Research Topic

Industry 4.0, impact on Physical Internet in the scope of trucks transportation

Bachelor Thesis

Geneva Business School

Bachelor in International Management

Submitted by:

Nikita Polomoshnov

Geneva, Switzerland

Approved on the application of:

Dr. Roy Mouawad

And

Dr. Oliver Elliott

Date: 29.05.2020

Declaration of Authorship

"I hereby declare:

- That I have written this work on my own without other people's help (copy-editing, translation, etc.) and without the use of any aids other than those indicated;
- That I have mentioned all the sources used and quoted them correctly in accordance with academic quotation rules;
- That the topic or parts of it are not already the object of any work or examination of another course unless this has been explicitly agreed on with the faculty member in advance;
- That my work may be scanned in and electronically checked for plagiarism."
- That I understand that my work can be published online or deposited to the university repository. I understand that to limit access to my work due to the commercial sensitivity of the content or to protect my intellectual property or that of the company I worked with, I need to file a Bar on Access according to thesis guidelines."

Date: 29.05.2020

Name: Nikita Polomoshnov

Signature:

Abstract

This research is focusing on the modern trend of the new logistics system which is called the Physical Internet. The Physical Internet is a set of complex solutions that are oriented to solve the logistics problems of Freight Road Transportation. The truck's transportation is highly affected by new technological trends. With Industry 4.0 and emerging technologies such as 5G, AI, Blockchain, businesses are gaining more opportunities to enhance their logistics operations and implement new innovations to get transportation advantages. The focus of this research is to analyze the potential benefits of the Physical Internet on logistics organizations in the scope of truck transportation and the potential benefits of implementing the concept of Physical Internet.

In the process of research, one of the discoveries is that the Physical Internet is highly connected to the technologies from Industry 4.0, which makes these concepts based on the same supporting tools. Because of this connection, most of the emerging technologies have a high influence on changes in the Physical Internet concept. With understanding the potential influence of emerging technologies on Freight Road Transportation, it is possible to predict the benefits of Physical Internet.

The results of the research show Freight Road Transportation will be one of the most innovative types of transportation, because of emerging technologies and the demand for this service. At the same time, the concept of Physical Internet will highly influence Trucks Transportations which will provide more advanced technologies. The main discovery is the potential advantages and challenges of implementing the concept of Physical Internet.

1 Introduction

1.1 Study background, Physical Internet

This paper investigates the potential of Physical Internet (PI), advantages and disadvantages in the scope of the Freight Road Transportation. This concept has origins from the similarity with a normal wired Internet connection, where a system of services and routers connects multiple users to increase speed of connection. The first person to define this concept, Montreuil, (2011), focused on the main problems of Freight Transportation as efficiency and sustainability. In this concept, the author also included various economic and social problems. The main purpose of this idea is to decrease emissions and provide opportunities to use trucks more efficiently with the provided Global Logistics chain. The global logistics chain is a network with Logistics organizations, which is based on a digital framework to provide real-time tracking and planning.

In this case, the organization needs to participate together to share its logistics resources and information to increase possibilities of Freight Transportations.

Taking into consideration the focus of Physical Internet on Freight Road Transportations, it is important to mention, that Freight Road Transportations have higher demand and this type of transportation has 80% of overland traffic, (Kunaka, Carruthers, 2014) and in the USA, Truck Transportation are responsible for 70% of Freight. (CB Insights, 2020) Also, including modern challenges of logistics, as sustainability and inefficient use of transport, (Transportation Research Board, 2019) which makes Physical Internet potentially attractive solution for logistics transportations.

In the process of the research, it appeared that the Physical Internet has a connection with Industry 4.0 and other emerging technologies. Other Researchers mention that the Physical Internet has various possibilities of implementing new ideas from technologies as 5G, Blockchain, AI. The one of the requirements of using PI is acceptance from logistics organizations and support of new technologies which will increase the efficiency of transportations by using security options provided by Blockchain, the possibility of automation from AI, and 5G connection. (Crainic, Montreuil, 2016).

1.2 Industry 4.0 and Emerging Technologies

Based on the previously mentioned connection with Industry 4.0 and emerging technologies, the chance of various implementations of 5G, AI, and Blockchain in the Physical Internet is high. With the necessity of PI to use digital technologies, this concept could be influenced by new innovations in Industry 4.0 and emerging technologies. (Maslarić & Nikolicic & Mirčetić, 2016; Osmólski, Voronina & Koliński, 2019)

With new technological trends, more people are aware of the term Industry 4.0. Industry 4.0, or the Fourth Industrial Revolution is a term from German scientists, who described Industrial innovations through digitalization and where the production process is influenced by cloud-based technology to create automated working processes. Based on one of the definitions of Industry 4.0, as the process of digitalization and automation, emerging technologies as 5G, AI, Blockchain are the main innovation trends based on the connection with the main purpose of the Fourth Industrial Revolution. (Jovovic, Husnjak, Forenbacher, 2018; Jovovic, 2019; Plattform Industrie 4.0.; Boulila, Naoufel 2019)

Based on the Fourth Industrial Revolution, the logistics processes are also covered in technological progress and changes are primarily connected with Industry 4.0 through the same concept and innovations which converts Logistics into Logistics 4.0. This connection provides adaptability of Industrial Manufacturing and Logistics operations and basically, it makes shared technologies between these two segments.

Many studies of Industry 4.0 mention different disadvantages of the concept, such as the low impact on sustainability. Most of the organizations are focusing on enhancing the efficiency and performance of the production. One of the ways to increase the efficiency of logistics is to provide additional digital instruments for decreasing road traffic. From this part of the problem, some of the authors mentioned the concept of Physical Internet which could have a significant impact on logistics operations and resolve some of the economic and environmental problems. (Skapinyecz, 2018)

In the process of investigation of the possible influence of Industry 4.0, it appeared that the main parts of the technological revolution could be divided into different categories. This paper will be focusing on 5G, Blockchain, AI. These technologies are mostly mentioned in Industry 4.0 components.

1.4 Research Questions and Objective

The first objective of this research is to find the definition of Physical Internet, analyze the advantages and disadvantages which could be implemented because of the trends of Industry 4.0, 5G, AI, and Blockchain and their benefits for truck transportations which could be used by companies to gain an advantage. As mentioned before, PI has a connection with Emerging technologies that are affecting the value of this concept and potential benefits for Logistics Organizations inside the PI network.

The second objective of this research is to analyze case studies of implementation of the Physical Internet to find data of influence from emerging technologies in the scope of Freight Road Transportations.

The third objective is to analyze potential Challenges and Benefits of the Physical Internet and provide an answer for Research Questions.

The Question of this research: Should the companies implement the Physical Internet concept in Freight Road Transportations?

2 Literature review

2.1 Road Freight Transportations

2.1.1 Trucks Transportation Overall View

With various production lines and globalization factors, organizations need to use transportation functions to increase the performance of the organization and have an economical advantage. With different needs, organizations have a choice between rail, sea, and truck options. (Amine,

Masmoudi, 2020) Freight Transportation is one of the most important segments of transportation services. Based on Ti research (Figure 1), Road freight transportation has high forecasting because of the potential technological influence and increase of logistics operations. According to Kunaka and Carruthers (2014), “In most regions, road transport (trucking) is the dominant transport mode for moving freight along corridors. In fact, more than 80 percent of overland trade traffic is by road, and nearly all trade freight is carried by road at some point.” At the same time, the European Road Freight market is growing. According to Eurostat, (2019): “European Road Freight Transport continued to grow slowly, with an increase of 0.2 % between 2017 and 2018.”

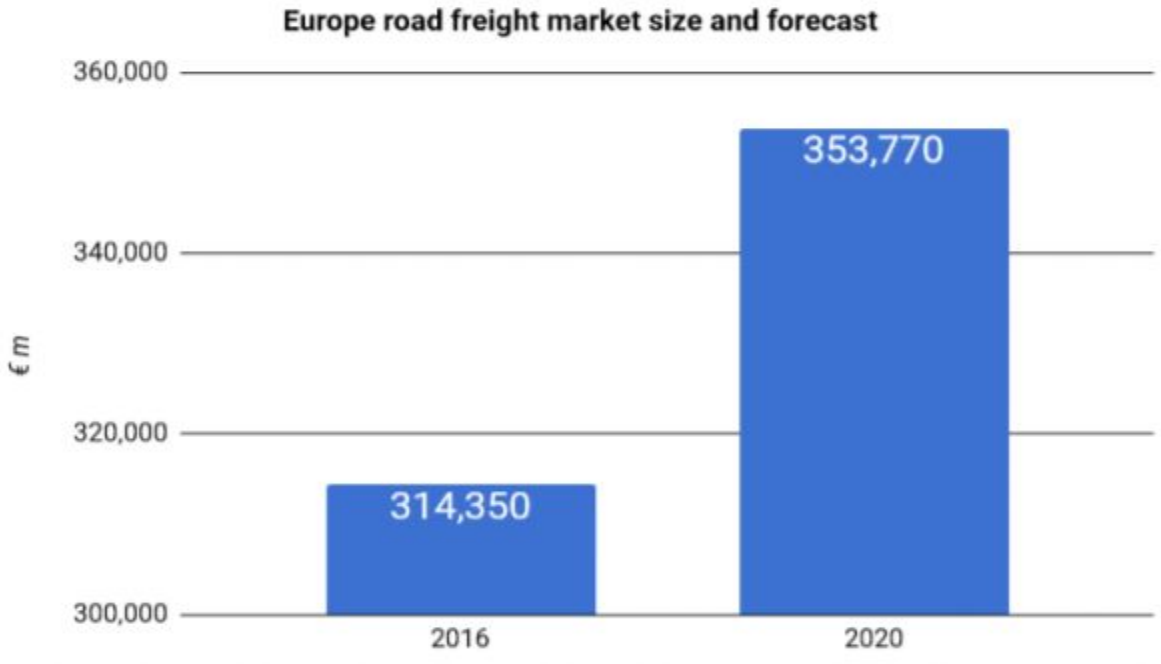


Figure 1. Source: Ti research

2.1.2 Types of Road Freight Transportations

Road Freight Transportations could be split into different categories. Some of the organizations are proposing their logistics services depending on the required type of car or necessary transportation measures. DENI International and Asstra (Figure 2) provide their information about trucks as various types of cars with various functions such as capacity, refrigerators, weather resistance, product adaptations, for example, car transportation. According to Hartl crew, (Hartl, 2018) the main classification of transport could be defined into 3 categories:

Distance, national or international traffic; Type of the goods.

Types of vehicles	Description	Length m, Width m, Height m, Internal volume m³	Weight Limit, t
Road-train 	Trucks with a lifting capacity of 20-30 tons are in demand due to cubic capacity. The difference with the standard Euro truck is about 40 cubic meters.	15.6-16.0 m, 2.4-2.5 m, 2.9-3.05 m, 110-120 m³ 38 europallet	12-20
Awning or curtainsider 	Designed to transport most types of cargo. Loading and unloading is possible top, side and back.	13.6 m, 2.4-2.5 m, 2.4-2.85 m, 82-95 m³ 33 europallet	24
Megatrailer 	Universal - a vehicle that allows the transportation of both standard goods and goods that differ in large volumes (lightweight).	13.6 m, 2.4-2.5 m, 2.87-3.00 m, 96-105 m³ 33 europallet	24
Jumbo 	Used for the delivery of bulk cargo. The volume of the trailer per cubic meter increases by the nut.	13.8 m, 2.45 m, 2.45-3.00 m, 96 m³ 33 europallet	20-24
Box trailer 	Rigid trailer over the entire length and trailer height. Sides of the body are not deform and can hold the load in during transportation. Download is possible just behind.	13.6 m, 2.4-2.5 m, 2.4-2.75 m, 82-92 m³ 33 europallet	22
Thermo box of Isotherm trailer 	Insulated trailer without refrigeration equipment. Intended for transportation over short distances while maintaining the temperature. Internal the temperature change is 1 degree in day. Download is only possible from the rear.	13.6 m, 2.4-2.5 m, 2.4-2.75 m, 82-92 m³ 33 europallet	22

Figure 2. Source: Asstra. Different transportation options

The main advantages of Truck Transportation are related to the availability of this type of cargo, the speed of delivery between cities. According to Carnarius, (Forto, 2018), the advantages of Trucks Transportations could be formalized into different sections such as cost efficiency, speed of delivery, the distance of transportation, door to door delivery, flexibility, tracking systems.

2.1.3 Trucks Transportation Challenges

With huge growth, trucks have different challenges. With modern trends of globalization, sustainability, and population growth, truck transportation has various issues that have a significant impact on potential changes where people need more advanced technologies to be able to prevent some of the negative influences created from economic and social parties and factors. According to CB Insights, (2020), one of the demanded features of delivery is fast home delivery and drivers shortages. In the case of the COVID-19, some start-up organizations provide tracking technologies which are focused on optimizations of lack of drivers through automation of transportations processes. With other factors such as technology, research, and innovation. According to the Transportation Research Board, these issues could be formalized into 12 topics:

- “Transformational Technologies and services: steering the technology revolution
- Serving a growing and shifting population

- Energy and sustainability: protecting the planet
- Resilience and security: preparing for threats
- Safety and public health: safeguarding the public
- Equity: serving the disadvantaged
- Governance: managing our systems
- System performance and management: improving the performance of transportation networks
- Funding and finance: paying the tab
- Goods movement: moving freight
- Institutional and workforce capacity: providing a capable and diverse workforce
- Research and innovation: preparing for the future”

2.2 Physical Internet

2.2.1 What is Physical Internet

The new concepts known as Physical Internet is one of the modern trends of logistics which brings different applying forms and improves real-time planning, communication infrastructure, and modular transport units. These tools are focused on data operation to gain additional information to decrease workloads, eliminate errors. The basis of this technology is the cooperation of Logistics organizations to provide joint resources for logistics purposes in the form of open Logistics Web, where participants are able to use information of each other and use the joint sources for transportation operations. (Figure 3) The main influence is in decreasing costs and increasing the value of information from the operating process. Physical internet is a concept that provides a global open logistics chain, which is called hyperconnected distribution where users have various types of transportation such as rail, trucks, maritime, which are using modular containers (Figure 4) and digital technologies to optimize route between manufacturer warehouse, and retailer. The main objective of this concept is to create a sufficiently efficient and sustainable supply chain to solve the environmental, social, and economic problems. (Montreuil, 2011).

The N-container, or Modular Container (Figure 4), is one of the main features of this concept. One of the transportation problems is the inefficient usage of Freight Road Transportations. With various logistics deliveries, most of the transport is empty and not fully loaded and it affects the logistics traffic and affects sustainability and organizational efficiency. (Transportation Research Board, Montreuil, 2011) The solution could be created through different sizes of containers, which are adapted for shipment processes to increase the inventory operations and use the full capacity of trucks. (Montreuil, 2011)

The today’s development of the Physical Internet is based on simulation processes that are focused on main logistics questions at the time of delivery, efficiency. Logistics systems. One of the problems of the Physical Internet is the limitation of real examples of implementation of this

concept, where most of the researchers are focusing on the main advantage, the timely delivery, and efficiency. Without physical prototypes, PI has a limitation in proving examples of benefits to logistics organizations. (Jaziri & Korbi, 2020)

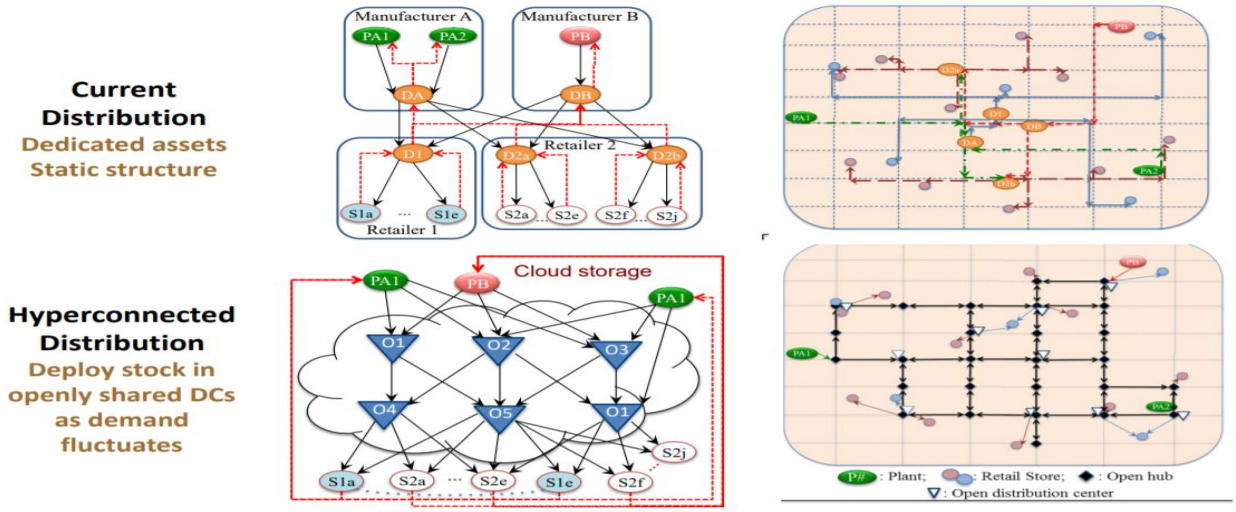


Figure 3. Source: Montreuil, International Physical Internet Conference, 2017. The logistics Network

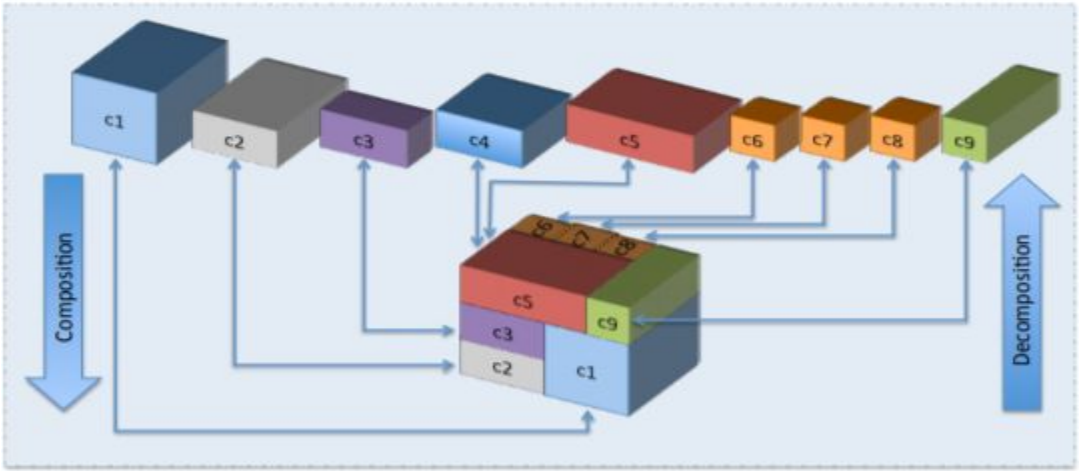


Figure 4. Source: Montreuil, 2011. Modular Containers

2.2.2 Objective of Physical Internet

Montreuil, (2011), describes the main problems of logistics which makes transportation processes underperforming and unsustainable with 3 levels of effect: Economical, Environmental and Social. The problems are ¨Half-empty transportations¨, high demand for the driver, and shortage of human resources. In the research of potential implementation of PI in Saudi Arabia, Jaziri, Korbi, and Gontara (2020) mention the county´s logistics status, where organizations have problems with HR, and efficient transportations between ports. As previously mentioned, Road freight transportations challenges include networking issues and ineffective

international transportations, because of the cost of service and the value of delivering goods in one way and challenges includes the demand of customers, which is based on increased number of population and users of transportations, who wants delivery to the door with high speed as the one of the main factors of choosing Transportation Organization. (Transportation Research Board; CB Insights, 2020)

According to Montreuil, (2011), the main issues in logistics is the efficiency and the influence of higher customer's needs on sustainability. As mentioned before, PI is a logistics solution that covers Economical, Environmental, and Social aspects of transportations. (Figure 5) The main problem of Logistics is the inability to use Truck Transportation more efficiently and some of the examples of poor transportation performance are empty packaging, not use of the transport while finishing transportation, the shortage, and surpluses in warehouses. It is important to mention that the author doubts the influence of smart or digital technologies which are focusing on data transportation and analysis. Based on this, the main objective of this concept is usage of N-containers and the Logistics Web to connect organizations and provide one united type of cargo which will help to solve the problems of empty trucks and the speed of shipment. According to Crainic and Montreuil, (2016), the possible implementation in the scope of the city needs advanced technologies for tracking which are part of Digitalization.

	Unsustainability symptoms	Economical	Environmental	Societal
1	We are shipping air and packaging	●	●	
2	Empty travel is the norm rather than the exception	●	●	
3	Truckers have become the modern cowboys	●		●
4	Products mostly sit idle, stored where unneeded, yet so often unavailable fast where needed	●		●
5	Production and storage facilities are poorly used	●	●	
6	So many products are never sold, never used	●	●	●
7	Products do not reach those who need them the most	●		●
8	Products unnecessarily move, crisscrossing the world	●	●	
9	Fast & reliable intermodal transport is still a dream or a joke	●	●	●
10	Getting products in and out of cities is a nightmare	●	●	●
11	Networks are neither secure nor robust	●		●
12	Smart automation & technology are hard to justify	●		●
13	Innovation is strangled	●	●	●

Figure 5. Source: Montreuil, 2011. Unsustainability symptoms.

2.2.3 Challenges of Physical Internet

In the first proposal, Montreuil, (2011) mentioned the main challenges of PI such as connectivity between various logistics operators in the Global Chain, the adaptation of digital technologies. According to Tran-Dang & Krommenacker, (2020), the main challenges of the Physical Internet could be formalized into 2 categories: system and business. In this research, the author mentioned the effect of IoT technology, which is a necessity in Modular Container. The challenge of IoT implementation is a potential emission and influence on the environment from this technology. At the same time, the performance of the IoT in containers because of the potential distortion of waves which will decrease the performance of this system. And according to the conclusion of Tran-Dang & Krommenacker, (2020):" Shift from the current logistics to the PI requires substantial transformations in infrastructure, technology, and business model." The second section of challenges was related to the Business part as the support of the concept and creation of the commitment which will provide a necessary PI connection between various organizations in the Logistics segment.

2.2.4 Implementations of Physical Internet

According to Dans, (2019), Amazon is a company, which is moving into a logistics system which is similar to the Physical Internet concept, because of the vertical integration of logistics through building airports, maintaining warehouses and using their own transports. Based on the opinion of the author, Amazon could potentially establish dominance on the Transportations Market which will lead to loss of customers to other companies, because of the advantages of Logistics network os Amazon, which provides additional digital services where B2B customers can improve their own expenses and increase efficiency of their sales. (Dans, 2020)

2.3 Industry 4.0

2.3.1 Fourth Industrial Revolution

According to the German Research Center for Artificial Intelligence, "Industry 4.0 describes the 4th Industrial Revolution through the introduction of modern information and communication technologies in production." According to Plattform Industrie 4.0, Industry 4.0 creates such possibilities as Flexible production, where the production process could be digitally networked and have better coordination, convertibility with the ability to create production modules for assembling processes.

One of the issues with Industry 4.0 is a various interpretation of this term. Based on an interview with Mr. Egersdörfer, "The first issue to be determined is what is an industrial revolution? People can talk about a revolution related to IT tools themselves because established data management tools like relational databases will no longer suffice for working with Industry 4.0.

In relation to production, I believe that we are talking less about a revolution and more about an evolution" Industry 4.0 also could be formalized as "logical continuation of the convergence of information and communication technology (IT) with automation technology (AT), focused primarily on communication and networking." (Ines, 2015). According to an interview with Oren Manor of Mentor Graphics, Industry 4.0 is a digitalization process with a connection between machines and the minimization of human interaction. With advanced technologies, the Supply Chain has new technological opportunities such as the ability to use computers and connections between machines to make fewer human interactions and increase the efficiency and productivity of the production floor. (Matties 2016). With different author's perceptions, the meaning of Industry 4.0 could be distorted.

The main difference between Industry 3.0 and Industry 4.0 is the implementation of Cyber-Physical Systems (Figure 6), which could be formalized as the Age of CPS. It is the concept of an internet environment of collecting data devices with automated control over decision making over the production process. (Xu, L. D., Xu, E. L., & Li, 2018). According to Cimini, (2020), the main attributes of Industry 4.0 are CPS and Industrial Internet of Things which provides real-time tracking for the production process and is a cloud-based computing process that is making the autonomous decision-making process over the production process.

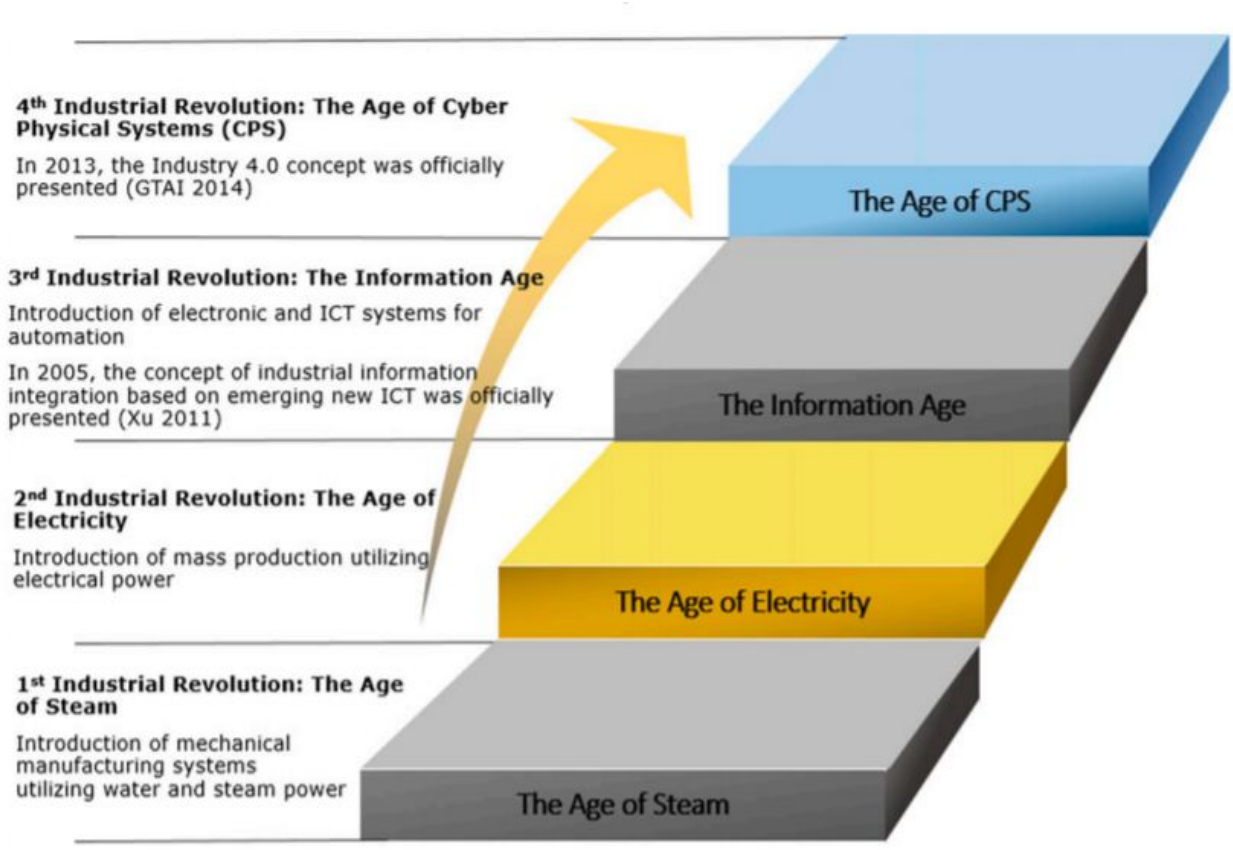


Figure 6. Source: Xu, L. D., Xu, E. L., & Li, L. (2018). Comparative analysis of Industrial revolutions

Industry 4.0 can increase efficiency and quality of the product by using Cloud and IoT technologies which provide various options of control possibilities and automated production processes. (Thames & Schaefer, 2017.) With different opportunities, advantages of Industry 4.0 could affect different aspects of production, from the performance of the Supply Chain to the consumer experience. According to Almada-Lobo, I (2017) Industry 4.0 can provide such advantages as an increase in efficiency, agility on the production line, an increase in customer experience, a decrease in cost, and optimization of revenue.

2.3.2 Main Concepts

In the research of definition of Industry 4.0, Gizem Erboz (2017) found mentions of 9 main concepts (Figure 7) in various researches, which represents these concepts as the main technological innovations provided by Industry 4.0 These concepts cover IT and AT technologies which are mentioned by Egersdörfer, Papenfort, and Manor. (Matties, 2016; Egersdörfer, 2020)

The main tools of Industry 4.0 are Cyber-Physical Systems (CPS), which transforms information from one point to another while using various sensors, supported by the Industrial Internet of Things (IIoT) and which are analyzing situations and providing autonomous decision-making processes (Skapinyecz,2018).

THE CONCEPTS	THE DEFINITIONS OF THE CONCEPTS	THE EXAMPLES OF THE CONCEPTS
BIG DATA	Large, complex datasets that affect the decision making of companies	Big data analytics, algorithms, software programs
AUTONOMOUS ROBOTS	Solve complex tasks which cannot be solved by human	Kuka Iwaa has the learning ability to achieve some certain tasks
SIMULATION	Mathematical modelling, algorithms that optimize the process	Software programs
HORIZONTAL&VERTICAL SYSTEM INTEGRATION	Integration of inside of the factory and SCs	Smart factories, cloud systems
INTERNET OF THINGS	Connection of the physical objects and systems	Smart network
CLOUD COMPUTING	Shared platforms that serve to the multiple users	Google Drive, BlueCloud, Windows Azur
ADDITIVE MANUFACTURING	3D printing technology, producing in mass customization	3D printers to produce smart phones
AUGMENTED REALITY	Human-machine interaction on maintanence tasks	Google Glass
CYBER SECURITY	Cyber attacks to business environment	National defense systems in order to prevent attacks

Figure 7. Source Gizem, (2017). 9 concepts of Industry 4.0

2.3.3 Cyber-Physical Systems

According to the National Science Foundation, “The term Cyber-Physical Systems refers to the tight conjoining of and coordination between computational and physical resources". The main purpose of CPS is to manage physical processes while using its own generated data from connected to the network devices, to adapt to new conditions in real-time. (Sabella, 2018) Based on Cloud technology and the connection of computers with the system´s sensors, CPS could work independently from humans and provide data in real-time with the ability to use machine-based decision making from the system’s settings which are based on the needs and requirements of the production line. (Figure 8) The CPS system is also able to provide logistical transportations based on data sharing processes and connection between Logistics transportation and Warehouse networks. (Skapinyecz, 2018)

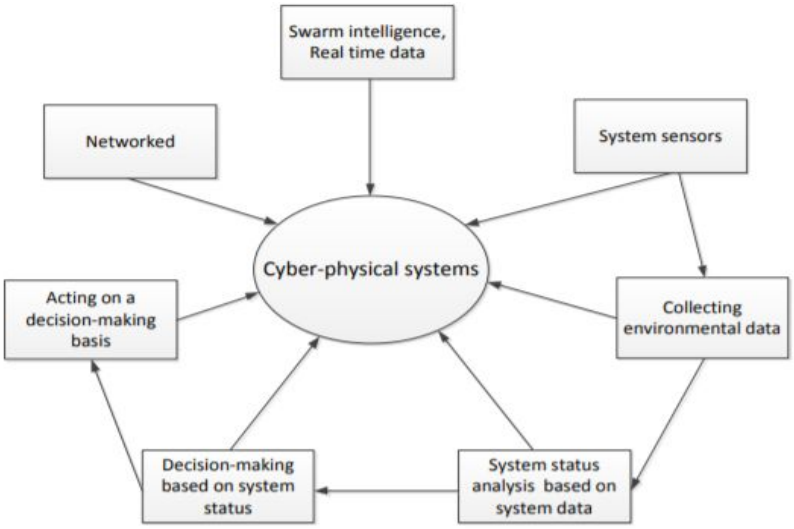


Figure 8. Source Skapinyecz, (2018) Components of CPS

Cyber-Physical Systems typically include a network of devices that receive and perform physical actions while simultaneously being controlled and monitored by software. Cyber-Physical Systems are the integration of embedded systems, sensors, communication networks, and control systems. The main purpose of using a cyberinfrastructure (including sensing, computing, and communication hardware and software) is to monitor (from physical to cyber) and control (from cyber to physical) the physical world. (Boulila, 2019) (Figure 9)

Figure 9. Source Boulila, 2019. CPS communication between devices

According to Boulila, (2019) Building systems that integrate computational and physical objects require new systems science foundations. It opens new research possibilities based on currently available technology as well as new technology innovations. By merging computing and communication with physical processes based on sensors, Cyber-Physical Systems brings many benefits including efficiency which is based on various devices connected to CPS, reducing the cost of building and operations systems, safety measures based on automated processes and sensors ability to understand a situation on production.

2.3.4 Cloud Computing

Cloud Computing (CC) provides the possibility to control the system and the parts of the production machines based on the environment provided by cloud technology. The parts of production are connected through sensors and controls and with real time data processing devices, information is transported to the cloud system, where computers are responsible for the decision making process and ability to give remote control over production. (Savtschenko, M. & Schulte, F. & Voss, S. 2017). One of the advantages of CC is the connection between producer and customer. One of the functions of the cloud systems is the availability of connections between different users. In the case of Industry 4.0, producers can connect with their customers to provide detailed information about their order and give more customer service, where individuals can search for production information by themselves, at the same time seeing the process and using the tracking abilities to know about the completion of the order. (Gizem Erboz, 2017). This technology could highly impact logistics because it will provide information about the time of completing the order which will help Transportation Units to adapt for the time changes, decrease the emissions, and increase the efficiency of the logistics network. (Cimini & Lagorio, 2020).

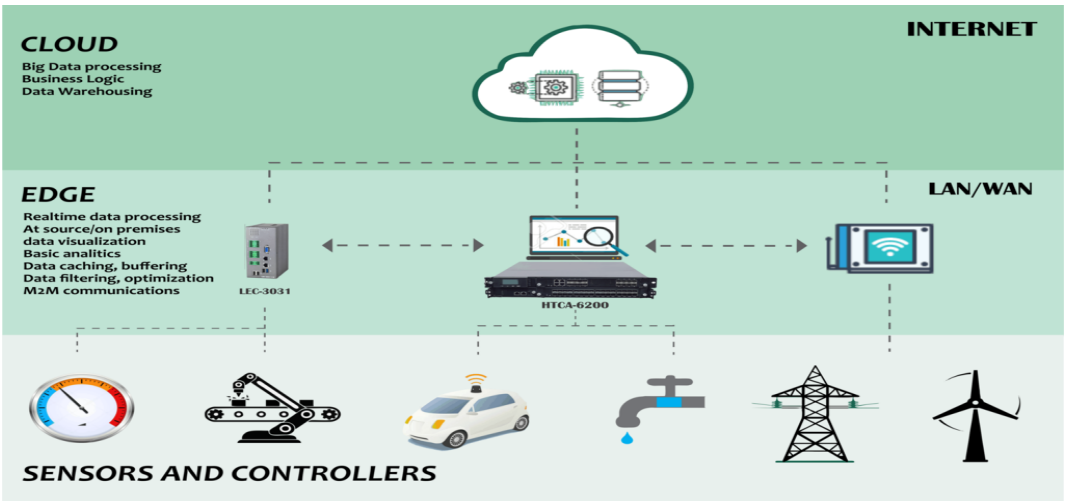


Figure 10. Source Kumar, (2018). As an IoT Platform, what should be the right balance of data computing between the Edge and the Cloud?

2.3.5 IIoT

According to Shakir, (2018), the Industrial Internet of Things (IIoT) and the Internet of Things, (IoT) have various definitions that mostly focus on the primary objectives of these technologies. For IIoT it is an environment of various intellectual industrial devices that are connected and corresponding with each other and provides organization and control of complex processes with the ability to use distant management of device´s activities. (Figure 11) As for IoT, it is physical and digital communication between various devices. (Fales, Control Engineering, 2019)

The basis of the IoT is the Radio-Frequency Identification (RFID) and wireless sensors networks (WSNs). (RFID) is an auto-identification technology, which is based on an audio receiver and transmitter. WSNs are a set of sensors which are collecting information such as pollution level, wind, humidity, sound, and temperature. The RFID and WSNs are connected, the RFID is responsible for the identification of sensors and the transmission of the information, which was collected by WSNs. (Landaluce, H. 2020)

The IIoT is the same concept as IoT but these devices are more adapted for industrial purposes. In the case of IIoT, devices require attention to security factors to protect the production line and at the same time, these gadgets need to have lower latency and better precision and accuracy to provide better connection of these technologies and make the processes secure and efficient (Figure 12). According to Benson Chan, (IoT For All, 2017), the difference between IoT and IIoT is the higher need for low latency for better connection inside CPS and special construction methods for better resistance and adaptability for Industrial purposes.

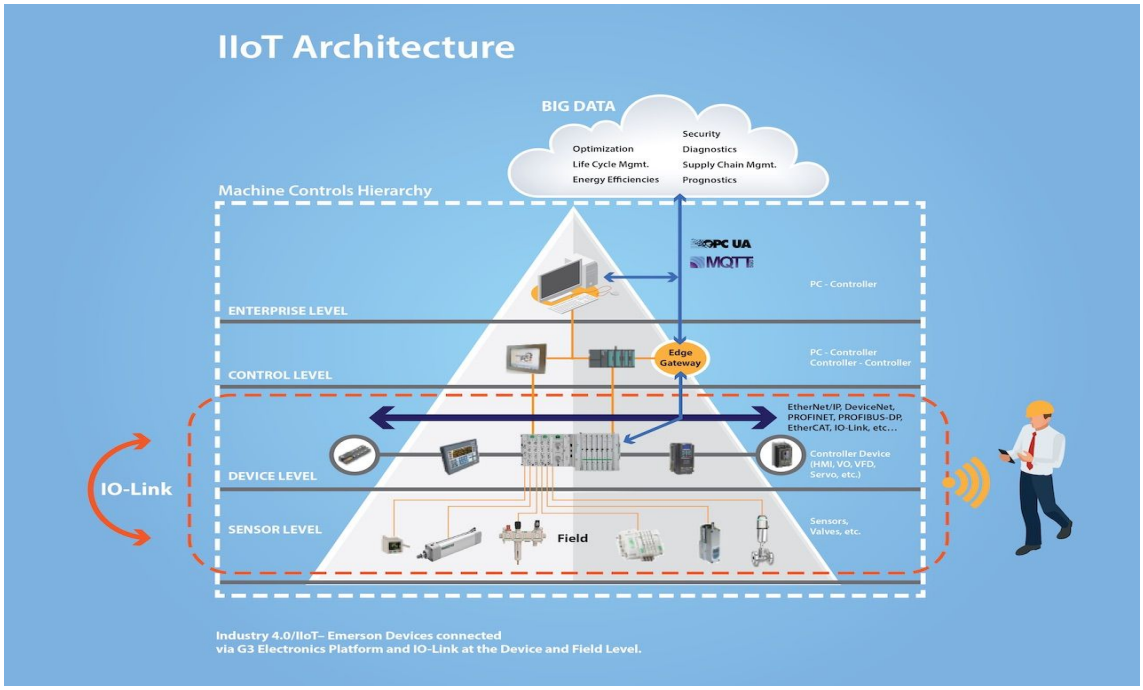


Figure 11. Source: Emerson Automation Solutions. IIoT Architecture

Perspective	Internet of Things	Industrial Internet of Things
Linked things	consumer-level devices, typically less costly	serious machines, sensors, systems, typically with a high degree of difficulty
Service model	human-centric	machine-centric
Applications	consumer-oriented applications	industry-oriented applications
Communication transportation	basically wireless	Both wireless and wired
Communication competences	a small number of communication standards	a high number of connectivity standards and technologies
Quantity of data	Medium to high	High to very high
Criticality	Not severe	undertaking serious (timing, security, privacy reliability)
	typically no, industry with less time-sensitive systems	the majority often has a key role

Figure 12. Source Shakir, 2018. Difference between IoT and IIoT

2.3.6 Impact on logistics: Logistics 4.0

Logistics 4.0 is an adaptation of Industry 4.0 concept in logistics. Primarily, the objectives of this process are the integration of SPC systems which will adapt transportation and production into one system with the ability to control these processes remotely or automatically. (L. Barreto, A. Amaral, T. Pereira, 2017).

According to Kesheng, (2016), the technological difference between Logistics 3.0 and Logistics 4.0 could be defined as the development of more complex internet technologies that can work in one ecosystem. (Figure 13) The difference between Logistics 3.0 and Logistics 4.0 is the focus of Value Chain compared to the Supply chain (Figure 14).

Because of increased demand for service from transportations, most of the organization needs to focus on the ability to fulfill customer´s expectations of quality of the service, which includes the availability of the product in the stock, quick delivery, and absence of damages and delays. (Ezzat, Kassem and Elkader, 2019). These factors have influence from customers' needs which affects demand and supply of organizations and affects the logistics of companies included in delivering goods and services to the final customer. At the same time, logistics impacted by technological changes and organizational as product structure, product life cycle which includes marketing. Based on Skapinyecz research, (2018), most of the changes could be formulated into globalization and localization, an intelligent distribution based on cloud services and networking.

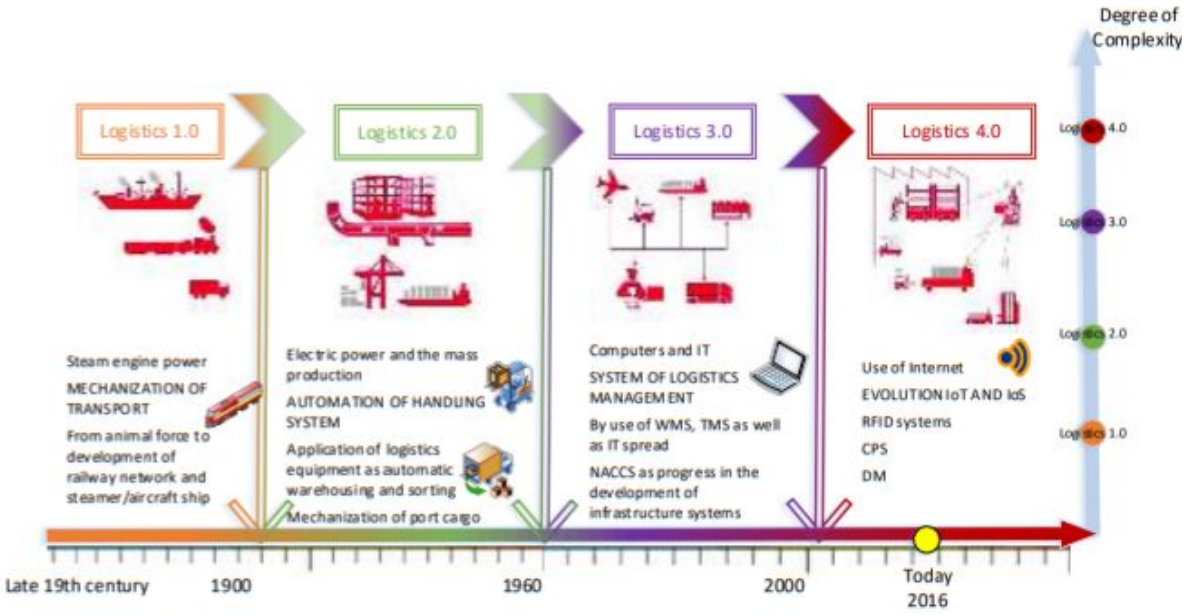


Figure 13. Source Kesheng. (2016). Changes from Logistics 1.0 to Logistics 4.0

Point of comparison	Value chain	Supply chain
Market Focus	End user or Consumer	Customer
Operations focus	Value stream	Demand stream
Maximization	Value delivered to consumer	Profitability among the parties
Scope	Macro level	Micro level

Figure 14. Source Ezzat, Kassem, and Elkader. (2019) Difference between Value chain and supply chain

2.4 Emerging Technologies

2.4.1 Blockchain

2.4.1.1 What is Blockchain

Blockchain is one of the most popular emerging trends in the world. With various segments, blockchain could have different methods of implementations. The main part of this technology is the blocks that contain digital information. According to Reiff, (2020), blocks:

- Blocks store transaction information, such as the date, time, and dollar amount of your last purchase.
- Blocks store information about users is involved in transactions. Purchase is recorded without any identifying information using a unique digital signature, such as a username.

- Blocks store information that distinguishes them from other blocks. Each block stores a unique code called a “hash”, which allows it to distinguish it from any other block. Hashes are cryptographic codes created by special algorithms.

According to Lichtigstein, (2018), the main idea of blockchain is the decentralized flow of data, where information is formalized in blocks and transformed into a cryptographic code called Hash. On the figure, blockchain performance could be defined as the Request of the customer, transformation into a block, the broadcast of the block into nodes of the network, the checking process of nodes to validate requests, adding to the chain, and completion of a transaction (Figure 15).

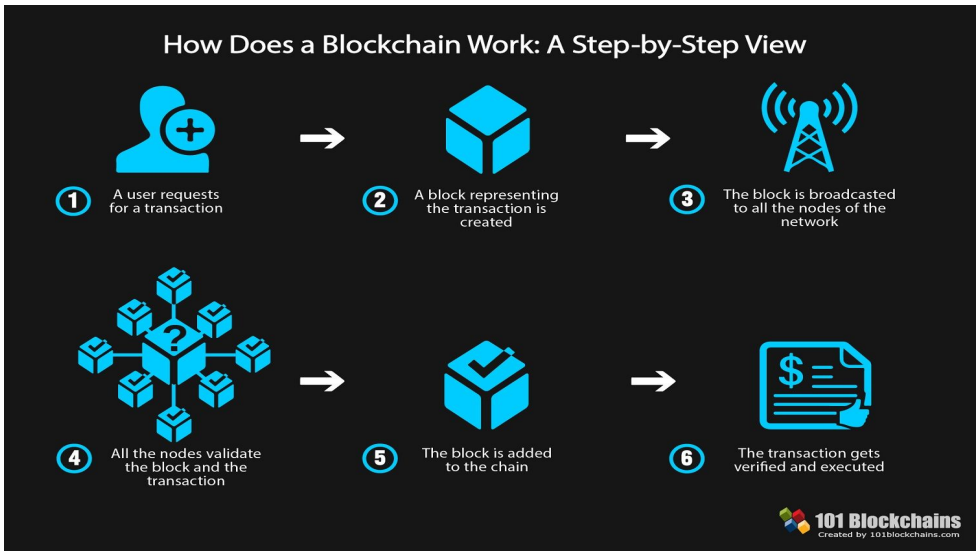


Figure 15. Source 101Blockchain, (2018) How does a Blockchain Work: A step-by-step view

2.4.2.1 Blockchain in Truck Transportation

According to Pervez and Huma (2019), Blockchain has an influence on the development of logistics. Based on their research, blockchain can bring various solutions that can impact logistics performance or increase customer value which can improve the perception of the company. Blockchain can establish public access for tracking of logistics contracts (Figure 16) and control over the state of transportation with Blockchain security measures as data transfer through Blocks and the possibility to track violations of the transportation contract. (Rožman, 2019).

Most importantly, in logistics blockchain can:

- Opens access to data concerning the activities within the supply chain
- Furnishes clients with the capacity to assess the item, service, supplier, carrier
- Provides customers with the provenance of data and cargo routes.

- Reduces risk regarding fraud or fake goods.
- Empowers monitoring, tracking, and tracing transports streamlines trade of merchandise and payment frameworks

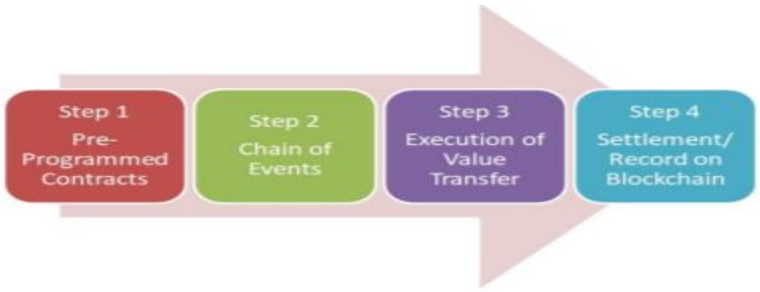


Figure 16. Source Pervez and Huma (2019), Smart Contracts

At the same time, structure based on the blockchain can increase performance and economic approach with smart contracts, which creates additional security of contracts which is supported by the blockchain system:

- 1) Pre-Programmed Contracts: The terms, conditions, and rules of an agreement that have been established among different parties and are written in the form of code are known as pre-programmed contracts / smart contracts.
- 2) Chain of Events: If the event/clause specified by the conditions occurs, It will invoke/trigger the pre-programmed clause automatically.
- 3) Execution and Value Transfer: On the successful execution of the contract clause/transaction, the rule of the smart contract will automatically transfer the asset/ value to the relevant party.
- 4) Settlement/ Record on Blockchain: Finally, the transfer of value will be made and the value transfer step will be recorded on the blockchain.

2.4.3 5G

2.4.3.1 What is 5G

According to Qualcomm, “5G is the 5th generation mobile network. It is a new global wireless standard after 1G, 2G, 3G, and 4G networks. 5G enables a new kind of network that is designed to connect virtually everyone and everything together including machines, objects, and devices. 5G wireless technology is meant to deliver higher multi-Gbps peak data speeds, ultra-low latency, more reliability, massive network capacity, increased availability, and more uniform user experience to more users. Higher performance and improved efficiency empower new user experiences and connect new industries.” According to Fisher, (2020), 5G has significant improvement in latency and the speed of data transportations is on the next generation, where people can use it in autonomous applications and technologies.

2.4.3.1 5G in Truck Transportation

According to DHL, (2020), Ericsson, (2018), Blume Global, (2020), Tøgard, (Wallenius Wilhelmsen, 2019) truck transportation will have such benefits as possibilities of establishment of autonomous truck transportations with the availability of low latency connection. At the same time, low latency brings better communication between IoT devices which can help to provide better tracking and real-time data on transportation processes. All authors mention that low latency has a significant impact on various road freight transportation. According to Ericsson, (2018), one of the advantages of 5G implementation is sustainability in the field of logistics because of the connection with automated vehicles, which have electricity of a hybrid base for enemy consumption.

2.4.4 Artificial Intelligent (AI)

2.4.4.1 What is AI

According to Fagella, (Emerj, 2018), AI is: “an entity (or collective set of cooperative entities), able to receive inputs from the environment, interpret and learn from such inputs, and exhibit related and flexible behaviors and actions that help the entity achieve a particular goal or objective over a period of time.”

According to Russell and Norvig, (2010) AI could be divided into 4 categories of implementation (Figure 17): Think humanly, think rationally, Act humanely, Act rationally. These concepts are based on possible imitation of human’s thinking which is formalized into different categories for a better understanding of realms of Artificial Intelligence.

	Human performance	Ideal performance
Thinking	Think humanly	Think rationally
Acting	Act humanly	Act rationally

Figure 17. Source Chanuwas/New Aswamenakul, Medium 2017. Implementations of AI

2.4.4.1 AI in Trucks transportation

According to Zhang, (2019), Artificial Intelligence can significantly increase the performance of road deliveries with different autonomous options where logistics organizations can use their own transportation resources to allocate need in other physical resources to complete delivery for finishing production objectives. In the author's example, Mercedes Benz unveiled technology called Vision Van which has an impact on the whole production because of the autonomous delivery process and communication with the warehouse.

2.4.5 Influence of Emerging Technologies on the Physical Internet.

According to Osmólski, (2019), Physical Internet has different possibilities to improve logistics. The author gives an opinion that the PI can provide universal data exchange platforms for logistics cooperation. Unification of business processes based on the network system of PI. Additional tools for occurring disruptions in logistics chains to find a replacement of different routes.

One of the issues in establishing the Physical Internet is the support of Digital technologies. According to Crainic and Montreuil, (2016), in the case of using Physical Intent concept in Freight Road Transportations, one of the requirements is enabling tracking technologies an IoT and 5G, because these technologies are supporting transportation system by providing real-time road status in the city and also, provide information about modular containers. One of the necessities of PI is the availability of digital technologies to provide real-time tracking for the networking processes which will control the main traffic of transportations inside Global Chain. Osmólski, W., Voronina, R., & Koliński, A., 2019)

With emerging digital technologies, the Physical Internet gains more capabilities. In the case of Modular containers, technologies such as 5G and Blockchain can provide additional value as better tracking of containers and an increase in the security of transportations. (Osmólski, W., Voronina, R., & Koliński, A., 2019; Pervez, H. & Haq, I. 2019)

3 Methodology

3.1 Existing situation

The Physical Internet is a new phenomenon that could significantly affect logistics organizations because of the idea of providing the shared network and modular containers for transportation operations.

The modern technological trends as Industry 4.0 is sufficiently influential and have different possibilities to change the whole segment of Trucks Transportations. With the existing demand and challenges of this segment, organizations are searching for solutions that can help to optimize and enhance the performance of road Freight Transportations.

As mentioned before, Industry 4.0 could have more influence from Small Medium Enterprise and start-up companies, which can bring new solutions and technological innovations, because the concept of Industry 4.0 consists of various technologies that are in the development of small organizations which are specialized on technologies.

Based on previous information, with existing trends of Industry 4.0, Truck Transportation could receive more advanced solutions because of the demand and challenges inside industry and connection with advantages of Industry 4.0.

Hypothesis 1: The Road Freight Transportation market will have more benefits from new technologies because of modern technological trends and the influence of Globalization and SME growth.

One of the possibilities of realization of the new technologies is the concept of Physical Internet. As mentioned before, the PI gained more awareness and has different perceptions based on various technological and social trends. Based on Industry 4.0 disruption of logistics and emerging technologies, Physical Internet could have a considerable impact on the development of the logistics industry.

Hypothesis 2: With various trends such as Industry 4.0, sustainability, and emerging technologies, the concept of Physical Internet will have more impact on Trucks Transportations.

It is essential to find information regarding the advantages and disadvantages of PI on logistics businesses based on the possibility of the Physical Internet to disrupt the existing Logistics operations. The main reasoning behind this project is to find the advantages of using this concept, which will prove the possibility of changing Freight Road Transportation. Issue of providing the answer on this question is limited to the possibilities of gaining data related to this case.

Hypothesis 3: The concept of Physical Internet is beneficial to Logistics Organizations

3.2 Research Strategy

The research is divided into two different categories: analysis of primary and secondary data. Hypothesis one and two researched based on the interview because of the necessity of an in-depth analysis of these potential theories. The interview's analysis will be based on the observation of similarities between Logistics Experts, new ideas, and correlations with previous

research.The interview candidates build on Logistics companies and Logistics Experts, who participated in the ALICE Physical Internet Conference. Because of the scope of this conference, the chances to receive answers will be higher. Based on the limitations of the study, for Hypothesis 3, the analysis will be based on a qualitative investigation of Case Studies, which are reflecting technological aspects of Physical Internet, challenges of PI, advantages, and disadvantages for businesses and it will answer the main question of the project, the benefits of PI and should the companies implement this concept.

The plan of the research:

1. Analysis of Freight Road Transportation
2. Analysis of Physical Internet
3. Analysis of existing researches related to Industry 4.0 and its impact on logistics and emerging technologies.
4. Analysis of Emerging technologies and their connection with PI
5. Analysis and formulation of hypotheses based on observation of literature.
6. Test of the Hypothesis
    a. Interview Analysis
    b. Case Study analysis
7. Data analysis.
8. Conclusion of the research.

Analysis of current existing researches related to Industry 4.0's impact on logistics and emerging technologies.

The main objective of this part is to find various literature on the Fourth Industrial Revolution or Industry 4.0 and find enough information about the impact of Industry 4.0 on digitalization, connection with logistics, and influence on emerging technologies.

Analysis of the Freight Road Transportations.

This part is dedicated to the analysis of the Freight Road Transportation, overview of the market, companies' proposals, types of transportations.

Analysis and formulation of hypotheses based on observation of literature.

This part aims to find correlations and connections between literature and find questions that need more attention and additional research after collecting information about segments, existing literature, and definitions of technologies.

Test of the Hypothesis based on interviews with experts in the logistics field.

To find supporting information for Hypothesis, the interview will cover three questions, with open answers, which will create a more in-depth analysis of the Physical Internet. The process of communication will be through email and LinkedIn accounts. The companies which participated in activities connected to the Physical Internet. ALICE PI conference and the Logistics Experts will be selected by personal networking. The main objective of this type of research will be a collection of qualitative data that will support Hypothesis two and three.

Test of the Hypothesis based on Case Studies.

Based on the limitations of professionals and in-depth research based on the connection of Industry 4.0 and Emerging technologies, the method of this research will be based on analysis of Physical Internet case studies, where authors provide a research implementation of this concept.

Most of the case studies related to the Physical Internet provide data based on conceptual development where research is based on simulation of logistics processes to find the effect of PP on logistics routes. The researches which are analyzing business aspects and the benefits of using the Physical Internet are hard to find.

The main objective of this question is to find the value of Physical Internet on organizations, and will it appear beneficial to Logistics companies. The advantages could be formalized as benefits of a logistics network, including real-time tracking system, autonomous control over logistics operations, availability of using joint resources, technological innovations such as modular containers.

After collecting advantages, the next step is to find challenges that represent the concept's problems, potential losses to organizations, and connection with advantages. With completing both parts, the analysis will be based on a case study approach to compare the results of research with previous interview research and present comparative analysis of existing challenges and benefits and their influence to implement possible factors that will impact an organization's decision on implementation of Physical Internet.

In this research, there will be an analysis of the advantages of Physical Internet by the original author of this term, Montreuil, and analysis of challenges by Tran-Dang, H. & Krommenacker, N. & Charpentier, P. & Kim, D., S.

- Montreuil, B. & Rougès, J .F. & Cimon, Y. & Poulin, D. (2012). The Physical Internet and Business Model Innovation. Technology Innovation Management Review. 2. 32-37. 10.22215/timreview/566.
- Tran-Dang, H. & Krommenacker, N. & Charpentier, P. & Kim, D., S. (2020). Towards the Internet of Things for Physical Internet: Perspectives and Challenges.

3.3 Data analysis

This research contains a mixed approach that will cover secondary and primary data through case studies and interviews.

Primary data

Interview with Logistics Experts based on three main questions:

- Which types of logistics transportation (ships, trucks, airlines) will have more benefit from new digital technologies such as 5G, AI, Blockchain?
- What do you think about the possibilities of using the Physical Internet concept for truck logistics operations?
- Which of existing technologies except for IoT, Blockchain, 5G, AI could bring new initiatives in truck transportations in the scope of the physical Internet?

Based on this, I received four full answers and three answers, which are demonstrating additional findings in this research.

Secondary data

The case study analysis includes:

- Montreuil, B. & Rougès, J .F. & Cimon, Y. & Poulin, D. (2012). The Physical Internet and Business Model Innovation. Technology Innovation Management Review. 2. 32-37. 10.22215/timreview/566.
- Tran-Dang, H. & Krommenacker, N. & Charpentier, P. & Kim, D., S. (2020). Towards the Internet of Things for Physical Internet: Perspectives and Challenges.

4 Analysis and Findings

4.1 Interview Analysis

The purpose of this analysis is to compensate for the problem of limited sources and use qualitative analysis in the interview style to find supporting information for Hypothesis 1 and 2.

For the interview, the main scope of candidates was based on the ALICE's participants, International Physical Internet Conference 2017. The base of the candidates were various organizations such as P&G, ELUPEG, Marlo, Bluegreen. The whole scope of candidates is diverse, with different companies' sizes and various segments of operations. The connecting part is interest in technologies and the concept of Physical Internet.

With the limitations of possibilities to connect with these organizations and the limitations of companies, which can provide their opinion, the interview's scope was changed due to difficulties in receiving data. Based on receiving harmful data from one of the Logistics Experts, the problem of receiving responses was based on the limitations of SME organizations to reach these technologies.

With an updated understanding of this problem, the scope of the interview was based on Experts in Freight Road Logistics Transportations. To find these experts was decided to use a LinkedIn profile and the search process of a professor of Logistics and employees of the Shippers and retailers of organizations that participated in ALICE 2017.

4.1.2 Hypothesis 1: The Road Freight Transportation market will benefit from new technologies because of modern technological trends and the influence of Globalization and SME growth.

For this Hypothesis, the author used questions 1 and 2, which are formulated for analysis of innovation's impact on the Road Freight transportations.

Firstly, it is essential to mention one of the issues of research methodology. In the process of sending interview questions, most of the organizations of Medium and Small size were not able to answer these questions and recommended to connect with ALICE, an organization that represents companies interested in Physical Internet.

Most of these responses were focusing on the problem of accessing these technologies and the inability to implement some solutions on the Small-Medium Enterprise level. According to previous secondary data research, Road Freight Transportations have a stable growth rate and the demand for services, but from the primary analysis, the main impact on the technological revolution will be based on tremendous leaders from the Logistics Segment. In this case, the influence of SME growth is questionable, and because of the limitation of this research, it cannot be proven because of lacking responses.

Based on the study limitations mentioned above, Hypothesis 2 will be adjusted as follows: **The Road Freight Transportation market will have more benefits from new technologies than other types of transportation.**

To prove the updated Hypothesis, the author used Question 1 in the interview: Which types of logistics transportation (ships, trucks, airlines) will have more benefit from new digital technologies such as 5G, AI, Blockchain?

The answers were divided into different types of transportations as ships, trucks, airlines.

Three Participants agreed on the point that emerging technologies would be beneficial for all types of logistics. To prove this statement, responder 1 mentioned an increase in efficiency of

data gaining processes based on IoT influence, especially RFID technology and other optic sensors that have the same purpose as RFID devices.

Also, responder 2 mentioned that truck transportation already has innovation and research, which brings benefits in the automation technologies for self-driving vehicles. The same opinion was introduced by responder 3—the idea of automated vehicles.

The responder four also supported additional benefits of Trucks transportations. In his view, "While I believe that all modes of transport will benefit from the advance in digitalization that we are now seeing, I must say that the greatest benefits will accrue to land-based transport operations. This is due to the size of this market and its relatively rudimentary use of digital technologies today."

Responder 5 mentioned that all transportation types would receive technological advancement, and, in his opinion, the cheapest innovations will be in shipped transport, and the technologies as 5G, IoT, and Blockchain will be more suitable for this type of transportation.

Based on answers from the interview, all logistics experts said truck transportation would have more benefits than other types of transportation. At the same time, experts provided similar technological innovations which can boost the technological progress of Freight road transportation. At the same time, one of the experts thinks that one of the main changes will be based on Ships transportations.

4.1.2 Hypothesis 2; With various trends such as Industry 4.0, sustainability, and emerging technologies, the concept of Physical Internet will have more impact on Trucks Transportations.

To prove this Hypothesis, participants were asked a question about Physical Internet: **What do you think about the possibilities of using the Physical Internet concept for truck logistics operations? And Which of existing technologies except for IoT, Blockchain, 5G, AI could bring new initiatives in truck transportations in the scope of the physical Internet?**

The combination of these questions provides a more in-depth analysis of the impact of the Physical Internet. With the main question 1 and supporting questions 2, Experts In logistics provided their view of PI concept in truck transportation, and they also provided their view of other technologies that are not described in this research.

Responder 1 mentioned an advantage of this system as information sharing between stakeholders. One of the problems mentioned in the message is communication between various parties and one of the points of trust. Also, responder mentioned the problem of accessibility of information regarding Physical Internet and inability to give a definite answer

Responder 2 mentioned the connection between transport and how it should be managed. At the same time, he admits the beneficial influence of Physical Internet optimization "Generalization of cargo sizes would allow us to hyper-optimize the truck shipping and enable us to automate the loading/unloading of any cargo without much repercussions to the results."

Responder 3 mentions research based on the Physical Internet, where there was a test of this concept. With this suggestion, I discovered additional research on the Physical Internet. At the same time, the responder mentioned additional project bases on trucks and the idea of modular containers.

Responder 4 discussed one of the features of Physical Internet, which is the ability to connect different types of cargo transport and make logistics more sophisticated and adaptable for the ability to use transport in the one ecosystem with possibilities to load/unload goods from each of the types of transportation.

Responder 5 mentioned that Physical Internet has existed for a long time, and it has some implementations in Automated Guided Vehicles. The Trucks in PI will be only focusing on autonomous transportation.

Responder 1 mentions electric and hybrid solutions for transportation. Also, he mentioned the automation of cars. The interesting thing in this reply is to focus on points that digitalization and connectivity will be a leading topic in this field. Responder 2 also mentions autopilot technology, and at the same time, he has a point about electric batteries and solar energy Responder 3 provided examples of Electric and hybrid cars technologies. Also, autonomous driving without 5G or AI application and redesign on trucks to increase aerodynamics impact. Responder 4 mentions real-time technologies, alternative power sources, collaboration processes, hyperloops.

Based on responses, only one person said that digitalization and connectivity would be more impactful on the Physical Internet. Also, all the responders replied with concepts based on similar existing technologies, for example, electric and hybrid cars. The different responses were Hyperloops, collaboration processes, and redesign of aerodynamics.

Based on those responses, three logistics experts agreed on the broad perspective of the Physical Internet in Trucks transportations. With more advancement, technologies such as Physical Internet could profoundly affect Trucks Transportations. Hypothesis 1, where Truck Transportation will have more benefit from technological progress. Physical Internet could be highly attractive because of the basic concept of possibilities to optimize road traffic in cities using logistics networks more optimized for decreasing traffic and increasing logistics between cities. Also, it is important to mention the response of Responder 5, who described, that PI is a concept which is usable by one Logistics Company. This response is correlated with Amazon vertical integration which gives additional information that the big leaders of logistics are able to

implement the idea of Physical Internet in their own logistics which could make this concept available for individual development.

4.2 Case Study Analysis

One of the limitations of this research is finding information that can provide a possible idea of advantages and disadvantages for logistics organizations. We only provide logistics simulation to find the main advantage of the system - increased efficiency and decrease in the transportations time.

In the previous part, one of the discoveries was a correlation of Amazon vertical integration and the Responder answer on Physical Internet and the testing of this concept in some organizations which are developing this idea individually. It provides additional hypotheses, of potential benefits of implementing this concept and how it will affect organization.

Based on observations from Hypothesis one and Hypothesis two, it was decided to implement additional Case Study research. This is based on 2 cases related to attempts in the analysis of the Physical Internet's potential influence on business through technological changes and the main functions of the Physical Internet. This analysis aims to find information that can answer the question of this research about the advantages and disadvantages of physical Internet in the scope of the business's advantages and disadvantages of implementation of the Physical Internet.

This analysis will be based on different technological implementations inside the Physical Internet and the business model to understand the value and advantages of using this concept. The analysis is a description of the Connection between Emerging technologies and Industry 4.0, the connection between Physical Internet and the predicament of the potential implementation of Physical Internet, and how it will affect the Organization and will it be beneficial for other purposes except for delivery timings.

The case study includes cases as:

- Montreuil, B. & Rougès, J .F. & Cimon, Y. & Poulin, D. (2012). The Physical Internet and Business Model Innovation. Technology Innovation Management Review. 2. 32-37. 10.22215/timreview/566.
- Tran-Dang, H. & Krommenacker, N. & Charpentier, P. & Kim, D., S. (2020). Towards the Internet of Things for Physical Internet: Perspectives and Challenges.

These researches are including the primary function of the Physical Internet and business implementation. These resources contain the proposition of the PI and the case study's central values, which represent current challenges that are affecting the physical Internet's current development.

This research will compare two different case studies representing the potential advantages and challenges of this concept, which is a part of the answer to the central question of the research, the benefit of Physical Internet to organizations.

4.2.1 Hypothesis 3: The concept of Physical Internet is beneficial to Logistics Organizations

Advantages and Challenges analysis

Advantages

The Physical Internet and Business Model Innovation.

This case describes the advantages of the Physical Internet business model. In the text, the main advantage of logistics companies in the shared logistics web, which allows using the resources of PI participants, is beneficial for small companies, which have limitations in transport services and inability to perform cross-city deliveries.

Logistics Network will be able to maintain the maximum capacity of trucks by providing information on the availability of space in trucks. In this part, organizations will be able to decrease emissions based on the decreasing number of trucks in cities. One of the advantages of this system is the usage of trucks in the transportation process between warehouses. With the ability of tracking technology, logistics will be more optimized to use the full capacity of trucks and provide additional transportations on the return transportation to the central warehouse.

The concepts include the networking system, which provides additional real-time activity, which is beneficial compared to alliances and partnerships where organizations do not have the same environment with the ability to track resources of each other. The central part of this concept is a Modular container that consists of various digital technologies to provide information about goods status and location.

The central part of the Physical Internet is the concept of Modular Containers. These containers could have different sizes to use the maximum capacity of the truck. In this case, transportation will be more effective because of the ability to close all holes inside the truck and use it more efficiently.

The modular containers are adaptable to any type of transportations which gives the ability to transfer containers which can be easily moved, and it gives advantages as the usage of other transportation types such as ships, railroad. In this case, the network will provide information availability of goods in different warehouses and automated control over route management.

With this network, Physical Internet can create benefits such as cost reduction based on the decrease of transportation routines, Enhancement of stock rotation, Reduction in order delivery time, which is based on ability to use transportation from one hub to another with the possibility to transfer goods to the destination point.

Challenges

Towards the Internet of Things for Physical Internet: Perspectives and Challenges.

In this study, were discovered Challenges of Physical Internet in the technological aspect, HR, and Business connection.

One of the reasons for using the Physical Internet concept is sustainability and control over emissions levels. With the possibilities of new policies, companies need to spend their time developing new ideas of how they can establish their processes more environmentally friendly. The issue is that IoT technologies require energy, and they also have emissions.

The second point is the development of IoT technology and the connection question. With the concept of containers and IoT integration, organizations can have data problems because of the possible issues in the information transfer process.

The third challenge could be formulated based on Business questions. One of the problems of PI is not enough real case studies where it is possible to receive data related to relationships between organizations in the logistics network.

One of the points of PI is the usage of IoT technology, which will be included in modular containers to provide additional information to the Logistics Network, which will present results to all participants of Physical Internet. In this case, one of the challenges is the adaptation of IoT technologies to modular containers with a problem of wave distortion. This challenge affects organizations based on the cost of implementation and the possible poor performance of this system.

From the Organization's perspective, the challenges are understanding the condition of participation in this system and how the distribution will be based. Because of the lack of real representations of The Physical Internet in the economic sphere, logistics organizations do not commit to using a PI on the city scale. It is essential to mention that in the previous part, the harmful data proved a point that Small Medium Enterprise has less impact on this concept, because of the size of the project.

The last challenge is related to the limitation of the technological aspect of IoT. Due to the idea of a global logistics network with free access to the information of participants, one of the challenges could be related to policy issues based on the flow of information and the inability of IoT to perform on the desired level.

4.3 Summary of the Case Study

It is essential to mention one of the issues of data related to the Physical Internet. Most of the research is based on analysis of efficiency of time delivery and other transportations issues. PI's main problems are the availability of prototypes of this system and examples of implementations. Based on the case study, the main feature of PI could be classified as a network system with the additional technological framework, which helps to provide real-time information on possible Logistics Agents.

One of the issues is a business model. In the perception of the network concept, Physical Internet has various advantages that are beneficial to any Logistics Organization. The optimization and possibilities to use other resources with real-time data give various opportunities to logistics organizations. With additional growth of emerging technologies and the availability of Industry 4.0, Physical Internet has many potential implementations as a concept of transportation.

It is important to mention previous interview research, where experts of logistics proved the point that the Physical Internet will be profoundly affected in the future and has the potential to disrupt existing logistics systems. In the case of establishing the Physical Internet Network, is it challenging to include all logistics companies. One of the problems is limited opportunities in the SME sector. The most beneficial part of technology is start-ups, but in the case of PI, the leading logistics organizations should accept the terms of the business plan. It is still unclear what are the requirements of accessing the PI Network.

With other facts, that some companies, like Amazon are able to implement the concept of Physical Internes is showing that it has a potential benefit. With vertical integration, organization are able to implement this concept for individual purposes and according to previous research, Amazon is able to do it and with the response of Responder 5, some organization are able to deliver it which is still beneficial to businesses as potential development of the original concept into some of the ideas to the organization's logistics. As mentioned in the challenges part, the business model is still in development and with additional policy issues, organizations may not be able to implement the concept of Physical Internet in the original state, but they can take some of the parts of this idea to improve their services.

Based on this, it is challenging to answer Hypothesis 3. With interview research, it proves the technological trends and benefits of Freight Road Transportation, which are influential in Social Internet. The answer could be given is that the Physical Internet creates additional influence on organizations by providing the new method of controlling the Logistics Network. In the case of long-term investment, organizations could increase the performance of logistics and decrease emissions by making the organized Logistics Web. Nevertheless, the answer could be negative at the same time because of the limited technological and organizational aspects and limited knowledge and lack of existing studies based on the implementation of PI in real case studies.

5 Conclusions

Physical Internet is a concept, which is still in in-depth development. This technology could be the next disruption of logistics based on the primary purpose of changing the standard way of cooperation between logistics organizations. With other emerging technologies, Trucks Transportation is receiving more attention because of the possible innovations to enhance this type of logistics. In connection with the Physical Internet, truck transportation significantly affects logistics organizations by providing innovations and possibilities to change the modern transportation problems and implement new advantages that will significantly benefit the logistics operations and efficiency of delivery and production.

In the research process, it was found that Small Medium Enterprises have less influence on today's Physical Internet concept. It profoundly affects the access to the new technologies to the small companies, but the main takeaway of analysis is the technological impact on truck transportation, which makes this market more innovative compared to other types of transportation.

Hypothesis one

One of the implementation requirements of PI is to understand the potential influence of Industry 4.0, which is a trend of digitalization and the implication of automated processes supported by IoT. Industry 4.0 is highly connected with this technology, which makes this technology more available based on the potential support of technologies to implement new solutions for logistics.

At the same time, with trends of emerging technologies and their impact on Trucks transportations, Physical Internet has a connection with these technologies, and it has existing connections through different researches and implementation of them together. Based on this, Hypothesis 1 approved.

With evidence of the technological influence on Freight Road Transportations, the second question is the theory of the potential high influence of the Physical Internet because of the idea behind the concept and technological similarities with emerging technologies.

Hypothesis two

Based on three responses of Logistics Experts, the Concept of Physical Internet will be more beneficial to Trucks transportation due to the ideas behind the concept and connection with emerging technologies. At the same time, one author did not respond to his view of this topic, and the other author replied with conflicting information. From the perception of the majority, Physical Internet will have a high possibility of affecting truck transportations.

Based on the connection of new technologies and the ability to change the Freight Transportations, Physical Internet could possess a beneficial influence on the Organization. One of the questions is what the advantages and challenges of PI are, and will it benefit Organization which will provoke other organizations to implement or participate in the Physical Internet concept.

Hypothesis three

In the process of research was discovered a problem of finding cases that will provide a clear answer to this question. The main feature of PI provides the concept of a new logistics model, which has significant benefits, but it is still in development. From the interview analysis, most of the Experts mention the impact of the Physical Internet and possibilities to generate additional value and innovations.

In the research of the case study, the advantages of PI could be absorbed by potential challenges that impact all concepts, including IoT technology, Network connection, agreement of logistics companies, existing policies, and lack of real case studies and physical prototypes. In the same time, the leaders of the segments as Amazon, are able to use the concept of PI in their own Transportations System. As was mentioned in Response 5, Amazon vertical integration and the Case Study, one of the problems of the Physical Internet is the business model and how organizations will connect together in the Logistics Web. From this point of view, some of the organization could have benefited from Physical Internet as an idea, which could have a new representation in Individual Logistics Systems as Amazon. In this case, the concept of Physical Internet is beneficial to organizations as the source of new ideas and concepts which could be developed individually without providing the Logistics Web with multiple organizations.

Research Question

In the end, the central question of this research is hard to justify because of limited possibilities to gain data and a lack of research on this topic. In the opinion of the author, Physical Internet has a beneficial influence on organizations based on the new methods of logistics connections and the concept of N-Containers. At the same time, PI is not developed in the real case scenarios and it is hard to prove the reliable reasons which will prove the possibility to implement this concept in its original state.

Limitations

Limited possibility to receive Primary data

In the process of the research, one of the challenges was to find contact and ask them questions regarding the Physical Internet. From the collecting of negative data, one of the responses mentioned that Physical Internet is an advanced technology that makes it harder to implement, and this problem limits the number of companies, which can contribute to this field. The main problem is difficult communication with big logistics organizations, and inability to receive their opinion on this concept. Another problem is difficulties with understanding these concepts and finding Professionals who can provide their view on the current situation.

A limited number of sources

The second limitation of this research is a lack of researches based on topics: Physical internet, Industry 4.0, 5G, AI, Blockchain. The only advantage of this topic is a part of Emerging technologies 5G, AI, Blockchain. These could be considered as a part of Industry 4.0. The main problem in searching for information is a limitation in papers focusing on Industry 4.0 and Physical Internet.

The Physical Internet has various research directions, but one of the problems is the Physical Internet's analysis from the technological components of this concept. In the process of research was found logistics tests which are focusing on the performance of logistics networks, timing, and emissions. One of the physical Internet problems is not enough resources, which focus primarily on the technological part of this concept.

Recommendations

One of the main issues of researching the topic of Physical Internet is the low number of real implementation case studies. The primary literature is based on the offering of technologies and possible implementations in different fields.

In the case of limited knowledge, mixed research was implemented based on the case study and interview. With additional data sources, it will be beneficial to have interviews with Logistics Experts, because of the possibility to receive diverse data based on different perceptions of the benefits of Physical Internet.

First recommendation: using additional research methods to receive more data for analysis. Second recommendation: usage of the interview to prove the theories.

6 References

Almada-Lobo, F. (2017). Six benefits of Industrie 4.0 for businesses. Control Engineering. Retrieved from https://www.controleng.com/articles/six-benefits-of-industrie-4-0-for-businesses/

Astra Veicoli Industriali. ROAD CARGO TRANSPORTATION. Retrieved from https://asstra.com/mode-of-transport/road-transport/

Boulila, Naoufel. (2019). Cyber-Physical Systems and Industry 4.0: Properties, Structure, Communication, and Behavior. 10.13140/RG.2.2.27890.76485.

Benson, C. (2017). IoT vs. Industrial IoT: 10 Differences That Matter. IoT for all. Retrieved from https://www.iotforall.com/iot-vs-industrial-iot-differences-that-matter/

Brozzi, R. & Forti, D.& Rauch, E. & Matt, D. (2020). The Advantages of Industry 4.0 Applications for Sustainability: Results from a Sample of Manufacturing Companies. Sustainability. 12. 3647. 10.3390/su12093647.

Blume Global. (2020). How Will 5G Technology Benefit Logistics Service Providers? Retrieved from https://www.blumeglobal.com/learning/how-will-5g-technology-benefit-logistics-service-providers/

CB INSIGHTS. (2020) How Trucking Tech Is Tackling Challenges In The Retail Supply Chain. Retrieved from https://www.cbinsights.com/research/trucking-tech-retail-supply-chain-challenges/

Cimini, C. & Lagorio, A. & Romero, D. & Cavalieri, S.& Stahre, J.. (2020). Smart Logistics and The Logistics Operator 4.0. https://www.researchgate.net/publication/340952295_Smart_Logistics_and_The_Logistics_Operator_40

Crainic, T. G. Montreuil, B. (2016) Physical Internet Enabled Hyperconnected City Logistics. Transportation Research Procedia,Volume 12, 2016, Pages 383-398, ISSN 2352-1465, https://doi.org/10.1016/j.trpro.2016.02.074. (http://www.sciencedirect.com/science/article/pii/S2352146516000752)

Carnarius, J. (2018). Modes of Transportation explained: Which type of cargo and freight transportation is the best? Forto. Retrieved from https://forto.com/en/blog/modes-transportation-explained-best/

Chanuwas. (2017). Artificial Intelligence and search problems. Medium. Retrieved from https://medium.com/newstories/artificial-intelligence-and-search-problems-4a680ab663b4

Dans, E. (2019). The Battle For The Physical Internet. Forbes. Retrieved from https://www.forbes.com/sites/enriquedans/2019/05/17/the-battle-for-the-physical-internet/#59c010c23baa

Dans, E. (2020). Amazon takes vertical integration to a new level. Medium. Retrieved from https://medium.com/enrique-dans/amazon-takes-vertical-integration-to-a-new-level-d9fd65d4d06d

DHL. (2020). BUSINESS 5G AND WHAT IT MEANS FOR LOGISTICS. Retrieved from https://discover.dhl.com/business/productivity/5g-and-logistics

Deni International. Discover 6 Types of Road Cargo Transportation. Retrieved from http://www.deniint.com.mk/discover-6-types-of-road-cargo-transportation/?lang=en

Egersdörfer, F. (2020) Interview about Industry 4.0 with our CEO, Frank Egersdörfer. Cosmino. Retrieved from https://www.cosmino.de/en/news/interview-industry-4-0-chairperson-frank-egersdorfer/

Ericsson, Einride, Telia. (2018). Ericsson, Einride, and Telia power sustainable, self-driving trucks with 5G. Retrieved from https://www.ericsson.com/en/press-releases/2018/11/ericsson-einride-and-telia-power-sustainable-self-driving-trucks-with-5g

Erboz, G. (2017). How To Define Industry 4.0: Main Pillars Of Industry 4.0. https://www.researchgate.net/publication/326557388_How_To_Define_Industry_40_Main_Pillars_Of_Industry_40

Ezzat, M. & Kassem, S. & Abd Elkader, M. (2019). Logistics 4.0: Definition and Historical Background. 10.1109/NILES.2019.8909314.

European Automobile Manufacturers' Association. (2019). Report: Vehicles in Use. Retrieved from https://www.acea.be/statistics/tag/category/report-vehicles-in-use

FALES, S. (2019). IIoT-ready technologies improve machine controls. Control Engineering. Retrieved from https://www.controleng.com/articles/iiot-ready-technologies-improve-machine-controls/

Fagella, D. (2018). What is Artificial Intelligence? An Informed Definition. Emerj Artificial Intelligence Research. Retrieved from https://emerj.com/ai-glossary-terms/what-is-artificial-intelligence-an-informed-definition/

Fisher, T. (2020). How Are 4G and 5G Different? Lifewire. Retrieved from https://www.lifewire.com/5g-vs-4g-4156322

German Research Center for Artificial Intelligence. INDUSTRY 4.0. Retrieved from https://www.dfki.de/en/web/technologies-applications/fields-of-application/industry-40/

HEALY III, W. (2018). What's the Difference Between Industrial IoT and Industry 4.0? Hydraulics & Pneumatics, 71(9), 8.

Hartl Crew. (2018). What are the types of road freight? Retrieved from https://www.hartlcrew.com/en/util-info/21/what-are-the-types-of-road-freight

Ines, N. (2015) How does the Smart Factory add value? Elektrotechnik 04/2015. Vogel Business Media. Retrieved from https://www.pc-control.net/pdf/022015/interview/pcc_0215_smart-factory_e.pdf

Jovovic, Ivan & Husnjak, Sinisa & Forenbacher, Ivan & Maček, Sven. (2018). 5G, Blockchain and IPFS: A General Survey with Possible Innovative Applications in Industry 4.0. 10.4108/eai.6-11-2018.2279695.

Jovovic, Ivan & Husnjak, Sinisa & Forenbacher, Ivan & Maček, Sven. (2019). Innovative Application of 5G and Blockchain Technology in Industry 4.0. Industrial Networks and Intelligent Systems. 6. 1-6. 10.4108/eai.28-3-2019.157122.

Jaziri, R.f & Korbi, K. & Gontara, S. (2020). The Application of Physical Internet in Saudi Arabia -- Towards a Logistic Hub in 2030. Journal of Management and Training for Industries. 7. 1-16. 10.12792/JMTI.7.1.1.

Khan, S. (2018). Modern Internet of Things as a Challenge for Higher Education. 18. 34. https://www.researchgate.net/publication/331257291_Modern_Internet_of_Things_as_a_Challenge_for_Higher_Education

Kunaka, Charles & Carruthers, Robin. (2014). Road Freight Transport. 10.1596/978-1-4648-0143-3_module7. https://www.researchgate.net/publication/300485533_Road_Freight_Transport

Kumar, R. (2018) As an IoT Platform, what should be the right balance of data computing between the Edge and the Cloud? Medium. https://medium.com/world-of-iot/as-an-iot-platform-what-should-be-the-right-balance-of-data-computing-between-the-edge-and-the-ec6ea99344c8

Landaluce, H. & Arjona, L. & Perallos, A. & Falcone, F. & Angulo, I. & Muralter, F.. (2020). A Review of IoT Sensing Applications and Challenges Using RFID and Wireless Sensor Networks. Sensors. 20. 2495. 10.3390/s20092495. https://www.researchgate.net/publication/340994071_A_Review_of_IoT_Sensing_Applications_and_Challenges_Using_RFID_and_Wireless_Sensor_Networks

Lichtigstein, A. (2018). Is Ethereum based ICOs coming to an end? Retrieved from

https://101blockchains.com/end-of-ethereum-based-icos/

Matties, B. (2016). Mentor Graphics' Oren Manor Explains Exactly What Industry 4.0 Brings to Manufacturing. SMT: Surface Mount Technology, 31(3), 68–77. http://smt.iconnect007.com/index.php/article/96315/mentor-graphics-oren-manor-explains-exactly-what-industry-40-brings-to-manufacturing/96318/?skin=smt

Montreuil, B. (2011). Toward a Physical Internet: meeting the global logistics sustainability grand challenge. Logistics Research. 3. 71-87. 10.1007/s12159-011-0045-x. https://www.cirrelt.ca/DocumentsTravail/CIRRELT-2011-03.pdf

Montreuil, B. (2017) Sustainability and Competitiveness Is the Physical Internet a Solution? International Physical Internet Conference Graz, Austria 2017/07/04 https://www.pi.events/IPIC2017/sites/default/files/IPIC2017-Plenary%20keynote_Montreuil.pdf

Maslarić, M. & Nikolicic, S. & Mirčetić, D. (2016). Logistics Response to the Industry 4.0: The Physical Internet. Open Engineering. 6. 10.1515/eng-2016-0073. https://www.researchgate.net/publication/310732890_Logistics_Response_to_the_Industry_40_The_Physical_Internet

Montreuil, B. & Rougès, J .F. & Cimon, Y. & Poulin, D. (2012). The Physical Internet and Business Model Innovation. Technology Innovation Management Review. 2. 32-37. 10.22215/timreview/566. https://www.researchgate.net/publication/326307503_The_Physical_Internet_and_Business_Model_Innovation

National Science Foundation. (2010) Cyber-Physical Systems (CPS). Retrieved from https://www.nsf.gov/pubs/2010/nsf10515/nsf10515.htm

Osmólski, W., Voronina, R., & Koliński, A. (2019). Verification of the Possibilities of Applying the Principles of the Physical Internet in Economic Practice. LogForum, 15(1), 7–17. https://doi.org/10.17270/J.LOG.2019.310.

Sabella, R. (2018). Cyber-physical systems for Industry 4.0. Ericsson. Retrieved from https://www.ericsson.com/en/blog/2018/10/cyber-physical-systems-for-industry-4.0

Savtschenko, M. & Schulte, F. & Voss, S. (2017). IT Governance for Cyber-Physical Systems: The Case of Industry 4.0. Lecture Notes in Computer Science. 667-676. 10.1007/978-3-319-58634-2_48. https://www.researchgate.net/publication/317175107_IT_Governance_for_Cyber-Physical_Systems_The_Case_of_Industry_40

Skapinyecz, R. (2018) Logistic aspects of Industry 4.0.
IOP Conf. Ser.: Mater. Sci. Eng. 448 012014
https://www.researchgate.net/publication/329331526_Logistic_aspects_of_Industry_40

Plattform Industrie 4.0. What is Industrie 4.0? Retrieved from
https://www.plattform-i40.de/PI40/Navigation/EN/Industrie40/WhatIsIndustrie40/what-is-industrie40.html

PT Computrade Technology International. (2016). IoT vs IIoT. Retrieved from
https://www.computradetech.com/blog/iot-vs-iiot/

Pervez, Huma & Haq, Irfan. (2019). Blockchain and IoT Based Disruption in Logistics. 276-281. 10.1109/C-CODE.2019.8680971.
https://www.researchgate.net/publication/332228542_Blockchain_and_IoT_Based_Disruption_in_Logistics

Qualcomm. Everything you need to know about 5G. Retrieved from
https://www.qualcomm.com/invention/5g/what-is-5g

Reiff, N. (2020). Blockchain explained. Investopedia. Retrieved from
Https://www.investopedia.com/terms/b/blockchain.asp

Rožman, N., Vrabič, R., Corn M., Požrl, T., Diaci, J. (2019) Distributed logistics platform based on Blockchain and IoT. Procedia CIRP, Volume 81,2019,Pages 826-831,ISSN 2212-8271, https://doi.org/10.1016/j.procir.2019.03.207.
(http://www.sciencedirect.com/science/article/pii/S2212827119305128)

Russell, S. J., Norvig, P., & Davis, E. (2010). *Artificial intelligence: a modern approach.* 3rd ed. Upper Saddle River, NJ: Prentice Hall.

Transportation Research Board. (2019) Critical Issues in Transportation 2019. Retrieved from
https://www.nap.edu/resource/25314/criticalissues/

Tran-Dang, H. & Krommenacker, N. & Charpentier, P. & Kim, D., S. (2020). Towards the Internet of Things for Physical Internet: Perspectives and Challenges. IEEE Internet of Things Journal. PP. 1-1. 10.1109/JIOT.2020.2971736.
https://www.researchgate.net/publication/339058892_Towards_the_Internet_of_Things_for_Physical_Internet_Perspectives_and_Challenges

Thames, Lane & Schaefer, Dirk. (2017). Industry 4.0: An Overview of Key Benefits, Technologies, and Challenges. 10.1007/978-3-319-50660-9_1.
https://www.researchgate.net/publication/314244349_Industry_40_An_Overview_of_Key_Benefits_Technologies_and_Challenges

Terbrüggen, S. (2018). CONTINUOUS GROWTH DESPITE SLIGHT BUMP IN THE ROAD. DHL. Retrieved from https://dhl-freight-connections.com/en/new-heavy-truck-registration-q4_18/

Ti. (2019). Leading European Transport and Logistics Markets. Retrieved from https://theloadstar.com/wp-content/uploads/Leading-ETL-Markets-Report-Final.pdf

Ward, J. (2018). The seismic potential of digitalized manufacturing. DHL. Retrieved from https://www.dhl.com/global-en/home/about-us/delivered-magazine/articles/2018/issue-1-2018/the-seismic-potential-of-digitalized-manufacturing.html

Xu, L. D., Xu, E. L., & Li, L. (2018). Industry 4.0: state of the art and future trends. International Journal of Production Research, 56(8), 2941–2962. https://doi.org/10.1080/00207543.2018.1444806

Zhang Y. 2019The application of artificial intelligence in logistics and express delivery. J. Phys.: Conf. Ser. 1325 012085 https://iopscience.iop.org/article/10.1088/1742-6596/1325/1/012085

Appendices

Which types of logistics transportation (ships, trucks, airlines) will have more benefit from new digital technologies such as 5G, AI, Blockchain?

All transport modes incl rail will benefit. Especially multimodal solutions gaining data capturing and sharing with the technics enabling saving in lead times and operational costs in e.g terminals.

When for example the use of IoT is brought in you can also together with sensor technics a better asset management and also use the knowledge in increased customer service.

Also predictive maintenance of assets with help of optics, cameras, RFID and sensors and of top of that AI can create large value for the operating companies.

What do you think about the possibilities of using the Physical Internet concept for truck logistics operations?

Sharing information in a transparent way between stakeholder in the supply chain can lead to a better usage of assets and gives also environmental advantages.
You need trust between partners and also fedarative platforms where you can share data.

Which of existing technologies except for IoT, Blockchain, 5G, AI could bring new initiatives in truck transportations in the scope of the physical internet?

Technics such as electrification, hybrid solutions and batteries can of course play a big role in future. Also platooning (and automated driving) is a method of producing truck transports effectively.
But of course connectivity and digitalisation is for sure leading topics for developments on the truck field.

One should also consider multimodal solutions(rail/road) to a higher degree in the future.

Manager of logistics, anonymous

1.All of logistics sectors will have a lot of benifit from new digital technologies:
The shipping industry can track every container on every ship, create optimized transportation plans and thus reduce excessive strain on ports which are in heavy use.
The truck transportation services are already benifitting heavily from new technologies, right now we are on the way of automating the trucks so we do not need humans to steer the car. So insead of taking several breaks on the way to the destination, we can deliver the cargo a few days earlier.
The air shipping has a big weight/fuel optimization problem, so an AI helping redistribute the cargo by more criteria will definetly help alleviate the strain on overfilled airports and maybe reduce global shipping time.

2.The use of Physical internet would be a big step forward for any logistics sector, since most of the time it is never just 1 type of thansportation involved. Generalisation of cargo sizes would allow us to hyper-optimize the truck shipping and enable us to automate the loading/unloading of any cargo without much reprecussions to the results.

3.The most desired and realistic technology for truck shipping is autopilot electric trucks, capable of transporting a more cargo in shorter time on longer distances. Adding highly

optimized electric energy batteries and solar energy to the mix would make inland logistics a good choise even on longer routes where train transportation was farourable before.

Namn: Jan Bergstrand
Senior strategiest and programme manager
Organisation/företag: Trafikverket (The Swedish Transport Administration)

Which types of logistics transportation (ships, trucks, airlines) will have more benefit from new digital technologies such as 5G, IoT, AI, Blockchain?

- *Ships can benefit from AI for fast load optimization and balancing algorythnms….especially container ships…but most shipping lines are pretty advanced on economic modeling actually*

- *Trucks and 5G: most fascinating idea is driving remotely thanks to 5G. you could have autonomous vehicles running on their on on bif highways (AI is helpful here), but a remote pilt can control the truck for the last mile thanks to 5G. Volvo and Ericsson are working on this.*
- *I am not sure about airlines.*

What do you think about the possibilities of using the Physical Internet concept for truck logistics operations?

- *Find attached an excellent article of a study done by Kriss Hakimi fro Prof. Montreuil that demonstrates how to operate truck logistics with a PI approach and all of the positive impacts….in fact this is nothing new….Postal services since the Roman times have been working with similar approaches….do note that no 5G, IOT or Blockchain is necessary to make it work.*

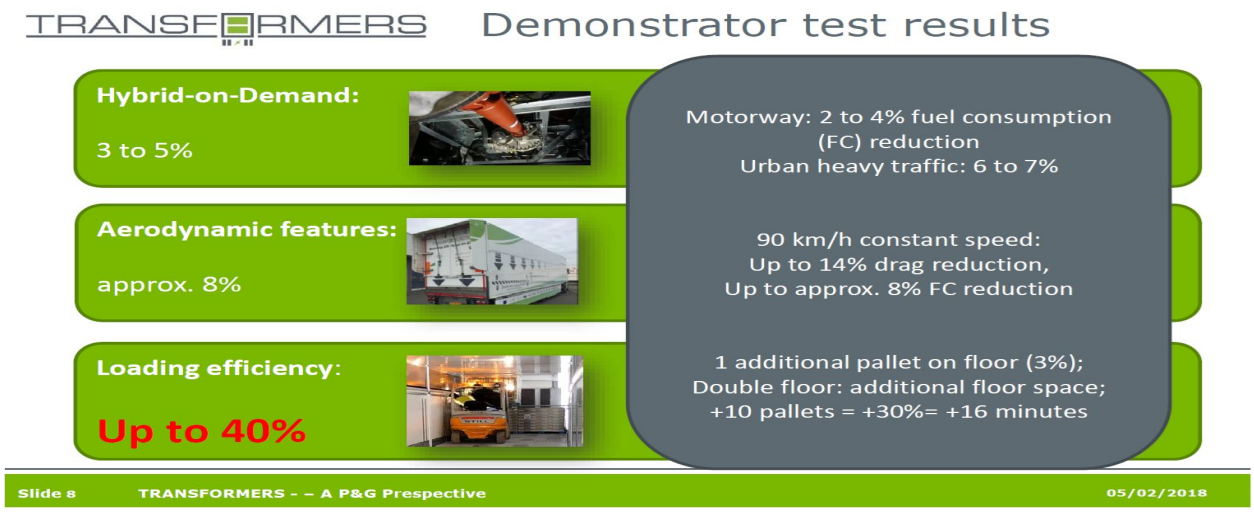
- *For urban logistics see the Dabbawalla in Mumbai:* https://hbr.org/2012/11/mumbais-models-of-service-excellence all they depend upon is synchronization (a good watch)

Which of existing technologies except for IoT, Blockchain, 5G, AI could bring new initiatives in truck transportations in the scope of the physical internet?

- *Overhead or Conductive charging (to overcome the issue of Batteries weight)*

- *Hydrogen & Biogas, to end dependence on fossil fuels*
- *Autonomous Driving (but this could be a 5g AI application)*
- *Better Aerodynamics, (some regulatory limits have been eliminated already)*
- *A redesign of Trailers and Loading units*

See Transformers Project conclusion below:



Sergio Barbarino
Alice Vice Chair

1. While I believe that all modes of transport will benefit from the advance in digitalization that we are now seeing, I must say that the greatest benefits will accrue to land based transport operations. This is due to the size of this market and its relatively rudimentary use of digital technologies today.

2. The PI is really focused on land based transport so its use in this area is looked upon as its primary starting point. Trucks are generally poorly optimized from a load/capacity utilization perspective and this is one area that the PI is working to change.

3. There are a number of technologies that could help in the land based transport domain. Digital twins for modeling in real time disruptions and their impact on transport operations, autonomous driving (this combines some intelligence, but it is not the key technology), alternative power sources, collaboration processes (based on automated game theoretic combination and sharing rules), hyperloops, etc. are all technologies that could/will have an impact on ground based transport.

Rod Franklin

Adjunct Professor of Logistics and Academic Director at the Kuehne Logistics University in Hamburg Germany

Physical Internet has been there for a long time now being implemented in many auto companies in AGV's.

RFID's are also there in many companies. Block chain is the latest tech in logistics that could be implemented on a full scale in the next 15 years. As I know only one company is doing research in block chain implementation which is Maersk, a danish shipping company.

Ships and airlines are used in intercontinental transport where as trucks are used nationally for transporting goods. Benefits are in every type but I would say cheapest is ship transport and exploring 5G, iot, blockchain more in ship transport would be better. I dont deny that these new tech have excellent uses in trucks and airlines.

Physical internet in truck transport is nothing but using autonomous vehicles to deliver.

There is this urban and inter urban eVTOL air mobility which is in planning by some companies. I suggest you to have a look on it.

Manager of logistics, anonymous

Hi Nikita,

I have spoken with various of my contacts of tracking companies, my contacts are small, medium-sized companies, they have all commented in the same way.

They are very far from such advanced technology.

I would suggest that you search for people in bigger companies such as Kuhne & Nagel, or DB Schenker through Linkedin, these kind of companies have a big warehouses in Europe and Hub’s in Europe, and I am sure that they are using this kind of technologies due to volume of commodities that they are moving daily.

I also think that in the international couriers are surely using great technology, such as Fedex, Ups, DHL.

I am sorry I could not help you more, although I will be attentive in case any information comes to me.

Manager of logistics, anonymous