

**Digitalization and its competency to transform Indian Logistics Industry to adapt Green Logistics**

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**Abstract**

Through this paper, in brief, I have tried to illuminate the logistics emergence and growing importance for Industry in respect to delivery of best customer service, optimizing logistics cost. Here in this research paper, it has been tried to emphasize that how logistics, although being, very important arm of industry, is also responsible for increasing carbon emission. To that context along with whole world, India being a responsible country and emerging power, has also committed, to reduce the carbon emission of its part. Now it is a very challenging part of the whole scenario. On one side India must maintain growth trajectory and on the other hand, sufficient effort is enforced to reduce pressure on environment. To balance the equation, digitalization has put forward various options to honour environmental requirements on one hand and maintain growth trajectory on the other side. With the concept of Industry 4.0, the concept of logistic 4.0 has also gained ground. There are many solutions with which, logistics can contribute to reduce the carbon footprint in its domain. In this paper I got opportunity to analyse the matter.

Keywords: Logistics, Green Logistics, Digitalization, Supply chain, IOT in Logistics, Blockchain, Logistics 4.0

**Introduction:**

After the Industrial Revolution, mass production has become solution to capture the market and increase the profit. With entering of new player and gradual upgradation of technology and customer change of choice due to availability of different variety has changed the technique to increase sale or profit by mass production. Here comes marketing. Marketing of product has gained momentum. Maximum the marketing is done for the product, maximum is the profitability. Although till date marketing has not lost the sheen, but now its turn to optimize the resources to increase the profit of organization. Initially Human Resource department has played vital role by optimizing the human resources. Effort has been given to increase the work efficiency of the workforce. Technology has also played a very important role to reduce the human intervention in job. Finance and Accounts has become actively started to intervene in cost optimization process. Various tool and technique of F&A are used. When all the sector such as production, human resource, Marketing, Finance is moving towards saturation point of maximising profit, then Industry turned towards Logistics expenses. Industry realized that 10-20% of cost on average of total material cost has attribution of logistics.

From 1990, organization has learnt that logistic process/operation which adds to the product cost. Around 14 per cent logistics cost needs to be delved into. High logistics cost, without doubt, impinges on competitiveness. It is from a report by consulting firm Armstrong & Associates, which routinely estimates logistics costs as a percentage of GDP for many countries. Information cited in this paper should be referred to as either:

But with emerging importance of Logistics for Industry, it is also playing a demon role towards environment. Globally Logistics and its related job resulting to 20% contribution towards CO2 emissions. India also being an fourth largest economy has also an role to take care of the environment. Following on step India has made some commitment at COP26

The Government of India has articulated and put across the concerns of developing countries at the 26th session of the Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Glasgow, United Kingdom. Further, India presented the following five nectar elements (*Panchamrit*) of India's climate action:

- i. Reach 500GW Non-fossil energy capacity by 2030.
- ii. 50 per cent of its energy requirements from renewable energy by 2030.
- iii. Reduction of total projected carbon emissions by one billion tonnes from now to 2030.
- iv. Reduction of the carbon intensity of the economy by 45 per cent by 2030, over 2005 levels.

- v. Achieving the target of net zero emissions by 2070.

### **Systematic Review of Literature.**

Intelligent transportation systems (ITS) use, process and manage information gathered by different applications to implement. And manage strategies that improve security, raise the level of service and capacity, reduce transit times and increase the productivity of transportation systems (Pérez-Salas, 2001). Rodrigue, J-P (ed) (2020), *The Geography of Transport Systems*, Fifth Edition, New York: Routledge. Rodrigue, J-P et al. (2020) *The Geography of Transport Systems*, Hofstra University, Department of Global Studies & Geography, <https://transportgeography.org>. Cybersecurity involves the prevention of cyberattacks and is concerned with the protection of information technology (IT)—which focuses on the processing of data into information—, of operational technology (OT) —which concentrates on the use of data to control or monitor physical processes—, and of data from unauthorized access, manipulation, and disruption. Meanwhile, cyber-safety covers the risks from the loss of availability or integrity of safety-critical data and operational technology (BIMCO and others, 2018). Financial Control and its' impact on Organizational performance – An empirical study of J/Municipal Council (Rathirane Yogendrarajah, 2014). Research on the Niche Evolution Game of Ecological Community Innovation of Corporate Venture Capital Based on Logistic Extended Complexity Model (Business School, Sanda University, Shanghai 201209, China, Glorious Sun School of Business and Management, Donghua University, Shanghai 200051, China), THE INTERNET OF THINGS AS THE FUTURE TECHNOLOGICAL TREND OF THE INNOVATIVE DEVELOPMENT OF LOGISTICS (Andrzej Magruk, 2016). According to K. Ashton, who in 1999 was first to introduce the concept of the "Internet of Things", IoT has the potential to revolutionize the world probably to a much greater extent than the "traditional" Internet (Ashton, 2009, p. 1). The Internet of Things is a concept inseparable from the new services related to new modes of communication – information connection between people and things, but in particular connection between objects (things) (Kwiatkowska 2014, p. 63).

### **Emergence of Logistic Industry & its importance**

The chronological evolution of the concepts of logistics and the supply chain implies the existence of 7 distinct and important phases as shown.

- The First: The Military Transportation Era (1950s)

- The Second: The Physical Distribution in commercial (1960s)
- The Third: Physical Supply, Deregulation and Logistics (1970s)
- The Fourth: Transportation, Deregulation, Physical Distribution and Business Logistics (1980s)
- The Fifth: Business Logistics (1990s)
- The Sixth: Logistics and Supply Chain Management (2000s)
- The Seventh: Supply Chain Digitalization (2010's)

Evolution of logistics in the period from the first industrial revolution to date.

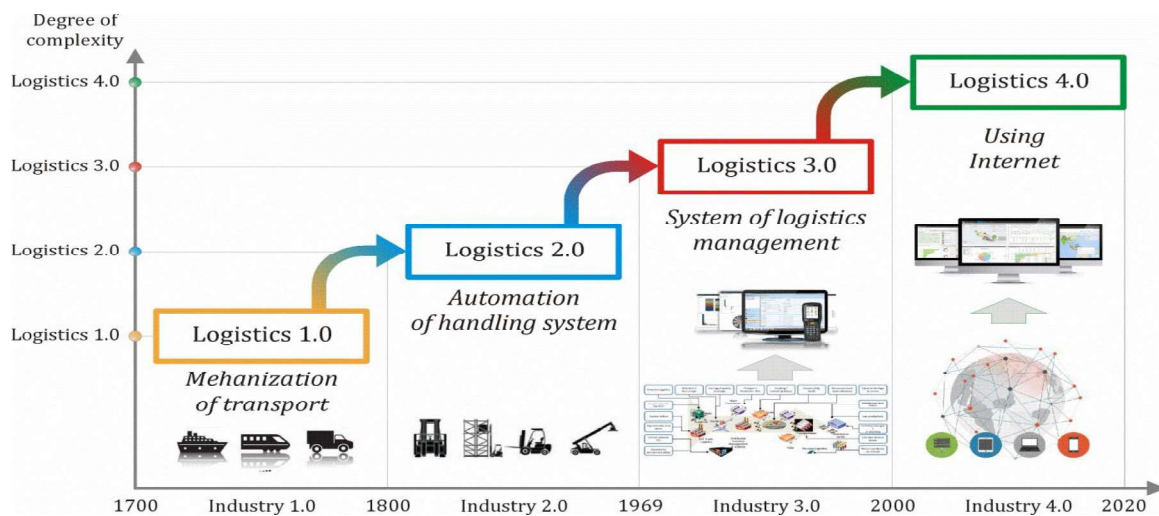


Figure 1. Evolution of logistics (adapted from Wang, 2016)

Why Industry suddenly focussed on Logistics and its cost;

Logistics centers on the movement of goods, but its effects extend much further. In business, success in logistics translates to increased efficiencies, lower costs, higher production rates, better inventory control, smarter use of warehouse space, increased customer and supplier satisfaction, and an improved customer experience.

Each of these factors can significantly move the needle on a company's success. Note that logistics also extends to managing returns to extract the most revenue from these goods. Logistics is an essential component of supply chain management. It involves the planning, carrying out and

management of goods, services, and information from the point of origin to the point of consumption.

As per one study of Michigan State University, Logistics aligns the complex pattern of traffic and transportation, shipping and receiving, import and export operations, warehousing, inventory management, purchasing, production planning, and customer service. Companies see logistics as a critical blueprint of the supply chain. It is used to manage, coordinate and monitor resources needed to move products in a smooth, timely, cost-effective and reliable manner. As the global economy moved into the 21st Century, logistics became a critical part of supply chain management and consumer demand. In less than two decades, logistics management has influenced product movement to meet or exceed consumer demand. Companies saw they could lower costs and increase productivity by managing logistics on a system theory and managing the company as a whole to boost performance.

Report of Statista,2023 has been referred as Figure 1 just to show the world wide logistic cost in between 2010 - 2020

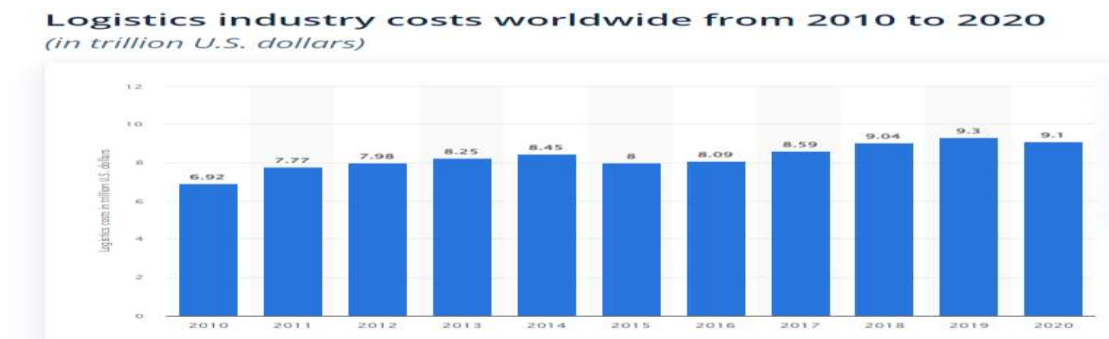


Figure 2 is being Logistic cost in terms of GDP%. The source of the data is referred from World bank.

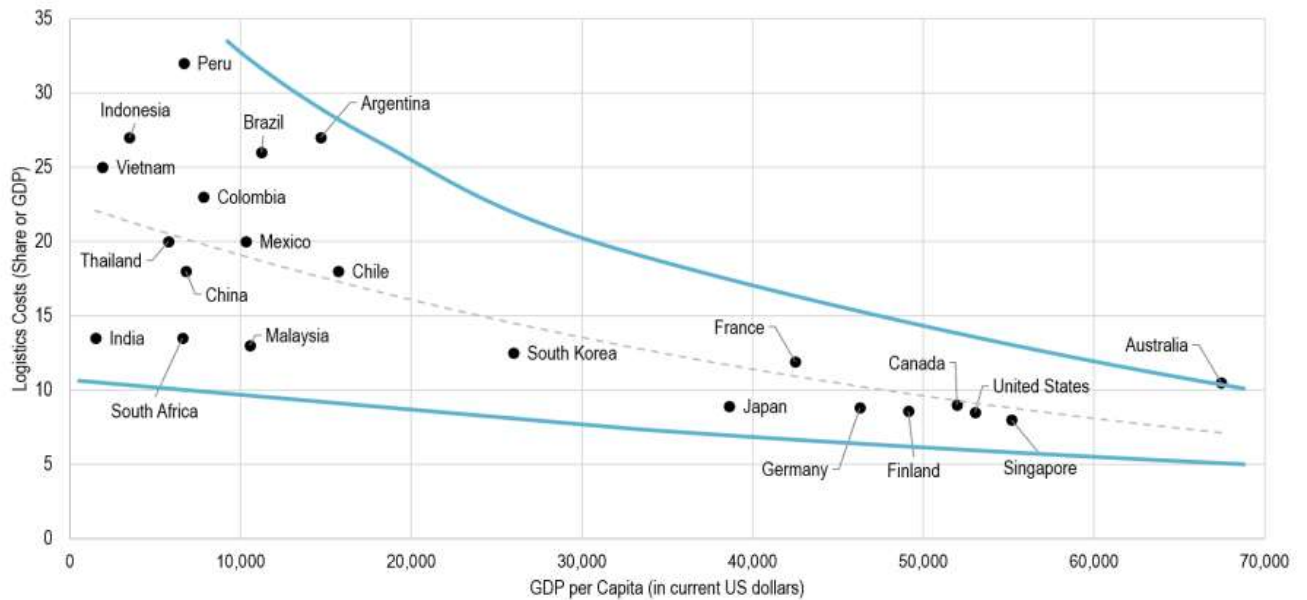


Figure 2 - Source: World Bank for GDP data. Various sources for logistics costs.

One can infer that, the logistic cost vary from country to country and it varies from as low as 5% to as high as 35%. Now country which have more controlled logistics cost has maximum profit.

### Logistics threat to Environment-

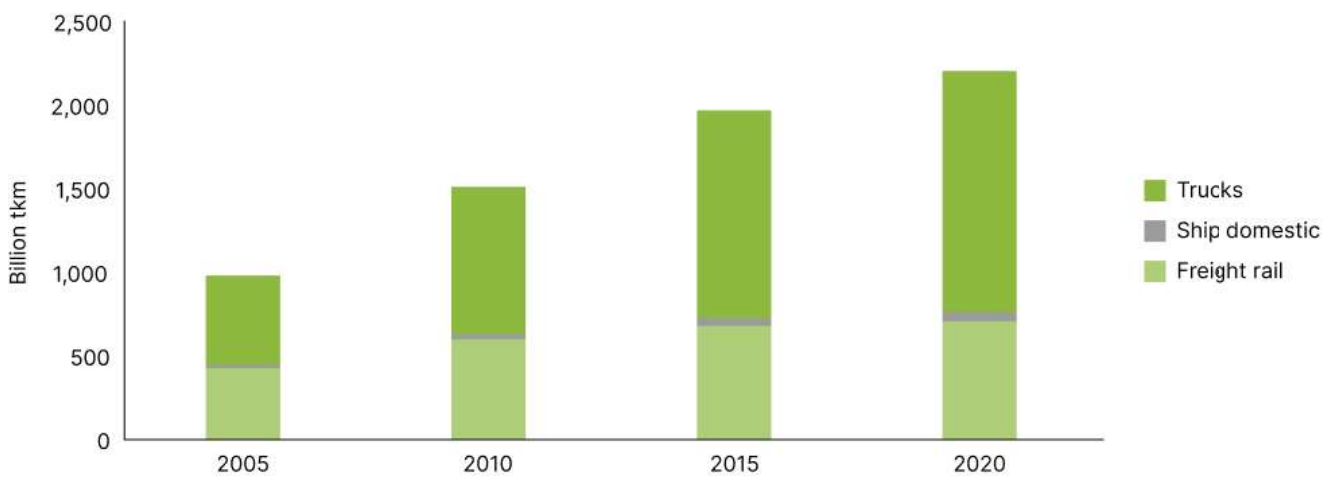
Logistics transportation emits high greenhouse gas emission rates. Transport and road traffic, in particular, produce fine particles that pollute the outside air, which is dangerous to humans and ecosystems.

Every year, billions of tons of goods are transported worldwide by ships, trucks, planes, and trains. There's no wonder that freight transportation makes up for 8% of global greenhouse gas emissions (11% if counting warehouses and ports). And without significant changes in motion in order to achieve sustainability, logistics is set to become the highest carbon-emitting sector by 2050.

With the rapid growth of the Indian economy, freight activity has increased significantly. The growth in freight demand primarily comes from the road sector. Freight movement in India has doubled to 2,250 billion tonnekilometres<sup>3</sup> (tkm) in 2020, compared to 2005 levels. According to the India Transport Report by the National Transport Development Committee, the increase in

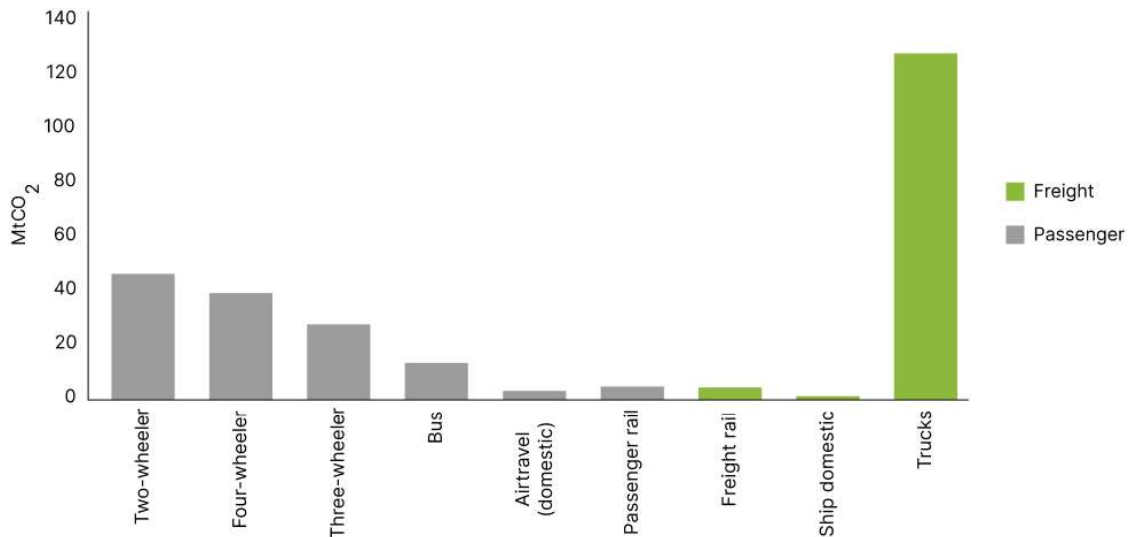
freight demand has been accompanied by the suboptimal development of the rail–road share (National Transport Development Policy Committee 2014).

Trucks dominate the freight modal share, accounting for 65 per cent of freight movement in 2020. Over the past two decades, India has invested significantly in strengthening road infrastructure by expanding and constructing new national and state highways (IEA 2021). This improved road infrastructure has helped increase the average distance across which commodities are transported by trucks. The Indian trucking fleet, which hauls freight over long distances, is mainly comprised of medium-sized trucks with a gross vehicle weight between 3.5 tonnes–12 tonnes (ITF 2021) resulting in relatively lower tonnes carried for a unit of energy consumed.



Source: Analysis based on GCAM-CEE

**Figure 4 Carbon emissions produced by the transport sector in 2020**



Logistic cost as far as India is concerned.

Logistics is the backbone of the economy. It affects all industries in three sectors – agriculture, manufacturing and services. In India, the logistics sector has been marred with inefficiencies, depriving the industry of achieving its full potential. The logistics sector makes up 14.4% of the country’s Gross Domestic Product (GDP), but it costs 14% of the GDP. The global average logistics cost to a country is approximately 8%. The gap of \$180 Bn per annum needs to be addressed to achieve the country’s dream of a \$5 Tn economy.

The largely informal or unorganised sector has contributed to the country’s growth, but its structural fragmentation has been neglected for far too long. In recent years, there has been a paradigm shift in the logistics sector with the move towards making it an organised sector.

The government of India institutionalised the Logistics Division under the Department of Commerce in 2017. The Department of Commerce here onwards became responsible for the integrated development of the logistics sector. The action plan includes integrated sector development through policy changes, improving existing procedures, identifying bottlenecks and gaps along with introducing technology. It is undoubtedly the right step towards the regularisation of the sector.



There have been several developments since then that have further triggered a much-needed shift in the sector.

### **GOI initiatives in the Logistics Sector**

Strong growth supported by government reforms, transportation sector development plans, growing retail sales and the E-commerce sector are likely to be the key drivers of the logistics industry in India in 2021. Online freight platforms and aggregators have been on the rise in the Indian logistics market, given the need for low entry barriers and less capital investment compared to setting up of an asset-based business model

### **The future of India's transport sector:-**

Our outlook provides insights into what India's transport sector might look like in the next few decades. In this section, we will highlight the key characteristics of the future growth of India's transport sector. Our analysis assumes that market forces will continue to impact the evolution of both passenger and freight transport in the absence of a dedicated policy push to promote any particular mode or technology. We also assume that the cost of oil and gas-based internal combustion engines (ICE) across all modes will follow historical trends. A crucial assumption of the BAU scenario is that the cost of electric vehicles across all modes of transport will continue to decline. We have assumed that by 2030, electric four-wheelers will reach cost parity with the ICE in terms of capital cost. For other modes, the rate of decline will differ since the share of battery costs differs for each mode.

The detailed assumptions for the transport sector are discussed in Annexure 1 of the document. The following are the key insights from our assessment.

India has a new logistics policy. On September 17, Prime Minister Narendra Modi unveiled the National Logistics Policy (NLP), which is aimed at promoting the seamless movement of goods and enhancing the global competitiveness of Indian industry.

The policy constitutes planning, coordination, storing and movement of resources—like people, raw materials, inventory, equipment, etc.—from one location to another, from production to consumption, distribution, or other upstream production points. The policy has also proposed some key targets to be achieved, like a reduction in the cost of logistics from the current 14-18 per cent of

the country's GDP to the global best of around 8 per cent by 2030. Countries such as the US, South Korea, Singapore, and some European nations boast of such a low logistics cost-to-GDP ratio. Another target set by the policy is to achieve a top 25 ranking by 2030, on the Logistics Performance Index (LPI) curated by the World Bank. NLP intends to cut the logistics costs in India by half, and thus achieve the set targets. The government has also envisioned a data-driven decision support system (DSS) to enable an efficient logistics ecosystem in the country.

### **India has two Head challenge.**

**First to** reduce the logistics cost - The country's logistics costs, which at present is 16 per cent of India's GDP, will reduce to 9 per cent by the end of 2024 aided by India's growing infrastructure. Addressing the annual convention and 95th AGM of FICCI, the minister promised that logistics cost, which is 16 per cent of GDP presently, will fall to single digits, up to 9 per cent of GDP by the end of 2024. To address this issue, the Centre recently unveiled the National Logistics Policy (NLP).

There is a relationship between the level of economic development (as measured in terms of GDP per capita), the composition of a national economy, and logistics costs. While logistics costs can amount to 25% of delivered costs in some developing economies, they can go as low as 8% in advanced economies. Many factors can influence this cost structure:

- Transportation infrastructures. They influence transport costs, capacity, and reliability. Extensive transport infrastructures are linked with lower logistics costs.
- Role of economic sectors. Economies relying on the primary (e.g. agriculture and mining) and secondary (manufacturing) sectors have higher logistics costs than economies relying on the tertiary (services) sector. These variations are linked with the amount of freight in circulation in relation to the total economic output.
- Interest rates. Mostly impact transactional and inventory carrying costs, which are more extensive with higher interest rates.
- Level of competition. Monopolistic and oligopolistic markets (e.g. state-owned enterprises) tend to have higher logistics costs as stakeholders have fewer incentives to innovate and use infrastructure (e.g. ports) from a rent-seeking perspective.
- Information technologies. Reduce transactional and inventory management costs.

- Legal system. Enforcement of contracts and protection of private property (e.g. terminals, warehouses).
- Regulations and taxation. The level of constraints the transport sector is subject to, such as environmental regulations, as well as its taxation level.

There is a convergence as the economy develops towards lower logistics costs. Low levels of economic development are associated with a high variation of logistics costs among countries, while this share narrows at higher levels of economic development. This is mainly attributable to a diversity of infrastructure conditions as well as different roles assumed by the primary and secondary sectors. Despite a high GDP per capita, Australia has a higher share of logistics costs than comparable countries because of the importance of mining in the economy.

**Second** to reduce the carbon emission-

While India continues to be the fourth largest global emitter, after China (31 per cent), the US (14 per cent), and the European Union, a media release regarding the report showed that India has nearly matched the share of the European Union made of 27 countries. India's total emissions in 2021 have been pegged at 2.7 billion tonnes, which is slightly below the EU's total of 2.8 billion tonnes. India's 2021 share of global emissions stood at 7.5 per cent, marginally below the EU's 7.7 per cent. In 2022, India's share is projected to reach 8 per cent. Supply chains are subject to the bullwhip effect, where changes and errors accumulated upstream keep amplifying as we travel downstream. The way to accommodate this characteristic of supply chains is to develop digital solutions which allow flexible reallocation of resources and costs in response to real-time carbon emissions. A single digital operating system for the supply chain can enable sharing of data on carbon emissions and costs of sustainable alternatives among the participants.

The Government of India has articulated and put across the concerns of developing countries at the 26<sup>th</sup> session of the Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Glasgow, United Kingdom. Further, India presented the following five nectar elements (*Panchamrit*) of India's climate action:

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Among those Logistics is a key contributor to carbon dioxide (CO<sub>2</sub>) emissions in India. It is 14% of energy-related direct (Scope 1) CO<sub>2</sub> emissions and one of the fastest growing emissions sectors in the country, along with industry (Godinho & Coetzee, 2020; International Energy Agency, 2020a). Within the transport sector, road transport is responsible for 90% of total energy consumption (Hagemann et al., 2020). As per one study done by Mr Neeraj Bansal COO of KPGM, A sustainable supply chain includes reducing water and energy usage, utilising renewable energy and decreasing hazardous waste generation. Electricity and transportation, for instance, contribute massively to greenhouse emissions and companies are increasingly focussing on greener logistics to reduce their carbon footprint. The global transportation sector is a major polluter, and in 2020, it produced approximately 7.3 billion metric tonnes of carbon dioxide (CO<sub>2</sub>) emissions.<sup>1</sup> Most delivery trucks use diesel since that is the affordable fuel option, but using diesel increases the carbon footprint by releasing 13 per cent more CO<sub>2</sub> into the atmosphere.

Now to help the Logistics sector to fulfill the target of minimal CO<sub>2</sub> emission, Technology already playing a a great role. In recent years Digitalization has become new weapon to optimize cost and reduce carbon emission by using smart transportation,

### **Key digital tools**

The latest megatrends and driving forces concerning the demographic, urbani-zation, consumption and individualisation changes substantially affect the tech-nology trends in logistics, which must inevitably be taken into consideration when formulating the operating strategies by individual companies (Bubner, Bubner, Helbig& Jeske, 2013, p. 5).

The group of significant trends in logistics include:

1. Cloud logistics;
2. Augmented Reality
3. Internet of Things;
4. Block Chain
5. Artificial Intelligence
6. 5G Technology

## 7. Autonomous Logistics

### **1. Cloud logistics influence on Green Logistics**

Cloud Logistics is a leading innovator and provider of a modern, intuitive and easy-to-use TMS. Uber Freight's integration with the Cloud Logistics TMS via API allows shippers to view instant quotes from carriers in Uber Freight's extensive network, tender shipments and take advantage of instant access to capacity. As unexpected market fluctuations define our new normal, real-time information on rates and capacity is more important than ever to both effectively plan ahead and make quick adjustments to their supply chain operations. Shippers need up-to-date visibility into market conditions and pricing to make decisions that maintain consistency and service for their clients.

"Our partnership with Cloud Logistics makes it easier for shippers to respond to market instability around capacity and rates in real-time by giving them more flexibility and proactive control over their shipping operations," said Laurent Hautefeuille, head of business development at Uber Freight. "This API integration provides real-time rating and instant capacity that Cloud Logistics shippers can count on, in a way that is fully integrated and keeps shippers at the forefront of the evolving freight market."

"We are excited to bring new, quality partnerships to our TMS solution," said Joe Olson, executive vice president and chief of customer operations at e2open. "Uber Freight is a provider that many customers already use and enabling access to their engines directly from our solution brings a single, streamlined user experience to our clients."

This integration will allow shippers on the cloud-based Cloud Logistics TMS to seamlessly access Uber Freight's real-time pricing and expansive network of over 60,000 global carriers without leaving the TMS platform. Shippers can get set up quickly and gain access to rates and available capacity within hours.

Uber Freight is continuing to partner with leading TMS providers to equip shippers with the tools they need to efficiently move goods around the world.

## **2. Augmented reality (AR) usage in Logistics Industry to go green**

How AR/VR helps to reduce Customer Return

Augmented reality (AR) is the integration of digital information with the user's environment in real time. Unlike virtual reality (VR), which creates a totally artificial environment, AR users experience a real-world environment with generated perceptual information overlaid on top of it. Augmented reality is used to either visually change natural environments in some way or to provide additional information to users. The primary benefit of AR is that it manages to blend digital and three-dimensional (3D) components with an individual's perception of the real world. AR has a variety of uses, from helping in decision-making to entertainment. AR delivers visual elements, sound, and other sensory information to the user through a device like a smartphone or glasses. This information is overlaid onto the device to create an interwoven experience where digital information alters the user's perception of the real world. The overlaid information can be added to an environment or mask part of the natural environment.

### **Application of AR in Logistics Industry to reduce carbon footprint;**

- a) Costume company **Disguise Inc.** is partnering with **Snapchat owner Snap Inc.** on an augmented-reality lens that lets users try on costumes virtually and then order them directly from their phone. Snapchat users take a full-body photo and then browse Disguise's Snapchat store for costumes, which they can "try on" using an AR filter that shows how the costume would look on their person before they buy it. The rate of eCommerce returns in India is pegged at 25-40% during the festive time. As the market gets more crowded and consumers have more options. Did you know 19% of consumers buy apparel in different sizes, shapes and fits, with the sole intention of choosing their best fit and returning the others? Not taking this into account can severely impact a business's cash flow, but also carbon foot increases due to reverse logistics. Clothes are also subject to a lot of impulsive buying. Your website visitors might often find themselves scrolling late at night for some retail therapy, but then they end up wanting to return it the next day. D2C brands that sell clothes online need to factor in a high return rate, especially during festive seasons. Clothes are also subject to a lot of impulsive buying. Your website visitors might often

find themselves scrolling late at night for some retail therapy, but then they end up wanting to return it the next day. D2C brands that sell clothes online need to factor in a high return rate, especially during festive seasons.

- b) According to a report by DHL, warehousing operations like packing, storage, and put-aways form around 20% of all logistics expenses. The task of picking orders forms about 60% of all warehousing operations. So DHL decided to cut its expenses significantly by setting the picking process on the new level using augmented reality. In 2017, DHL launched its Vision Picking pilot project that brought AR smart glasses-based vision picking to warehouse operations. These AR smart devices provide employees with a digital picking list and show them the best routes so as to cut their travel time by instant and accurate pathplanning. Through barcode scanning, smart glasses allow employees to understand whether they are at the necessary location and help them efficiently locate necessary items on shelves. The experiment with the implementation of augmented reality resulted in the 25% growth of the total picking efficiency along with increased productivity and reduced error rate. The initiative also allowed DHL to cut the time needed for both employee training and onboarding by 50%. Since Vision picking proved its efficacy, DHL decided to turn the AR pilot program into the permanent approach of the further company's improvement vector. The transporter is exploring new ways of how to apply augmented reality in employee training, transportation optimization, last-mile delivery, etc.

### **3. IOT usage helps to reduce carbon foot print;**

Infrastructure management, waste reduction, and fuel efficiency are all made possible by IoT. IoT technologies assist in rational route planning and fuel consumption reduction. Second, a business may track the state of the goods as they are transported. An item is replaced if any damage occurs or if it is about to expire. IoT solutions for managing civic infrastructure make it more eco-friendly. Sensors, LEDs, and lampposts that collect data pave the way for green lightning. IoT technologies have been incorporated into the businesses of many worldwide leaders. Well-known businesses are aware that digital opens up new possibilities and has positive commercial effects.

Road transport accounts for 62% of all the logistics emissions even when almost 75% of the global cargo movement is through ships. The reason is that trucks emit up to 100 times more CO<sub>2</sub> than ships. However, the positive side of this equation is that there is adequate access to smart

technologies such as AI, machine learning and data analytics to address the challenge. Alongside switching to greener fuels, integration of cutting-edge technologies in road transport can bring down emissions even when the demand is increasing.

### **Using data and GPS to create optimum routes**

Trucks burn a lot of fuel when travelling on longer and poorly maintained roads. Sometimes, the drivers prefer to stick to a known route despite a shorter and faster alternative exists. This is where advanced GPS and data-analytics are helping turn things around. A mix of real-time traffic data, weather updates, and longer-term averages such as time taken, average speeds, etc., are factored in to determine the routes that will deliver maximum fuel and time efficiency. Intelligent route modelling alone has the potential of reducing a sizable percentage of emissions per vehicle per trip.

### **AI to optimise vehicle utilisation**

A big drawback of manual road transportation is the common occurrence of trucks running empty or partly utilised. There is stiff competition for loads. Instead of waiting for the right load, most truckers tend to pick up what they get, especially on their return journeys. However, with smart AI-powered logistics platforms, there is not only access to a much larger number of transporters and shippers across India, but also automated vehicle-load matching on the return route. For shippers, this optimised vehicle matching means that they would need to hire fewer vehicles to ferry their loads. With reduced empty vehicle operations through intelligent demand-supply matchmaking on the return route directly reduces emissions and makes logistics more sustainable.

### **Improving vehicle performance**

Poorly maintained vehicles can cause more pollution. Integration of Internet of Things (IoT) sensors can enable truckers to monitor the performance of the vehicles in real time. Mileage, speed, time spent and that wasted on longer or circuitous routes are all factors that can be analysed. This makes it possible to undertake a predictive analysis of the vehicle's performance and forecast when it will require service. Such efficiencies of operations have a direct bearing on cutting-down emissions and ensuring sustainability.

LEADING EXAMPLE OF IOT USAGE IN LOGISTICS INDUSTRY TO EASE CARBON FOOTPRINT



- c) DHL Smart rucking solutions epitomize ‘TechLog’ – logistics made smarter through the use of new and emerging technologies. Following a successful three-month pilot that covered over 2,770,000 kilometers,DHLSmarTrucking leverages Internet of Things (IoT) technology and data-driven insights for route optimization. This reduces transit times by up to 50 percent compared to the traditional trucking industry, and provides over 95 percent reliability with ease of use, end-to-end consignment visibility, temperature-controlled capabilities and real-time tracking.IoT-enabled sensors monitored through the company’s centralized control tower provide real-time temperature and consignment tracking. Information alerts and status updates are also sent to customers and DHL SmarTrucking’s operations teams through the customer portal and external and internal mobile applications. Utilizing an innovative and agile model, drivers are rotated at predetermined stops located across the country, with the originaldriver returning to the point of origin with another truckload. This transportation model helps optimize efficiency.
- d) Unmanned Aerial Vehicles (UAVs) or drones are the new medium to deliver packages. Their potential lies strongly in the field of retail, logistics, agriculture, and e-commerce. Amazon, one of the Big 4 tech companies in the world has also unveiled the use of drones for delivering ordered items to people located in remote areas. Drones applications and implementation of Internet of Things in logistics can ensure automated process execution and quick delivery of goods. The market of drones-based delivery systems is growing at a rapid rate and is expected to reach a market valuation of \$11.2 billion by the end of 2020. This will help to reduce the most costliest last mile delivery process and reduces carbon foot print.

#### **4.BLOCKCHAIN- BENEFITS OF BLOCKCHAIN IN THE LOGISTICS INDUSTRY**

The Internet of Things technology is necessary to achieve multi-party data exchange and real-time decision-making. Yet, problems with data security and privacy come up when this technology is used. A system through which unidentified persons can create and maintain any database on a distributed basis is the foundation of blockchain technology. Stakeholders may get consistent and trustworthy data and information on the logistics process of goods thanks to the traceability made possible by blockchain technology. Based on consistent and trustworthy data and information, stakeholders can reduce their use of resources and commodities to increase business earnings. In logistics and supply chain design, the vehicle routing application is essential. Real-time data allows for the real-time optimization of vehicle routes to prevent gridlock and cut carbon emissions. As a result, energy use can be decreased while also protecting the environment. Users can access

requirements and shipping details from the blockchain network and establish optimization goals to determine the best results. Better green logistics and supply chain design decisions can result from vehicle routing, which will increase sustainability performance.

### **Carbon Traceability on the Blockchain**

The key to carbon tracking is transparency and this needs to be accurate and complete. The data regarding the carbon emissions at each stage needs to be gathered or at least estimated. This requires greater integration and coordination between multiple nodes in the ecosystem. Organizations need to have better visibility and insights to make decisions on the data collected.

How is Carbon traced on the Blockchain?

- Blockchain technology with the help of smart sensors helps to calculate energy consumption and generate data that can be aggregated and analyzed on the blockchain. These carbon emissions are transformed into carbon credits that organizations can exchange to offset their footprint.
- The traceable and authentic information gives an opportunity to neutralize carbon emissions.
- Smart Contracts help to calculate, track and record reduction in carbon footprint.
- Real-time authenticated and verifiable data is recorded.
- Decentralized approach with the involvement of all stakeholders makes it a collaborative approach in tackling climate change problems.
- Time stamping of transactions of carbon emissions helps to prove the single source of truth and validate the claims of accumulated carbon credits.
- Authenticators can be onboarded into the system to verify the carbon emissions and calculate the credits, following consistent standards.

Benefits of Blockchain Carbon Tracing

- Transparency of emissions tracked.
- Authentic and verifiable data satisfy regulatory compliance.
- Facilitates trading of carbon emissions
- Informed insights with accurate data tracked and recorded.
- Prevents over estimation of carbon emission.

How Blockchain helps establishing Carbon Credit License process. A carbon credit is a license that allows the company that owns it to release an equivalent to one ton of carbon dioxide or other greenhouse gases. In this system, carbon credits function as a new commodity that can be transferred and sold. Each unit is tracked and recorded through the Kyoto Protocol registry systems and an international transaction registry that ensures the secure transfer of emission reduction units between countries. The carbon credit market is estimated to be worth more than \$50 billion by 2030, and cryptocurrencies surpassed a market cap of \$2 trillion in 2021. The main objective of the carbon market is to create incentives for companies to reduce greenhouse gas emissions. They are fined when they exceed the limit and can earn money by storing and reselling some of their emission credits.

### **What's the Tokenization of carbon credits?**

Universal Carbon [UPCO2] was introduced in 2020 as the world's first exchangeable carbon token available on a public Blockchain and created by the Universal Protocol Alliance and leading voluntary carbon credit companies. According to the World Bank, by 2020, humanity will offset only 22% of global emissions through the purchase and retirement of carbon credits. Yet, the share of countries operating regulated carbon markets has increased from 40% of global GDP in 2016 to 70% in 2020. The Tokenization of carbon credits allows not only companies and organizations but also individuals around the world to participate in this important – and potentially lucrative – new market, as well as doing the right thing for the planet. Seventeen GHG emissions trading schemes have now been established worldwide, operating in 35 countries, 12 states, and seven cities, either through the allocation or purchase of allowances from a central authority or the purchase of emission credits from market participants. The world's six major CO2 emitting countries/regions (China, the United States, the European Union, India, Russia, and Japan), along with New Zealand, South Korea, Switzerland, and Canada, have already implemented carbon trading systems and many more are on the way to doing so. Blockchain technology provides business leaders with a robust infrastructure to calculate and reduce carbon footprint through intelligent data management.

### APPLICATIONS OF BLOCKCHAIN IN THE LOGISTICS INDUSTRY

- a) Maersk, is committed to environmental sustainability through efforts to decarbonize marine operations, launching the first carbon-neutral vessel by first quarter 2024. In addition, we are providing new solutions like Emissions Dashboard: a tool that supports our customers to

consolidate emissions data across all carriers and transport modes. Simplifying the process of gathering, analysing, and visualizing emissions data. This effective method of tracking goods could significantly boost productivity levels and improve supply chains by enabling faster and more cost-efficient delivery. It also enhances the traceability of goods, enables better communication between partners, and, most importantly, simplifies access to monetary resources.

- b) Leading Example to reduce carbon footprint in supply chain and Logistics is Amazon Warehouse system. Blockchain in the logistics industry comes in the form of a decentralized public ledger system which documents all the changes to a record in real time. Armed with this data, companies can implement faster routes and eliminate unnecessary steps in the delivery process. Distributed and decentralized ledgers reduce mistakes and save time. Smart contracts enable retailers and logistics companies to conclude agreements that will immediately dissolve if all the agreed-upon terms aren't met. These ledger-based contracts increase transparency and profits, while decreasing delivery time and costly errors.

#### **5. Usage of AI to reduce Carbon emission:**

The use of algorithms encourages collaborative synergy, which is essential to the efficiency of a logistical chain. A corporation can share transportation options with its partners when the supply chain is collaborative and intelligent. This technique records specific information about shipping companies using GPS data. In this approach, a business can speed up logistics, promote cost-effectiveness, reduce waste production, and go green. The most well-liked use of artificial intelligence in logistics is for driverless cars. A company can improve its route planning by identifying more helpful routes. With this automation, the human element is removed, increasing accuracy. There will be more autonomous, zero-emission boats on the water in the coming years. AI is also used for EV fleets. EV fleets have cheaper operating expenses and less downtime because electricity costs less per mile than gas or diesel and doesn't need tune-ups or oil changes. Another benefit of EVs for businesses is how simple it is to include them in a larger supply chain network that is connected to the cloud. Organizations may use AI-powered solutions to analyze both historical and current operational data, providing important insights into how to save costs, reduce fuel use, and improve their operations. Another application for AI algorithms is in the planning of delivery urgency. More, they contribute to increased transportation efficiency by identifying the true need for it. The environment is analysed by algorithms, which then produce routes that balance

urgency and fuel. Furthermore, artificial intelligence is adaptable to changes in delivery priority. This kind of calculation can be time-consuming and inefficient when done by hand. AI expedites the decision-making process. An organization determines the precise quantity of items, the precise shipping window, and the best vehicle type using deep reinforcement learning. The system's ability to operate in real time helps it reduce risks and adjust to changes. Smart solutions suggest improvements and friendly partners and contractors by analysing the supply chain.

## **6.Usage of 5G Technologies to support Logistics.**

Transporting an item from point A to point B is simple. However, transporting an enormous number of small items to various locations requires a lot of calculations and effort. The complexity of the last mile delivery is a pain that bothers retail businesses, e-commerce players, manufacturers, and 3PLs. For e-commerce, last-mile delivery is a burden that stays on couriers' shoulders. Digital instruments help simplify both their lives and the customers' ones allowing for dynamic route planning and maximum delivery control.

Significant potential for the last mile delivery lies in IT crowdsource tools. These platforms enable businesses to find contract couriers based on the location proximity to the destination. Blockchain will become a solution to the security issues of these types of transactions. With 5G technology, however, we can implement technology to monitor and control operations to reduce carbon emissions and implement more efficient and flexible traffic designs.

City sensors deployed on 5G networks will allow us to monitor and improve air quality by measuring pollutants and particulates at street-level in real-time. With this real-time data, connected traffic lights can be programmed dynamically, gauging and adjusting traffic on vehicular volume (Source: Brookings). Using 5G climate change technologies, improvements in traffic flows will be made, resulting in better air quality and less congestion.

Not only will you get to work on time, but parking will be a breeze.

Sensors used for geographic information systems will be attached to parking spots, providing you with information on which spots are available or taken before you arrive. Looking into the future, these are just the first steps of connected driving, soon you'll be able to avoid the trouble of driving altogether.

Driverless cars for last mile delivery are the next step in decreasing carbon emissions in the transportation sector. With efficient cruise control, automated braking and other automatic driving

features, driverless vehicles can deliver up to a 20-30% improvement in energy savings (Source: Brookings).

Driverless Last mile cars are quickly being coined as “connected cars”, running on the immense 5G networks that will enable smart cities. The real benefit of the driverless car is its ability to stay in constant communication with all the smart technology running in a city, from the traffic lights and monitors to parking spots and businesses themselves. This constant communication allows a connected car to make decisions without needing to use physical sensors on the vehicle. Think braking for a red light that is around the corner and blocked from view by a building.

But smart cities are much more than transportation game changers, when it comes to environmental impact, smart buildings could see the biggest benefit from 5G.

## **7. Autonomous Logistics influence on Green Logistics**

autonomous logistics technology collects data and applies the information in ways that improve the performance or efficiency of the machine activity. In short, autonomous processes become smarter based on information collected during operation.

Automation uses a well-defined, static set of parameters to execute tasks. Some decision-making is supported by predetermined information, but an automated system performs specific tasks based on original inputs and outputs.

Autonomous logistics management relies on artificial intelligence and machine learning to evolve smart transportation movements and improve supply chain processes.

Autonomous logistics technology adjusts delivery routes and predicted arrival times based on real-time conditions, such as weather, traffic, order cancellations, new orders, or driver exceptions. Subsequently, changes occur for any related automated tasks, such as instant push notifications and delivery alerts. This improves communication among supply chain partners.

Logistics management of automated tasks uses robotic process automation (RPA) to complete manual tasks. For example, automation supports digital freight matching, load management, shipment execution, freight claims management, invoice audit and payment, and other necessary supply chain management functions.

### **Benefits Of Autonomous Logistics Supply Chain**

In an autonomous supply chain standardization, connectivity, and intelligence supports the ability to anticipate events, develop plans and improve logistics. Benefits derived from this functionality include:

- Save time and increase productivity by eliminating repetitive manual processes through robotic process automation.
- Increase supply chain agility by anticipating and adjusting a delivery route, process plan, or other exception before a disruption occurs.
- Reduce costs in countless ways:
  - Deploy machines for tasks that are routinely plagued by human error.
  - Move and deliver goods more quickly and efficiently.
  - Optimize routes to limit vehicle miles or avoid time lost in traffic.
- Improve planning by leveraging technology to automate supply chain decisions and transportation execution based on real-time data.

### **Future of Green Logistics**

The future of green logistics depends on people being more conscious of how traditional logistics methods affect the environment. The public is more inclined to request more eco-friendly goods and services as they become more aware of the problems related to climate change and sustainability. Many sectors of the economy, including the logistics industry, have already noticed this change in consumer behavior. A lot of logistics organizations are starting to integrate sustainability into their operations in reaction to this development.

The transition to electric cars is one of the most important trends in green logistics. Compared to conventional gasoline-powered vehicles, electric vehicles have several benefits, including fewer operating costs and pollutants. Electric vehicles are more and more practical for logistics tasks as battery technology advances. For their local operations, many logistics companies have already started using electric vehicles, and this trend is likely to continue.

The rising usage of renewable energy sources is another noteworthy development. Many logistics organizations are starting to use solar and wind power to run their operations as these technologies are becoming more and more accessible. For logistics operations to have less of an environmental impact, a transition away from fossil fuels is necessary.

Finally, the future of green logistics will be affected by the development of new technology. New technologies have the potential to increase the efficiency and sustainability of logistics operations.

The logistics sector is developing. For instance, drone use is becoming more widespread in the logistics sector, and this technology has the potential to cut the carbon footprint of logistical operations.

Green logistics appears to have a promising future. More businesses are starting to integrate sustainability into their operations as the relevance of sustainability is becoming more recognized. For the logistics sector to have a smaller negative environmental impact and for the earth to have a bright future, more sustainable practices must be used.

## **Conclusion**

Green logistics benefits from having the Internet of Things, blockchain, and cloud technologies integrated. Smart management, planning, and control are essential for now and tomorrow since synergy and complete synchronization are the foundations of productive work. A business gains advanced optimization, real-time visibility throughout the supply chain, and valuable information. Besides being able to respond, an organization becomes proactive, anticipates different outcomes, and takes wiser choices at every level.

Whether it's choosing between different transit options, storing and handling different commodities, labeling, and packing, or something else, logistics decisions demand innovative and flexible solutions. Aside from innovation, investing in digital solutions also entails investing in exceptional experiences and high-quality services.

The future of green logistics will be centered on robust, AI-powered cloud-based logistics solutions that can help companies combine loads, automate dispatch and monitoring, optimize routes, decide when and where to charge batteries, compute ETAs, keep track of vehicle maintenance, and more. Routes and fleet capabilities will be tested using data modeling and simulations, and integrated technology can help integrate and check delivery and supply chain data along the whole value chain.

Every step taken to ease the delivery of goods benefits all parties involved, as it increases consumer satisfaction and engagement while also assisting businesses in enhancing their sustainability profiles and financial performance.



## Conclusion

As per IEA, in 2021 global CO<sub>2</sub> emissions from the transport sector rebounded by 8% to nearly 7.7 Gt CO<sub>2</sub> as pandemic restrictions were lifted globally. Even with anticipated growth in transport demand in India and across the world, following the Net Zero Scenario requires transport sector emissions to fall by about 20% to less than 6 Gt by 2030. So, bringing down the transport industry's carbon footprint is as critical today as expanding the capacity and efficiency of logistics operations. Any growth that comes at the cost of sustainability can backfire eventually, and that's why the logistics industry needs to urgently revamp itself. Usage of an integrated logistics platform that provides the right technologies and tools to optimise operations and reduce carbon footprint should no longer be a choice, but a mandatory requirement

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