, we outline the transport process taking into account the idea of operations that exist surrounding transportation via such a mode and also taking into account the opinion of the management of the forwarding company. The transport process can be outlined as follows: -

1. Generation of the invoice/ packing list and other required documents
2. Custom Processing- Documents filling in the Custom and Excise Department
3. Booking placement with the concerned carrier for an empty container
4. Allotment of empty container from carrier and its transportation to the shipper's premises
5. Stuffing/ Stowing of goods in the container
6. Excise sealing process by the concerned custom officer
7. Container transportation to the CFS, New Delhi for further custom clearance and other operation such as Verified Gross Mass (VGM)

   The container if transported via New Delhi, will have to be routed through CFS there; As discussed above CWC allows trucking operations and the container will have to be sent via a truck to the container terminal at Allahabad after the necessary custom procedures are completed so that once it reaches the Inland Waterway Terminal at Allahabad, it can be directly loaded onto a barge and shipped to Kolkata.
8. Container gate in procedure at the Port of Kolkata.

It is important to note that in the case of transportation via IWT, there is considerable leg of the transportation which involves trucking. The approximate distance from New Delhi to Allahabad is 702 km for which the shipper will have to pay in addition to the charges incurred for IWT transportation.

Furthermore, the cost of transportation via barges will have a surcharge as operators will have to make up for the laden voyages. Unless there is a reverse container flow from Kolkata towards the northern region, one can expect IWT to not offer the drastic transportation cost reduction that it is expected to bring with itself. However, for the purpose of our case study, we will assume the best-case scenario and take into account the transportation costs of this mode without any surcharges.

As discussed earlier, at present barge services for container transportation are not present. Therefore, for the inputs of the cost model we will refer to the barge operations of a 1000-ton barge in Myanmar which operate under conditions very similar to that of India in terms of infrastructure and other physical constraints on the Mandalay-Yangon corridor. Also, the vessel specifications are very similar, with India importing the IWT vessels from Myanmar as well. We will also refer to the barge operations in Thailand between Nakorn Luang port to Laem Chabang port.

A typical self-propelled container barge costs approximately 1.17 crore INR. The variable costs consist of diesel costs, cost for lubricants, maintenance and repair costs while the fixed costs

include the cost for 6 crew members (1 captain, 1 first mate, 1 first engineer, and 3 sailors) which is required for the barge operations (Inmuang, 2010). The operating costs for the model can be found in the table below: -

Table 5.3 Capital Costs and Operational Costs for transportation of a 40-foot-container by Barge

Price of Barge	INR 11700000
Economic Life of Barge	12 years
Depreciation	INR 975000
Interest	INR 57000
Labour	INR 1384000
Taxes	N/A
Maintenance and Repair	INR 269000
Fuel Costs (Diesel) for approximated for 12 drums	INR 101940
Overhead Costs	INR 1090000
Insurance	INR 2100000
Miscellaneous	INR 70000 INR

Source: - (Nam & Win, 2014)

Thus, we can find out the costs that we need to compare the three modes as follows: -

$$Total\ Transport\ Cost\ (TTC) = Total\ Capital\ Cost\ (CC) + Total\ Operating\ Cost\ (OC)$$

CC = 975000 + 57000 = INR 1032000

OC = 1384000 + 101940 + 2100000 + 1090000 70000 = INR 4692940

TTC = 1032000 + 4692940 = INR 5724940

$$Average\ Transport\ Cost\ per\ km\ (ATCkm) = \frac{Total\ Tansport\ Cost\ (TTC)}{Total\ Kilometers\ per\ annum}$$

The distance of the inland waterway from Allahabad to Calcutta is 1620 km. We assume 1 sailing per week which translates to 84240 km per annum. Therefore: -

ATCkm = 5724940 / 84240 = INR 67.95

$$Average\ Transport\ Cost\ per\ TEU\ km\ (ATCteukm) = \frac{Average\ Transport\ Cost\ per\ km}{Number\ of\ TEU\ carried\ per\ haul}$$

The number of TEU per voyage is 54 TEU assuming 90% utilization of the container barge's total capacity of 60 TEU for it to remain profitable and ultimately viable to provide its services.

Commented [av1]: I consider this leg as per our case study. I am trying to find the transportation costs/ reduction in transportation costs compared to the trucking case where the cargo FOR SEA and FE countries is directed to JNPT, Mumbai since shippers do not have the option of routing their cargo to the eastern ports. If NW-1 becomes operational (which I am taking as an assumption for my case study) and the shippers get his option, they will be directing the cargo towards Calcutta via IWT at much a cheaper price, the cost of which I am calculating.

Commented [av2]: I do not take into account the round trip as the input figures have already been adjusted to take this account. Also, I want to take into account only the cost of transporting the cargo up till Kolkata.

Thus, ATCteukm for inland shipping = 67.95/ 54 = INR 1.25

The costs (ATCteukm) that we have calculated for all three modes are summarised in the table below: -

Table 5.4 Summarised Average Total Transportation Costs per TEU per Kilometre of the three modes

Mode	Average Total Cost per TEU per kilometre
Trucking	INR 45
Railing	INR 23
Inland Shipping	INR 1.25

As we can see the ATCteukm is drastically lower compared to the cases of trucking and railing.

5.7. The Impact of NW-1 on Container Freight Flows

We will now extend our qualitative analysis by taking by estimating the container traffic that can be diverted onto IWT for its transportation to Kolkata. We will ultimately try to assess the savings in transportation costs that can be realised in the logistics industry with NW-1 becoming operational.

For this purpose, we estimate the east bound container traffic that is bound for eastern countries and is routed through JNPT, Mumbai. The data for this estimation is sourced from K-Line which provided us with the export figures for one month from all North India's ICD's to Southeast Asian countries including Brunei, Burma (Myanmar), Timor-Leste, Cambodia, Indonesia, Laos, Malaysia, the Philippines, Singapore, Thailand, and Vietnam and Far-Eastern countries. The total cargo transported from the Northern Region to SEA and FE region via JNPT was reported to be 6641 TEUs for the month of April 2017 (K-Line, 2017). Due to insufficiency of data of cargo volumes of other months, for the purpose of our thesis we will refer to this figure as an average to estimate the yearly export volume in the same corridor.

The yearly volume in the same corridor can then be estimated to be 79682 TEUs.

5.8. Cost Savings Generated

For the purpose of estimating the potential cost savings that can be realised, we will divert a percentage of the yearly volume onto IWT based on the Inter-Modal split of country.

Literature on the structure of composition of fright flows in India report that the presently 50 per cent of total transport sector freight flows is carried by trucks, 36 per cent is carried by rail,

6 per cent is carried by coastal shipping, 0.2 per cent is carried by inland waterways, 7.5 per cent is carried by pipelines, and 0.01 per cent is carried by airways (Kumar, 2014).

5.9. The Different Scenarios Possible

With IWT becoming operation there are quite a few possibilities in the context of the freight flows being diverted onto this mode. What the IWA is planning for is reaching a balanced modal split among the different transportation modes with IWT gaining it fair share of freight flows using the rich waterways network that India is endowed with which is the ultimate aim of reviving the inland waterways of the country. Keeping in mind the limitations to IWT operations discussed in the previous chapters, another possibility is that IWT does not gain the forecasted momentum and railing and trucking stay the preferred mode for transportation for the foreseeable years. For the purpose of our thesis, we will estimate the cost saving in both the scenarios namely: -

1. *The Optimistic Scenario*: - This would be the maximum barging situation where the modal share of barging will be at par and at a level equal to the countries where inland shipping is used fully and accounts for a large percentage of volume for freight transported. In the context of our case study, this would mean that for the estimated 79682 TEUs of container traffic that is bound for SEA and FE countries presently routed through JNPT, Mumbai, most of it will be diverted onto IWT and shall be shipped to Kolkata directly. For simplification purpose, we will assume that in the optimistic scenario, all of the 79682 TEUs is transported via IWT.
2. *The Pessimistic Scenario*: - This would be the case where barging will account for a little more than the present national level IWT transportation i.e. 0.2%. The modal share of IWT in such a case remains small relative to that of trucking and railing. In the context of our case study, we will take an appropriate percentage of the estimated 79682 TEUs which shall represent a small share as diverted traffic assuming that IWT operations are not very successful on NW-1.

5.9.1. The Optimistic Scenario

For estimations relating to the optimistic scenarios we assume that NW-1 becomes fully operational and is completely adept at handling the container freight generated from the northern region. If this happens then all of the present cargo for SEA and FE countries will be diverted into IWT for Kolkata port.

To estimate the cost savings, we will use the transportation costs that we calculated for Inland Shipping in section 4.4.

We estimated the yearly freight volume to be 79682 TEUs. If IWT manages to capture all of this volume the cost savings can be estimated as follows: -

ATCteukm for inland shipping = INR 1.25

Thus, for 79682 TEUs, the Average cost per TEU km equals 1.25 x 79682 = INR 99602.5

Presently this cargo was being directed towards JNPT via trucking or railing. Taking into account the modal split we can calculate how much is being spent presently on the transportation by two modes respectively which will give us an insight on the potential cost savings.

The cost for railing operations can be estimated as follows: -

Modal share of railing = 36 per cent

ATCteukm for railing = INR 23

Then, ATCteukm of railing for transportation of 36% of 79682 TEUs = INR 659766.96 per annum ≈ INR 659767

Thus, the cost saved when IWT is used instead of railways = 659767 – 99602.5 = 560164.5 ≈ INR 560165

Similarly, for trucking, the potential cost saving can be estimated.

ATCteukm for trucking = INR 45

Modal Share of Trucking = 50 per cent

Then, ATCteukm of transportation of 50% of 79682 TEUs = INR 1792845

Thus, cost saved = 1792845 – 99602 = INR 1693242.5

5.9.2. The Pessimistic Scenario

For this case, we take first consider the present national level of IWT operations in India as our benchmark. The current modal share of inland shipping in the country is 0.2 per cent. With so many difficulties with the supply of infrastructure for IWT and other issues that we discussed thoroughly, in the worst-case scenario, we can expect all the National Waterways to collectively capture a modal share of about 3 per cent for total freight volume moved throughout the country. If this happens, any potential cost savings can be calculated as follows:

ATCteukm for inland shipping = INR 1.25

Thus, the cost for transportation of 2% of 79682 via IWT is: -

INR 1.25 x 2390.46 TEUs ≈ INR 2988

The cost for railing operations can be estimated as follows: -

Modal share of railing = 36 per cent

ATCteukm for railing = INR 23

Then, ATCteukm of railing for transportation of 36% of 79682 TEUs = INR 659766.96 per annum ≈ INR 659767

Thus, cost saved = 659767 – 2988 = INR 656779

Similarly, for trucking, the potential costs saving can be estimated.

ATCteukm for trucking = INR 45

Modal Share of Trucking = 50 per cent

Then, ATCteukm of transportation of 50% of 79682 TEUs = INR 1792845

Thus, cost saved = 1792845 – 2988 = INR 1789857

It becomes important here to note that even though in the pessimistic scenario there are considerable potential cost savings for shipper, however, the cost that the shippers pay for the cargo movement would not be enough to sustain IWT operations in the long run. Eventually service providers will exit the industry. Added to this will the problem of convincing the concerned stakeholders to provide their services in the first place considering the low margins and large operating costs.

The costs (ATCteukm) that we calculated are summarised for comparison in the table below-

Table 5.5. Summarised Costs (ATCteukm) and Cost Savings

Mode / Scenario	Trucking	Railing	Inland Shipping	Costs Saved (Trucking to IWT)	Costs Saved (Railing to IWT)
Optimistic Scenario	INR 1792845	INR 659767	INR 99602.5	INR 1693242.5	INR 560164.5
Pessimistic Scenario	INR 1792845	INR 659767	INR 2988	INR 1789857	INR 656779

5.10. Transit Time and Reliability Advantage of IWT

Added to the cost advantage that IWT has over trucking and railing, it also has the advantage of faster transit times and reliability.

While time is not a considerable hindrance in the case of railing, for trucking it can lead to significant costs incurred. While roadways may seem like a faster option, in the case of India, the seamless flow of freight is disrupted due to the multiple check posts/ check points and of course the quality of road infrastructure like we had discussed previously. Added to this is the problem of heavy documentation procedure at every interstate check point and inexperienced

and illiterate drivers. All this contributes to a poor service quality in terms of reliability and on time delivery. Also, taking into account the congestion on the roads, the transit time often gets stretched by as much as 2 days. Indian Railways are infamous for their schedule inconsistency; there is a lack of service schedule reliability with trains often getting delayed due to a number of different reasons such as weather conditions or other operational issue. Another major impediment in trusting the railing operations is that any delays or problems in the passenger movement sector of the railways ultimately affects the cargo transportation sector as well because both the sectors share the same track capacity at present. However, railways are considered more reliable than trucking any day.

In the context of our case study, IWT will bring down the time for operations as the cargo will stop taking the longer route of first reaching the western ports and then being routed towards the FEA and SE countries.

Presently, forwarders indicate the time for transportation procedure from New Delhi to Mumbai as 4 days and 3 days for trucking and railing respectively.

Assuming out barge operates at a speed of 12 knots and taking into consideration the distance of 1653 km from Varanasi to Kolkatta via NW-1, the transit time calculated comes out be approximately 59 hours or 3 days. This will be faster than both of the other modes and will being down the consignee's pipeline holding costs, inventory costs enormously along with the transportation costs.

5.11. The Prerequisites for Cost Competitiveness of IWT

As per a study conducted by RITES on Integrated National Waterways Transportation Grid (INWTG) in 2014, cargo moved by water can help save INR 1.52/ USD 0.02 compared to the movement of the same cargo by road and save INR 0.35/ USD 0.01 compared to movement of the same cargo by rail.

However, it becomes important to point out the operational advantages that the other two transport modes like for instance road transport offer door to door services while railways are more adept at handling bulk cargo over long distances.

In terms of Roadways, the cost advantage that is attributed to the waterways is essentially fuel cost advantage which are just one part of the costs. IWT will need other parts of the transport chain for instance to full fill the last mile deliveries. For instance, presently the price advantage on NW-1 are nullified by the additional costs borne by the shipper as pre-carriage and onward carriage is required most of time with users not located close to the waterways. Furthermore, there are terminal costs which can be expected to nullify the cost advantage.

The length of transport is another contributing factor for the viability for transportation by IWT in terms of it being cheaper. Though waterways are cheaper in fuel costs per tonne km of transport, this advantage can be reduced if waterways require transport through longer distances (Dhamadhikary & Sanbhor, 2017). The stretch of Haldia to Allahbad is about 1600 km long by the waterways by only 900 km by road.

Another aspect that affects the cost advantage of IWT is LAD which as discussed is one of the most crucial factors influencing the viability of waterways with it ultimately affecting the size of the vessel and hence the scope for economies of scale. It is generally considered that if an inland waterway is capable of plying 1000 DWT vessels, it is commercially viable. For this normally a depth of 2.5- 3 meters and at least 45 m width is required in the fairway. In regard to this if the waterways have a depth of only 1metres then they definitely will not be cheaper than the movement by railways or roadways. However, if they are well developed and a depth between 2.5 to 4.5 metres can be provided, the cost can be lowered by as much as 10 percent or more than that. However, this leads to the added costs of providing for such high depths which are very expensive even if we do not take externalities/ social costs.

The direction of transport also contributes towards the cost competitiveness, the transport costs is only marginally better than railways as presently it offers the opportunity to transport cargo only one way with the total operating costs shooting up with the vessel having to come back empty. The total costs for inland transportation is between INR 0.74/ USD 0.016 per ton per km for a 3000-ton vessel downstream and INR 2/ USD 0.03 per ton km for a 1000-ton vessel upstream. Thus, there needs to be connectivity enhancement for cargo transportation for both ways to become viable to support the economics of IWT transportation.

6. Conclusion

The need for IWT in India stems for the existence of inadequate and inefficient infrastructure, operations, and systems; there also exists the need for a sustainable transport development. We discussed the case of Europe and the Netherlands where IWT has been fully developed to discuss its potential to provide an example from which India could learn while IWT is at its very nascent stage and is just being revived, so that appropriate measures may be taken for its effective integration into an intermodal or multimodal transportation networks. The general trends such as the increase in containerisation, increase in shipment sizes, and transport distances in the transportation sector prove to be very important for IWT and support its application and operations to a large extent. However, there are certain areas where IWT lacks in Europe such as the legal regime that governs it and the overall market structure., Therefore, there are still many areas and possibilities to improve its productivity. India could perhaps take into account all this, address such issues discussed for the development of a world class IWT transport network.

There is no doubt about the fact that India's logistics sector lacks critically and to keep up with India's fast paced economic growth it needs to improve it rail, road, and waterways infrastructure tremendously. The growth of the logistics sector will be supported by effective infrastructure development which also includes the soft infrastructure like education, training, and policy frameworks. The development of IMT and MMT transport systems which incorporates IWT efficiently is what is needed to tackle the inefficiencies in the logistics sector. With the goal of making the logistics in India more sustainable while ensuring economic development, development of IMT and MMT economic systems is one viable solution for the creation of an efficient way of transportation where the different modes combine their services and better use of the available resources is made. The need for an efficient sustainable IMT and MMT network is essentially the opportunity that exists for the IWT sector in India.

While incorporating IWT in an efficient network of logistics does seem to be practical, for it to be efficient there will have to be considerable development of IWT before so that it becomes adept at handling the volumes of cargo diverted. For IMT and MMT systems to be successful, long distance and high cargo volume corridors need to be present; With both of the requirements fulfilled, there is now only a need for the services to be of international standards. However, though the prospects of IWT in India are really rich there are considerable impediments for it effective development. The primary causes for this are ineffective use of public funds, ineffective policy regimes, disinterested private players, critical shortages in

infrastructure such as depth restrictions which need to be affectively addressed. Also, there are major impediments for the successful implementation and adoption of MMT and IMT transport systems in India which need to be addressed; it is only with an effective IMT and MMT system that IWT will become successful and the bring the advantages that it has with its implementation. All this coupled together pose as significant challenges for the revival of the IWT sector and need to be carefully and effectively tackled for the long term success of not just the IWT but the logistics network of India as whole, failure of which will have huge repercussions on the country's economic growth.

The research we conducted does provide for an argument in favour of significant cost reductions as our case study pointed out however, its sustenance needs to considered contextually with the whole sector in the picture as we discussed. The policies and measures that encourage the development of usage of IWT need to be supported by policies and measures which encourage an efficient IMT and MMT transport network. It is pointed out that IWT in its own does not hold the solution for the logistics problems in India. The solution is to incorporate IWT into an effective IMT and MMT system which in effect will have the potential to transfer cargo flows from the other modes to inland waterways which earlier was not an option for shippers.

The potential of IWT as our research pointed out the opportunity for transportation cost reductions are enough to justify the huge investments being made in the revival of the country's waterways by the government of India. However, there needs to be considerable attention paid in context of intermodal integration, utilisation of public funds, standardisation, navigational infrastructure, policy parities, and adoption of technology.

7. Limitations and Future Scope

There is not much literature available on Inland shipping in India given its recent revival. Much of the reports that are available are published by the IWAI and require the disclosure of the Government of India as they have confidential cost figures. Thus, our research had to rely upon a limited number of sources which affected our analysis. Also, the much of the literature available on topics such as 'intermodal transportation systems', 'multimodal transportation systems', 'choice of transport modes' is quite outdated. In the face of all this, our literature review had to be based on the limited available literature.

Another limitation is related to case study which involved a quantitative analysis of the transportation costs. Firstly, the cost calculations for the railing process are based on interviews with CONCOR officials which is just an estimation as the real figures were subject to their discretion. Though the estimation does provide an idea of the operational and capital costs, an exact figure like in the case of trucking and barging would have made our analysis more accurate for cost comparisons. Secondly, the data that we obtained from K-line to estimate the yearly cargo flows from the states in Northern India to South East Asian and Far Eastern countries via JNPT, Mumbai was only for one month. Therefore, to obtain a yearly figure we had to assume a linear estimation technique which does not take into account any surges assuming the figures are independent of any contributing factor such as freight rates volatility during certain months, which would not have been if there was data available for 3-4 months; the estimation would have been more accurate and relevant. However, the K-line management reported that there is mostly an increasing trend observed in the volumes rather than a decreasing one and therefore, the conclusion of our analysis would have been just stronger had the accurate data for different months been present. Related to this, our figures for the calculation of operational and capital costs for inland shipping are based on examples of other countries such as Myanmar since such services are not widely available in India at present. We took the example of Myanmar because the similarities it shares with the IWT sector in India in the context of the structure and vessels used. However, there will be some differences in such costs and figures which will essentially depend on the Indian market scenario and can be different when similar operations materialise in India considering the fact that the IWT sector is just being revived there.

7.1. Scope for Further Research

As can been seen we have pointed out the development of IMT and MMT systems is a major requirement to stir the logistics sector of India along with their incorporation of IWT into them. One particular area which can be addressed by the means of future research is modelling the modal shifts in India. This can identify the effective distances for transportation of containers taking into account the spatial scale of India and identify efficient locations and distances for modal transfers. It can further identify strategic locations for ICDs and logistical parks which can help build an effective IMT and MMT infrastructure system. Also there can be research which models the coordination in hinterland transport chains.

There can be similar research done more on the environmental front which incorporates a social benefit analysis taking into account the reduction in carbon emissions and congestion with the incorporation of IWT in India.

The lack of research done on Inland shipping in India provides for the potential for research and analysis in this field. The relevant literature available on inland shipping in other countries provide a good idea for the topics on which research can be done on the Indian case as well. For instance, inland shipping if successful will change the flow of freight volumes significantly which will affect the traffic in certain ports. Thus, research can be done on the port competitiveness and pricing between the Western and the Eastern ports of India.

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