

**How different materials are carried on the routes of India in
supply chain**

Research dissertation presented in partial fulfilment of the requirements
for the degree of
MSc in International procurement and supply chain management

Griffith College Dublin

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28th August 2020

1.1 Candidate Declaration

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I certify that the dissertation entitled:

How different materials are carried on the routes of India in supply chain

submitted for the degree of: **MSc in International procurement and supply chain management** is the result of the my own work and that where reference is made to the work of others, due acknowledgment is given.

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1.2 Acknowledgements

I want to thank all the following people who supported and assisted me in writing this thesis.

First of all, I want to thank my family member, especially my dad and mom, for reviewing my research at many stages of the design process, not only in this study but across the educational year. I also want to thank them for all their support and kindness throughout this master courses.

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1.3 Abstract

How different materials are carried on the routes of India in supply

Gurprit Singh Randhawa

In this research , it was presented that how there are different kind of materials which can be transported by commercial vehicle, various category of heavy vehicles, weight segments for carrying distinct product with safety, emission standard for vehicles and numerous challenges faced while transporting the goods. This study focusses on five category material, commercial vehicles, weight, new emission norms and challenges. For analysing this paper descriptive coding was used so that data can easily be divided into these categories. The result shows that for loading and unloading of materials documents, workforce, equipment and safety kit are needed, different type of commercial vehicle is needed for carrying distinct material like liquid in tankers, parcel in container and generic product in trailers, safety measures like plastic covers and straps for open body vehicles, SS tank for chemical products and wooden or cardboard sheets in containers, the new norms has improved the engines, vehicles produce less pollution, better safety equipment, only improvement is done but no major changes has been noticed. Finally, the challenges faced in transit are theft, less margin, low infrastructure, harassment and corruption.

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2 Introduction

2.1.1 Overview

Transportation plays an important role in moving goods from one place to another. There are three basic mode of transportation air, water and road. Among the three modes, road is the one which connects with other two modes. In road transportation it contains various commercial vehicles which can carry huge or small loads as per the requirement which shows the diversity in roadways. India is a huge market which uses roadways a lot to transport goods. As being a developing nation, India have a rural background where only road transport can reach any other means which is not possible. Due to which Indian logistics heavily depend on heavy vehicles like trucks or trailers to move goods so that a large number of quantise can be carried. It's because of these vehicles huge quantities are lugged and delivered on time.

Distinct commodity requires a different way or process to transport so there are particular kind of commercial vehicle present for each product so that they are transferred with proper care. Each vehicle has its own carrying capacity due to which a certain amount can be moved by each automobile. This vehicle is also prepared to perform specific task like milk being carried on a tank, steel being carried on an open trailer or coal will lugged on a dumper.

This dissertation focus on the road transportation of India which plays a huge part in maintaining the country's supply chain. This research will help to understand how demand and supply of developing nation is been managed with the help of roadways. These studies will also concentrate on various problem face by roadways, how much weight is allotted to each vehicle to carry materials on road and how different materials are transported on road of India.

2.1.2 Research objectives

The main aim of this research is to find what are the different kind of road vehicles that are been used to carry different kind of materials in India. This will help to understand the current situation better on the ground level. For achieving this objective, data will be collected from the base level by conducting personal interview and interacting with the audience who are involved in these activities directly. This research will help to answer numerous question such as:

- What are the various ways in which distinct products are been loaded and unloaded?
- Which vehicles are been used to carry various products in Indian market?
- Which documents are required to transit material by road?
- How much weight is allotted to various segment of commercial vehicles to transmit?
- Which safety rules need to be followed while transporting different commodities?
- What changes does new emission norms bring into commercial vehicles market of India?
- Issues faced by Indian transporter while transporting material form one place to another?

2.1.3 Background and issues

Wheels were created in 3,500 B.C.(Lay, 1992) and after that they were present in every parts of the world. So thus, the road transportation which is one of the oldest and till date used to making the goods or materials available to the customer as per their convenience. After the globalization the demand of goods and services have increased and the time needed to make such product available in the market has decreased. This led to change in way of transportation and increasing the speed of delivering. Indian market is quite complex and usually follow the traditional way of moving goods. India have vast network of road due to which many kinds of vehicles are needed to fulfil the task. This kind of requirement for the vehicles attract a lot of automaker to enter the market and to try their machines and capture some of the market share. It's an open market place where various kind of vehicle can be tested and this is a market for each and every kind of vehicle available to satisfy any kind of needs.

The issues that are been faced in a road transportation in India are as follows:

- Infrastructure plays a very important role because if there is no proper connectivity of the road network it may lead to a huge problem of transferring the goods in a safer manner.
- Time is a huge issue as we got only 24 hour a day the product needs to move as fast as possible.

- Proper container which usually hold the goods needs to be maintained.
- Loading and unloading costs a lot because some time it takes weeks to load or unload.
- Paper work need to be done in a systematic way and in a proper order.
- Need to find a suitable drivers and labors because they are the one involved in transporting the goods.
- Funding also play a very important role as it cost fuel, insurance, loan and many more. so, if the inflow and the outflow is not right in lead to big losses.

This are the issues that road transport faces in India on a daily bases but they still try to maintain the supply network.

India is a huge market where this research will be conducted. It is not possible to gather data from all parts of country so research will be focusing on the metropolitan region of India. There are many language barriers because English is not the first language and the information will require to be collect from the worker class who are closer to the final functioning of activities in the road logistics.

2.1.4 Justification of the research

India have a large road network which is the second largest road network in the world. About 60 percentage ("India Transportation,") of movement of goods is done by the road transportation. There is a huge market for commercial vehicles. vehicles are been imported as well as manufactured. Some of the key players in this market are Tata motors, Mahindra and Mahindra and Ashok Leyland.

Due to globalization and a huge population the demand is at the pick and to fulfil it require a large volume of vehicles which are needed. Inspired of having a low condition of roads more than 50 percent of transportation is done on lanes. All kind of goods are transported on roadways. India comes under top 10 most traffic nations in the world as per ("Traffic Index by City 2020,") . As for recent time India is going through a huge transformation from Bharat Stage 4 (BS4) to Bharat Stage 6 (BS6) which are the new emission norms ("Emission Standards: India: Heavy-Duty Truck and Bus Engines,") to control the level of increasing pollution. This change has led to introduction of new vehicles in the market which can carry lots of loads along with taking care of environment.

All kind of different vehicles can be seen in this market and how they are able to contribute in an effective and efficient functioning of a supply chain. The input given by roadways in supply chain is quite important as they are able to make the product available in rural parts of India where any other mode of transportation is not able to reach.

This will help to know the importance of roadways in supply chain better because it's the primary mode in India and what new ways can be develop to improve road transportation which will benefit the rural areas of the world.

On an academic point of view, it is related to supply chain management. As per the business discipline it will help in gaining the knowledge of transportation cycle of land. The type and maintenance depend on different kind of material carried by vehicles. It has been observed that right from transporting raw material to making the finished product available in each process some kind of commercial vehicles are used to complete the work.

The result of this research will help to understand the relationship between the commercial vehicles and supply chain for transporting different kind of materials. This is the main aim of the research. As Indian market uses road transport the most because there are rural areas where only road freight can reach. It will help many nations and companies who are trying to expand their market in rural areas.

This research will benefit many new roads transport company to know about the bases of what is required in this business, what's the job of transporter, which material can be transferred, which safety rules need to be followed, what are the loading capacity and what are the issues faced by transported on daily bases in India.

Outcome of this research is also going to provide guidance to many upcoming researches because there is not much literature available on this topic.

2.1.5 Dissertation structure

This research shows a critical literature review of the studies previously done on this topic and locates various points that have been missing or can be added in the literature. This is then followed by a conceptual framework that has helped

to place various queries in the existing text and form a frame or design for the research. After the conceptual framework comes to the research methodology, it will present how interviews will be conducted for the transportation sector and which method is taken into consideration. Next comes finding and discussing where the information collected and the observation made from the interviews are displayed. The final phase is of conclusion in which analysis of the primary research is being made as per the research questions followed by recommendations, limitations faced, and observation of the research. It is assumed that this study will provide a floor for supply chain or logistical profession in better transit of commodities and to father conduct research in transportation to manage demand and supply.

3 literature Review

3.1 overview

Road transportation is a basic concept which started in early time and still now it's been used but the only difference is the way it's been used in now a day. India is a large market and quite a multicultural. Things change within small fraction of time but still maintain the traditional value that was in the past. For example India first rocket launch was in 1963 at Thumba Equatorial Rocket Launching Station in terls ("Sounding Rockets - ISRO," n.d.) but its parts where carried on bullock carts and bicycle ("Transported on a Bicycle, Launched from a Church," 2016) but as time changes the way of carrying the rocket parts also changed now they are brought on pullers truck which can hold capacity more than 19000 kg.

The literature that has been reviewed undertake various matters. This research will help understand many concepts, theories, and methods or practices like how goods are transported, different ways of storing commodities, and problems faced in transit.

However, this research mainly focuses on five primary fields: commercial vehicle trips for loading and unloading, the transformation of commercial vehicles in India, GVW of heavy vehicles in India, distinct ways of loading heavy vehicles, and issues faced by road freight mover in India. Although the literature review of some articles is of a different region, they connect to a similar point of the study, so they are being considered. Nevertheless, this may not change the focus from the importance of road freight in the supply chain.

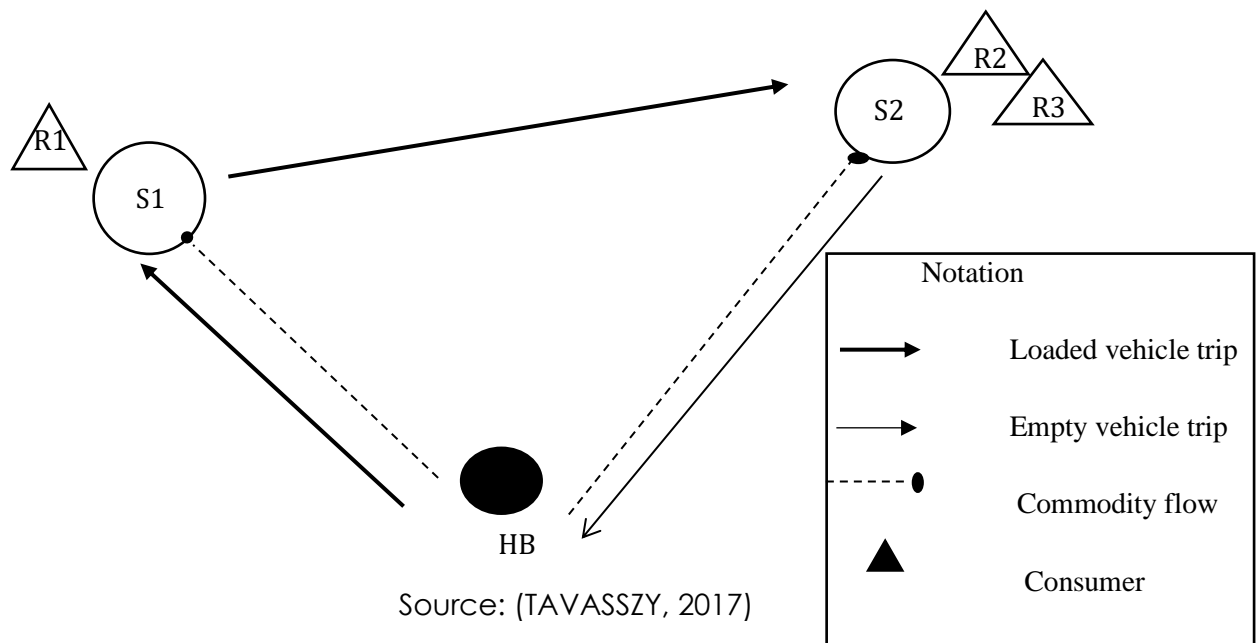
The critical point is to understand or gain knowledge of basic concepts to focus on points that are not being discovered. This will help the researcher focus on a

new subject and give guidance to pursue and make sure that this kind of study has not been repeated, copied, or addressing similar research. This research contains some peer reviews that were referred to so that they could be extended or could take the research into deeper meaning to identify and provide solutions to various problems.

3.2 Commercial Vehicle trips for loading and unloading

A trip is considered to be a total journey of the vehicle that it travels from loading to unloading of the materials (TAVASSZY, 2017). The trip can be explained in a simple figure 1.

Figure 1: Vehicle trips, Commodity Flows and Delivery tours.



The Figure1 illustrate us that there is one home base HB and three receivers R1, R2 and R3. The goods are first transported from S1 to S2 then the empty truck is sent to HB. It is clearly seen that commodity flow between HB, S1 and S2. This is a small cycle of a single trip but sometimes while returning tankers which carry chemical products or hazardous products which need to be cleaned before they are send for next journey. Two very important component in a trip is time and economic of scale which means larger volume transported in short amount of time.

As we know that India is a complex and a huge market this two-component time and economic of scale become more important. As demand is been rising in a fast pace the need to fulfil it also need to be faster. Loading is usually done at warehouse, factory like food, chemicals, tier and automobile. Unloading is done at receiving end it may be at store, factories, warehouse or customers at home. The main task of any transport commercial vehicle is to manage the goods which are in transit for example the product like fish, fruit and vegetable which require a cold environment they are usually transferred in refrigerated trucks which manage to keep this kind of goods in their familiar habitat.

There are two kinds of trips: the loaded trip and the second one is an empty trip. In a loaded trip, the vehicle is not empty; it has been filled with any goods which need to be transported. Here the vehicle is not considered to be loaded with its full capacity because only the internal storage is used to stockpile the commodity, and on the other hand, in an empty trip, it is stored in full quantity because the vehicle is vacant.

It is important to note that if a vehicle is on a single load trip, it may lead to massive loss of time, cost and under utilizations of asset because commercial vehicle is occupied with goods in one way and while returning it does not carry any commodities, so the time which could be used to fulfil more orders has now been lost along with the cost for an empty return trip. So, it is always beneficial to have a two-way loaded trip than a single loaded trip because vehicles now carry some products towards the destination and return with some materials to the original start point. This may lead to proper utilization of time, cost, and asset.

Transportation cost is the cost of transit of goods from location A to location B. Cost which are considered over here, are driver, fuel, vehicle, infrastructure use, and capital cost for transportation. All these five costs are united to form a single transportation cost. In driver, it includes the salary of the worker and the training to handle the commercial vehicle. Second, comes the fuel which is required for running of the vehicle. The price of fossil fuel is always fluctuating. Third comes the vehicle, which includes the cost of the commercial vehicle and maintenance cost like engine oil, tires and repairs. vehicle costs also include insurance and vehicle documents. Fourth comes infrastructure to use; it covers the roads, parking space, bridges and electricity. The last cost is the capital cost

for transportation, which consists of tolls price, weighting cost of the vehicle, cleaning of heavy vehicle and security check. all this cost is considered in every trip so that goods are transferred more securely. If any of the costs, as mentioned earlier, is ignored, it will cause enormous damage and lead to delay of products towards the required destination on time.

3.3 The Transformation of commercial vehicles in India

India is going through a major change in recent time. Changes are done in emission norms and carrying capacity of heavy vehicles. The focus is to increase the safety and reducing the rising pollution level. These changes has led to introduction of Bharat Stage 6 (BS6) which are the new emission norms ("Emission Standards: India: Heavy-Duty Truck and Bus Engines," n.d.). As per the transition vehicle manufacturer are now likely to increasing the used of steel components to make vehicle lugged huge loads, using panic button and many new sensors to monitor the health of vehicle and launch of new engines to reduce harm full PM (particular matters) which affects the environment("India BS VI Policy Update vF.pdf," n.d.). all this change has made Indian commercial vehicles manufacture to introduce new models in Indian market.

Table 1: Emission standard for heavy-duty vehicles in India

stage	year	Test	CO	HC	CH ₄	NO _x	PM	PN	NH ₃
			g/kwh					Kwh ⁻¹	ppm
	1992	ECE R49	17.3	2.7		-	-		
	1996	ECE R49	11.2	2.4		14.4	-		
India 2000	2000	ECE R49	4.5	1.1		8.0	0.36 ^a		
BSII	2005	ECE R49	4.0	1.1		7.0	0.15		
BSIII	2010	ESC	2.1	0.66		5.0	0.10		
		ETC	5.45	0.78		5.0	0.16		

BSIV	2010	ESC	1.5	0.46		3.5	0.02		
		ETC	4.0	0.55		3.5	0.03		
BSV	<i>n/a^b</i>	ESC	1.5	0.46		2.0	0.02		
		ETC	4.0	0.55	1.1 ^d	2.0	0.03		
BSVI	2020 ^c	WHSC(CI)	1.5	0.13		0.40	0.01	8.0x10 ¹¹	10
		WHTC(CI)	4.0	0.16		0.46	0.01	6.0x10 ^{11e}	10
		WHTC(PI)	4.0	0.16 ^f	0.50	0.46	0.01	6.0x10 ^{11e}	10

Sources: ("Emission Standards: India: Heavy-Duty Truck and Bus Engines," n.d.)

As we can see in table 1 of the emission standard for heavy-duty vehicles in India. It shows us how India has changed from 1992 to the current 2020 year and the steps it has taken towards the environment. We can see all the stages, years, tests conducted, and the results of each test. As we can observe that from the year 1992 to the year 1996, India used to take the ECE R49 test. This test consists of thirteen modes of steady-state diesel engine test cycle, which was introduced by ECE regulation (unece.org, 2011). This test is used to approve different emission testing types for commercial vehicles as per the euro II standard. The test is taken on an engine dynamometer through a lugged position and with an arrangement of speed at thirteen. Fuel consumption is indicated in g/KWH to show engine efficiency. As you can see in India in 1992, the only particle included where CO (cobalt) and HC (hydrocarbons) but in 1996 NO_x (nitrogen oxide) was also considered. We can detect that level of CO and HC has reduced. CO deducted from 17.3 to 11.2 and HC from 2.7 to 2.4. In the year 2000, the stage is called India 2000, and a new component was added PM (particular matter), and a drop was noticed in CO, which came to 4.5 from 11.2, HC reached 1.1 from 2.4 and NO_x hit 8.0 from 14.4. Officially Euro II was launched in India as BSII (Bharat stage two) in 2005 with similar ECE R49 test, which showed a difference in CO at 4.0 from 4.5, HC remains the same, NO_x drop to 7.0, and a massive fall was in PM to 0.15 from 0.36^a. After five years in 2010, Euro III was launched as BSIII (Bharat Stage three), where the ECE R49 test was replaced by ESC (European Stationary Cycle) and ETC (European transient cycle) ('Emission Test Cycles: ESC', 1999).

Here the engine is tested on a dynamometer over steady-state modes. The engine is being operated for the recommended time frame. In BSII the CO drop in ESC to 2.1 but increased in ETC to 5.45 from 4.0, HC reduces to 0.66 in ESC and 0.78 in ETC from 1.1, NO_x came down similarly 5.0 in ESC and ETC from 7.0 and PM was down by 0.10 in ESC and 0.16 in ETC from 0.15. However, by mid of 2010 Euro IV was launched as BSIV (Bharat Stage four) due to which a large amount of downward trend can be seen like CO fall to 1.5 in ESC from 2.1 and 4.0 in ETC from 5.45, HC downfall can be seen as ESC to 0.46 from 0.66 and ETC to 0.55 from 0.78, NO_x fall was identical as ESC and ETC were 3.5 from 5.0 and PM shorten to 0.02 in ESC from 0.10 and ETC to 0.03 from 0.16. BSV (Bharat stage five) was never announce in India instead after ten-year Euro VI was offered as BSVI (Bharat stage six) which had two new tests WHSC (world harmonized stationary cycle) and WHTC (world harmonized transient cycle) (Worldwide Harmonized Heavy-Duty Emissions Certification Procedure, 2003) in this test a steady-state engine with dynamometer in a schedule is used. Here two test cycles are set one with hot and another one with a cold start condition, and it was defined by GTR (global technical regulation) along with three new particles PN (particle number), NH_3 (ammonia), and CH_4 (methane). A significant breakdown was seen in HC which came to 0.13 in WHSC from 0.46 in ESC and 0.16 in WHTC from 0.55 in ETC, CH_4 came down to 0.50 from 1.1^d, NO_x reached 0.40 in WHSC from 2.0 in ESC and 0.46 in WHTC from 2.0, PM fall to 0.01 in WHSC from 0.02 in ESC and WHTC to 0.01 from 0.03 in ETC remaining where exact like CO was 1.5 in WHSC and 2.1 in WHTC, NH_3 was 10 in both WHSC and WHTC.

3.4 GVW of heavy vehicles in India

GVW is gross vehicle weight the capacity of volume that is allowed to be carried by a vehicle. In recent times India Ministry of road transport and the highway has revised the gross vehicle weight of transport vehicles more than five percent. Which allowed transporter to lift more load then previous time ("Revised GVW of Indian Trucks in India 2020," 2018). Vehicle axles plays a very important role in lugging the materials. Axle is the central shaft on which wheels are been attached. It helps in proper rotation of tire. The new GVW of Indian vehicle can be seen in the table 2 with the past and increased weight. This changes in GVW

has helped a lot to satisfy the demand of goods which was made by wide masses in much faster and efficient way.

Table 2: Improved Gross Vehicle weight of India

Serial Number	Tire and vehicle common name	Past Weight in tons	Enhance weight in tons
1	6 tire truck	16200	19000
2	10 tire multi-axle truck	25000	28500
3	12 tire single chassis rigid truck	31000	36000
4	12 tire single chassis rigid truck with 3 axles in rear	31000	36000
5	14 tire single chassis rigid truck	37000	43500
6	14 tire single chassis rigid truck with 3 axles in rear	37000	43500
7	14 tire semi-trailer	35200	40000
8	18 tire semi-trailer	40200	49500
9	18 tire semi-trailer with 3 axles in front	40200	49500
10	22 tire semi-trailer	49000	55000

Source: ("Revised GVW of Indian Trucks in India 2020," 2018)

As shown in the figure 3 that each vehicle has to carry their allotted weight as per the new GVW implemented by India Ministry of road transport and highway. If any vehicle exceeds the weight limit, they have to pay a penalty of rupees 2 lakhs (more than 200,000 euro). The axles present in some vehicle are placed in different location in similar number of tire vehicle such in eighteen tire semi-trailer it consists of five axles in total but sometimes three axles are present in front and two axles in rear than two axles located in front and three axles in rear.

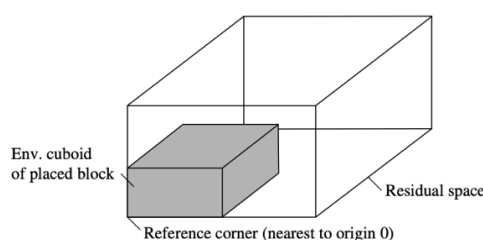
The Legal Metrology Department of India is present in every state. ('Legal Metrology | Department of Consumer Affairs | Ministry of Consumer Affairs Food and Public Distribution | Government of India', 2009) Which is authorized to allot weight. A weighbridge is a tool that is being used for calculating the weight of commercial vehicles. In India, weighbridge is also called Dharam Kanta. There are two times when a heavy vehicle needs to go on the weighbridge. The first time at loading location where the empty truck or trailer goes on the weighbridge for weight and then when it is loaded, it again goes on the weighbridge to check how much quantity has been lugged. The second time is when the vehicle goes to unloading location first; the loaded truck or trailer is on the weighbridge, and after emptying the commodity, it again goes to the weighbridge to audit how much material is taken off the vehicle. Weighbridge plays a significant role in insuring that goods loaded at loading point are the exact goods unloaded at the empty spot.

RC book (Registration Certificate) of the vehicle contains RLW (Registered laden Weight), which is the weight of the loaded vehicle and the weight of the driver and other material required in the truck ("Registered laden weight-RLW / gross vehicle weight-GVW Latest revision," n.d.). ULW (Unladen weight) is the weight of the vehicle without any load. When RLW is subtracted from ULW, we get PLW (Permitted laden weight), which is the permitted weight allowed to be carried on the road. This is also a method of monitoring the heft granted to the commercial vehicle.

3.5 Distinct ways for loading heavy vehicles

Commercial vehicles carry huge quantity of goods or products while transporting from point A to point B so that both time and cost can be minimized and the task is performed in an effective and efficient manner. Moving large loads is the main task for these vehicles but piling this material in proper order is the main job.

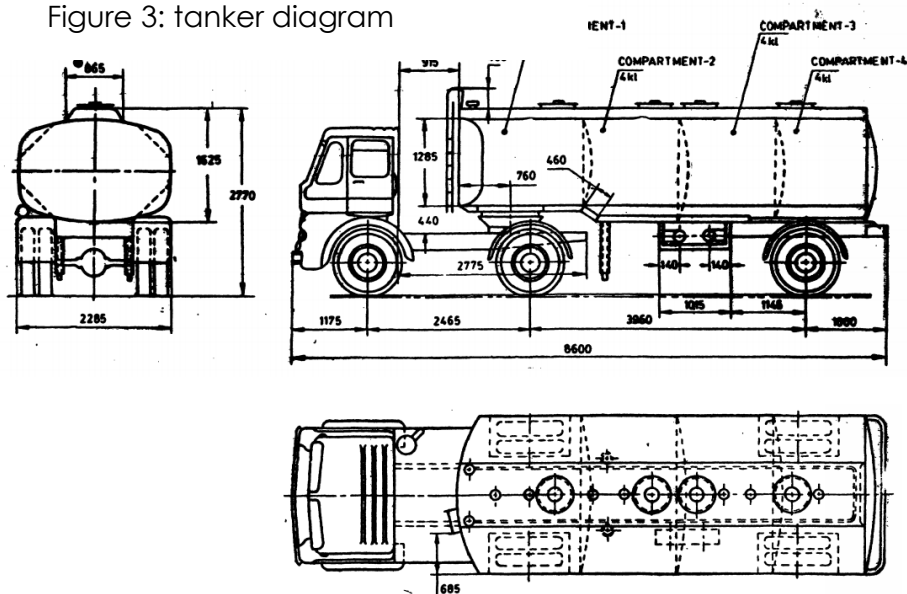
Figure 2: goods loading in container



Source: Fanslau and Bortfeldt, 2010

If these products are not stored in appropriate way it may lead to damage of the products while they are in transit. For stockpile a goods it depend on the weight, size and space of the truck or trailers like storing goods in a container truck have many different approaches like wall building where container is filled in a vertical cubic row as a wall alongside the container, horizontal layer building here container is piled from ground to ceiling in horizontal manner to cover the maximum surface area, stack building products are stacked from the bottom to save maximum space in a container, the block building in the container is contained with identical boxes and usually boxes are only stored in this approach and many such similar strategies for proper loading is used (Fanslau and Bortfeldt, 2010). Now we are going to focus on liquid kinds of materials like petrochemical or milk. which have been transported on the road. There are two type of tankers one is with compartment and one without compartment('IS 13187 (1991) Road tankers for light petroleum .pdf', 2008).

Figure 3: tanker diagram



Source: 'IS 13187(1991) Road tankers for light petroleum .pdf', 2008

As shown in figure 5, the tank structure is required for the transportation of liquid products. Components required for building a tanker are shell, saddle, baffle, cleat, stiffener, flang, bolting, gasket, pipes, and forging. The minimum standard of government keeps the thickness of the tank. Each container needs to be tested after the tank's construction and cleaned on every trip before going for any other loading of material. A certificate is given after the vessel's inspection by the authority, which would be legal for five years, and revalidation of certification needs to be collected from the jurisdiction every two years. Non-

compartment tanker carries the only single product, but a truck with a compartment encompasses different materials; for example, a two-compartment can be filled with acid, and remaining can be stocked up with methenolone. So, it is important for packing any kind of products in a convenient order so that they are not flawed while transporting.

3.6 Issues face by road freight movers in India

India is a multi-culture market which continue to keep its traditional values. This values usually keep India in its developing position. But this kind of values also bring many problems that the freight industries need to face on an daily bases (Farmer, 1966). These troubles are common one that maybe shared by any other developing nation. Some of this issue are as follow: -

- Technological changes

As India is going under a huge change from Bharat Stage 4 (BS4) to Bharat Stage 6 (BS6) it had led to various changes in the technological front which may be a problem for many drivers to understand the vehicle and how they need to maintain their vehicles. For example, BS6 vehicles are considered to be more advance, refine, and loaded with tach. Still, if the driver and the mechanic are not able to understand its functioning, it may lead to a massive issue because, for the driver, if they don't know how to operate the truck or trailer, they might not be able to drive it. It can lead to delay in delivery, and on the mechanic end, if they are not able to fix problems or detect the issues, they may not be able to solve it, which may lead to more significant complications and lag the process. Equipment always helps but is of no use if peoples don't know how to use them in a proper manner so an appropriate instructor is also needed.

- Better Infrastructure

Infrastructure is an important part for the road transportation because vehicles usually travel on roads and if this road are not in better condition and there is a lots of road traffic issues it will result in an long hours of movement of goods and damages can also be done to the products which are been traveling in such environment. Infrastructure gets lag due to a lot of issues(Sahoo, 2011)Like funding, settlement, area procurement, and nature approval. However, some are massive problems like first the instability of public, private partnership (PPPs)

regarding logical structure, data diffusion and risk limit. second comes the investment in infrastructure as projects are so vast and expensive that the government lack resources to finance it is not only constructing it but maintaining it too. The third is the relationship issues in central and state governments, which led to not getting timely confirmation, red rope, and managerial obstacle. The fourth and final one is an environmental problem where a Non-government organization may file an application or land acquiring issues that may slow the project, then the required time it takes to build.

- Improved Material handling

Handling material while loading and unloading is an important task because if it's not performed in a proper order it will lead to a under loading of stock, goods may suffer a huge damage and it will be difficult for the drivers to transport the goods. India is a huge labour market which will be facing such activities. But due to lack of safety a lot of accident happens. Some of the biggest causes of improper handling of commodities are not storing or even unloading the right amount of quantity at a time, not having a decent condition where goods have been hauled or unpack. It becomes more difficult in monsoon season, and sometimes goods are taken at the wrong address where there may not have any handing function, insufficient time available for stocking or clear out the material, many times the posture for carrying a product is not right which may not only led the body pain but also can damage the product. In contrast, transit and finally the amount which has been paid for this job is quite low because India has large masses due to which competition is quite high, so it led to low wages, and people are people tend to cause considerable damages to themselves and goods to earn more.

- Better Equipment

The need for an improved equipment is necessary because it led to saving a lot of time and cost. Due to lack of equipment it consumes a huge amount of time which may delay the task. Changing the way of completing the work with better equipment can help in making faster delivery of goods. Some of the root causes of not having or using a piece of improved equipment for the task can be not being able to hold or manage the part in order manner which may damage the equipment this kind of situation arises due to lack of training or knowledge about

the material, maintenance of equipment also plays a vital role because if they are not repaired or serviced on time, it may lead to failure of function them, rusting of the issue is one of the critical problems which needs to be faced regularly because of the rust sometimes the material losses its hold that it had at its prime time, alignment of machinery is crucial because if they are not in the aligned position, it shakes the balance and performance and lastly reliability of the part is a critical point because is the equipment in not make of particular standard they may not be able to implement the task that they are being claimed of and cause more problem and delay in completion of the task.

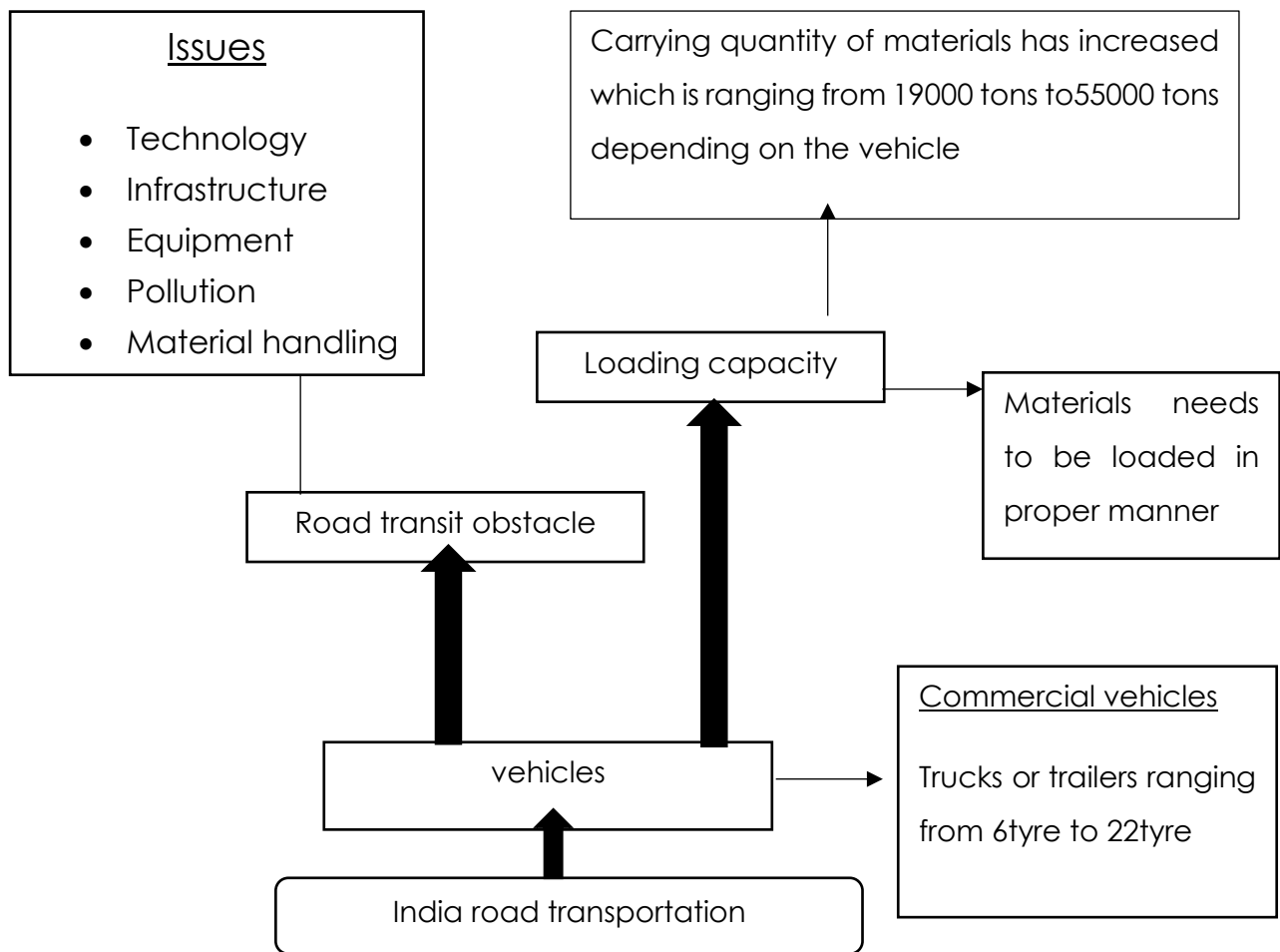
- Pollution

The environment is where we live, and they provide us with each and everything to satisfy our needs. Vehicles not only help in traveling but also take care of making products available to us. However, in this process of transportation, they release harm full gases that damage nature and make it difficult to live in such a habitat. It is believed that commercial vehicles are more polluted than small cars because they have a large engine, consume more fuel, and release a massive amount of harmful gasses than small vehicles. There is a trade-off between delivering goods more and on time or saving the environment because if demand is high, material demanded needs to be transported as fast as possible means more powerful and more massive heavy vehicle, and it led to more pollution. So, a balance needs to be found between environment safety and satisfying demand, and it can only be done by manufacturing vehicles which work on electric and can carry a large load or commercial vehicle that uses the full potential of fossil fuel on which they run or finding a new source of energy to operate these large vehicles.

3.7 Conceptual Framework

According to this research and literature review, there aren't any literature available on road logistics of India for conceptual framework. So, I am going to use my knowledge on this topic and by using three concepts of vehicle, loading capacity and road transit obstacle to form my conceptual framework. I am going to use Frieb and Baumgarther studies as a reference to frame my conceptual framework on Indian road transportation. Figure 4 shown below is my representation of knowledge on this topic from the literature review.

Figure 4 : Conceptual framework



Source: (Referring Frieb and Baumgarther studies on various proposal)

As shown in figure 6 we get to know about the whole network of Indian transport and how it is connected to each other.

- Indian road freight has different segments of heavy vehicles, which can be identified by the number of wheels. Commercial vehicles come in a different form of a chase in which they are being attached to a container, open body container or tank, as per the requirement of the product demanded in the market. After selecting the road freight, the next two significant segments are open loading capacity and road transit obstacle.
- The loading capacity depends on the vehicle segments and its axle. Different kinds of heavy vehicles are being used to carry distinct capacities. For example, a vehicle with six tires which have two axles can

carry nineteen tons, twelve tires vehicle has four axles that can lift thirty-six tons of goods or eighteen tires vehicles that lug forty tons and more, which has five axles. This shows us the loading capability of the various vehicle, but the material should be loaded with care so that it is not damaged in transit. The weight of this commercial vehicle is also available in the RC book (registration certificate).

- Road transportation of India faces tremendous obstacles while delivering goods due to which sometimes products could be damaged in the transport process. This obstacle is a lack of technological knowledge like even if vehicles are being modified to bring improvement and efficiency in the work. However, if the driver or the worker do not have any training in the field of advancement he or she may not be able to use the advantage of technology given, second comes the infrastructure issues where all the poor condition of roads and colossal traffic affects the delay and damage of the material, third is equipment in which lack of awareness about the tools to be used correctly leads to failure in the supply process, fourth is pollution as this kind of vehicle pollute a lot in the environment which led to damage to nature and many more issues and last one is material handling where there are no decent tools, kit and work environment which can cause huge issues. These are the problems of Indian road transportation.

Before loading any materials on heavy vehicle, the lugging capacity of the vehicle needs to be check so that the goods are not over or under loaded. The commercial vehicle should be selected as per the quantity of products. This will help to move any goods in a proper and safer order. While loading materials in trucks or trailers an appropriate measure should be taken so that products is not damaged in transit.

3.8 conclusion

As data is being concluded on how different materials are carried on India's routes in the supply chain, researcher has noticed a gap in the field of literature in information as there is not much supporting content for this research. All knowledge is divided and is available in different researches. If we combine the information on Commercial Vehicle trips for loading and unloading, The

Transformation of commercial vehicles in India, GVW of heavy vehicles in India, Distinct ways for loading heavy vehicles and Issues face by road freight movers in India. It will benefit in better understanding of the logistic functioning in the road freight area. The pieces mentioned above in literature help analyse the research's objective and advise on gathering the right info, which is useful for the research.

4 Methodology and Research design

4.1 overview

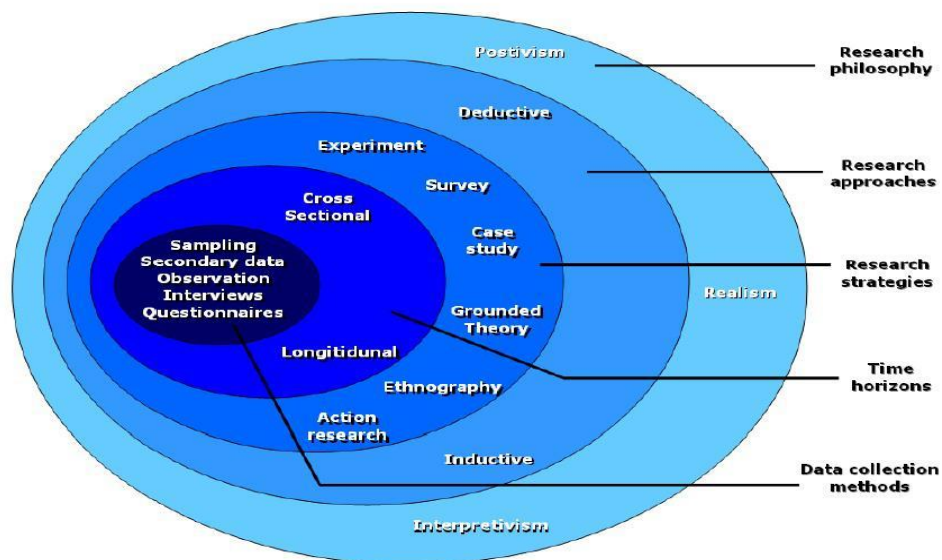
In this area, we will know about the approaches taken to know about the finding of this research. Each step, method and technique that are going to be used is mentioned to understand various products and how they are being delivered to the final customer with the use of road transportation. The questions that will help to achieve the objectives of the research are presented as follow:

- Which kind of materials are transported?
- How products are stocked and unloaded form the commercial vehicle?
- Which type of vehicles are been used?
- Difference between material and heavy vehicle weight?
- How change in emission norms effect?
- Challenges faced on daily based of transit?

4.2 Research Paradigm

In this section we are going to draft a philosophical way for research topic. Research methodology of this research has taken guidance from Saunders research onion (Emmanuel and J, 2019) so that a proper framework can be constructed. Figure shown below is the research onion.

Figure 5: Research onion



Sources: (Emmanuel and J, 2019)

The main aim of research is to identify various vehicles suited for carrying different kinds of materials, so research philosophy is ontology because it is more on reality-based than the scientific or options impact like the epistemology or axiology. My research will be qualitative in nature, so it's an interpretivism philosophy as it will observe the relationship between the vehicle type and materials category (Manuel, 2012).

Next comes the research approach here. There are two types of approaches deductive and inductive approach. Designing a framework is deductive but in inductive it is a flexible way that allows for an adjustment as the proposal is ongoing and understanding of research text (Collins, 2017), in this case, an inductive approach used because there is no literature about which commercial vehicle comes under which category or used for what purpose.

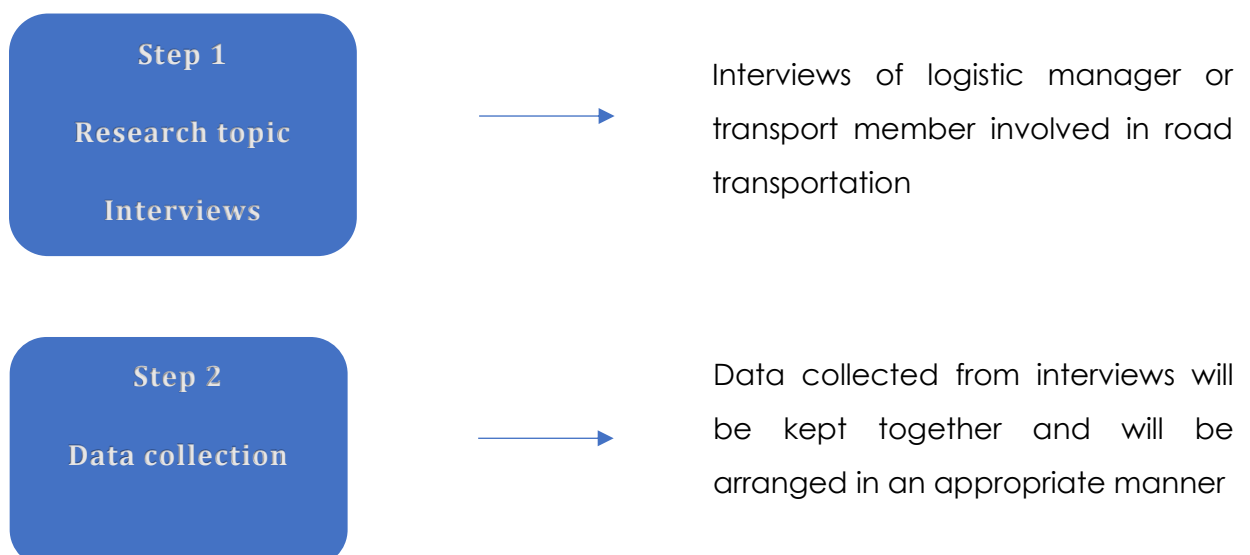
The research is more towards finding how the relationship between commercial vehicles and kind of materials can benefit the supply chain. Taking a qualitative approach than a quantitative approach will help to find the advantages. Lack of availability of data shows a shortage of information around this topic. An exploratory step will be taken to fulfill the gap of knowledge.

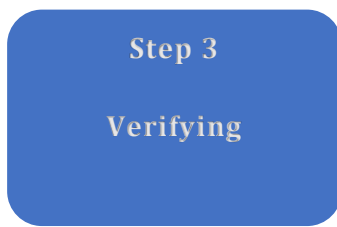
This topic is going to display the importance of road logistics in the supply network and how the weight or quantity of goods also contributes to the smooth functioning of the network. By following the exploratory approach, it will help verify my finding so that all the information collected for the research is helping to follow the right path.

4.3 Research Strategy

This thesis's research strategy is going to be a qualitative approach because of the absence of data on this topic, leading to an inductive approach where data is collected and analysed to verify the information. Interviews are taken at the management level or transport members directly involved in the front line of transportation (Belk, 2007). The info collected will be precise by taking interviews of professionals who are working in road logistics. The interviews help gather the data so that proper research is being conducted where only shortlisted individual experts will be asked questions to know about the relation between vehicles and materials. After the interview, the information will be evaluated to get the final report. The figure below displays the research strategy for this research.

Figure 6: Research strategy





Information gathered from interview will be verified to draft the final report.

Sources: (Created by the author of the research)

4.4 Method for data collection

Data is an integral part of this research, and as mentioned in the research strategy, Interviews have been used to collect data. In the information collection stage, the researcher is going through various steps to ensure that data accumulated is right and appropriate before being noted in the final report. The steps for collecting data are mentioned below and can be seen in figure 7:

Step 1

The first step is to research the road transportation of India. This will help the researcher to generate questions for the interview and do some fieldwork to get on-field knowledge.

Step2

The second step is to interview the managers or workers directly working in transportation to know about their work experience and how they are so far in the market. Some of the fundamental question in this interview will be:

Q1) What kind of product is loaded or unloaded?

Q2) Which kind of heavy vehicles are been used to carry those products?

Q3) How much load quantity is been lifted in one trip?

Q4) What changes did the new emission norms brought in India?

Q5) What daily issues are faced in road transportation?

The interview of ten administrators or industrial experts is taken. The individual involved will be differentiated based on materials they trade-in, and the interviews are conducted in the metropolitan region (Mumbai) of India.

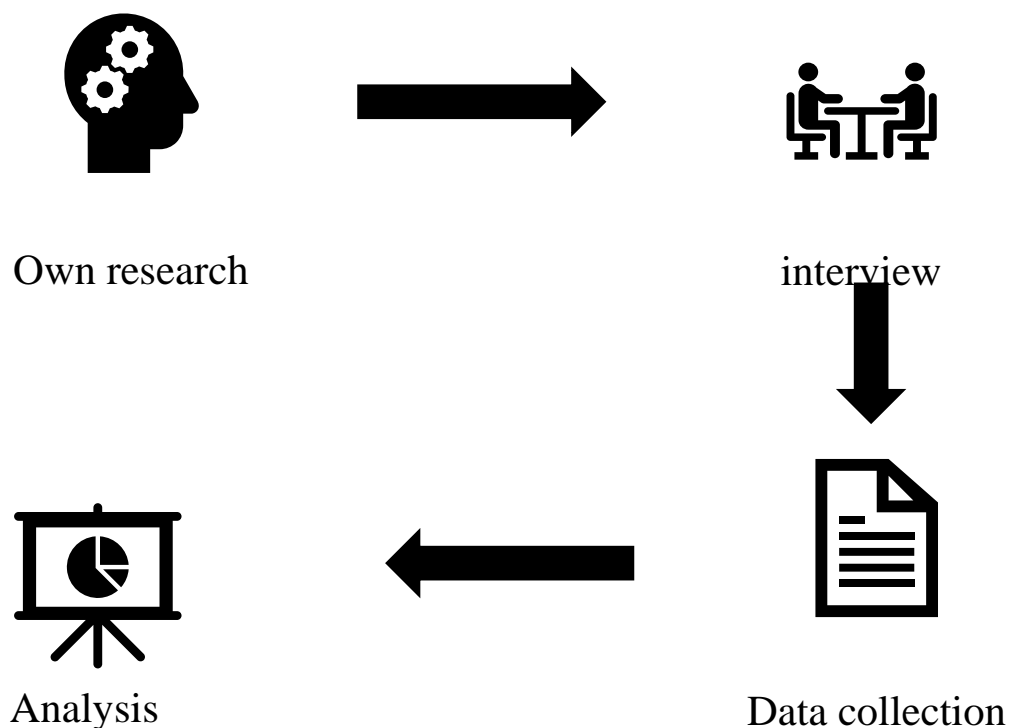
Step 3

Data is going to be collected from these interviews and is being arranged on the bases of material, loading weight, vehicles and so on.

Step 4

Data assembled from the interviews are analysed so that a proper and correct report is built.

Figure 7: Data Collection Method



Sources: (Created by the author of the research)

4.5 Sources of data

There are two types of data sources primary and secondary data. Primary data consist of all the information that is collected directly or link directly to the research(Sapsford and Jupp, 2006).

Primary data for this research is being collected from the interviews that the researcher is going to conduct. Interviews with the manager or interview of experts in road logistics are taken. Individuals who are retired from this sector are also included, social media contacts like Linked In, What's app, and friends' references. The researcher has many friends who work in this field. With their help,

the analyst is getting access to a lot of resources and contacts and has also requested the interviewers if they can refer him to other participants for the interview. One of the critical features for primary data collection would be observation because it will help increase knowledge in this field and verify the information collected.

Secondary data for research is the pre-existing literature, peer views, articles, books, reports on Indian transport, news articles, and data available on the internet. All this data helps in writing the literature reviews, preparing for interviews, shortlisting some questions for the interview, and increasing researcher knowledge on this topic. The information generated by secondary data plays a crucial role in verifying the information so that an appropriate report is made. In this kind of data, the information is existing, unlike primary data, where information needs to be collected.

4.6 Nature of data

The researcher is doing qualitative research, so he intends to collect qualitative information. Many mentioned steps would help the researcher to collect data. The first step is collecting information from online articles or literature reviews and many more, second step is to take interview of transport managers or industrial experts who are directly performing the road transport job, the third step is to collect information from first two steps, and the fourth step is to analyse the data before it has been entered in the final report.

While collecting data from the interviews, the researcher can use his observation skills like anecdotal research (Saracho, 2014) when the interviews are over and jotting notes at the time of interviews is held. The analyst is going to observe the individual participants know the level of their interest in the topic. Some of the common questions that the researcher is going to ask in interviews are:

- Q1) What kind of product is loaded or unloaded?
- Q2) Which kind of heavy vehicles are been used to carry those products?
- Q3) How much load quantity is been lifted in one trip?
- Q4) What changes did the new emission norms brought in India?

Q5) What daily issues are faced in road transportation?

Q6) Essential requirement for loading and unloading?

Q7) key factors require in a vehicle for transit?

Q8) Difference between the commercial vehicle weight and material weight?

Q9) How is weight of loaded and empty vehicle is calculated?

Q10) Difference between new emission norms and old emission norms?

4.7 Access and research ethics

Permission of individuals will be taken before the interview to maintain the privacy of participants. Any data that they do not want to disclose will be kept confidential. The researcher will keep his behaviour professional and follow all the ethics rules and regulations to maintain ethical guidelines.

The researcher's many professional allies working in this field are helping him to access different data sources. In addition to his reference group, he is also going to get help from social media platforms like linked in to build and use contacts to gain information. The researcher will also ask the interviewer to recommend the audience who belongs to this field and is willing to help by providing data related to this research. Participants are also contacted with what's app call, Skype, and zoom. As per their convenience for the interview.

For gaining access to these source following steps were taken:

- A lot of website along with social media platforms related to logistic in India were checked to collect the vital connection.
- Peoples whom researcher know where working in this field were also contacted to find potential participants in this area.
- Emails and social media messages at their respected platforms where send for the interview appeal.
- Interview request consist of reason of the dissertation and what it is along with the interview question that will be asked.

4.8 Techniques for analysing and interpreting data

Interviews of industry experts are being collected for this research. Once the data is gathered, then it needs to be analysed. For this research, a qualitative approach is taken. So, to analyse the research, descriptive coding is being used. This analysis technique will help the researcher to summarize the interview's response, believe, and comments into specific codes (Kemp et al., 2018). This technique will further help the researcher in building themes and summarizing the finding of this thesis.

Only ten interviews of the Metropolitan city Mumbai in India will be taken. The reason behind such a quantity of interviewer is; first, the pandemic has restricted many resources to be attended. Secondly, as the thesis takes a qualitative approach, it would be beneficial to get qualitative data rather than just an increasing number of interview participants.

The outcome of this data will be made by finding the relationship among the categories and how the information relates to the literature review and different philosophies.

4.8.1 coding

Descriptive coding is used for this research because the researcher is much more comfortable to sum up the gathered data from the interview in smaller labels with this method. The information can also be broken down into different sections so that it is understood in a much simpler way. The interview questions were divided into five distinct areas so that it would be simpler to capture data related to that particular section. The five labelling sections are mentioned below with their respected labelling colour and research question:

- What are the various ways in which distinct products are been loaded and unloaded? **Material**
- Which vehicles are been used to carry various products in Indian market? **Commercial vehicle**
- Which documents are required to transit material by road? **Commercial vehicle**
- How much weight is allotted to various segment of commercial vehicles to transmit? **Commercial vehicle**

- Which safety rules need to be followed while transporting different commodities? **weight**
- What changes does new emission norms bring into commercial vehicles market of India? **New emission norms**
- Issues faced by Indian transporter while transporting material from one place to another? **challenges**

The data collected from the interviews is then split into codes so that all the individual codes are categorized into similar groups on the bases of relation found in them, and after grouping the codes, they form a theme that represents them. The themes and the relation these themes share among each other are summarized in the finding chapter of this study.

4.9 conclusion

The method mentioned above to cluster the information have the most compelling ways to excerpt data, which is fundamental for this dissertation. The steps are taken in strategy for qualitative research and along with the approach in data sourcing and kind of data that is essential for this qualitative research.

5 Finding

5.1 overview

This section consists of data collected by conducting interviews with experts in the transportation sector. The interviewees were operating in different products or use different commercial vehicles as compared to other participants. Information is displayed in tables for individual sections and presented as per their themes. All five segments material, commercial vehicle, weight, new emission norms and challenges are broken down as per the interview question in three parts. Participants details are provided in the table 3 below:

Table 3: participant cart

Participants	Occupation	Date of Interview
Participant 1(P1)	Entrepreneur	20/06/2020
Participant 2(P2)	Entrepreneur	29/06/2020
Participant 3(P3)	Entrepreneur	29/06/2020
Participant 4(P4)	Entrepreneur	06/07/2020
Participant 5(P5)	Entrepreneur	06/07/2020
Participant 6(P6)	Entrepreneur	06/07/2020
Participant 7(P7)	Entrepreneur	06/07/2020
Participant 8 (P8)	Entrepreneur	06/07/2020
Participant 9 (P9)	Project Head	06/07/2020
Participant 10 (P10)	Entrepreneur	06/07/2020

Sources: (Created by author of the research)

5.2 Material [colour code: Orange]

The first segment is about various products or materials because a better understanding of which products can be transported and how they have been lugged and removed. In this section, the researcher has mentioned different materials themes shown in table 4, 5 and 6.

Research question:

What are the various ways in which distinct products are been loaded and unloaded?

Interview question 1:

Which kind of material is transported?

Table 4: material transported

Big machinery and heavy vehicles	Liquid products	Parcel service	Finish goods	Raw material	Generic product
Big machinery and heavy vehicles (P1)	Liquid product (P2) (P3)	Parcel service (P4) (P5) (P9)	Finish goods (P6)	Raw material (P7)	Generic product (P8) (P10)

Sources: (Created by author of the research)

The outcome of the first question shows various fields in which participants operate their business and which kinds of multiple products are transit on roads and for what purpose.

- Big machinery and heavy vehicles

Transporter dealing in huge machines or heavy vehicle which has been imported in the Indian market. This kind of product are demanded by big companies and require commercial vehicles depending on the type of machine being transported. [P1]

- Liquid products

This category includes chemicals, milk, and petroleum. such materials are transported in tankers. Some products like chemicals need to take extra care due to their hazardous nature. [P2] [P3]

- Parcel service

Transporter providing parcel services usually deliver door to door services. It not only involves delivering goods from companies to the customer but also to companies to companies (B2B). [P4] [P5] [P9]

- Finish goods

Products under this category are considered to be the final product like spare parts of vehicles, brown goods, white goods, and much more. This kind of material transit from manufacturer to retailer or companies to warehouses or warehouses to distributors. [P6]

- Raw material

Here products are in the raw stage and are going manufacturer for further processing in the finished product. Raw material example chemicals or textiles. [P7]

- Generic products

This category consists of goods like wheat, cloth and stationery. These products are transported to retail stores or big warehouses from companies. [P8] [P10]

Interview question 2:

How it's been loaded and unloaded in the vehicles?

Table 5: Requirement for loading and unloading

Big machinery and heavy vehicles and raw material	Liquid products	Liquid products and parcel service	Finish goods	Generic product
Document, workforce and machinery [P1] [P7]	human resources, documents, safety kits, pipes, and dip [P2]	workforce, documents, and equipment [P3] [P4] [P5] [P9]	human resources, documents, safety kits, and various equipment [P6]	equipment, workforce, documents, and machinery [P8] [P10]

Sources: (Created by author of the research)

The second question's outcome shows similar stuff needed for loading and unloading materials that answer the research question.

- Big machinery and heavy vehicles and raw material

The requirement for loading and unloading such products is similar to each other documents, workforce, machines like Crain and pallet. [P1, P7]

- Liquid products

Loading and unloading of such materials are human resources, documents, safety kits, pipes, and dip (it is a scale used to measure the liquid product in the tanker). [P2]

- Parcel service and liquid products

Loading and unloading of parcel require workforce, documents, and equipment like a forklift or trolley. Here products are of different shapes and sizes, so they are covered in boxes or plastic to provide a safety layer. Such a requirement is also needed in liquid products.

- Raw material

loading and unloading of the product require human resources, documents, safety kits, and various equipment like Crain or forklift. [P6]

- Generic products

Specification needed for loading and unloading materials in the commercial vehicle are equipment, workforce, documents, and machinery like a forklift. [P8] [P10]

Interview question 3:

Key elements needed in loading and unloading of commodities?

Table 6: key elements for loading and unloading

Big machinery and heavy vehicles and raw material	Liquid products	Liquid products and parcel service	Finish goods	Generic product
Document, workforce and machinery [P1] [P7]	human resources, documents, safety kits, pipes, and dip [P2]	workforce, documents, and equipment [P3] [P4] [P5] [P9]	human resources, documents, safety kits, and various equipment [P6]	equipment, workforce, documents, and machinery [P8] [P10]

Sources: (Created by author of the research)

The third question's outcome is similar to that of the second question because it relates to the research question as a reassessment of the answer to the previous question.

5.3 commercial vehicle [colour code: Blue]

The second segment is of commercial vehicle. It is essential to understand the vehicle because different vehicle types are needed for different materials. Heavy vehicles like trucks, trailers, and semi-trailer are available in distinct sizes, shapes, and capacities. This segment topics are shown in table 7, 8 and 9.

Research question

Which vehicles are been used to carry various products in Indian market?

Which documents are required to transit material by road?

How much weight is allotted to various segment of commercial vehicles to transmit?

Interview question 1:

Which type of vehicle is been used?

Table 7: vehicle types

Big machinery and heavy vehicles	Liquid product	Parcel service and finish goods	Raw material	Generic product
container body, open body, and trailers[p1]	Tankers [P2] [P3]	container body [P4] [P5] [P6] [P9]	open body and container body [P7]	Trailers [P8] [P10]

Sources: (Created by author of the research)

The result of the first interview question shows that similar vehicles can be used for carrying different materials, but specific vehicles are also needed for particular materials to respond to the research question. Themes of this section are divided as per the material transit by vehicles.

- Big machinery and heavy vehicles

This type of material includes all forms of heavy vehicles starting from pick-up trucks carrying small machines such as small generators weighing about seven hundred kilograms, and moving up to open platform trailers with a loading

capacity of fifty-five tons for goods such as building pillars. Three kinds of vehicles are often used container body, open body, and trailers. [P1]

- Liquid products

This kind of product is in the liquid stage, so they are carried in tankers. The tanks are made of steel with compartments build in it or without compartments depending on the material. [P2, P3]

- Parcel service and finish goods

Parcel service transportation is divided among small parcel transporter and big parcel transporter. In finish goods vehicles are considered to be 40 feet long. Here material is loaded in containers, and these boxes are kept on a container with the help of machinery like forklift. [P4, P5, P6 and P9]

- Raw material

This good is transported in an open body or container commercial vehicles. Usually, twenty-one tons of carrying vehicles are considered in this field. [P7]

- Generic products

General cargos are transported in twenty feet trailers, and this product is commonly in domestic transit or been imported. [P8, P10]

Interview question 2:

key factors required in a vehicle for transit?

Table 8: transit factors

Work force	documents	fuel	Daily cash	safety	maintain
Workforce/ human resource [P1- P10]	Documents [P1-P10]	Fuel [P1- P10]	Daily cash expenses [P1-P10]	Safety safety equipment [P2, P3, P6, P8 and P10]	Maintained [P2, P3]

Sources: (Created by author of the research)

The result of the second question displays various factor in transit and reply to the research question. The themes for this section are factors.

- Work force

This factor is considered by all the participants because, without drivers and laborers, goods cannot move and delivered to final consumers. This is an essential factor for the transit of material. [P1- P10]

- Documents

This is another factor significant in the movement of products. Critical papers needed are invoice, e-waybill, lorry receipt, goods consignment notes, vehicle document, driver license, custom clearance (for imported or exported goods), and training card for transportation of products. [P1- P10]

- Fuel

Commercial vehicles need fuel for transportation of goods. This is an important necessity for heavy vehicles on a daily basis.

[P1- P10]

- Daily cash

Another factor which is very vital to maintain the supply chain. it includes tolls, loading charges, parking and much more. [P1-P10]

- Safety

Human resources safety is essential because any miss happening can happen while transporting, loading, and unloading of materials. Safety kit includes first-aid, helmet, gumboots, gloves, ropes, and so on. [P2, P3, P6, P8 and P10]

- Maintain

Maintaining the vehicles is also essential, especially the commercial vehicles because of this vehicle's transit daily, so they require more attention than other kinds of vehicle classes, and any damage is costly for the transporter. Timely service can save enormous costs and time. [P2, P3]

Interview question 3:

How much weight is been allowed to be carried?

Table 9: weight carried by heavy vehicles

Big machinery and heavy vehicles	Liquid product and finish goods	Parcel service	Raw material	Generic product
1 to 55 tons [P1]	Gross vehicle weight/ GVW set by government [P2, P3 and P6]	Nine to forty tons [P4, P5 and P9]	Twenty tons, twenty-five tons and sixteen tons [P7]	Nine-tons, sixteen tons, and twenty-one tons [P8, P10]

Sources: (Created by author of the research)

The third question's result shows various weight categories, along with how much weight is granted to be carried. This outcome points to the research question. The theme is again divided as per the materials so that result can be better understood.

- Big machinery and heavy vehicles

This category includes all the weight starting from one ton to fifty-five tons. Because all goods are fulfilled on the requirement of companies which order them. [P1]

- Liquid products and finish goods

The loading capacity depends on the class of vehicle; for example, the tata 4923 model trailer can load forty-nine tons, but in reality, thirty-seven tons is material weight, and twelve tons is vehicle weight, so in total it is forty-nine tons. Class of vehicle are break down as per the GVW set by government. [P2, P3 and P6]

- Parcel service

Small parcel requires miniature vehicles that can carry up to nine tons of weight, but the big once in which parcel imported goods need forty tons of commercial vehicles. [P4, P5 and P9]

- Raw material

twenty-one tons of weight is being lugged after it the twenty-five tons commercial vehicles are being used and finally the sixteen tons vehicles are generally considered. [P7]

- Generic products

three weight categories are commonly used: nine-tons, sixteen tons, and twenty-one tons of heavy vehicles.[P8,P10]

5.4 weight [colour code: Yellow]

The third segment is of weight where we can find the relation between the material weight and vehicle weight because, after understanding which material is carried on-road and which type of commercial vehicles needed, it is essential to know about weight so that materials are appropriately carried. The themes are displayed in figure 8 , 9 and table10.

Research question

Which safety rules need to be followed while transporting different commodities?

Interview question 1:

Difference between material weight and vehicle weight?

Figure 8: PLW

$$RLW - ULW = PLW$$

- RLW= Registered laden weight
- ULW= Unladen weight
- PLW= Permitted laden weight

PLW formula

Sources: (Created by author of the research)

The result of the first interview question had a unanimous answer from all the participants of the interview, shown in figure 17.

"Registered laden weight is weight of vehicle with material minus Unladen weight is only vehicle weight give us permitted laden weight." [P1-P10]

PLW (Permitted laden Weight) is the total weight of the commercial vehicle, including the material weight on it. The RLW (Register laden weight) is the vehicle's weight, which includes only vehicle body, chases, tier, fuel tank, engine, gear, and much more, including the material which is going to be loaded. Which is subtracted from the ULW (Unladen weight) were material is not loaded rest of vehicle weight is considered to get the exact material weight.

For example:

In an open body trailer, the consignment weight is nine-ton weight, and vehicle weight is nineteen ton, which totals up to a twenty-eight ton.

The tanker which carries the liquid materials has a gross weight of forty-two tons in which twenty-eight tons is the weight of the material, and the remaining fourteen tons is the weight of the vehicle.

In the case of a container truck that twenty feet long, the carrying capacity is forty tons in which the weight of the vehicle is eighteen tons with the container, and the remaining twenty-two tons is the weight of the parcel or any other material.

Interview question 2:

which safety steps are taken to maintain commodities in the vehicle?

Figure 18: Safety taken in transit

Container body commercial vehicles and Open body commercial vehicles	Container body commercial vehicles	Safety equipment	Common safety steps taken in all commercial vehicles
Plastic cover/ tarpaulin/plastic sheets [P1, P5, P6, P8 and P10]	Flooring with wooden sheets/cardboard sheets [P1, P7]	Panic button/ hazardous sign/ safety kit/ safety step/insured/double lock/locks/insurance /seal lock/lock material and security [P1-P9]	Maintain vehicles/ maintained/ timely serviced/serviced vehicles [P1-P7] [P9, P10]
Tanker body commercial vehicles	Workforce		Open body commercial vehicles
SS tank [P2, P3]	Train workforce/ driving license/ proper driver/ training card [P2, P4, P8 and P10]		Ropes/ strap belt/ belt [P5, P8]

Sources: (Created by author of the research)

The outcome of the second question reveal various action taken to safely transit goods in vehicle which answers the research question. The theme is cleaved in vehicle types, common steps and security equipment as manifest in above figure.

- Container body commercial vehicles [P1, P7]

There are two types of container one with a hardtop and the second one without the top. It's essential to cover the top with plastic in a vehicle that does not have a hardtop. The flooring with wooden sheets or cardboard sheets, a bucket at the side of vehicles with sand and wrap material like wood or steel slabs.

- Open body commercial vehicles [P5, P6, P8 and P10]

The materials should be adequately staked and strapped. The product is fully exposed, so a three pair of tarpaulin (plastic cover) is needed to cover it from all sides and use ropes or straps to hold the goods and use the stopper to prevent the product from falling off the heavy vehicles.

- Safety equipment [P1, P9]

The person should have a helmet, gumboots, gloves, glasses, fire extinguisher, first aid kit, ropes while loading or unloading some material and necessary equipment.

- Common safety steps taken in all commercial vehicles [P1-P7] [P9, P10]

All vehicles need to be maintained and required to be timely serviced. Locks should be appropriately sealed once the goods are loaded. Vehicle's tires should also be taken care of any cuts or a flat tire and lastly all vehicles should have a GPS system, insured and panic button installed.

- Tanker body commercial vehicles [P2, P3]

It is essential to make a SS (stainless steel) tank because it has the particles which can hold many dangerous liquids like acid or methanol. Compartments are built-in tanks to manage the material, and hazardous signs are also put on tanks.

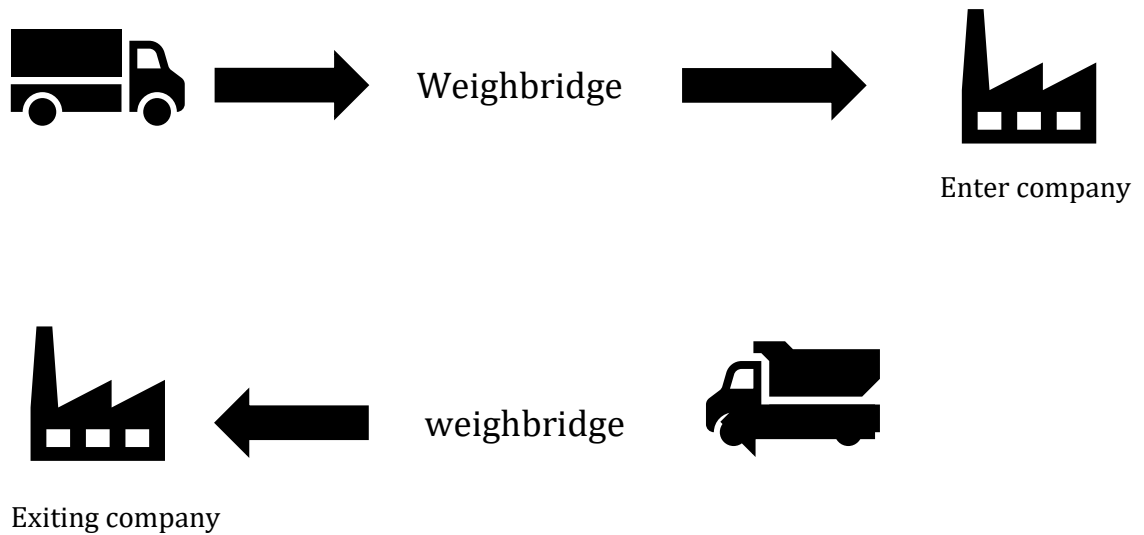
- Workforce [P2, P4, P8 and P10]

It consists of a driver who should have a legal driving license and training card for the transit of that particular material.

Interview question 3:

How to calculate weight of loaded and unloaded vehicle?

Figure 9: weighbridge process



Sources: (Created by author of the research)

The solution of third question was unanimously given by all interviewers. The theme of this segment is the process of weighbridge shown in figure 19. This is a common way of calculating weight.

The weighbridge is using to calculate stocked and empty commercial vehicles. "There are two types of weighbridge: public and private weighbridge" [P1]. In private weighbridge, they are installed in companies where two times weight is calculated. First, when the loaded or unloaded vehicle arrived in company and second time when loaded and unloaded vehicles are leaving the company. The public weighbridge is also used similarly as private weighbridge, but any private company does not own it. Small companies or traders usually use public weighbridge.

5.5 New emission norms [colour code: Green]

The environment is an integral part of the plant and is essential for survival and bring innovation. Governments implement new emission norms to reduce

pollution and promote using more eco-friendly products to save the environment. The fourth segment is of new norms launched in India as BS-VI (Bharat stage six). Thematic can be seen in table 10, 11 and 12.

Research question

What changes does new emission norms bring into commercial vehicles market of India?

Interview question 1:

Difference between old norms and new norms?

Table 10: old norms vs new norms

BS-VI technical engine BS-IV mechanical engine	Lot of difference like reduce emission, more sensors for safety and new engine	Not applicable or no comments	engine variation and small changes
"BS-VI technical engine BS-IV mechanical engine" [P1]	"Lot of difference like reduce emission, more sensors for safety and new engine"/ "CO2 less"/ "Advance technology " [P2] [P7] [P3]	"Not launched"/ "Not in market" /" Not available' /" Not in use yet"/" Not applicable or no comments" [P4, P6, P8, P9, P10]	"engine variation and small changes" [P5]

Sources: (Created by author of the research)

The result of this question is shown in comments given by the participants. All similar quotes are drawn into one theme. This would make the explanation part much simpler. This question answers the research question.

"BS-VI technical engine BS-IV mechanical engine" [P1]

Many changes are expected in the engine of a commercial vehicle as they would be more refined and silent and provide more mileage and less pollution than old norms vehicles.

“Lot of difference like reduce emission, more sensors for safety and new engine” [P2, P3 and P7]

The primary revision is to cut down the pollution and take one step closer to the environmentally friendly product, improving safety by providing sensors to prevent any accident and a more robust and refined engine.

“Not applicable or no comments” [P4, P6, P8, P9 and P10]

New BS-IV commercial vehicles are not available in the market, so it was difficult for the experts to comment on it. Here the industrial professionals want to see the commercial vehicles in practical use so that a better understanding of new heavy vehicles can be known.

“engine variation and small changes” [P5]

Some experts' minor changes can be noticed in new commercial vehicles compared to old vehicles. More refine and silent engine. Add on of some new sensors like clutch oil indicator, brake oil indicator. More safety norms are being implemented and a reduction in pollution particles.

Interview question 2:

how new norms helps in transportation?

Table 11: New norms advantages

Less pollution	Better milage	Computer data analysis
Less CO2/ Eco friendly/less CO2 / Less pollution/ Eco friendly engine [P2- P6] [P8- P10]	better milage [P3]	Computer data analysis/technology data analysis/ Fine technology/ More technology/ road safety/ driver safety/ electrification [P1, P2, P4, P5, P6 and P8}

Sources: (Created by author of the research)

The outcome of second question present various advantages of new emission norms. The themes are taken as per the advantages.

- Less pollution

The new norms will bring in better systems to reduce pollution so that everyone can live in a better environment. If commercial vehicles produce less pollution, they may enter areas where they are usually restricted from entering for business or continue their activities like in Mumbai vehicles, which are eight-year-old, are not allowed to perform activities even if they are well maintained. They are considered to pollute more as compared to other passenger vehicles, which are eight-year-old. With the depletion of pollution generated, many transporters experts are waiting to see the change in rules.

- Computer data analysis

A lot of new technology and sensors are expected to come with the new commercial vehicles. This advancement can help in evaluating the overall performance of heavy vehicles. The information generated will help better understand the vehicle functioning and manage the products while transporting in a better way. A proper data can be achieved to compare the progress report over the past performance. The knowledge will guide how to run the vehicle in a particular situation.

- Better mileage

Commercial vehicles are expected to run more miles than past performance because ab blue is added in vehicles with fuel, and the quality of fuel is purer than the quality in the past. It is believed that the new engines will utilize the fuels in its full capacity so that more kilo meter are covered with less carbon realized in the environment.

Interview question 3:

Difficulty faced in new norms if any?

Table 12: Disadvantage of norms

BS-VI technical engine BS-IV mechanical engine	Lot of difference like reduce emission, more sensors for safety and new engine	Not applicable or no comments	engine variation and small changes
"BS-VI technical engine BS-IV mechanical engine" [P1]	"Lot of difference like reduce emission, more sensors for safety and new engine"/ "CO2 less"/ "Advance technology" [P2] [P7] [P3]	"Not launched"/ "Not in market" /" Not available" /" Not in use yet"/" Not applicable or no comments" [P4, P6, P8, P9, P10]	"engine variation and small changes" [P5]

Sources: (Created by author of the research)

The result of the third question present various issues that can be faced in new norms. Themes are noted on the basis of issues.

- Increased cost of asset and maintenance [P1, P4, P5, P6, P7, P8, P9 and P10]

New norms bring new technology, better body structure, and refine engines, but all of this comes at a cost and increases in the purchasing price. Commercial vehicles are expected to have a price hike of ten to fifteen percent. This increase in price will affect small traders because they might not be able to afford heavy vehicles that they used to do. The improvement in vehicles will also raise the maintenance cost due to additional lubricants or any new part that needs to be changed timely. The repairs are also considered to be costly due to the increasing price of spare parts.

- Training of drivers, No easy repairs and road side assistance [P2, P10]

The advancement in commercial vehicles will require well-trained drivers. The workforce needs to skilled with all the advanced knowledge that is required in

operating vehicles. The add up of sensors and the more technical engine will make it hard to repair, and roadside assistance is also tricky because it is anticipated that these engines require individual machines and equipment which would be available in companies so it may increase time and cost.

- Eight-year restriction in city [P3, P5]

Commercial vehicles are not permitted to enter the city if they are eight-year-old. It is believed that these vehicles are very polluted and not good for the environment. The experts are not happy with this rule because even if they purchase new vehicles, they cannot operate in the city after eight years. This may force transporter to purchase new vehicles even if old vehicles are well maintained and are capable of transporting goods.

- Increasing freight rate and cost of operation [P7]

The freight rate and operating cost will increase because new norms have raised the price of commercial vehicles. As vehicles are becoming more expensive, it indirectly demands transport owners to ask for more freight rate and inflexibility in fuel cost along with other daily outlay, the cost of operating is also increasing, which results in the rising price of products.

5.6 challenges [colour code: Silver]

Every field faces some threat on a daily or long-term bases. Road freight movers also encounter some challenges that may not arise in other fields but can significantly impact every territory. This segment is all about the challenges that occur in transportation. The themes are shown in table 13, 14 and 15.

Research question

Issues faced by Indian transporter while transporting material form one place to another ?

Interview question 1:

which risk is encountered on a daily basis in transit ?

Table 13: Daily challenges

Minor challenges	Major Challenges
Theft/high competition/ maintenance/ GPS issues/ Accidents/ GPS off/ tracking issues/ driver fogging/ Competitive rates/ less margin [P1-P3] [P5-P8] [P10]	Less workforce/low business volume/ infrastructure/ police harassment/ RTO/ E-way bill/ Less infrastructure/ document mistake/ Police/ less work/ Driver shortage [P1, P2, P4-P10]

Sources: (Created by author of the research)

The solution of the first research question is presented in themes of minor challenges and significant challenges shown in above mention figure. Result directly point to the research question.

Minor challenges [P1, P2, P3, P5, P6, P7, P8 and P10]

- Theft

This is a common issue that is faced by every transporter. It is vital for the transporter to fulfil his order on time but with the right quantity because even if they reached the final destination on but are short on the end of the good, which was loaded at the original location, it will lead to a big issue on carrier front.

- High competition

The rivalry is a familiar word in the business world. In any trade environment struggle is found, but when there are many transporters to complete a single job, it creates issues for everyone because profit margins are dropped, and big ones overshadow multiple small businesses or small business cut the rate to such a extend that no businesses can perform the task.

- Maintenance

As commercial vehicles are becoming more advance, they need more lubricants, timely service, changeable parts and many more stuff. All this thing cost which has made maintaining the heavy vehicle very costly. Sometimes due any condition like unloading in a faraway location with no service centre access

major damages are done to vehicles which may add up to the cost of maintenance.

- GPS issues

GPS is a device that helps monitor the vehicle's location, a route that was taken, add up as a security feature, and analyse data for performing a task. However, significant issues arise because of network issues, and wrong data is given; a device may have a defect, devices get stolen, and manipulating the user with wrong information. This problem affects the functioning of the supply chain.

- Accidents

This challenge can cause large-scale issues, but it is still a minor challenge because mishap happens when commercial vehicles move on the road. However, these uncertain events can still play an essential role in the delay of delivery and loss of material—the second reason for considering accidents as minor challenges is because insurance is involved.

Major Challenges [P1, P2, P4, P5, P6, P7, P8, P9 and P10]

- Less workforce

There is a considerable decline seen in human resources. Maximum interviewers mentioned this issue because as profit margin has reduced due to stiff competition, the workers are paid less; thus, fewer people are enrolling for the job. This drop can fail the entire supply chain. For example, demand for goods increases, but if drivers are not available, materials may not be delivered, and demand will be unsatisfied.

- Low business volume

Businesses are considered to be functioning low because of high competition, less profit margin, and workforce unavailability. These three things have forced businesses to not work at full potential and cause many problems for other sectors to function correctly. Many uncertain events like pandemic have also contributed to making the situation worst.

- Infrastructure

This is a challenge which needs close attention because the lack of proper infrastructure like uncertain road condition, no proper restrooms for labours, not having appropriate structure for loading and unloading. The reason behind such

disastrous infrastructure is bribery, administrative anger, and corrupt government functioning.

- Police harassment

Law was made for protecting, not for harassing. Many experts see this as a significant challenge because it slows down the speed of delivering the goods and adds other expenses. These abuses of power are making trying to find the workforce and operating the transport.

- RTO

RTO stands for the regional transport office. Here commercial comes for a clearance certificate to perform an activity on the road. But it is also a cause of significant time delay process like vehicles get token to enter the premises for checking so if vehicle certificate ends and draw a token after a month of checking the vehicle comes in hold position and is not authorized to perform activities even if the vehicles are fit for operating. Even if vehicles pass the test, they are still in hold till the time paper arrives, and this arriving document can take months to arrive.

- Documents mistake

Paperwork plays a critical role in the transit of materials. If documents are wrong like a mistake in E-waybill, which is one of the essential documents needed in unloading the goods has minor blunder, it may cause time, money, and stoppage of all activities.

Interview question 2:

Any changes or step that is recommended to oppose these challenges?

Table 14: opposing steps

No government body	Fuel stability	Driver training	No night driving
No government body/ Private structure/ Rules/ organized / standard policies/ Policies [P1, P5, P6, P9 and P10]	fuel stability/ Fuel fluctuation fixed [P1, P4]	Driver training/ Proper manpower [P2, P8]	No night driving/ No driving from 11;30 pm to 5 am/ Fixed time [P3, P7 and P9]

Sources: (Created by author of the research)

The second question results indicate the actions or improvements that should be taken to resolve the challenges. The themes are distributed based on changes recommended by participants in figure 24.

- No government body [P1, P5, P6, P9 and P10]

There is no particular body that primarily focuses on transportation. Indian road freight is under the Ministry of Road Transport, but the Ministry also manages a variety of sectors, which neglect this sector, which links it. If an individual body is made, it will be able to focus well on fuel fluctuation prices, unstable roads, and many more problems that are not being raised by transporter due to lack of voice.

- Fuel stability [P1, P4]

The fuel price in India is quite unsteady, and it usually goes upward due to which operating cost is becoming higher and higher. Such a situation arises due to taxes imposed in every state, district, and city. Reduce prices, a single tax is enough, or some subsidies should be provided to a transporter to consume fuel regularly or use some substitute of fuel like electricity so that transit can happen in a much efficient and cleaner way.

- Driver training [P2, P8]

As technology keep's changing it's important for the driver to learn it's been used because if they are not aware of the automation, they may not be able to take advantage of it. A proper driving school for commercial vehicle drivers are needed where they can learn about such changes. This step would be a major progress.

- No night driving [P3, P7 and P9]

Maximum experts seriously consider this step because many accidents happen at night time. This can improve safety and can even help in proper time functioning in the field of transportation. The time frame suggested for not driving heavy vehicles at night by experts are between 11;30pm to 5am.

Interview question 3:

which step you will take to improve road freight in India?

Table 15: steps to enhance road freight

Unity	Excel infrastructure	User friendly law	harassment and corruption	no caping of price	Collaboration
Unity [P1, P5, P6, P8, P9]	Excel infrastructure/ Better diesel rates/ driver shortage [P2, P3, P4]	User friendly law/ Better laws/ Organized sector/ government policies [P2, P7, P8, P9]	harassment and corruption [P7]	no caping of price/ Inflexibility/ fixed up rate government [P4, P5, P6]	Collaboration/ same platform [P9, P10]

Sources: (Created by author of the research)

The outcome of the third question demonstrates the different measures that can be taken to boost road transport in India. The themes indicate various phases in the figure above.

- Unity [P1, P5, P6, P8 and P9]

Tight competition among the transporter has led to various issues like cutting down the profit margin, delay in delivery, and many more. If unity is created, everyone will be able to help each other grow, and goods will be distributed in a much faster way.

- Excel Infrastructure [P2, P3 and P4]

One of the most significant changes needed is improving the infrastructure because preparing a framework is much easier than maintaining and managing it for long life. India every year faces a problem of bad roads, bridges, facilities which may fall or be cracked and need to be repaired every year instead of just rebuilding it the structure should be built in such a way that it does not get busted and only require repair work and focus can be done at creating a new building, roads, and some new technology.

- User friendly law [P2, P7, P8 and P10]

Overwhelming power on any side is not suitable. It is essential to have a balanced distribution among both parties. Law, which is made for protection, should not be used the other way around if laws help transporters and are easily understandable. It will promote more transit.

- Harassment and corruption [P7]

This comes under one of the most demanded change. The harassment done by power centric persons should be stopped, and there is no need for corruption for a task that needs to be performed by an official because it is their duty and is being paid for it. So, such activities should be banned, and strict rules with hefty fines should be imposed on such activities.

- No capping of price [P4, P5 and P6]

The discrimination of price among the transporter due to companies' tender is entirely wrong. The prices should be fixed as per the quantity and kilometres/miles covered, just like taxi fare. This way, it will reduce unwanted competition, provide the right price, and increase the speed of transporting goods as prices are fixed for all so anyone will be available to perform the task.

- Collaboration [P9, P10]

This clearly states that different companies in different locations can form a team and help each other by providing more business to each participant and covering more ground. For example, if transporter A commercial vehicles transit from Kerala to maha and transporter B heavy vehicles transit from maha to Kerala. The company's vehicles are returning empty, so they can collaborate so that they can get a loaded trip back to the original destination while returning. This will increase business for both.

6 conclusions

6.1 Research Conclusions

- Finding different ways in which distinct materials are being loaded and unloaded. The research discovered that most components are similar in all the fields of materials like documents, workforce, and equipment. The only distinction was the material and the process of loading or unloading it. For example, liquid products were filled and emptied with pipes' help, but parcel requires a forklift or trolley for a similar task.
- Commercial vehicles are available in different weight categories, starting from one ton to fifty-five tons. These vehicles are built in various shapes and sizes according to loading weight, and materials like tankers are used for a liquid product, containers for raw material, or generic products. The main document requires for transit is E-waybill because, as per government norms, no vehicles are allowed to transport material without this document, and if found transporting without it, a hefty fine is imposed.
- Heavyweights are lifted by commercial vehicles, and if this material is not stacked correctly, accidents can occur. So this research has found various rules that need to be followed while stockpiling different goods like container body trucks needs to have a wooden or cardboard flooring, open body vehicles need plastic covers, ropes, stoppers and for tankers carrying chemicals needs to be built with stainless steel to contain the product.
- The finding of new emission norms has uncovered various changes that are going to be brought in the commercial market of India like new

engines, security features, and better mileage. These are some of the changes that have been introduced in new norms.

- This thesis discovered varied Challenges that are being faced in the transit of materials from one place to another. These issues are theft, competition, less workforce, and many more. Due to such challenges, other sectors are also delayed, and a problem like shortage can arise.

6.2 Recommendation practice

- This research aims to provide a forum for other researchers to investigate the road freight role in the transportation of goods as much data is not available on this topic, so this paper can serve as a basis of starting point for many new analysts. This paper shows various issues that can be explained in more detail and how far the road transport has come. The data gathered from industrial experts display steps or recommendations that can help researchers know about various practical points for new research.
- The outcome of the research can help many transporters by spreading awareness that they are not the only trader facing the issues, but others are also facing similar problems. A series of new laws are recommended so that a better operating system can be established. The company's functioning can be enhanced so that goods are delivered to the consumer at a much faster pace, and more business is produced in this sector.

6.3 Research limitation

The process used for data collecting in this qualitative research was an interview, but the number of participants is quite less. It would have increased if some unexpected events did not occur. The paper's quality could be better if many more kinds of material transporters interviews could be collected like there is no interview of participants that transport gas products, which has created a hole in the research. However, the data gathered for the research seems satisfied because they are not much information available on this topic. The simplicity of

road transport has kept the researcher avoiding such a subject. This was noticed in the process of assembling the knowledge of this research

6.4 Research contribution

This research paper will help many future research pieces by giving them a base to start. Analysts can access various kinds of materials, types of vehicles, weight distribution, how emission norms have evolved, and which kind of challenges are being faced in a transit. Road transportation is one of the essential modes because it gets easily connected to any mode of transportation. It is expected that information compiled will inspire much new research to do more in-depth research on this topic, like the area of gaseous material, providing a new solution to challenges face in transit, and how to organize road transport more effectively and efficiently.

6.5 Suggestion for future research

- The researchers should collect many data for the research and explore many products area which is being transported so that different ways of that materials loading and unloading can be analysed. More quality data should be gathered rather than just increasing the number of participants for volume.
- The interview should be taken in a personal meeting rather than a telephony or video interview because observation skills will help to gain more knowledge so that future readers or researchers could get more information access on the topic.

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8 Appendix

Reference to one of the participants interviews

i) Material (P1)

- truck (good transport) Multiproduct
- L - Customs B2B [Domestic
- UL - Consign. No Insurance]
- Path (chargeable base) Service
- Element - Manpower, Not Samatas, hand

2) Commercial Vehicles

- 1 tonner to 4.9 tonner
- Container body, open body, trailer
- 2 Document - Invoice
- - Eway bill (online)
- - Good consignment Notes, L.R. (Lorry receipt, Consignment Notes)

1 to 6 to 9 ton

3) Weight

- 19 ton^{vehicle} + Cargo = 28 ton total
- GVD [19 ton RLW Registered load Weight]
- ULW - Unladen weight
- RC of truck - RLW - ULW
- Permissible RLW

- Depend Product
- Pulses or grain take care of telf
- Plastic cover
- Pharma Container truck
- Bucket - Packing in vehicle, wooden
- Shuts, wrapping

- Empty weight bridges E - L
- - public weight bridges
- - private weight bridges

Compulsion not on cargo

* Shampoo eg.

4) BSG - Technical engine

- BSL - Mechanical
- Advantage
- - Computer data Analytic
- Disadvantages
- - Cost of asset
- - Reparing / Maintenance*

5) Challenge

- theft, Freight payment, Manpower
- low margin, high competition
- No Govt body, private structure
- Minimum amount of payment, Fuel stability
- Unity, ~~xxxx~~