DISTRIBUTED LEDGER TECHNOLOGIES APPLIED TO LOGISTICS SYSTEMS

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POLITECNICO DI TORINO

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About the Cover Photo:

The above image illustrates an Intermodal, international terminal that offers multimodal/intermodal transportation services in the north-west of Italy. The photograph depicts trucks, goods, and trains all side-by-side working together to bring a sustainable logistics for the future of European logistics and transportation industry.

Advanced Studies
Icelab - ICT For City Logistics And Enterprises

Master Thesis of Sajjad Khaksari
in Engineering & Management

Supervised by:

Professor Guido Perboli

Professor Stefano Musso

PhD Eng. Edoardo Calia

Torino, Italy

This research is a strategic study concerning the implementation of Blockchain Technology in logistics and intermodal freight transportation.

Master of Science in Engineering & Management from Polytechnic of Turin

To be defended publicly in June, 2018.

Supervisors: Professor Guido Perboli and Professor Stefano Musso.

The Engineering & Management Master Degree Thesis at ICELAB - ICT for City Logistics and Enterprises. The thesis project has aimed to study and analyzed the potential applicability of BLOCKCHAIN Technology in the expansive world of logistics and transportation. Sequentially, the research outline has headlined as “Distributed Ledger Technologies Applied to Logistics Systems”. Professor Guido Perboli and Professor Stefano Musso were academic the supervisors of the dissertation. Moreover, the thesis has been written in collaboration with Istituto Superiore Mario Boella (ISMB) and its Deputy Director, PhD Eng. Edoardo Calia.

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Master Thesis in Engineering & Management

Sajjad Khaksari

Politecnico di Torino

Spring 2018

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ICE ICT FOR CITY LOGISTICS AND ENTERPRISE

ISMB Istituto Superiore Mario Boella

Sajjad Khaksari
Torino, Italy

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Advanced Studies
ICELAB - ICT for City Logistics and Enterprises

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Dedicated to
Dante Giovale Gangai,
Farzad Kamangar, and Hoda Saber
those who bravely fought against
Italian and Iranian fascism

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Sincerely yours,

Sajjad Khaksari

Turin, Italy

May 2018

EXECUTIVE SUMMARY

Concisely, the following dissertation comprises a strategic analysis for the implementation of Blockchain Technology in transportation and logistics industry. The thesis has an especial interest to investigate the applicability of Distributed Ledger Technologies through the Logistics Systems and Intermodal Freight Transportation as a sustainable mode. With another words, the following dissertation is a global and comprehensive *Strategic Analysis* concerning the real possibilities and practical applicabilities of the Blockchain technology throughout the current world of transportation and logistics industry. Considering that by the opening scenes of Blockchain's technological development, it raced to develop its applicability in several industries other than the financial area. In particular, Supply Chain Management (SCM), City Logistics, Cross-modality, Multimodality, Intermodal Freight Transportation, and Internet of Things (IoT) are recognized as fertile territories for some systematic blockchain-based accomplishment due to the diverse parties involved in these multifunctional processes.

The constant need of confidence and trust among the participant of regional/national/international supply chain, would support the identification of blockchain technology as a prolific innovation and an industrial empire by its performance in logistics industry. The following research has begun by the severe academic interest of ICELAB - ICT for City Logistics and Enterprises, to estimate the latent applicability of Blockchain and Distributed Ledger Technologies among the logistics and transportation. The entrance of Blockchain Technology in logistics market does not only boosted the enthusiasm of ICELAB, but it awes the complete ecosystem of many principal logistics companies around the world. For instance, many sea ports, air ports, dry ports, and intermodal freight terminals are investing on blockchain because of its guarantees of full process perceptibility and real-time traceability.

On the other hand, during the relevant research of the following dissertation, the Blockchain technology has acknowledged as a novel technology but not as a primary key for any problems in transportation and logistics industry. Consequently, in the opinion of the author, reading the PART I is an important assignment to capture some comprehensive points of views regarding the ground conditions of the Italian inland transportation. Furthermore, the PART I, particularly tries to discern the Blockchain as an individual but valuable piece of a big puzzle. Having said that, PART II attempts to illustrate the hallmarks, features, applicabilities, and characteristics of some actual blockchain-based applications/platforms. Moreover, it is essential to remark that the following essay has followed a critical approach regarding the current condition of Italian logistics. It means that the author did not wish to achieve the compliments of readers or any blessings from some Italian logistics God Fathers. Therefore, in units 2 to 6 of PART I, author tried to reflex only some a few (from many) irregularities concerning the violation of safety and performances among the logistics of heavy trucks and intermodal freight movements in Italy.

The safety breaches and all mentioned case studies had observed and reported personally by the author (without mentioning the name of the transportation company but all relevant proofs and precisely detailed and appropriate documentation concerning the claims are available). In fact, the real world of work (daily work circumstances) of the Italian logistics is sometimes brutal and mortal as well (e.g. the tragic loss of Mauro Cagnoni and Abd El Salam).

However, concerning the research method of the following dissertation, the author attempted to respect all the characteristic of an academic writing and tried to represent the pure and creative words. In case in which, the words or phrases were needed to be reflected as their exact original speak/written, they are highlighted between two "Quotation Marks". Moreover, in PART III and PART IV, all supporting appendixes and bibliography has been represented.

In PART I and PART II, many studies and investigations has been done regarding the desirable design and develop of distributed platforms for anonymized dataset speculation and blockchain-based platforms those are not possessing any centralized trusted (Third Party) in business model of logistics and transportation industry. These platforms are consists of peers and consensus-based blockchain mechanism, and every peer serves as a data broker, data receiver, and a verifier for Blockchain during a logistics data transfer transaction. Hence, the data brokers collect data from the data partners under their permission for data speculation.

Additionally, business applications regarding the blockchain technology are deduced by analyzing some popular applications meanwhile contemporary blockchain market in various disciplines and especially concerning the supply chain and logistics areas. Presumably, three strongest points of this dissertation are: (1) The extensive practical information and critical investigations regarding the reality and requirements of Italian intermodal freight transportation. (2) The comprehensive study of over 34 blockchain-based applications/platforms. (3) The immense bibliography and evidence within the accessible online resources.

After all recent improvements, it seems the employment of the Blockchain technology for the commercial routes in Logistics is just a beginning of a larger expansion. Therefore, the author desires to take part in these intellectual stepping stone towards the productivity and efficiency throughout the entire supply chain of the logistics divisions and transportation modes.

To conclude, the author encourages the Polytechnic of Turin (PoliTO) to establish and perform a proper Blockchain Laboratory for investigating and developing different kind of blockchain-based applications/platforms in many proper ways for some proper use. The blockchain Lab of the TU Delft [blockchain-lab.org] would be an example of this proposal, because students, professors need an adequate space to work and research about blockchain technology. This is an important investment for PoliTo in a period of time in which blockchain is recognized as a disruptive technology and it is going to revolutionize many aspects of modern enterprises. Also, supporting, offering, organizing, and encouraging more Thesis Proposals about the effective implementation and execution of Blockchain technology is extremely required because as Paulo Freire firmly concluded, "We Make The Road by Walking".

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ABBREVIATIONS

ADR	Accord européen relatif au transport international des marchandises Dangereuses par Route - European Agreement concerning the International Carriage of Dangerous Goods by Road
AGVs	Automated Guided Vehicles
AI	Artificial Intelligence
BCT	Blockchain Technology
BEV	Battery Electric Vehicle
BiTA	Blockchain in Transport Alliance
BNCT	Busan's New Port
BPS	Best Possible Scenario Score
CDG	Carriage of Dangerous Goods
CFVs	Conventional Freight Vehicles
CMR	Convention relative au contrat de transport international de Marchandises par Route - Convention on the Contract for the International Carriage of Goods by Road
CO2	Carbon Dioxide
CPC	Driver Certificate of Professional Competence
CQC	Carta Qualità del Conducente
DDT	Documento di Trasporto
DG	Dangerous Good
DSM	Decision Support Model
DWTR	EU Driver Working Time Regulations: Regulation (EC)
E-CMR	Electric-CMR
EC	European Commission
EFVs	Electric Freight Vehicles
ETF	European Transport Workers' Federation

EU	European Union
EV	Electric Vehicle
FSC	Financial Supply Chain
GHG	Greenhouse Gas
GPS	Global Positioning System
GTD	Goods Transportation Documents
GUI	Graphical User Interface
HGV	Heavy Goods Vehicle
ICELAB	ICT Center for City logistics and Enterprises (ICE) Laboratory
IMDG	International Maritime Dangerous Goods Code
IMO	International Maritime Organization
IoT	Internet of Things
IT	Information Technology
LPG	Liquefied Petroleum Gas
MTI	Marine Transport international
MTOE	Million Tonnes Oil Equivalent
NHTSA	National Highway Traffic Safety Administration
NO2	Nitrogen Dioxide
OECD	Organisation for Economic Co-operation and Development
PIARC	World Road Association
QR	Quick Response Code
QRA	Quantitative Risk Assessment
RC	Radio Control
RFID	Radio-frequency IDentification
SC	Supply Chain
SCM	Supply Chain Management
TEU	Twenty Foot Equivalent Unit
UN	United Nation
VCE	Vapour Cloud Explosion
VR	Virtual Reality

PART I

Overview

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INTRODUCTION

1.1 ICT CENTER FOR CITY LOGISTICS AND ENTERPRISES - ICELAB

The following research project commenced by the reinstatement of ICELAB's interest to assess the potential applicability of BLOCKCHAIN and Distributed Ledger Technologies in the logistics industry and Multimodal transportation. The ICELAB abbreviation stands for ICT Center for City logistics and Enterprises (ICE) laboratory in DAUIN of the Polytechnic of Turin. Also, the Lab works in close collaboration with the Istituto Superiore Mario Boella (ISMB).

ICELAB strives to promote research activities for the creation of ICT based solutions for the urban management, principally converging on the integration of industrial projects, and on the planning of smart systems for people mobility and freight movement. The ICT technologies of ICELAB grant various sustainable solutions for the integrated management and intelligent control of logistics and enterprise administration in urban and suburban areas. As a consequence of urbanization[1] phenomena, citizens sprang to consider the metropolitan area as the hub of their social and professional pursuits, and as the matter of fact the urban areas became larger and crowded. Therefore, the research fields in which ICE operates include Smart Cities, City Logistics, Smart Enterprise, Industry 4.0, Lean Business Development, Freight Analysis and Transport Studies, Blockchain Technology, Multimodal transportation, and Lean Startup. The intentions of ICELAB transpire in the following quintessential pillars:

- To perform a multidisciplinary environment in which different competencies can be merged;
- To implement the network of various academics and different researchers interfaces;
- To foster the development of an industrial system for the applied research and the technology transfer toward Firms and Institutions, both public and private.

Fig. 1.1: The Objectives of ICELAB

1.2 BLOCKCHAIN TECHNOLOGY AND LITERATURE

Since 2008, after the leading paper of Satoshi Nakamoto, the number of literature concerning the Blockchain Technology, and sequentially about the usage of Blockchain in Supply Chain and Logistics has increased. Mention that the literature includes an expanding research area, and a large number of contributions in appropriate issues such as finance, Bitcoin organization, cryptography, security and failures of the blockchain, and pharmacy and medicine science. However, a broad different view of the field is still missing. To illuminate the expansion of literature in 2017 and additional needs for further studies, please reconsider Fig. 1.2.

The pie chart denotes that almost 71% of the papers regarding the blockchain and logistics have published in 2017. The results are considered from 62 studies during the analysis phase of the dissertation. The analysis was not only focused on the most recent literature in a specific period, but by considering the beginning of Bitcoin organization the absolute studies have published after 2009 and 2012. Also, the literature analysis was referred to the IEEE Xplore[2] and the Scopus bibliographic[3,4] databases because they contain articles from all major journals dealing with transportation. The following list of keywords (and their combinations) was used to search for studies: Blockchain, distributed ledger, logistics, supply chain, intermodal, freight, and transportation. However, concerning the analysis regarding the following pie chart only English language literature was included, but during the thesis research in a few cases some German, Italian, Persian, and Arabic literature, books, and articles were investigated.

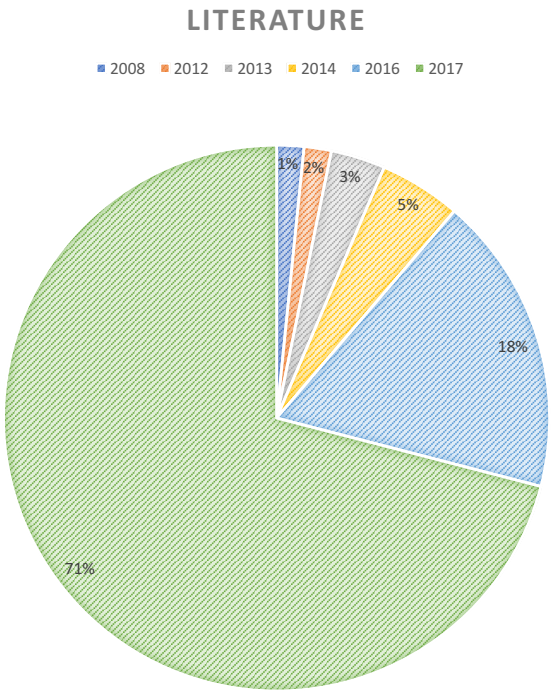

Fig. 1.2: Literature Taxonomy per Years

However, the paucity of literature concerning the applicability of distributed ledger technology in logistics, supply chain, and is strictly notable. In fact, the author observed a significant gap in the literature, particularly regarding the shortage of studies about the utilization of Blockchain technology in Intermodal freight transportation. Consequently, the further research and additional studies are required.

Having said that, in majority of literature the Blockchain Technology is referred as a technology that makes use of the cryptographic algorithm, hash chains and consensus mechanism to implement consensus, irreversibility and traceability for online data. Furthermore, the recent research proves that Blockchain is a practical solution to address problems such as high-cost operation, low efficiency and insecure data storage. Also, the Blockchain is observed as an efficient software architecture that allows reaching a distributed consensus for transactional data without the need for a trusted and centralized individual (X. Xu et al., 2016).[5]

Intuitively, Blockchain is outlined and designed to maintain a single ground truth, and the chain itself is the order of the transactions that all members should respect (Lewis Tseng, 2017).[6] The Blockchain is an immutable history of the network, which can be distributed among all nodes in the system. The essence of the Blockchain is a technical scheme of the reliable database which is collectively maintained by the behavior of decentralized and trust-less methods (Feng Tian, 2017).[7] Besides, the blockchain is latterly introduced and revolutionized the digital world leading a new perspective to security, resiliency and efficiency of complex systems, and it is mostly a simplified payment verification system (Tareq Ahram et al., 2017).[8] Also, (Conoscenti et al., 2016) denote that the Blockchain is hard to tamper and it is adaptable to the number of transactions. Moreover, the Blockchain is hidden at the application level, so low-performance IoT devices are not required to compute the Proof-of-Work (PoW).[9] Likewise, in Blockchain, each block contains the data of all transactions in the system within a period, and it could create Digital Fingerprinting which can be used to verify the validity of the information and connect with the next block (Bruce, J.D, 2014).[10]

Sequentially, a problem regarding the Blockchain size will occur. For example, in case of Bitcoin, continuously the end of 2010 the size of the chain was pretty light (around 10 MB), and the difficulty was extremely modest. However, by the exponential growth of Bitcoin digital currency near the end of December 2017, the blockchain size rise close to 148 gigabytes.[11] As a matter of fact, just from the beginning of January 2013 to the end of December 2017, the Bitcoin Blockchain size has increased over 35 times (Fig. 1.3).

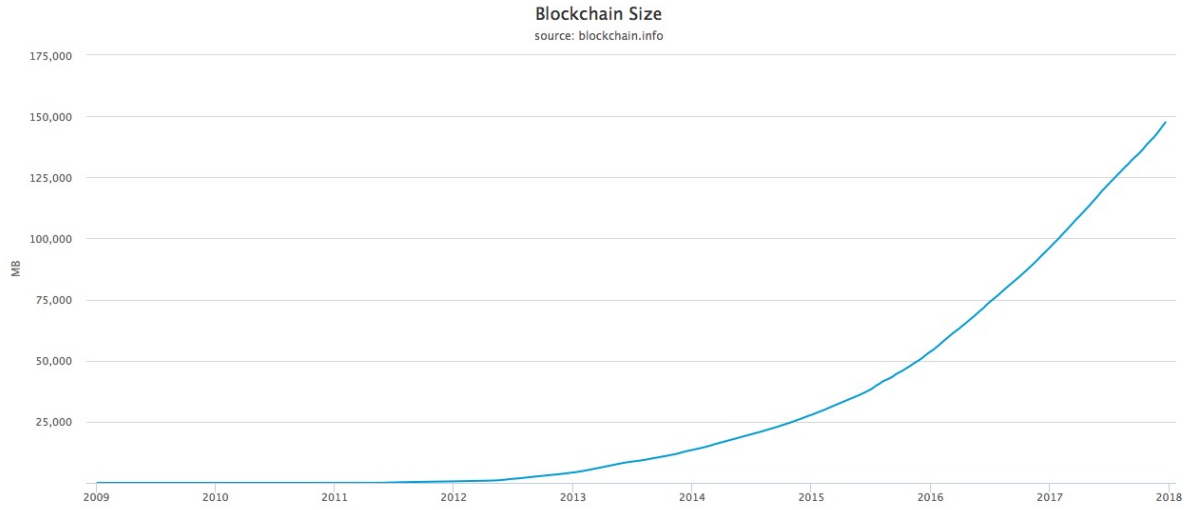

Fig. 1.3: The Blockchain Size - All Time

By the way, the Blockchain technology (disregard the financial organization of Bitcoin) has recognized as an infrastructure for smart contracts that can operate in a fully autonomous and decentralized manner, and it can be used for financial, administrational, or general services

(Thomas Bocek et al., 2017).[12] The Blockchain is an open registry where information about buyers and sellers are stored (Chronicled, 2018).[13] Also, Blockchain technology is a transformative platform that might impact every level of business and society, and it is a disruptive innovation (SoliX, 2018).[14] In fact, the Blockchain is a data structure that makes it possible to create a tamper-proof digital ledger of transactions and share them, and it is suitable for complex workflows. As a matter of fact, Blockchain technology can be used to register time, location, price, parties involved, and other relevant information when an item changes ownership (Nir Kshetri, 2017).[15] Moreover, Nir Kshetri highlighted that the Blockchain might play a vital role in the improvement of overall security in supply chain networks, and with Blockchain technology, it is possible to access the permanent records for several aspects of transactions involving a product to understand critical vulnerabilities in the upstream Supply Chain. Blockchain can also help strengthen downstream Supply Chain (SC) co-workers' and device owners' precautionary and defensive cybersecurity measures.

Also, startups such as Provenance practice Blockchain to increase trust in the supply chain by providing transparency and visibility when the product travels from its origin to the customer (B. Dickson, 2016).[16] In addition, Blockchain has introduced such as an individual sequence of timestamped transactions, where each transaction includes a variable number of output addresses (Guy Zyskind et al., 2015).[17] On the other hand, the ledger of Blockchain is allowed to be downloaded and stored by all nodes whatever they download and store, and nodes involved in the blockchain are random and non-counting. Also, the Blockchain is based on the block as a basic unit, which is formed into a chain employing a directed relation and has no boundary. (Li Jun Wu et al., 2017).[18] Furthermore, the initial blockchain assumes that any participant may "create" and "verify" transactions and blocks (see Fig. 1.4).

Also, any blocks have to be verified by the majority of participants, and any minor modification for the existed block must be concurred with by all participants who store blockchain image, and merchants do not need to be wary of their customers (Satoshi Nakamoto, 2009).[19]

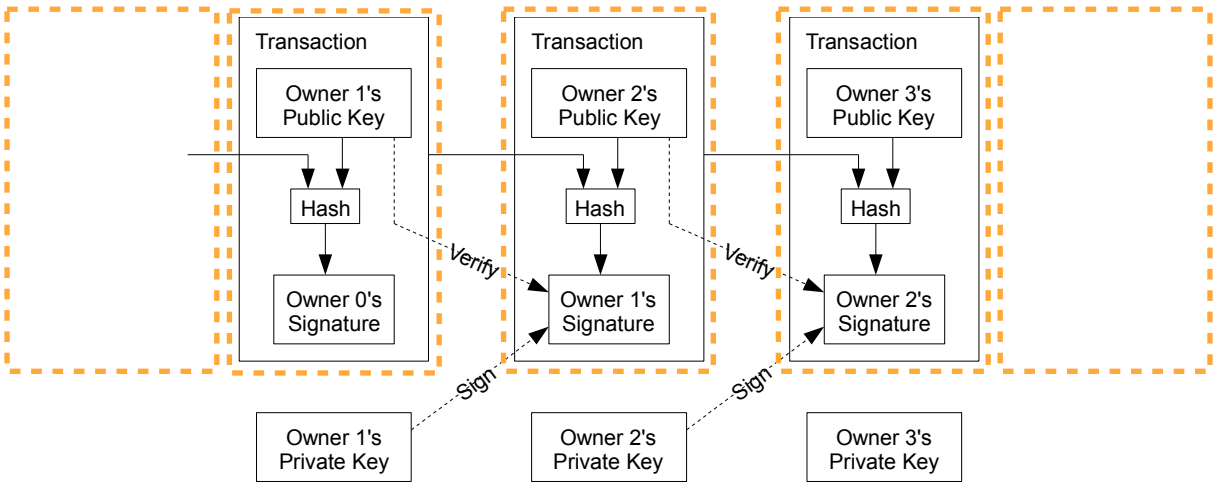

Fig. 1.4: Blocks Transactions and Verifications (Satoshi Nakamoto, 2009)

While on the subject, for many people the Blockchain technology is considered as the fifth disruptive innovation following mainframe, personal computer, Internet, mobile and social network, and it is recognized as the fourth milestone of the credit evolution following consanguineous credit, precious metal credit and currency credit (Swan M., 2015).[20]

Moreover, the Blockchain is considered as a driving force of future Pervasive Social Network[21] (PSN)-based healthcare applications, and it is infeasible to store health data on the Blockchain since this will cause heavy load on the PSN nodes (Jie Zhang et al., 2016).[22] On the other hand and by a little bit extension, a Blockchain is a database containing a ledger of all the transactions carried out between users since it was set up (Lee and Pilkington, 2017).[23] In fact, a Blockchain is a group of blocks that are linked by the hash of the block headers, and it is a sequence of timestamped transactions where each transaction includes a variable number of output addresses. The transactions in one block are considered to have happened at the same time, and a block is a group of transactions. Also, each block is constituted of the number of transactions broadcasted to the network in 10-minute supplements (Nakasumi, 2017).[24]

Sequentially, (Tanaka et al., 2017) concludes that the Blockchain is a decentralized and secured ledger system, which enables us to provide "bitcoin" transactions, and all participants are connected to the peer-to-peer network and they have the same transaction record.[25]

> Additionally, the typical attributes of blockchain are three points:
>
> > 1. Making data alteration almost impossible. 2. Eliminating multiple transfers of value. 3. Implying the possibility to build consensus among participants.
>
> These three (3) characteristics enable the following two (2) functions:
>
> > 1. Publishing the value as digital data. 2. Exchanging each value of participant between individuals. (Tanaka et al., 2017)

Additionally, the Blockchain technology has identified by Conoscenti, Vetro`, and De Martin (2016) as a P2P ledger, firstly used in the Bitcoin cryptocurrency for economic transactions. However, they aimed to understand whether the blockchain and Peer-to-Peer approaches can be manipulated to promote a decentralized and private-by-design the Internet of Things (IoT). In fact, they found out eighteen (18) use cases of blockchain in the literature. Four (4) of these use cases were explicitly produced for IoT.[26]

However, regarding the Anonymity, they discovered that in the blockchain only Pseudonymity is guaranteed, and concerning Adaptability and Integrity, they realized that the integrity of the blockchain largely depends on the high difficulty of the Proof-of-Work. Also, it is approaching a large number of honest miners, but at the same time, a problematic Proof-of-Work restricts the adaptability (Conoscenti et al., 2016). On the other hand, A. Kostin et al., (2017) indicates that the Blockchain technology is a reliable decentralized mechanism for fixing legally significant events in the digital world or digital identification systems.[27] While, Ingo Weber et al., (2017) believe that a common way to participate in a Blockchain is to join a mining pool, where block creation is distributed over many individual participants.[28,29] In fact, there is a though competition between miners to solve the POW algorithm to earn reward and the right to record transactions on the Blockchain (Chen et al., 2017).[30] That informational and technical struggle is the cornerstone of Bitcoin system security model.

Also, Blockchain is essentially a distributed account database, which is composed of a chain of data blocks generated through cryptographic correlation. The data of Blockchain is stored in a series of blocks and transactions are the carrier of data storage (Chao Xie et al., 2017).[31]

In essence, Blockchain is a peer-to-peer ledger system, where information that constitutes provenance for physical, virtual, and application resources can be stored publicly for transparent verifiability and audit (Deepak K. Tosh et al., 2017).[32] Sequentially, Hashemi et al., (2017) remarked that Blockchain is a collection of blocks, and it has to be noted that the Bitcoin's Blockchain is just an example of an appropriate protocol, possibly, there exist other such appropriate protocols.[33] Having said that, (Natoli and Gramoli, 2017) expressed that Blockchain systems are distributed implementations of a chain of blocks. Each node can issue a cryptographically signed transaction to transfer digital assets to another node or can create a new block of transactions, and append this block to its current view of the chain.[34]

Besides, Lundbæk and Huth (2017) believe that Blockchain is created and maintained in an intranet with stronger abilities to control system dynamics. This idea seems at odds with the original intent behind systems such as Bitcoin – which appears to foster free trade through relatively anonymous transactions.[35] Conjointly (Huawei Zhao et al., 2017) purported that the Blockchain is a technology of recording ledgers in a distributed manner, and it is a developing technology, and few studies have been done on key management schemes for it.[36] While as a supporting technology of Bitcoin, the Blockchain is known by the public with the popularization of Bitcoin, and parenthetically the Blockchain is a core technique of Bitcoin (Hirotsugu and Tetsuya, 2017).[37]

However, in technical languages the blockchain is a technology that attempts to use perfectly the Cryptographic Algorithms, Hash Chains,[38] and Consensus Mechanisms to execute traceability for online data, irreversibility, and consensus. Also, practically Blockchain technology helped many people to facilitate their financial affairs and send money to their families (directly from their mobile device to the mobile device of their relatives) without going through an intermediary. One of the applications that is active in this field is called ABRA.[39]

After all, the Blockchain as a distributed ledger technology is a strong invention. Even the critics of Bitcoin such as Jamie Dimon (President of JPMorgan Chase) who said once "if you're 'stupid' enough to buy bitcoin, you'll pay the price one day",[40] remarked that the blockchain technology which is behind the Bitcoin organization is valid. In fact, the innovative actors in City Logistics, Internet of Things (IoT), Synchromodality, and Intermodal freight transportation, are engaging in scrutinizing the potential advantages of Blockchain technology as a Disruptive Technology[41] as "the first native digital medium for value".[42]

Additionally, Blockchain technology already has served several social aids (e.g. HelperBit)[43] or welfare applications, even thought the complicated and classified systems such as Medical Data Access and Permission Management.[44] For example, (N. Zhou et al., 2017) mentioned that in volunteer activities, sometimes the credibility and traceability of volunteer service are questioned, and volunteer managers confronted severe difficulties. Since traditional time record systems cannot protect the related data security of the volunteers, and there some studies regarding the Volunteer Time Record System based on the Blockchain Technology.[45]

Finally, notwithstanding the various individual projects and innovative Start-Ups those are blooming in IT business, there is still some considerable skepticism on the sustainable implementation and full advantages of blockchain solutions in the logistics industry and particularly concerning the Cross-modality and Intermodal transportation.

1.3 DISTRIBUTED LEDGER TECHNOLOGIES APPLIED TO LOGISTICS 4.0

The following dissertation aims to study and analyze the current and possible future implementation of distributed ledger technology concerning logistics and freight transportation. Furthermore, it aims to mention the shortage and limitation of the academic literature regarding the Blockchain Technology through the logistics, freight transport, Cross-modality, and pillars of intermodality. Consequently, the thesis proposes to describe critically, some aspects of the current circumstances of the Italian logistics industry and conventional shipping methods in the 1st PART of the dissertation. Then in 2nd PART, the thesis attempts to explain some prevailing application and ultimate fulfillment of some common cases regarding their permissible capability and studying their possible advantages for logistics efficiency.

Hence, there are some important features (e.g. transparency) that candidate the Distributed Ledger Technology as a backbone infrastructure of international logistics clarity. In fact, (Shorouq Alansari et al., 2017) denotes that Blockchain is a distributed ledger of data and computations on these data cannot be modified.[46] By and large, blockchain is a tamper-proof public ledger of transactions among nodes in a peer-to-peer network and unlike traditionally centralized systems. The goodness of Blockchain is that it does not rely on any trusted central authority, and members (supply chain nodes) in a Blockchain network might use a consensus protocol to agree on ledger content and cryptographic hashes to guarantee the integrity of transactions. However, the important question remains open: How will blockchain change the world of logistics and transportation? (as a 0 and 1 cryptography coding theory)[47] Eventually, according to FreightWaves logistics editorial, "in May 2017, Deloitte tweeted that 10% of global GDP would be built on top of blockchain applications. This huge and ambitious claim was made because of the transformative nature of the technology and the effect it will have on society. For logistics and transportation, it will have a bigger impact promising to shake up the $8T industry".[48] However, there are several banks (e.g. Deutsch bank and Shanghai Government)[49,50] and various administration or governments those realized blockchains technology as distributed ledgers technology as a revolutionary method to engage information infrastructure,[51] and distribute financial transactions globally. In addition, the Distributed Ledger Technology seems to be match with the future and prospective of IoT - Internet of Things. The futuristic logistics in which IoT offers the vision of self-managing logistic systems, where autonomous objects (such as containers) can autonomously determine their path from a cost point of view and autonomously order necessary resources for transport.[52] Continuous digital networking is also associated with the term of "Industry 4.0"[53,54] (illustrated in Figure 1.6). The schematic figure shows a historical development of enterprise circumstances in recent centuries (from 1800 to the possible future). Besides, two curves regarding the Logistics Flexibility and Versatility (purple color), and the Logistics Productivity and Complexity (green color) are converging the present and future of logistics industry. Please consider that the origin of Fig. 1.6 is coming from the remarkable study of (Benjamin Aunkofer, 2013) regarding the history of "Industry 4.0".

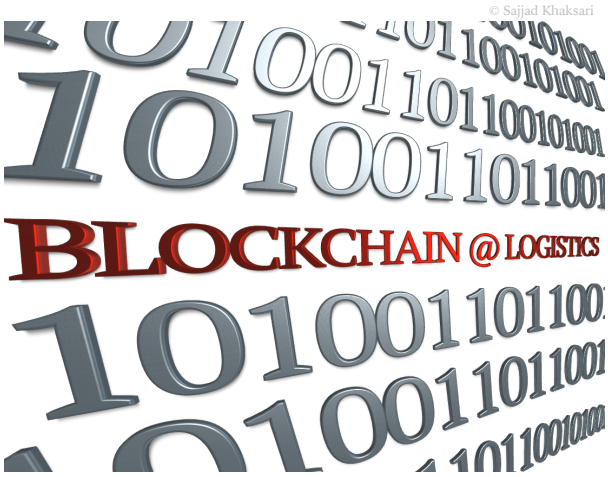

Fig. 1.5: The 0 and 1 through Blockchain

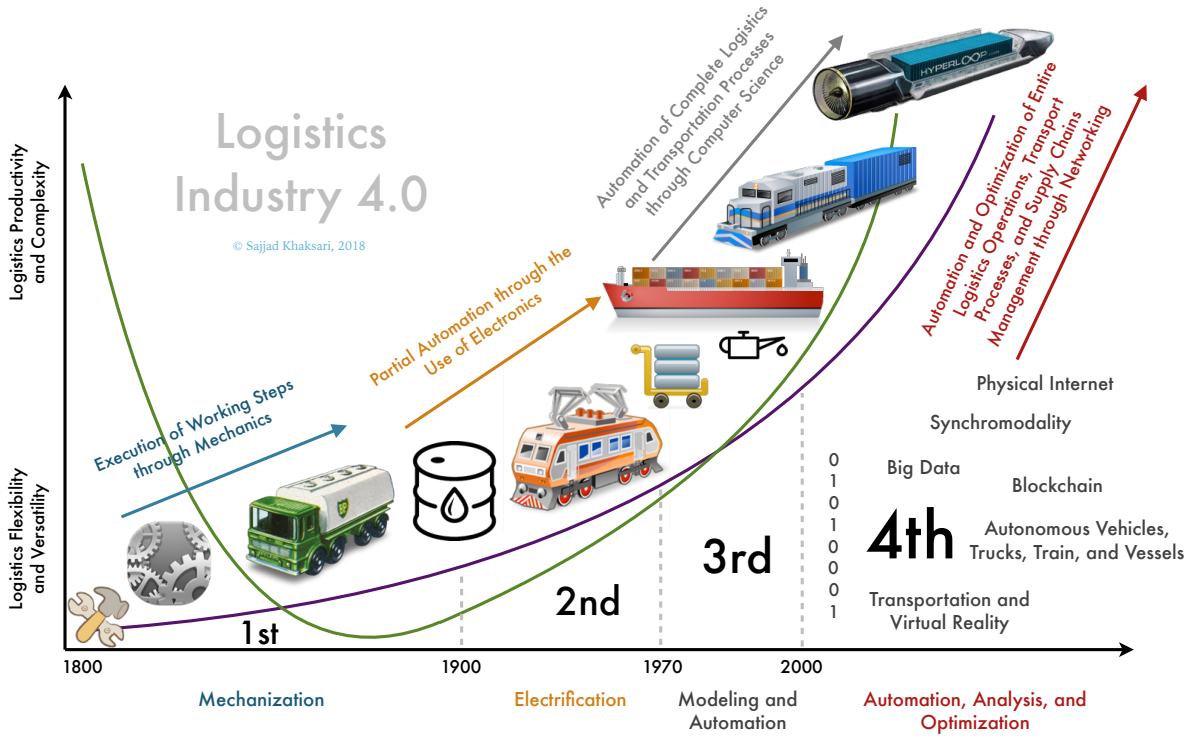

Fig. 1.6: The Logistics 4.0 & Blockchain

1.4 PROBLEM EXPLORATION

The following units of PART I, are designed to explore the current problems of logistics, particularly regarding some crucial problems those are related to the Cross-modality and multimodality, and intermodal freight transportation. However, a critical research method and accurate problem identification during the following dissertation's research appeared essential. The reasons for gaining such critical study approaches are hidden right behind some specific problems of Italian (and European) logistics and freight transportation. These problems involve, engage, and cause significant social harms and financial costs, environmental damages, and mortal events of the labour safety regulations because of conventional methods of shippers, transporters, and carriers companies in both levels of Strategy and Logistics Operations.

On another hand, the railroad transportation businesses are growing steadily inside the Italian economy. In fact, the report of (Confetra, 2015) illustrates precisely the whole circumstances of Italian railway freight traffic from 2009 to 2015 by types of transport (National or International) and companies size (Small And Medium-Sized Enterprises or Large Companies).[55] The report demonstrates an increase in railroad transportation business from 76 million tonnes up to 92 million tonnes of goods. However, in a more global view, this transport pillar needs to increase and empower much more than ever because the percentage of the Italian railway freight traffic is still meagre compared with the Italian on road freight transport. In point of fact, in 2014, the statistics of freight traffic through the Alps shows that the railroad transportation involved only 9.18% of whole goods transportation between Italy and France.[56]

As an aside, aforementioned improvement concerning the increase of Italian intermodality rail-road traffic, denotes once again the needs and importance of critical studies in this area.

Hence some studies illustrate that by promoting intermodal transport base on a Blockchain framework, logistics companies could increase their productivity, effectiveness, and also might intend to contribute to an enormous respect for the environment with higher safety in transportation of containers (TEUs) and goods. Additionally, the Blockchain perspective is to increase transparency, trustiness, efficiency, reliability, effectiveness, and dependability of the national and international logistics industries in different transport pillars (Road, Sea, Rail, Air) and their interactions via cross-modality, inter-modality, and combined transportation.[57]

1.5 RESEARCH METHODS

The research methods are essential for the achievement of academic research. In fact, the following thesis employed the methods that provided insight into the progresses, approaches, and relevant information during the investigation studies. Fig. 1.7 illustrates a brief overview of the applied methods from work experience and desk research into the final dissertation.

Fig. 1.7: The Schematic Overview of the Methodologies and Research Designs

The methods globally characterize the distinct stages of the research. The author personal groundwork experiences are spinal column of the introduction section of the thesis (PART I). In fact, in whole parts of the project in many cases when the text tries to illustrate some logistics aberration or some irregularity of Italian transportation, the pictures and cases are captured and apprehended by the author. Moreover, in desk study phase the literature has reviewed and proposed solutions were included in whole parts of research. Also, these literature are the primary components for further research and the farther addition of appropriate erudition. Eventually, the bibliographies and articles citation have extracted via the Mendeley's library.

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COSTS OF CONVENTIONAL TRANSPORTATION PLANNING

2.1 FAMILY-RUN COMPANIES WITHIN ITALIAN TRANSPORTATION

According to economic segment of "wholesale and retail trade, transport and warehousing, accommodation and catering services", the Italian national census in 2015 has illustrated an increase of 3715 million Euro from 2010 to 2014 (review Chart 2.1).[1] Also, the entire logistics and transportation portions occupy more than 20.69% of the whole Italian economic activities in 2014. These statistics once again explain the importance and need of the broad and critical academic studies regarding the efficiency and transparency of logistics and transportation as an important financial pillar and as an influential national economic division.

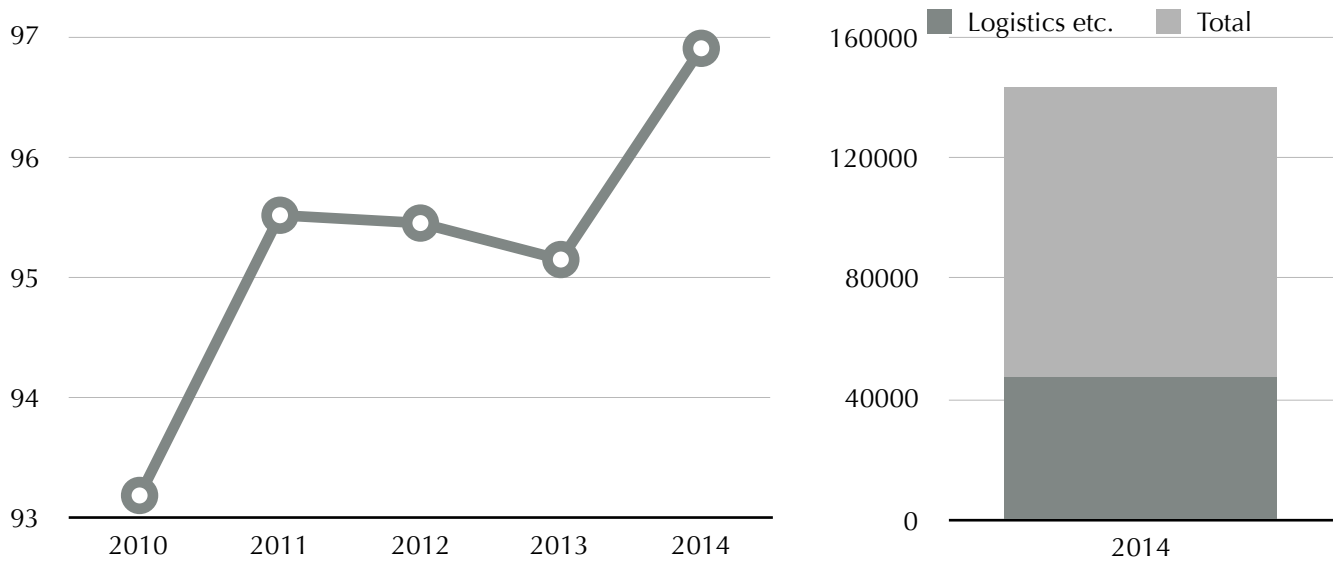

Chart 2.1: The Statistics Regarding The Wholesale And Retail Trade, Transport And Warehousing Etc.

In addition, the Italian national census of 2015 highlighted that during economic year of 2014, the costs of transport services increased (by road, + 1.4%, maritime + 7.2%, aircraft + 0.8%) and warehousing and storage by + 0.1%. Having said that, the prices for postal services and courier activities decreased by - 0.2% and goods handling by - 0.1%.[2] However, another exciting information in Italian Census 2015 is regarding the expansion of the 2.2% Rate of Expenses for Innovation concerning the On-Road Transport, Transport by Pipeline, Air Transport, and Sea and Water Transport.[3] While the results show a numerical increase in European freight transportation, at the same time this fundamental industry is suffering from some shortage of efficient method in both operational and theoretical levels.

In fact, still many carriers and Freight Logistics Providers (FLPs) are familiar with the traditional and conventional method of their ancestor fathers. In the following unit, the critical impact of conventional transportation outlining will be analyzed. However, (Todd Litman, 2017) believes that conventional transportation planning minds to focus on a limited set of impacts,[4] and practically neglect the long-term impacts of its logistics or transportation acts. The reasons for this practical ignorance concerning the consequence of transportation activities might be hidden behind the relevant difficulty of quantification of the direct/indirect environmental impacts. Moreover, maybe simply because the new transportation methods are out of tradition (specially among the Italian family-run transportation companies). In fact, the conventional and traditional transportation planners attempt to minimize operation costs (as it is possible without thinking about the long-term consequences) and maximize traffic speeds (even by violating the traffic speed limits or by commanding truck drivers to infringe their standard working hours: 9 hours/day, 56 hours/week, and 90 hours/two weeks).

However, concerning the Italian transportation characterizes, the real fact is that the majority of Italian transport and logistics companies are family-run business organizations. In fact, it is challenging for the author to mention a name of an Italian transportation company that is not run by the family. As a matter of fact, the preponderance of Italian freight transport and logistics companies are family-run organization. Companies such as Bartolini (BRT),[5] SAVINO DEL BENE,[6] ARCESE,[7] FERCAM,[8] Gruppo Argol Villanova - BCUBE,[9] Gruppo Gavio,[10] Albini & Pitigliani,[11] Fagioli,[12] LANNUTTI group,[13] Franco,[14] Ambrogio Trasporti S.P.A.,[15] Riboni srl.,[16] De Poli Autotrasporti,[17] and Ital Logistic.[18] (for more information review Confetra-2014)

Even in some cases if an Italian transportation company does not carry the family name, it is however a collection of smaller family-run companies those decide to work and collaborate together to empower their collective power in a competitive logistics industry. The MOLE s.c.p.a. is an example of this kind of combination, and it is composed by the strategic alliance of some Italian family-run auto transportation (carriers) and logistics companies such as BORDIGNON *Trasporti*,[19] MANTOAN *Trasporti*,[20] RICOTTO,[21] SEGALIN *Trasporti*,[22] and Fratelli *(brothers)* Cavaglià S.r.l. In fact, as illustrated previously, they are many family-run companies in Italy, and they operate in different segments and different industries from agriculture and tourism to the logistics and transportation of goods. These companies own their business structure, and they are benefited or suffered from their advantages and disadvantages.

The advantages of these Italian family-run transportation companies might conclude in their extraordinary motivation to keep the business of family alive. They never steal from their own company, and they try their best to cut, hunt, and gain everything from everywhere that is possibly helpful for the increase and expand of the family capital. In such circumstances, the logistics labors, truck drivers, and office workers those are not part of the family, discover themselves in front of the integrated barriers of the family (include grandfather, father, mother, wives, sons, daughters, aunts, uncles, cousins, nephews, and so on).[23]

On the other hand, these Italian family-run transportation companies are seriously suffering from their traditional business model. As a matter of fact, the leadership and strategical management of the company is exclusively in the hands of family members (normally the more powerful son of the family).[24] Even if there is a graduated employee and she/he is fully smart logistics engineer, and she/he has 40 years of work experience in logistics and transportation, and she/he is informed about the newest logistics methods in the world, without any doubt the next absolute top manager of that freight transportation company will be the son (of the funder father). Another significant disadvantage of family-run carrier companies is regarding the shortage of enthusiasm among human resources because all critical or strategical decisions are made by family members (in particular the father and mother and sons) and workers recognize themselves as porters or coolies. Following figure (Fig. 2.1) denotes these contradictions.

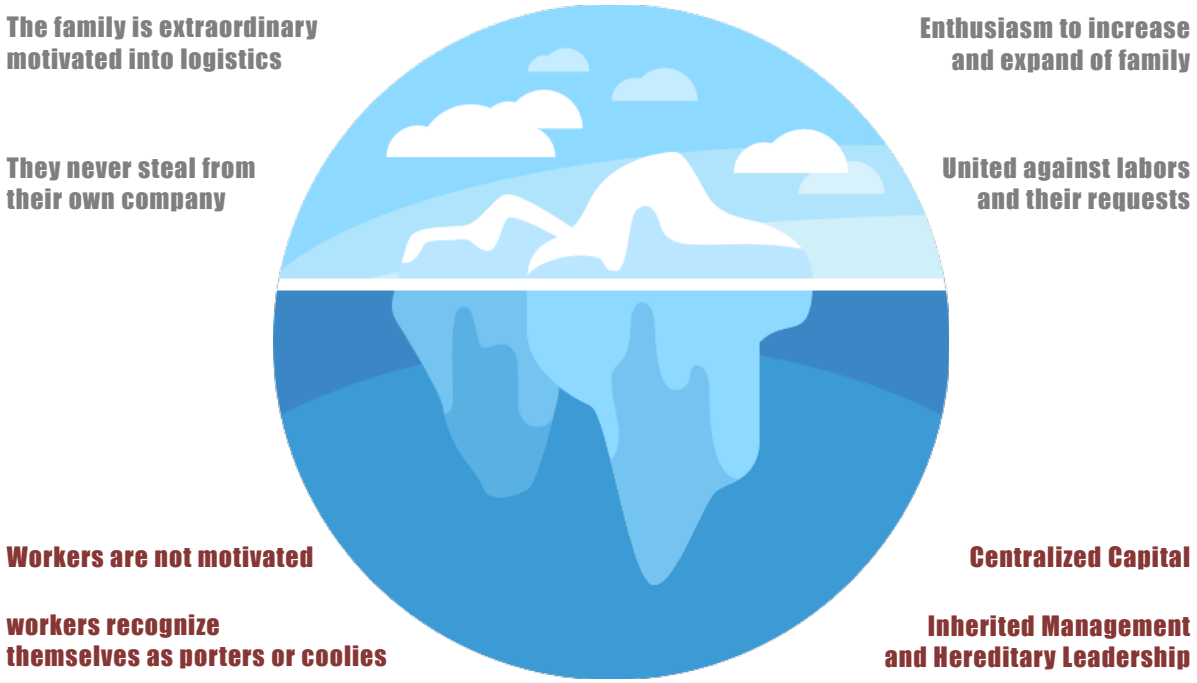

Fig. 2.1: The Iceberg Of Italian Family-Run Transportation Companies

Having said that, in public opinion of Italian traditional freight logistics providers, only distance (by km) is considered the parameter that could properly reflect the economic influence of supply chain or a Dry/Sea-Port. However, the research of (Ferrari et al., 2011) denotes that traditionally, the *Containerisation* and intermodality progressively eroded such a paradigm, while currently, distance became only one of the factors across the overall intermodal freight "equation".[25] In fact, in this regard, the effectiveness of inland connections plays a fundamental role. Mention that the major purpose of their paper was to measure container traffic diversion from Ligurian ports [Genoa, La Spezia and Savona] to the principal Italian and European competitors. Also, the exceptional studies of (Ferrari et al., 2011) illustrate that better is the connection of a port to the various inland markets, the bigger is the potential logistics opportunity to enlarge its overall captive area.[26]

Consequently, concerning the Genoa freight transportation, another study with consideration of the sequential simulation-optimization approach has revealed by Ambrosino and Sciomachen (2012). They considered the problem of Hubs' Locations concerning freight mobility in urban and suburban areas, with a devotion to the multimodal freight network of Genoa (Italy).[27] Also, their study has selected the possible modal change nodes by analyzing the communication capabilities between nodes and with other nodes of the intermodal freight network such as depots, transit points, retail points, principal accesses to the highways and railways. Eventually, in conclusion of this section, that is important to highlight once again the negative impacts of traditional and not innovative ways of logistics operations. Moreover, that is an important duty to strongly invite all supply chain actors including shippers, carriers, FLPs, authorities, and governments to rethink and remodel some sustainable transportation plans, and through consolidation of goods of different shipper-consignee pairs.[28]

2.2 SOCIAL COSTS OF CONVENTIONAL TRANSPORTATION PLANNING

Before getting directly into the following argument, probably it is important to mention that the major transportation modes according to their main transportation engineering infrastructure are described and categorized as the following: roads, railways, (oil) pipelines, inland waterways, maritime, and coastal navigation, and air transportation.

However, concerning the EUROSTAT 2017 report, the transportation of freight via air somehow could be neglected because of the absolute majority of freight transportation via road, sea, rail, and pipelines. Nevertheless, the ATAG expressed that the sustained growth in demand for air travel has also directed airlines to rethink how they can maximize the effectiveness of their transportation networks.[29] In fact, the create linkages and improve connectivity with other transport modes are one of the sustainable solutions. While intermodality can include a combination of access to airports, corresponding feeder services between the airport and the numerous parts of the surrounding region, and alternative services that fully reinstate airline feeder services to airports. However, the most examples of intermodality are progressing on a bilateral basis such as combined journey involving an on-road transport and Dryport/Seaport or a railway and an airline terminal.[30,31]

On the other hand, the EUROSTAT 2017 has unveiled that in 2015, the Total Greenhouse Gas (GHG) Emissions in EU-28 has increased by 28.1 MILLION TONNES CO2 EQUIVALENT corresponding to the previous year.[32] Also, the report shows that in 2015 the TRANSPORT consumed 31% of whole European energy consumption by absorbing 358.6 Million Tonnes of Oil Equivalent (MTOE).[33] The tragic oil base freight transportation energy consumption of Germany (63.2 MTOE), UK (51.8 MTOE), France (50.1 MTOE), Italy (39.5 MTOE), and Spain (33.6 MTOE) as major European country consumers is thought provoking.[34] The disturbing news is that the absolute majority (277,715.5 KTOE fuel) of this energy consumption and emission expansion has caused by MOTOR GASOLINE and DIESEL OIL for European transportation. Sadly, the BIOFUELS include Biogasoline, Biodiesel, and other liquid biofuels obtained a tiny portion of the European energy consumption.[35]

These aforementioned fossil fuel energy consumptions generate a fatal network of lethal emissions, and it causes numerous of the health issue for citizens. Consider that children, sick and elderly people are the first victims of CO, CO2, H2, SO2, NOx, NO2, and GHG. In particular, the Nitrogen Dioxide is an irritant gas, which at high concentrations causes inflammation of the airways.[36] While nitrogen is released during fuel combustion, it mixes with

oxygen atoms to produce nitric oxide (NO) and further combines with oxygen to create nitrogen dioxide (NO2). The diesel engine[37] and internal combustion engines and fossil fuel combustion in vehicles during their movement and especially during congestion and traffic is the major cause of NOx emission in city centers. Certainly, there are many possibilities to reduce the emissions by utilizing biological fuels, energy saving appliances, electric vehicles, and commonly limited application of fossil fuels.[38]

Case in point, an efficient transportation system requires to serve several demands in a right time, with proper equipment, and with the right (or in a better world with the) qualified personnel. For example, in case of the City Logistics, would be inefficient and vague if inadequate sidewalks and paths force parents to chauffeur children to local destinations to which they would instead walk or ride (a bike), or if some insufficient mobility possibilities force urban commuters to drive although they would favor to rideshare or use transit. In fact, the improvement of City Logistics and Freight Synchromodality might increase the performance of logistics and transportation in both city centers and urban movements. Also, nowadays there are modern ways of transportation those arise on the soil of innovated cities. These modern methods do not include only in modes of transportation, but they incorporate sportive liveliness. The TurinMarathon is one of these examples. In fact, the marathon running for achievement of sustainable transportation is currently on the way in many metropolitan cities.

Also, regarding these events, some companies like BlueTorino are actively sponsoring such green projects. The BlueTorino is 100% electric car sharing[39] in Turin (the capital of Piedmont region in Northwest of Italy). The BlueTorino network announced that the energy required for recharging its fleets are coming from certified renewable sources. Even, the "LMP" batteries are reusable at the end of their lifecycle, and their battery electric vehicles possess the amount of 97% recyclable components.[40] After all, the BlueTorino occasionally participate sports[41] events such as TurinMarathon[42] and biking around the city in collaboration with [TO]BIKE.[43] Also, BlueTorino posses the fleet of 100% Electric Buses (E-Bus)[44] and they work for sustainability and essential improvement of a Green City Logistics in Turin.

Likewise, the green artillery of Bike-Sharing organizations such as [TO]BIKE, Obike, Mobike, Gobee.bike are already in the battle against CO2 emission in Piedmont province and beyond (please review the APPENDIX I). However, [TO]BIKE is a Bike-Sharing system in Turin with more than 140 bike stations. That is a conceived network “for those who want to experience the city on two wheels and prefer to feel free from traffic”.[45] [TO]BIKE is the modern bike sharing service for citizens and for all Turin's visitors who arrive into town for recreation, tourism, and work. [TO]BIKE has been designed for short trips, and its project aims to contribute the most suitable and affordable urban transportation. The users of [TO]BIKE are obliged to possess an electronic card, and they will be able to use the bicycles every day per 24 hours regarding their available credit. However, in general the idea of sharing is exciting (e.g. BlaBlaCar case). Regarding the case of “oBike-Stationless Bike Sharing”,[46] in February 2017, Obike was initially the first homegrown station-less bicycle-sharing system in Singapore, but today Obike works in various countries such as Italy[47] and UK.[48] In fact, oBike is a Global Bicycle Sharing Platform,[49] and it grants commuters an eco-friendly, convenient, and accessible alternative method of urban transport. The bikes possess a Built-In Bluetooth lock, and they can be dropped anywhere not just at the particular docking stations. Riders are required to utilize a smartphone application to locate and pick up bikes. Users can locate a bicycle around them through the GPS technology for Geo-localization of bicycles. The bikes are unlocked by employing the unique QR code which is present on each bicycle, and can be left in any public place without creating obstacles to the flow of traffic and people walking pathway.

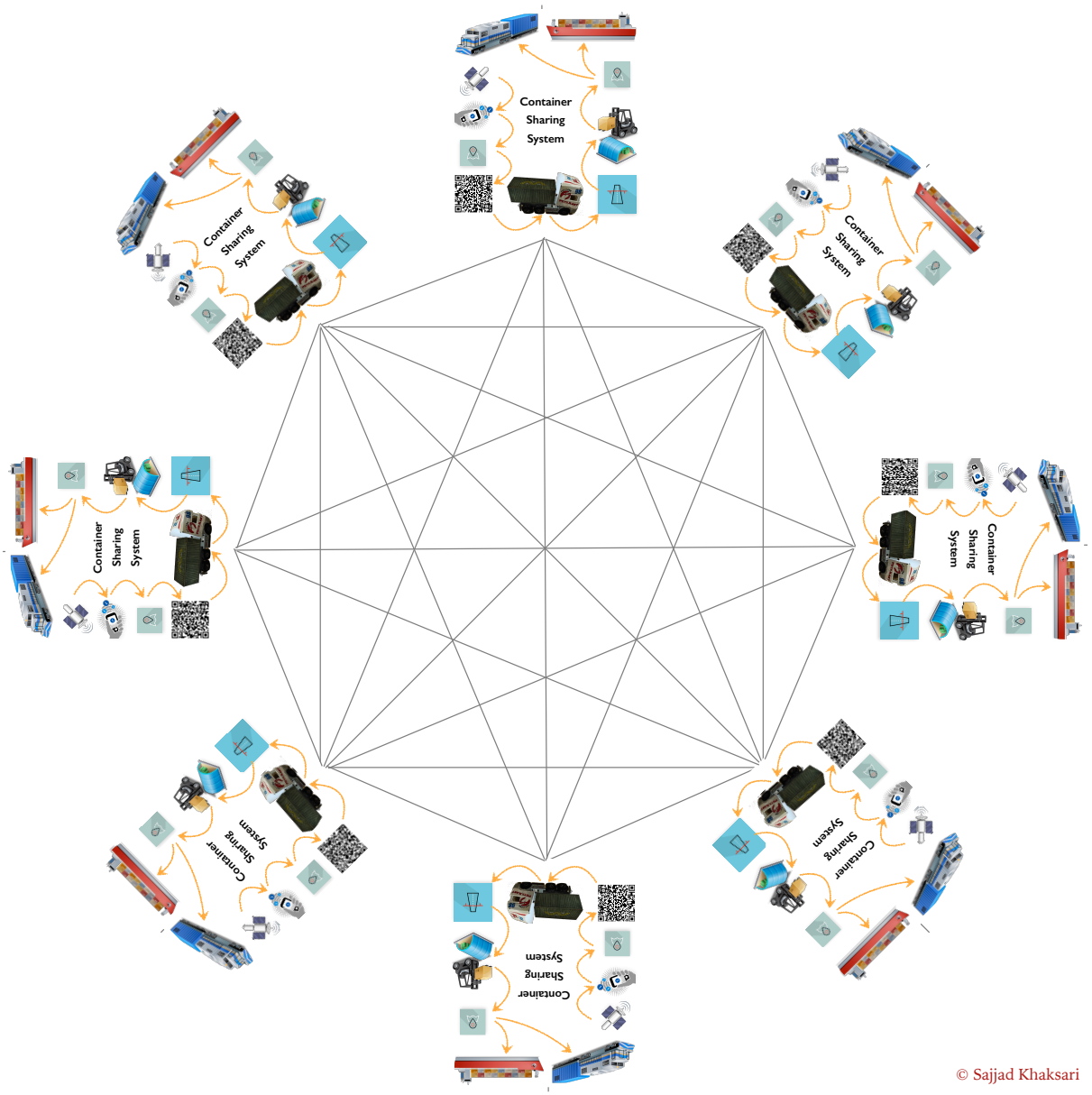

Fig. 2.2: An Ample View Thorough A Decentralized Container Sharing System

Furthermore, besides Obike, the Mobike is one of the world's most extensive bike-sharing program and technologically advanced smart bike-sharing platform. Mobike has launched the #MobikeMovement on Twitter social media and attempts to provide "an affordable means of shared transportation for convenient short urban trips while reducing congestion",[50] and defeating the cities carbon footprint. Moreover, Gobee.bike is a "global operator and a leading station-less bike sharing operator in the world outside of China",[51] which is headquartered in Hong Kong. However, following a pilot phase in Hong Kong and successful launches in France (Paris and Lille) and Belgium (Brussels), the Gobee.bike sustainable mobility service, since 2nd of November 2017, the Gobee.bike has begun its operation in Turin.[52] However, sadly, in February 2018, Gobee.bike has stopped its operation in Italy, because shamefully, nearly 60% of their European fleet got damaged, stolen, and privatized.

By the way, Gobee.bike had empowered individuals with the newfound freedom to ride anywhere, at any time, in the spirit of the interconnectivity, sharing economy, and the epoch of Smart Cities. Gobee.bike described its New Way To Travel in three steps: Find a Bike, Scan & Ride, and Lock.[53] Users could download the application and register, and tap to locate the nearest bike. After reaching the bicycle, they can directly scan the QR code or insert the bike's plate number to unlock and ride. Finally, once they arrived at their destination, they might manually lock the bike to finalize their travel.

After considering all aforementioned descriptions regarding the purposes and advantages of Bike-Sharing Systems, might it is the proper time to imagine an interchangeable units (e.g. Containers and Semi-trailers) Sharing System base on Blockchain technology and distributed ledger infrastructures (review APPENDIX I). The imagination of a future in which the logistics industry benefits from various advantages of Container-Sharing System is plausible. The advantages such as the possibility to park the containers everywhere and pick up the Cross-modal and intermodal trailer everywhere thanks to the transparency which is assured and guaranteed by BLOCKCHAIN technology (review Fig. 2.2).

Furthermore, a comfortable access including real-time documentation of containers with a simple QR code scanning and signing a Smart Contract. Moreover, increase in approachability of Supply Chains and intermodal freight transportation and some significant reduction of wasting time and detrimental Truck Idling. While building a sustainable network of Intermodal freight transportation among European Union members earnestly requires further compatibility between the international and regional logistics actors, designing a business innovation model regarding Container Sharing System might help European transportation companies to reduce their carbon footprints and enhance their productivity and financial sustainability.[54]

However, the revolutionary improvement will not happen until the Container-Sharing providers do not share their platform with each other. It means that if the companies are fixed to follow their conventional and traditional business methods, and they only attempt to capture clients inside their individual platform, the real sharing opportunity will not realize. Take the example of Bike-Sharing Systems, if citizens are obliged to install all the Apps and pay to all individual providers in different ways, the authentic purpose and the real meaning of Smart City might not be defined in its signification.[55] The old example of this mismatching was the incorrectly and unsuitably of E-mail providers at the beginning stage of the internet. In fact, at that time the transaction of an e-mails was possible only between the same e-mail providers (e.g. Gmail-to-Gmail and Yahoo-to-Yahoo). Hopefully, today internet users are able to send emails and distributed messages to any email addresses, and they do not need to register or enter into all those email websites. However, nowadays, the same problem of mismatching is disturbing the users of social media those are required to change their platform between Facebook, Google+, Twitter, LinkedIn, Pinterest, and so on. In fact, if someone wants to read or confirm an event on Facebook needs to signup into the monopoly of the most prominent social network company.[56]

After all, another practical problem that might affect the environmental issues directly, and it might increase the social (external) costs of logistics and transportation is embroidered on the ***conventional delivery addresses*** of warehouse identifications or reconnaissance final clients. Unfortunately, in practice of logistics transmissions, the inaccuracy of addresses cause some significant waste of time and partial delays in delivery of freight via intermodal transportation.

In fact, the current addressing system in logistics and transportation has remained conservative and obsolete even after the invention of the Container.[57] Unfortunately, even today the whole logistics and transportation industry (particularly among the Italian small and medium size companies) is indicating the direction or destination of goods and containers by naming

countries and cities, calling the name of streets, and defining the civil (house) numbers or plaque number of establishments. This prehistorical addressing method maybe could be useful or less harmful concerning transportation via pedestrians or in case of light vehicles.

However, the traditional location directing modes are not able to offer an innovative and dynamic solution regarding the "Last Mile Problems" and day-by-day problems of heavy vehicles (long-haul trucks) and their routing optimization problems. The productivity, sustainability, door-by-door logistics expresses, and smart mobility in intermodal freight transportation fully expect the innovative and agile delivery methods. Sorrowfully, the inaccuracy of the current loading/unloading addressing system, in any circumstances can generate some tremendous and detrimental problems for unimodal, multimodal, and intermodal transportation. In point of fact, the personal experiences of the author report that nearly all written so-called "*Civil Addresses*" are inaccurate for truck deliveries. The real fact is that when a container is loaded on trailer chassis, and truck driver try to insert the addressed destination in her/his GPS, the results are not accurate and precise.[58]

Besides, consider that this lack of exactitude is an additional problem to the cases in which the *NOMINAL* address that is written on transportation documents is referring to the Legal Seat or Headquarter of the client. Throughout the time, these kinds of systematic errors might appear only when the truck driver arrived at the destination, and client redirects the truck toward the *REAL* location of delivery. These ridiculous and trivial Addressing problems are happening every day during the on-road transportation of Italian logistics,[59] while for conventional transporters these problems seem shallow, normal, and only they are natural part of trucking jobs. Precisely because of this, some delays and waste of time during the parcel delivery and intermodal freight transportation are caused by the inaccurate indications and not precise addresses of clients, warehouse suppliers, freight logistics providers, Dry/Sea Port basements, or intermodal terminals. However, the studies elucidate that the truck idling,[60] waste of time, and energy lost in first-mile and last-mile section of intermodal freight transportation are notable.[61]

In fact, these archaic techniques of Addressing perhaps can satisfy the driver of light vehicles those have enough time and the possibility to search or to exercise U-Turns and drive back or ahead to discover the final destination, but the indication such as City X, Street Y, and Building Z exclusively are ineffective and inefficient. The future of transport documentation needs to be accompanied with fascinating smart and straightforward ways to offer the precise and accurate GPS COORDINATE (N° and E°) NUMBERS. One of the simple solution to solve the problem of Inaccurate Addresses for small and medium-size carrier companies is to create a domestic Database and share the accurate and specific GPS COORDINATE NUMBERS with truck drivers. The ITALIAN COMPANIES' REAL ADDRESSES is an initiative project to help truck drivers in the north of Italy.[62] Only that is vital to mention that the Main Function and Core Competence of a heavy truck driver during intermodal freight transportation are to conduct goods and vehicles (including semi-truck, semi-trailer, and container) in fully safe and secure manner. In fact, inserting of Addresses, road planning, and route optimization are supposed to be the Main Function and Core Competence of logistics officers in carriers depot and FLPs directors. The following shape (Fig. 2.3) expresses a schematic view of designated functions.

An e.g. of GPS Coordinate Numbers: 45°27'08.2"N 8°37'55.6"E

However, at the first level, the transportation documents should supplement with the exact coordination numbers of the exact gate or passage in which trucks are supposed to enter or exit, and both shippers and clients need to update and cure the correct GPS data of their suitable business addresses. Moreover, transport documents [in case of Italian transportation: *Il Documento di Trasporto (DDT)*],[63] and international commercial documents must be

accompanied with QR codes and UHF RFID[64] to facilitate the induction of data within papers and GPS devices. Succeeding, in next level regarding transport documents synchronization, the linkage, digitalization, and decentralization of all relevant documents are necessitated.

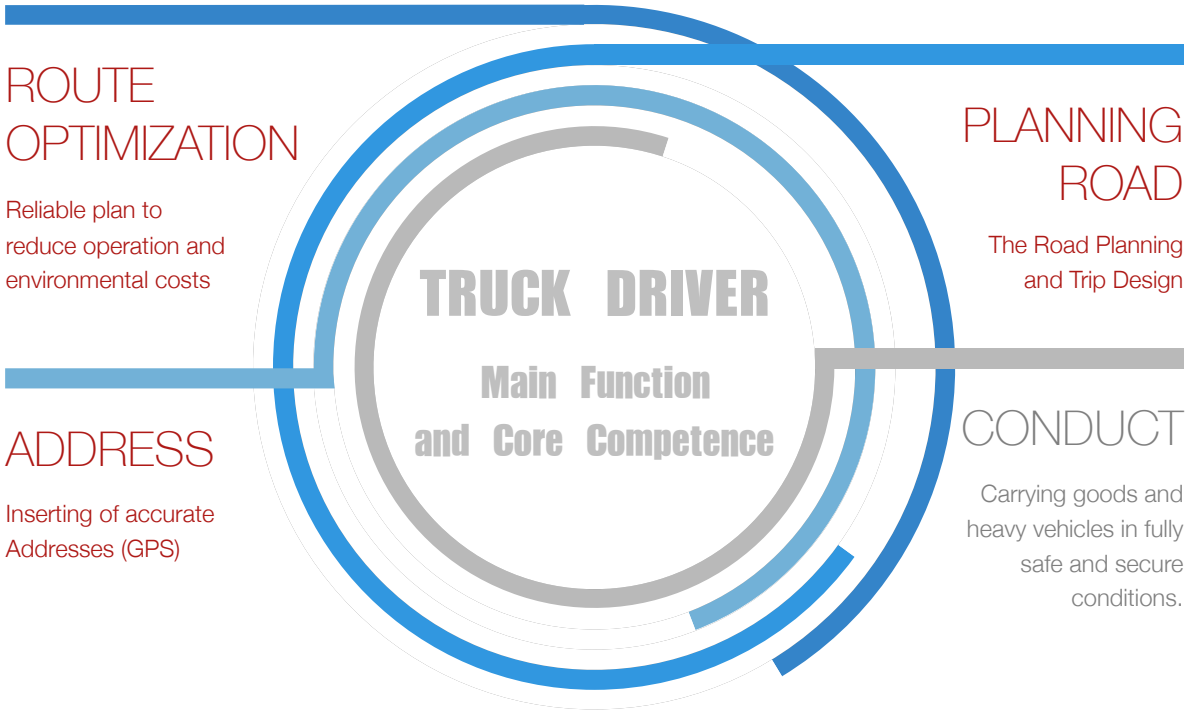

Fig. 2.3: Road Safety and Goods Security & Main Functions and Core Competences of a Truck Driver

The accurate loading/unloading location identification of firms would decrease the waste of time and fuel, and it might increase the performance of transportation systems. Sequentially, in the following PART II of this dissertation, the idea of Smart Contract, Smart CMR (e-CMR), Smart Penalty, Smart compensation, and Smart Goods Damage Report would be proposed and somewhat will be developed. It might also be noted, the Smart Addressing systems and Coordinate Numbers might assist qualified managers to boost the efficiency of their fleet programming. These smart methods might increase work performance of both truck drivers and even for truck managers by radically reducing the both Last-Mile idling and wasting times. Notwithstanding, the shreds of evidence and approved cases related to the inaccuracy of Italian companies real addresses are plenty. The following image (Fig. 2.4), as an ostensible proof, demonstrates one of the several (probably millions) comparable examples.

Here in Fig. 2.4, the author intends to demonstrate one of the best cases (very common examples), not one of the worst cases which are in particular maybe caught hours of drivers' time to be discovered, and the real addresses are kilometers far away from the nominated addresses. Besides, intentionally the AMAZON case has been chosen to demonstrate the fact that conventional addressing system is not any more efficient indeed, even concerning the gigantic international logistics companies. The image is seized from Google Maps Satellite Pictures, and it is representing the huge logistics center of AMAZON Italia in Castel San Giovanni (Province of Piacenza). This hub is probably the biggest logistics cities of AMAZON in Italy, and it occupies over 70,000 square meters.[65] Seven days per week, 24 hours per day, and almost all days and night of every year AMAZON of Castel San Giovanni receive light and

(in the majority) heavy trucks from all of Europe and beyond. Therefore, every year thousands of truck drivers insert the relevant address (the nominal address which is written on transport documents) and search for it: Strada Dogana Po, 2/T, 29015 Castel San Giovanni PC.

The result is fascinating (indicated as House 1 in Fig.2.4) because the result addresses truck driver to goes into the other side of the principal road, inside a street (*Strada Dogana Po*) which is sadly a dead end street. Unfortunately, many trucks (usually by 40 tonnes weights and 18 meters length) are finished in this dead-end road, and if someone visits *Strada Dogana Po*, who will see in the last section of the street how the asphalt has been disappeared or damaged because those trucks are forced to exercise a U-Turn in that wrong, tight, and narrow street. As previously mentioned, the reason behind of these logistics troubles those generate waste of time and significant loss of energies, is only because most of the *Civil Addresses* are not precise and they are dangerous for a sustainable logistics.

However, assume that someone is more skeptical and even she/he has the occasion to search and navigate on Google Maps Application and recognize that probably the AMAZON is on the right side of the principal road (indicated as House 2 in Fig.2.4). Moreover, assume that when the truck arrives close to the main square, the truck driver can see the street indicators (if they are available) and drive to the AMAZON gate (indicated as House 3 in Fig.2.4). Then, the truck driver is supposed to park the truck, turn off the engine, walk to the reception, and ask them what the next step is? After some minutes of search and identification, they will answer, this loading will be implemented in another Gate (indicated as House 4 in Fig.2.4).

Then finally, the loading operations will start on decided docks or loading bays (indicated as House 5 in Fig.2.4) at the decided time by AMAZON logistics supervisors (RED lines in Fig.2.4 denotes simply the trajectory of truck and truck driver). Furthermore, once the loading operation is finished, the truck driver has to sign all transport documents, close the semi-trailer, seal the container, pass the security control, and drive to the destination (a warehouse or an inland terminal). Also, please consider that "driving to another destination" practically means repeating the same problematic RED cycle again and again.

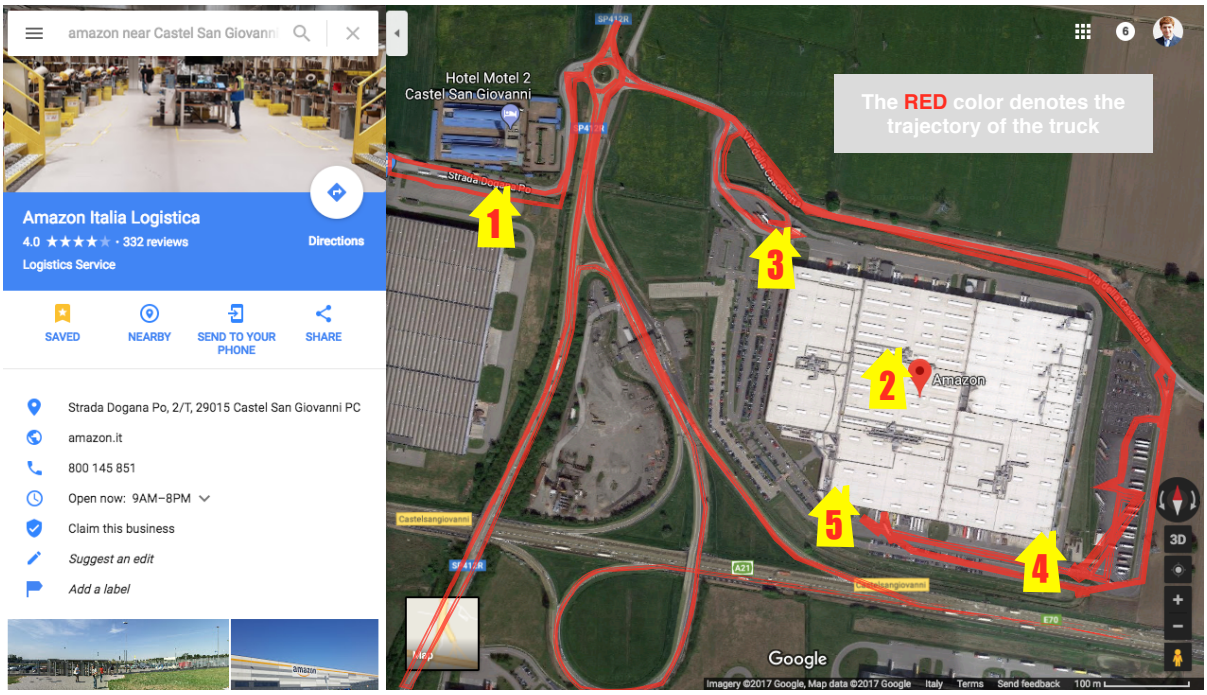

Fig. 2.4: AMAZON Italia Logistica & Inaccuracy of the Addresses

Conclusively, another important problem regarding the social costs of conventional logistics and post-industrialization (of fossil fuel based) transportation, gravely and soberly is concerning the ***Heavy-Duty Truck Idling***[66] throughout on-road logistics services or during an intermodal freight transportation, while on the other hand, the social performances characterize the sustainability of cross-modal transportation comparing with unimodal shipments.

Whereas, the enormous expenses of truck idling and its economic costs harm global economy, the social costs of *Truck Idling* attacks globally and undeviatingly the health issue of people. In fact, Andrew Wolman (2007) had introduced the predicament of Heavy-Duty Truck Idling practices as a harmful energy factor and environmental challenge.[67] According to the EPA (2004) study, an idling truck burns nearly one gallon of diesel fuel per hour and the long duration truck idling in the United States in 2004 had consumed 960 million gallons of diesel fuel per year.[68] The report expressed that the reduction of unnecessary idling could save each truck over $3,000 in fuel costs, diminishing air pollution, and condensed 19 metric tons of carbon dioxide annually. Moreover, with increasing interest in climate change issues, the Metropolitan Planning Organizations (MPOs)[69] are working to face requirements for greenhouse gas (GHG)[70] analysis of their regional or national long-range transportation plans. In fact, in some countries, the NO-IDLING LAW is straightforward.[71] Also, the law control parking space of trucks and long-hauls, and authorities encourage citizens to call and report the law violations. In another side, some effective administrators try to install the proper facilities to help and assist truckers to comply with the no-idling law. Whether the need for innovative regional transportation planning had grown,[72] and traditional plans do not satisfy or do not exchange traffic and congestion information in real-time. As an example, in 2010, the Pennsylvania Turnpike Commission (PTC) had a ribbon-cutting ceremony to mark the opening of a Truck Stop Electrification (TSE) facility at its New Stanton Service Plaza.[73] The Electrification system fits into truck cab windows to provide heat, air conditioning, internet, TV, and electrical power to heavy trucks and other diesel-powered vehicles while the engine is shut off.

Fig. 2.5: NO-Idling sign

However, Fig. 2.5 illustrates a *NO-Idling* sign that directly concern the diesel trucks, and the sign indicates a NO-Idling area (in New Jersey). In point of fact, the State of New Jersey is suffering from air pollution and toxins emissions, and there is an active movement called: http://stopthesoot.org. The New Jersey environmental activists believe that cars, trucks, buses, off-road construction vehicles, locomotives, marine engines and planes represent the most significant source of air pollution in New Jersey, while every year, hundreds of New Jerseyans die prematurely and suffer heart and lung illnesses due to fine particulate matters.[74]

On the other hand, besides the environmental externalities, the fuel expenses break down and vanquish a notable piece of the revenues of logistics and transportation companies. Therefore, the ***Fuel Surcharge Analysis*** is important to monitor the operations of logistics companies and to control their real incomes. As an example, Chart 2.2 shows an increase of fuel price (with consideration of Minimum and Maximum price) in a specific period of BRT operations.

Consider that the fuel surcharge signifies a price adjustment prepared base on the tariff terms and conditions agreed on, and it is calculated as a function of the reference base price indicated in the contract signed by the transport customers, the average weekly price of diesel fuel, and the Minimum Value Applied (M.V.A.) Euros/litre.[75] In point of fact, "fuel surcharges"[76] is an important issue concerning the cost portions and increase or decrease of revenues. In 2017, according to the "XPO Logistics North American, Summary Data Table" in "Three Months Ended September 30", the fuel surcharges has plunged off almost 12% of XPO Gross Revenue.[77] Besides, PLS Logistics Blog announced that according to a Dallas-based third-party logistics (3PL) provider, in a survey of 150 large shippers a $0.1 per mile adjustment in the formula for the fuel surcharges calculation could cut the company's annual fuel surcharge bill to $32 million from $38.8 million.[78] This phenomenon does not involve only On-Road transportation mode, but the huge industry of maritime logistics and vassal navigation is addressed either to examine the latest logistical developments and environmental advancements. As an example regarding this matter, in January of 2018, the British International Freight Association (BIFA) announced that the International Maritime Organization (IMO) has recognized the procedure in which from 1st January 2020, the maximum authorized sulphur content of marine fuel will degrade from 3.5% to 0.5%. Unless a ship is utilizing an approved equivalent compliance method, there should be no reason for it to be carrying non-compliant fuels for combustion on board.[79] Moreover, concerning the aforementioned problem, the advanced studies regarding the modern business models (in logistics and intermodal freight transportation), health issues and labour safety, environmental arguments regarding Bulk cargo[80] logistics[81] and container transportation, Bioeconomy, ban on non-compliant fuel,[82] possible variety of transportation modes, and innovation in shipping industry are required.

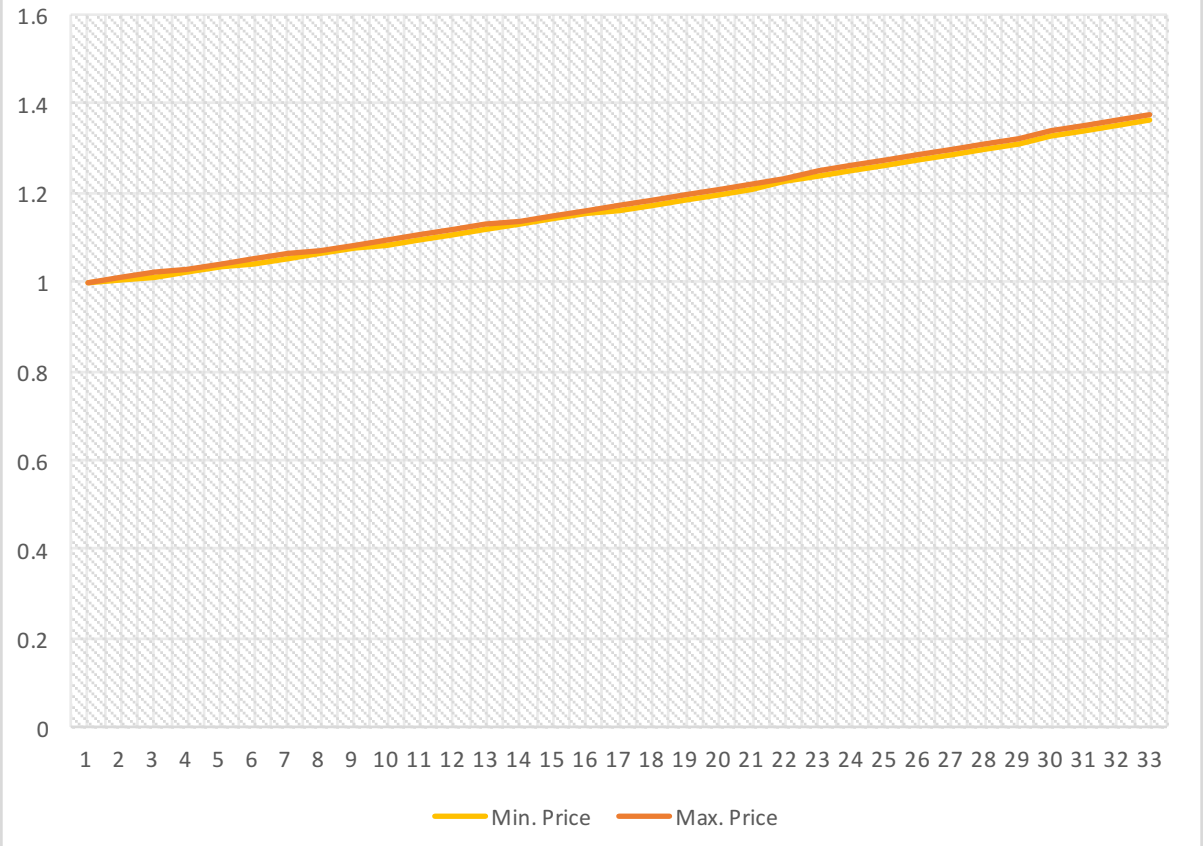

Chart 2.2: The Fuel Surcharge Analysis: An Example of Fuel Price Increase

Eventually, before the conclusion of this segment that is necessary to highlight that unlike the public opinion of conventional Italian family-run transportation companies and their traditional business model, it is not efficient to effort only on decreasing (or resist to increase the salary of the truck drivers and logistics workers). In fact, the arguments mentioned in this section endeavor to propose and invite transportation planners and logistics managers to minimize their total costs of resources[83] in heavy-duty logistics and intermodal freight transportation in an efficient way by an increase in their real-time logistics interactions and by a reduction or an elimination of time waste and inadequate transportation plans.

2.3 ECONOMIC COSTS OF CONVENTIONAL TRANSPORTATION PLANNING

Unlike conventional freight transportation, the Intermodal Transportation promotes the performance and effectiveness of emerging operational and business models for shipping and logistics (e.g., City Logistics, Physical Internet, and Synchro- modality). Also, Intermodal Freight Transportation aims to achieve economic purposes, environmental goals, and societal objectives simultaneously. However, regarding the intermodal freight transportation and its environmental responsibilities, it seems that institutional authorities may be traced and predominant an increase of their involvement in addressing environmental and city-related issues. Moreover, concerning the T.G. Crainic et al., (2017), note that following the ratification of the Kyoto Protocol,[84] institutional authorities have launched numerous projects since 2005 to promote more environmentally responsible freight transportation, bolstering intermodal and collaborative transportation systems.

Having said that regrettably, according to the STATISTICAL POCKETBOOK (2017), the conventional freight/passenger transportation and current European logistics is fundamentally based on consumption of Crude Oil (please review APPENDIX II) and Petroleum Products[85] (such as fossil fuels, gasoline, benzine, avgas, all plastic components in all kind of vehicles, tires, lubricant greases, and bitumen for asphalt of road pavements). Whilst, the particular consideration of the environmental damages caused by Oil Rigs and Oil Platforms is strictly demanded. Besides, base on EIA report, in 2016, the United States consumed a total of 7.21 billion barrels of petroleum products, an average of about 19.69 million barrels per day.[86]

Therefore, the rescue of crude oil and GASOLINE might have saved the future of transportation particularly in tough circumstances such as polar regions of the earth, high mountains, deserts, and forests or anywhere the approachability to electric resources is a severe challenge. In fact, burning fossil fuels during the urban and suburban transportation is one of the worst ways to waste and sacrifice these non-renewable energies and sadly dissipate them permanently (in best scenarios at least for millions of years). Throughout the time, generation of energy is a delicate, thorny, challenging, painful, and sometimes a complex culmination. Homogeneously, the engendering of electric power requires a lot of fatigues and exhaustion.[87] Furthermore, Katharina Grave et. al. (2016) had classified oil product prices for end consumers in Europe into five groups: automotive diesel and gasoline, diesel for industrial use, heating oil for business, and heating oil for non-business applications.[88] Their study highlighted that the taxes and levies on automotive diesel and gasoline are high, although varied over time. Also, the minimum tax rate is established in the Energy Taxation Directive of €0.33 /litter, and it has been exceeded in all European states members.[89] This facts once again demonstrate the strong influence (in both positive and negative side) of government policies on energy prices and decision making for determining a transport mode by citizens or logistics companies.

These policies might be reviewed in several sub-components such as renewable energy supports, subsidies for decommissioning of nuclear power stations, provision for energy efficiency, protection of supply chains, research investment on innovative technologies (such as Blockchain), and environmental taxes or excise duties. However, for the sick of efficient transportation, the transport companies and logistics establishments need to constantly use the advanced IT technologies and superior techniques of statistical analysis,[90] to guaranty high performance of their logistics operations and to control the effective employment conditions periodically. This attitude might ease transportation companies to investigate and measure the trends of their internal and external costs. In fact, athwart of conventional transportation, the modern intermodal freight transportation is advantaged in many aspects such as reduction of CO2 emissions, and increase of sustainability and performances of operational logistics. In this division, CEMAT is one of the busiest Italian logistics players with more than 300 thousands of combined transport expeditions in 2010.[91] CEMAT aims to be a pilot in domestic[92] and international road-rail and maritime combined transport, and their core business is the development of the Italian intermodal freight transportation.[93] CEMAT endeavors to offer the logistics market transport services with high-quality to meet the needs of various customers.

Also in this section, HUPAC is another bustling CH-DE-IT logistics player with more than 457 thousands of combined transport expeditions in 2010.[94] In fact, HUPAC posses some notable dry-port in Italy (Hupac Intermodal Italia srl) such as Terminal Busto Arsizio and Gallarate Terminal.[95] After all, possessing remarkable neutral position from the side of academic studies, authorities, logistics safety and security controllers, during the intermodal freight financial exercises and dealing practices are essential. Also, the logistics managers and the broad spectrum of logistics and transportation companies need to obtain the new model of cognitive logistics business.[96] Therefore, some transport analyzers believe that the intention of terminal managers might be pointed on HR motivation, lessening retrieval times and container storage, and decreasing the containers' dwell time and developing the models to predict transit times.[97] Moreover, such improvements might result in further efficiency, shared economy, transparency (of both data and container exchanges) during the prolonged and combined procedure of container screening or during the time consuming loading and unloading operations.[98]

Ultimately before the conclusion of this section, sadly it is important to express that in some real cases during the Italian intermodal freight transportation, corresponding the 1910s still today in some occasions among the substitution of transport modes, the ***problem of Stevedores*** appears. As a matter of fact, the following illustration (Fig. 2.6) demonstrates a typical but popular manual handling problem that sometimes occurs in some circumstances during the conventional Italian unimodal, multimodal, and intermodal transportation.

The figure denotes that, in 2016, surprisingly, an unrepresentable circumstance fell out of favor on ground of the principal warehouse of an international company (in north of Italy) which globally possesses around 91,000 employees, in 1,444 locations, in 32 countries, and it is working with 50,000 logistics customers around the world. The problem scenario occurred as the following: The carrier has ordered the truck driver to join the client and load the client's goods into a semitrailer (anterior red color in the figure), while the semitrailer was not containerized. During the loading and fixture operations, the client has mentioned the problem. In consequence, the truck driver (who was not notified previously concerning the cross-modality nature of the trip) has communicated the problems with the carrier officer. Consequently, the carrier signals the problem to the responsible of international company which was the Freight Logistics Provider (FLP). Amazingly, the FLP replied: "Alarm the truck driver and tell: Do not say anything to the client".

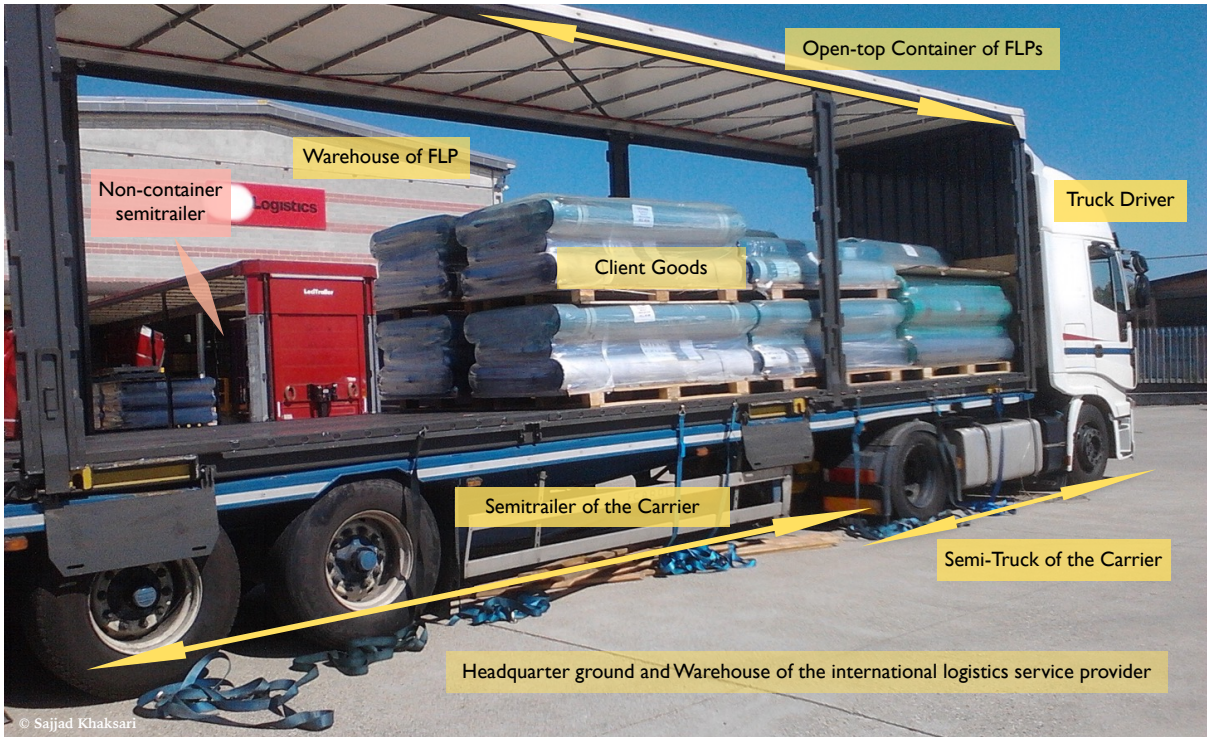

Fig. 2.6: The conventional Problem of Stevedores among Italian Intermodal Freight Transportation

Later, when the precise operations of loading, fixing, closing container, caulking the seals, and signature of all documents (including CMR and ADR responsibility) have completed, the carrier ordered truck driver to transport client's goods in their warehouse (and not to the terminal). Once truck driver reach the warehouse of FLP, they ordered driver to unhook the trailer, unlock the seals, reopen the trailer, hook their available Open-top Container and its semitrailer, release the fixtures, unload the client's goods (without their awareness and their happiness), load them on the Open-top Container (one by one), re-fixture them, close the container, put the new seal, and drive it to an intermodal terminal. These whole Stevedores operations took almost half day working hours. Moreover, it has wasted the precious time and energies of four human resources because it has involved critically the truck driver, warehouse labour (lift truck driver), carrier manager, and the operational responsible of the FLP company). All these wastes and exhaustions have caused only because of the desynchronization, lack of transparency, and disorganization among the SC nodes concerning intermodal freight transportation. The author believes that the Blockchain technology as a decentralized network might donate generously the topic of *transparency* into the intermodal freight transportation and logistics industry.

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[2] Ibid. Page 544

[3] Ibid. Page 698

[4] Litman, T. (2017). Introduction to Multi-Modal Transportation Planning Multi-Modal Transportation Planning. Victoria Transport Policy Institute. Retrieved from http://www.vtpi.org/multimodal_planning.pdf

[5] Bartolini S.p.A. (BRT) Azienda - Wiki

[6] SAVINO DEL BENE (CONSOLID.), Company History: "Savino Del Bene, whose name is homonymous of its founder, started up in Florence, Italy, at the beginning of the 1900's".

[7] ARCESE Group: SO FAR, SO GOOD - Founded by Eleuterio Arcese in 1966. Highlighted and mentioned by the history line of Arcese website as the following: "In 1966, Mr. Legrenzi, known as the "Commendatore" and owner of "Arti Grafiche" and "Cartiere del Garda", makes an offer to Eleuterio Arcese: the purchase of two lorries through contracted work, in return for continuous work. In this way, Mr. Arcese founds a one-man business for contracted freighting."

[8] FERCAM, Company History: "FERCAM was established in the year 1949 as a rail and road transport company and was later taken over by Eduard Baumgartner in the year 1963, a hauler coming from Fié.".

[9] Gruppo Argol Villanova - BCUBE: Company History: "BCUBE, founded in Italy in 1952 by the Bonzano family, is an international leader in integrated logistics services for Supply Chain Management".

[10] Gruppo Gavio, Company History: The Gavio Group takes its first steps in the early 1900s, in Castelnuovo Scrivia, an agricultural and commercial centre in the province of Alessandria, when the founder Marcello Gavio starts transporting cereal and other agricultural products with horse-drawn carts.

[11] ALBINI & PITIGLIANI, Company History: On the 2nd of August 1945 Mr Albo Albini and Mr Alessandro Pitigliani, old friends and colleagues at a trucking company based in Prato, Italy.

[12] FAGIOLI, Company History: "FAGIOLI has founded by Giovanni Fagioli in 1955".

[13] LANNUTTI Group - Founded by Giorgio Lannutti in 1963 and later run by his son Valter Lannutti. Review the CURRICULUM VITAE of VALTER LANNUTTI (President of the Transport Commission in C.C.I.A.A., the Co-founder of Fai - Federazione Autotrasportatori Italiani, the Vice President of Astra - Transporters Association, and the Vice President of Fedit - Italian Transport Federation).

[14] Corriere Franco Second SRL: http://www.corrierefranco.it/chi-siamo

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RC, ROBOTIC LOGISTICS, AND FUTURE OF LONG-HAUL TRANSPORTATION

3.1 LONG-HAUL TRANSPORTATION

Long-haul transportation is recognized as a long distance transportation method.[1] In fact, long-haul freight transportation is principally involved with the movement of goods over comparatively prolonged distances, generally between Dry-Ports or sea terminals and cities or commercial areas. During the long-haul transportation, the products may travel by one or any combination of rail, truck, and ship transportation modes.

Perhaps, the vital advantage of long-haul transportation is its distinctive mobility prospects which decrease the CO2 emissions significantly. Hence, physically, economically and socially advantaged cities, in particular, need diverse mobility options: walking and cycling for local travel, public transit for longer trips, and automobiles (ride-sharing, chauffeuring and taxi travel) when necessary. As a result, an efficient transportation plan might be intermodal or at least multimodal (e.g. walking, riding bike, and walking again).[2] However, long-haul freight transportation during intermodal freight transportation tackles some problems, regarding the exchange, replacement, substitution, or carrying of semi-trailers through diverse transshipment points (such as clients logistics departments, hub and warehouses, and Dry/sea terminals).

In this transport style, the novel characteristics of logistics networks consider and provide some short-haul missions to reduce the empty truck trips drastically. Also, the greater flexibility concerning long-haul and heavy freight transportation has achieved with faster response technologies and advanced IT & Logistics infrastructures.[3] Whilst, freight transportation problems during an Intermodal Freight Transportation need to be predicted and major studies regarding the location of logistics centers in urban and suburban areas are open challenges.[4]

During the long-haul intermodal transportation, these hurdles are performed because of the equipment and data exchange requirements (e.g. property, logistics organization data, transport schedule, driving time, goods classification, distinguished IT systems or databases, and transportation record), and the continues shifting between the cargo, trucks, trains, and vessels. Furthermore, the obsession preparation and projection of these complex transportation systems led researchers to the definition of a problem so-called: The long-haul freight transportation problem with multiple transshipment locations. Consequently, F. Neves-Moreira et al. (2015) had proposed and developed a novel mathematical formulation to ensure resource synchronization and realistic features of the problem.[5]

3.2 RC TRANSPORTATION AND SUSTAINABILITY

Initially, talking about Radio Control (RC) devices apparently is touching and immediately reminding the childhood life of everyone. The felicitous days in which controlling, moving, carrying, and transporting a (metaphorical and symbolic) heavy truck was not certainly a tragic fatigue. In contrary, the transportation of RC trucks for a child is completely an entertainment business and funny job.[6] The author has mentioned the RC argument intentionally to encourage audience and invite them to let their imagination fly in the direction of the logistics world in which truck drivers do not need to seat inside a heated, vibrated, and noisy cabin (on the peak of a diesel engine) per hours or weeks.

Regarding this problem, Peter Turnbull (2017) has noticed that 4.4 million drivers accompanied freight vehicles moved between the UK and continental Europe in 2016. Moreover, the majority of these goods are carrying or transporting by thousands of East European truck drivers who work for weeks on end, sometimes months, in Western European countries, driving, eating and sleeping in their cab.[7] Also, a questionnaire[8] of about 1,000 East European road long-haul truck drivers has published by the European Transport Workers' Federation (ETF) in 2013.[9] The results have discovered that the large part of truck drivers (60%) have spent between 3 to 12 weeks away from their home, 80% cooked and ate their meals in their lorry, and 95% of them caught their breaks and rest periods (including the weekly rest of 45 hours) in their trucks (contrary to EU Driver Working Time Regulations: Regulation (EC) No 561/2006).[10] In addition, the report (titled as: Modern Slavery) denotes that 60% of long-haul truck drivers were paid by driven kilometers despite the Regulation (EC) No 561/2006: Article 10.1 which is forbidding the payments per kilometer schemes because of its negative impact on road safety.

CHAPTER III

LIABILITY OF TRANSPORT UNDERTAKINGS

Article 10.1. A transport undertaking shall not give drivers it employs or who are put at its disposal any payment, even in the form of a bonus or wage supplement, related to distances travelled and/or the amount of goods carried if that payment is of such a kind as to endanger road safety and/or encourages infringement of this Regulation.

Unfortunately, the report revealed that approximately 80% of the interviewed truck drivers declared their fatigue and exhaustion are problems, but they would not report it as they are afraid to lose their job. However, besides the legal and moral responsibilities of EC and European governments to control and guarantee the implementation of labour rights regulations, the RC technology holds a possibility to protect logistics employees and defense truck drivers who are far away from their home and their family for a long period. In fact, RC and the idea of Radio Controlled Trucks might lead the network of heavy transportation services from a childhood dream into a real sustainable future.[11] In the opinion of the author, the #RadioControl in general is one of the future scenarios which would involved various transportation segments including the long-haul transportation.

Despite the shortage of legislatives and European policy challenges, the RC technology is not any more sultanate a childhood dream but critical logistics operations are practically under

work. As an example of this current reality is represented by Volvo. A test in which a 4-year-old child (Sophie Brown) can drive a heavy truck (Volvo FMX)[12] from distance, thanks to the Automatic Traction Control instruments. This alive test[13] might help the imagination of logistics designers to think about the future of logistics concerning radio control systems.

Also, Imagine a future in which carrier companies do not need to send away their truck drivers inside the truck body but their RC Truck Drivers would work behind their individual desk monitors (look like playing the Euro Truck Simulator 2 video game)[14] in office terminal of the company, and they conduct radio controlled trucks from distance. Consider that the Truck Simulator is an extraordinary vehicle simulation game series created by SCS Software, and its first release was on 29 August 2008. These simulator systems accommodate an excellent possibility to educate, instruct, and illuminate the world of long-haul trucks for who is interested to gain a truck driving license. The author believes that "truck driving with simulator" must become one of the compulsory steps to obtain truck/long-haul driving license, because of their educational illustration capacity and diversity of their available work environments. As a matter of fact, the following picture (Fig. 3.1) represents a screenshot of Euro Truck Simulator 2 during an ADR (liquid hazardous goods) transportation. By the way, even in managerial level, the simulation is an essential and extensive assignment. In fact, simulation is a derivative of the IDEF6 model,[15] and it is an undeniable part of the IDEF4 design activities. Besides, regarding this issue, the IDEF Software which is an Automated IDEF-based Software might help transport planner and logistics analyzer for some deeper investigations.[16,17]

Fig. 3.1: A screenshot from Euro Truck Simulator 2 environment

However, unfortunately, still, there are many policy and infrastructure problems in front of the total RC truck (or train and vessel) conducting reality. Problems such as shortage of legislative arguments and open questions like "if an accident happened, how is the responsible?" or "if police or authorities need to control the general condition of the truck driver, what they can do?". Besides, the logistics service clients are not still prepared to receive an autonomous truck or RC conducted truck and independently from the presence of the truck driver, determine the loading, unloading, and sealing operations of a container or semi-trailer. Unfortunately, the logistics industry is trailing far behind, however, in the task of analyzing possible savings potentials,[18] while the sustainability of logistics and transportation require a sustainable allotment of physical resources and precise dedication of vertical infrastructures (including IT platforms). In fact, the concept of transportation has acknowledged by Mike Ashby et al. (2008) as the *Step 2* of "Eco Audit" under the CES EduPack software toolbar.[19,20] The tool provides a sustainable analysis regarding the logistics and transportation of goods and containers base on some important factors such as "transport type" and "distances (km/mile)" of manufacturing site

to point of delivery. Moreover, the CES EduPack tool allows multi-stage transport analysis, similar to the intermodal freight transportation or multimodal of shipping and then delivery by truck. Also, the valuable software of GRANTA would represent the final summing of the stages by retrieves the energy/tonne.km and the CO2/tonne.km for the preferred transport type from a look-up table database and multiplies them by the goods (or container) weight, and the distance travelled. However, it seems growing human ways into a Sustainable Future with robotic logistics and automated devices and environmental friendly mechanisms would be possible and strictly required to save the Earth.[21]

With this in mind, Teodor Gabriel Crainic (2015) has expressed that intermodal transportation is a "core activity enabling global trade and supporting economic growth", and it is "also a mean toward more efficient and sustainable supply chains and transportation networks, within the city as well as for long-haul intercity exchanges".[22] Also, according to the study and literature of Joa˜o Lemos Nabais et al. (2013) and the increase of international commerce and the expected container vessels capacity with 18,000 TEU (twenty-foot equivalent unit), the operational pressure on container hubs will considerably increase as well.[23] Therefore, high flow peaks of containers and goods will arrive at gateway hubs, and directors of intermodal freight transportation networks need to compromise the cargo transportation towards the hinterland, and that will decrease the capacity of logistics network.

Although, the core activity of logistics has been fundamental to economic development and social well-being for millennia. Nevertheless, sadly, it is only over the past 50 years that logistics (in particular Green Logistics) has come to be regarded as a key determinant of business performance, a profession and a major field of academic study.[24] In addition, Alan McKinnon et al. (2015) stated that what is now so-called: 'green logistics' represents the convergence of several strands of research that began at different times since the 1960s, and it has three main broadening perspectives: Public-to-private, Operational-to-strategic, and Local-to-global (Also review Stephen Wolfram, 2018).[25] Then again, Fahimnia, B. et al. (2015) worked on the argument of green logistics and transportation as a sustainable supply chain perspective,[26] and their study have criticized the fact that in the past the majority of the shipping fleet used to run on bunker oil with sulphur content up to 4.5 % (Corbett et al. 1999).[27]

Ultimately, the UN and EU authorities are supposed to force governments to implement and ensure the sustainable ways of logistics and transport services. Also, the top managers in logistics industry are required to take into account the sustainable Key Performance Indicators (KPI) to secure the sustainability of their businesses. Considering that, the harmonization of social, environmental and economic components performs an endurable logistics network regarding sustainability, and that makes fundamental development in supply chains.[28]

3.3 ROBOTIC LOGISTICS

The demand and usage of the robot in logistics are steadily increasing. Robots as strong, precise, immortal, and tireless Iron Mans of manufacturing among various industries, because of their extraordinary capacities were always in the center of attention of enterprises. Nowadays, these favorites are increasing because of development in major technical capacity and flexibility of robots, and perhaps because of increase in salaries of human resources (primarily among developed countries in EU and USA). Sequentially, exciting as it is, this *Robotic* phenomenon has changed logistics industry in various divisions from inbound and outbound logistics systems into the dry ports and sea terminals. However, robotics technology

looks to be arriving slowly but certainly incautious and well-considered planes. In fact, many logistics companies are working hard to benefits from robotic technology and maximize their profits by decreasing of the operational costs and reduction of their ineptitude and carrier inefficiencies. In March 2016, Dr. Markus Kückelhaus and Dr. Clemens Beckmann from DHL Trend Research, have represented the report in which DHL examines the current state of robotics and automation in the logistics industry, and propose a visionary outlook of how DHL supply chains will be transformed and improved by emerging technology trend of robotic.[29]

DHL's report expressed that research reveals that 80% of current warehouses are manually operated with no approving automation. Simultaneously, these warehouses have dealt with demands for increased productivity and throughput by helping existing operators with good layout design, handling equipment, mobile material, and constant improvement of IT, but it seems not enough to satisfy the increasing demand regarding logistics performance. Moreover, the DHL Trend Research determines that merely 5% of current warehouses are automated, and these automated warehouses are usually highly mechanized environments, but they still employ people in key functions. Another key point to remember is that "loading" and "unloading operations" of trailers and containers are acknowledged as a potential territory for Robots, because on arrival of these boxes, the contents of the container typically load or unloaded by hand, then distributed, and stacked onto pallets and stored in the warehouse. This highly manual and labor-intensive manner can take multiple hours. In 2003, to deal with this problem DHL and its research partners worked to develop a new Parcel Robot prototype. Robot was placed in front of the arriving containers to unload them and employ its laser to scan boxes.[30] Furthermore, the Goods-to-picker concept is another growing thought to improve the efficiency of warehouse logistics with Automated Guided Vehicles (AGVs).[31] In this matter, the SSI SCHAEFER (with its AGV WEASEL® auto-guided transport system) is an international actor.[32] The SSI SCHAEFER report states that WEASEL® are holding unlimited possibilities as long as they varied in transport operations and logistics tasks.[33] In fact, Automated Guided Vehicles are carrying enormous potentiality for future development of logistics industry, and even highly complex projects can be realized with these robots because these Frankenstein systems can be optimally blended into various levels of the supply chain and proffers some significant contribution to the Added Value of Intralogistics.[34,35]

Consider that the industrial self-organization systems and logistics robots are installed on warehouse grounds, carrying out repetitive duties such as picking, replacing, and transporting goods autonomously. These robots are programmed to perform extremely specific tasks in extremely constrained environments (e.g Intralogistics) and normally with no human contacts. Additionally they can help workers, for example in Alibaba Group as the Chinese multinational e-commerce, retail, Internet, B2B, B2C technology and sales service providers, robots are currently profiting the company. In Alibaba's smart warehouse almost 70% of the intralogistics works are done with robots while only with the five-minute charge they can accomplish for 4/5 hours.[36] Besides, in October 2017, the Alibaba Group acquired EJoy, and attempted to construct a gas station that rely on robotic arms to fill up gas tanks.[37]

Eventually, in February 2017, the European Parliament Legal Affairs Committee performed a report on civil law rules on robotics, because there was an increasingly public debate about the application of robots and artificial intelligence.[38] In fact, the study was commissioned to evaluate and analyses, from a legal and ethical perspective, some future European civil law rules concerning robotics. Moreover, MEPs stress that as human-robot interactions become commonplace, the EU-wide rules are needed to guarantee a standard level of safety and security, and these rules are even required for the fast-evolving field of robotics.[39]

3.4 AUTONOMOUS DRIVING SYSTEMS & LIGHT AND HEAVY VEHICLES

An autonomous vehicle or a driverless car (even so-called: self-driving car or robotic vehicle) is a vehicle that is intelligent enough to sense and to percipience its environment. An autonomous vehicle could be light (e.g. urban single passenger car) or heavy (e.g. long-haul truck that operate within intermodal freight transportation). Therefore, autonomous vehicles are capable of performing a transport service without any human input. Moreover, autonomous vehicles recognize their surroundings by using radar,[40] GPS, Odometry, computer vision, software components,[41] and lidar systems.[42] Perceiving for many practitioners, the autonomous driving systems are representing a high-level version of vehicle safety, because unlike humans they do not rush to take risks. Also, TomTom organization contemplates that autonomous driving is a leap forward in automotive safety, comfort, and efficiency.[43]

In fact, dissimilar to human the autonomous vehicles do not generate accidents intentionally or for seeking of accelerating pleasure.[44] However, despite the different opinions regarding the aforementioned theory, the trend of studies and implication of projects concerning autonomous vehicles are promoting strategically.[45] Additionally, in September 2017, the U.S. Department of Transportation has released an important report (A Vision for Safety) to promote improvements in safety, mobility, and efficiency through Automated Driving Systems.[46] Moreover, the Federal Government highlight that they want to ensure it does not impede improvement with unnecessary or unintended barriers to innovation, while safety remains the number one priority for U.S. Department of Transportation, and safety persists the specific focus of National Highway Traffic Safety Administration (NHTSA).[47]

Also, the report describes and classifies the safety level of different kinds of the autonomous driving car from No Automation vehicles toward Full Automation vehicles. The following schematic diagram (Fig. 3.2) represents a screenshot of NHTSA statement.

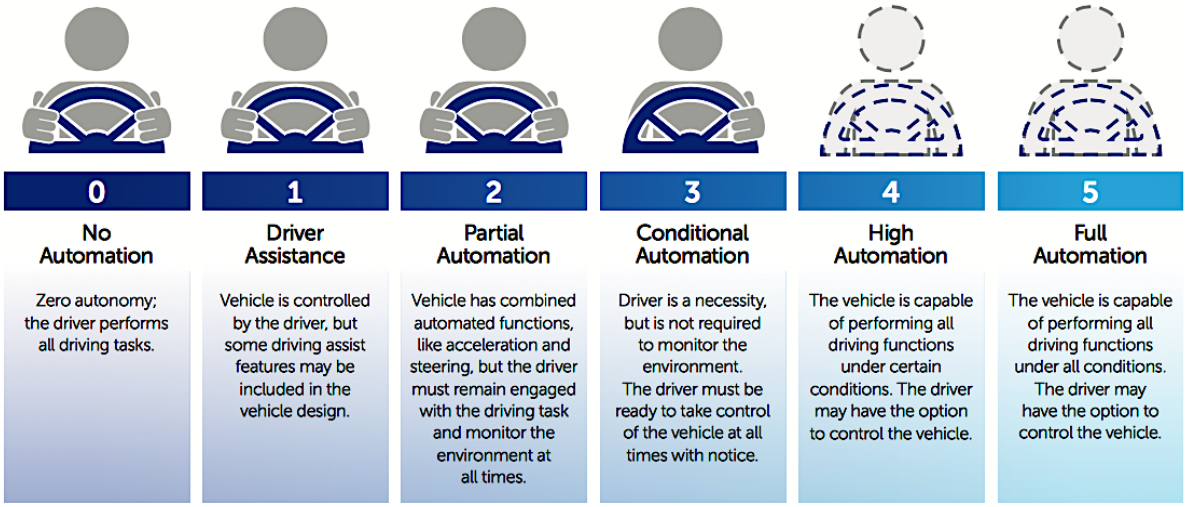

Fig. 3.2: From No Automation into Full Automation © NHTSA

Having said that, in case of light vehicles the Google self driving car (Waymo) is popular and recognized among the public opinion of technology news readers.[48] Plus, many Google's smart applications are concerning the City Logistics including Google Maps and Google 360° view. Besides, the autonomous driving systems for seek of urban logistics, High or Full Automation driving system could facilitate the life of many handicaps or disable citizens. Regarding the case, in 2016, Google Maps has launched a campaign for Answering Accessibility Questions

with a purpose of increasing visibility and accessibility for people with wheelchairs.[49] However, as some researchers and some transportation writers acknowledge that, fortunately or unfortunately, Google has dominated the research engines (specially in EU). As the matter of fact, according to StatCounter[50] in 2014, around 92.38% of European citizens used Google to navigate or search for what they wanted to search about.[51]

Despite the Google trouble, that was only December 2015 when Elon Musk (Tesla Motor CEO) announced that "Tesla vehicles will drive themselves in two years" and he hoped to commercialize Tesla autonomous driving technology by 2020.[52] In fact, today the Tesla Motors autonomous driving car (Autopilot Project) owns a high sensibility regarding any abnormality On-Road and any traffic movements. Also, Tesla publicly proclaimed that all Tesla vehicles including Model 3 and so on, are possessing the Full Self-Driving Hardware that is needed for full self-driving capability at a safety level substantially elevated than that of a human driver.[53]

The reality is that if the real-time interact of a human driver or an autonomous driving system decrease, the risk of eventual accident or on-road disasters will decrease. Nevertheless, the autonomous vehicles are lower risk-taking and exploratory in driving. In fact, that is a crucial character and preventive attitude which might guaranty the safety and security of passengers, road, and materials (transporting goods). Following picture (Fig. 3.3) illustrates the "Tesla Self-Driving Demonstration".[54]

Fig. 3.3: Demonstration of Tesla Self-Driving

Furthermore, likely, the future of autonomous driving would offer the major safety and security, and it could realize the elimination of human death because of vehicles accident. Also, autonomous driving would expand in various sectors of logistics and transportation, from long-haul trucks and on-road transportation pillar into the rail, air, and sea navigation. As a matter of fact, they are some serious incrementation those happened regarding the topic of autonomous driving. In October 2017, the QUARTZ announced that on October 2nd, the Australian-British mining giant Rio Tinto had completed its first fully-unmanned rail journey crossed the Western Australian desert. The autonomous train had traversed nearly 100 km (62 miles) without a driver onboard, while Rio crews and Australian government representatives supervised the conduction and real-time progress of the train in control rooms from afar.[55] Furthermore, the future IT infrastructures of logistics and freight transportation systems may take benefits from Blockchain technology to enhance the transparency and visibility of autonomous driving.

Having said that, the RC systems and Onboard Condition Monitoring systems for freight trains might demonstrate significant revenue in short and long-run business strategies.[56] The objective of these systems is to improve railroad safety and efficiency through continuous monitoring (and hopefully in close future, the total control) of mechanical components to detect defects and safe conduct of the train before they cause delay, breakdowns, or any accidents.

Coupled with, in 2016, Netherland as the holder of the EU presidency has organized the European Truck Platooning Challenge to make truck platooning a notable step closer to its implementation.[57] Furthermore, it has involved the Intertraffic Amsterdam as a B2B portal for professionals within the infrastructure, safety, parking industry, and traffic management.[58] The available evidence seems to suggest that the Truck Platooning is beneficial for environmental sustainability and reduction of air-drag friction and drivers' fatigue,[59] where two or more trucks

travel in convoy close to each other. The first truck arranges the driving while the ones following are associated with a wireless electronic communications system, similar to the carriages of a train. Further research in this area may include risk control and road safety while the concept of Truck Platooning was open to academic discussions even before the beginning of the third millennium. In fact, the practical results of (Gehring and Fritz, 1997) illustrated the longitudinal administration for Truck Platooning in Vehicle-To-Vehicle communication.[60]

Along similar lines, in 2017, ACEA announced that by 2023 it should be feasible to drive across Europe on motorways (thus crossing national frontiers) with multi-brand truck platoons, without needing any specific exemptions.[61] Still, the list of challenges and critiques regarding Truck Platooning Systems are long, and they include truck platooning reliability, road and weather contradictions, and the issue of different weights among trucks that cause different speeds and Co2 emission of trucks in practice (notably during uphill and downhill).[62] In addition, during a synchronized freight transportation, whole fleet of containers may evolve in collection of sensor platforms that provide information to trucks, truck drivers, and FLPs. These sensors might upload and communicate filtered data (e.g. GPS location and temperature of containers) to the Blockchain. Furthermore, the sustainable intermodal freight transportation demands a network of autonomous appliance that exchange their sensor inputs with shippers, carriers, and FLPs in order to optimize a well-defined logistics utility function.

3.5 DRONE DOOR-TO-DOOR LOGISTICS

Even for capable logistics corporations, the door-to-door national or international shipping is a complex process. However, the clients might be happy once their required goods arrived and rang the door of their homes or companies. As an another key thing to remember, logistics companies for the sake of their clients happiness work hard to satisfy their requirements by decreasing the transportation costs and reduction of delivery time. Having said that, the door-to-door logistics does not include only unimodal transportation method. Along similar lines, the sustainable logistics' views are grounded on the assumption that the door-to-door logistics and freight transportation might be multimodal or intermodal.

In fact, in 2004, Commission Of The European Communities has released a final report in which the commission has communicated with the council, the European Parliament, the European economic and social committee, and the committee of the regions. The communication was concerning the important issue of Short Sea Shipping. The report highlighted that the "Motorways of the Sea should become an integral part of door-to-door logistics chains and offer efficient, regular, reliable and frequent services that can compete with the road, for instance, in terms of transit time and price".[63] Moreover, the report mentioned that there are overcoming obstacles to the development of Short Sea Shipping and some barriers still hinder the mode from developing faster, because it has not yet reached full integration in the intermodal door-to-door supply chain.[64] To put it another way, the improvement of door-to-door logistics is essential for intensification of European transportation and its high-quality performances. There seems to be no compelling reason to argue that why giant logistics companies like Amazon,[65] UPS, HorseWork,[66] and DHL are investing in industry of Drone Delivery.[67] In particular case, in December 2014, the DHL Parcelcopter driven by four rotors takes off irrespective of the wind and weather situation without direct line-of-sight of a pilot, and it has flown 12 kilometers across the open sea. The DHL scientific team has consequently processed the flying capability and speed at 50 meters altitude, while the copter has been

circumnavigated a distance of 18 m/s. The project aimed to guarantee the emergency supply with medicine and other urgently needed goods, and provide the technological results to offer specific added-value in the field of express and emergency delivery also in challenging areas but to be used by end customers.[68] In fact, pros of using drones in the logistics industry include not only savings on transportation costs but also faster, reliable, cleaner, and effective deliveries. Moreover, the consensus view seems to be that the Drone Delivery might induce traffic decongestion and reduce the number of home delivery vehicles.[69] All things considered, drone delivery is a notable idea which had transferred from a simple human imagination into a factual possibility. Besides, the real fact is that RC and Drone technology can intercross each other and improve the visibilities of transportation motions.[70] Also, drones with the thermal video camera have been used to help firefighters because they can search for the centre of a fire, as well as people lost in the fog or smoke, and the Firefighter Drone can be used instantly during rescue operations.[71,72]

Moreover, the strategic business plan of drone delivery and its economic impacts would expand in close future. Just because drone logistics can cover the vast range of cases, from small, light, valuable, time-sensitive cargo into the delivery of a delicate medicine to a rural patient, or retain an oil rig working by delivering an important piece of machinery.[73]

For the sake of discussion, it is relevant to argue that the triumph of ITS for E-grocery Business has intensified the interest of drone delivery.[74] Coupled with, the studies concerning the energy efficiency and how to increase the hovering time for drone are in progress.[75] On the other hand, some literature discuss and investigate the idea of Air Taxi. Jeffrey A. Boyd et al. (2006) analyzed the marketing and logistical considerations of an air taxi service using discrete-event simulation, while the Air Taxi service consists of a small fleet of aircraft carrying passengers on-demand inside a regional network.[76] Eventually, the further research in this area is strictly required. As a matter of fact, searching the single keyword "drone" on Scopus shows the 7,882 document results, but by adding "Blockchain" keyword, the notification of "No documents were found" has appeared. Also, by doing the same procedure on IEEE Xplore® database, only two results have occurred while the "drone" word was not included in the titles. The first one of these two studies belongs to Xueping Liang et al. (2017) where they introduced a remarkable architecture concerning the Blockchain-based drone communication (Fig. 3.4).[77]

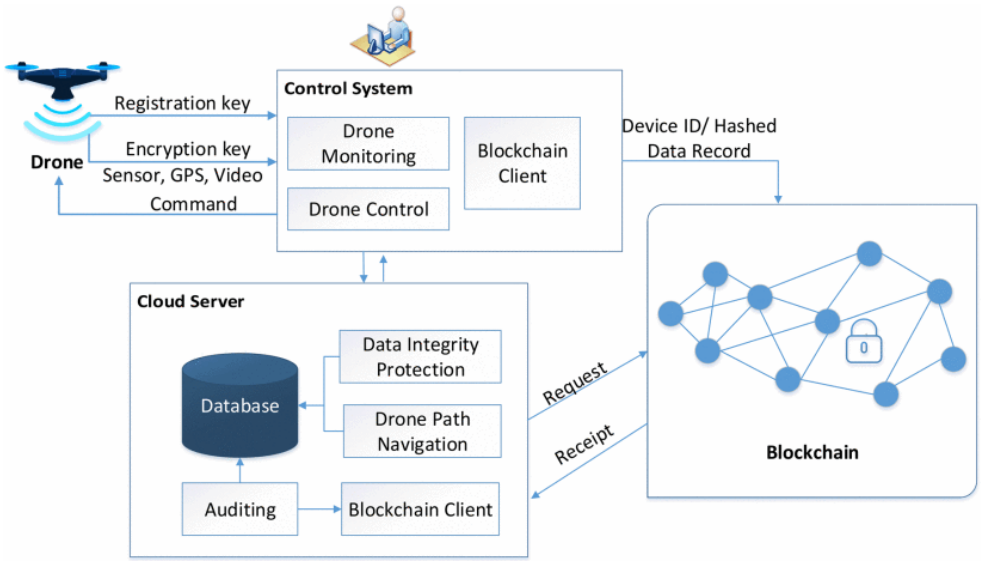

Fig. 3.4: DroneChain; Blockchain-based Drone Communication Architecture. ©Liang et al. (2017)

3.6 AUTOMATED CONTAINER TERMINALS

The argument of automation recently has expanded in various segments of the industry including the container terminals (in both dry and sea ports).[78] The uncomplicated reason behind this enlargement is the importance of logistics improvement and the requirement for logistics development.[79] Furthermore, automation will increase the precision of logistics operation, and it will increase the performance of freight transportation.[80] Moreover, the accuracy is another significant fruit of computerization and robotization.

On the other hand, the Container Reshuffling at internal of Sea-Port or Dry-Port terminals has identified as one of the primary sources of process delays. Consequently, (Francisconi, 2017) highlighted that container reshuffling at the terminal, customs and commercial clearance, and hinterland transportation planning were three primary sources of bottlenecks during the internal terminal logistics processes.[81] Moreover, (Güven and Eliiyi, 2014) demonstrated some critical results concerning the trip allocation and stacking policies at Sea-Port or Dry-Port container terminal. The results show as "reshuffling/shifting occurs, defined as an unproductive move of a container required to access another container stored underneath." Also, their study has been focused "on increasing the efficiency of the yard via consideration of the container stacking optimization problem for transshipment, inbound and outbound containers at a container terminal".[82] In fact, the loading and unloading operations on a train (active in intermodal transportation) inside a Dry-Port container terminal, or loading and unloading containers on an international vessel within a Sea-Port, is a highly time-consuming task.

Given the centrality of this issue to the importance of logistics automation, the major advanced Automated Ports and Automated Container Terminals around the world are attempting to use robotic and industrialization equipment to enhance their logistics efficiency. In fact, the support for the automated container terminal is growing, and in March 2016, the WSJ proclaimed that the Los Angeles Terminal would employ "highly automated systems and machinery, with minimal human intervention, to handle the flood of goods that new free-trade agreements will push to the docks".[83] In addition, the Busan's New Port (BNCT) in South Korea,[84] Shanghai Port, Chicago Container Port, Liverpool 2 (UK), and Port of Rotterdam[85] are another notable examples of this automation. Having said that, unloading a container ship is a dedicated task, and it requires a specific plan including an extraordinary attention.[86]

The underlying argument in favor of container terminal automation is the distinguished case of Rotterdam's Port because it is the busiest port in Europe according to the Hamburg-Le Havre range in 2014.[87] The automated Port of Rotterdam practices Automated Guided Vehicles (AGVs) and automated stacking cranes, and these high automation logistics mechanism is celebrity secret of the port with remarkable intermodal connections among European countries. However, Evers and Koppers (1996) concluded that when a large number of vehicles practice the same infrastructural facilities, the control of AGVs traffic at a container terminal is critical to the system performance.[88] Furthermore, performing more studies similar to the notable research of Demetris Stavrou et al. (2017) concerning the optimization of container loading with autonomous robots, are demanded.[89]

Notwithstanding the aforementioned arguments, in 2017, the ABB News published an article concerning the automated container terminals, and it has announced that the automated terminals are taking off.[90] The author (Björn Henriksson) highlighted that the container terminal arena is changing rapidly, and more than 16,000-19,000 twenty-foot unit (TEU) ships are introduced in the Asia-Europe trade every month. Moreover, within the next two years, the average ship size under international logistics trade will reach 14,000 TEU.[91] Considering that, the ABB is a pioneering technology leader in electrification products, robotics and motion,

industrial automation and power grids, serving customers in utilities, industries, logistics, and transport infrastructure globally. Through the 125-year history, ABB operates in more than 100 countries with about 136,000 employees, and it has a notable history of working with automated systems for cranes and terminals.[92] After all, this penetration once again illustrates the importance and the performance of AGVs for container terminals.

Also, another smart case concerning the Smart Logistics in global scale level is the case of SMART-PORT.[93] The SMART-PORT describes and highlighted the intention of its organization as follows: "the smartest and first in class port worldwide. That is exactly the intention of Rotterdam to be in 2030. As it is, Europe's leading port and industrial complex boast a winning combination of "Global Hub" and "Europe's Industrial Cluster" – both leading in the field of efficiency, quality and sustainability".[94] Moreover, the SmartPort Community of SMART-PORT institute is an intermediary organization with a specific purpose to align demand and supply of ports those would like to participate in academic research.[95]

In conclusion, the Robotic systems are increasingly using in logistics facilities (e.g. warehouses and container terminals), the real achievement of adjusted efficiency in this circumstances poses different challenges regarding the real-time execution, acclimatization to unpredictable situations, and coordinated resolution of robot conflicts in operational environments. Therefore, Stavrou et al. (2017) examine a problem related to the coordination of a group of autonomous robots operating inside a container handling facility (a terminal), where containers are required to be transported from the storage area to the loading station. Their study considered and involved in a topology in which containers were arranged in lanes for efficient storage but with inflicts limitations on the movement of autonomous robots. Stavrou et al. (2017) denoted that such a topology is commonly found in container terminals where straddle carriers have to carry containers from a storage yard to Quay Cranes in Container Terminals[96] or trucks and vice versa. However, straddle carriers might have limitations on moving on the same or even adjacent container lanes. Accordingly, they developed an innovative method to address this robot related problem and evolved the efficiency of containers assignment via robots and defined appropriate timing for collective coordination of robot movements.[97]

3.7 FUTURE OF ROBOTIC LOGISTICS

In conclusion of this Part, that is important if readers could fly their imagination and try to imagine the future of logistics industry. A future in which the fundamental facilities of logistics and transportation infrastructures are advance, sustainable, and highly qualified concerning the Information Technologies (IT). To portray the future of logistics in compressed terms, maybe that is adequate to consider that apparently in close future the Applications concerning City logistics and Intermodal Freight Transportation would expand significantly. Furthermore, dry ports, sea ports, and container terminals would work in an automated manner while the use of sensors, QR codes, blockchain technology, and RFID[98] systems will increase. Also, probability the use of smart cards as the automated fare collection systems will become common among transit experts, to improve techniques and mechanisms to concoct and validate the transaction data on a consistent virtual source. In this critical occasion, the combination of Smart Card, automated passenger count, and usage of GTFS data[99] to visualize transit network is crucial.[100]

On the other hand, plausibly the automation and robotization of long-haul trucks will appear on the soil of all developed or modernized countries. Whereas, this robotization is positively begun. For instance, while a long-haul truck might achieve 400 cm height, 1875 cm length,

255 cm width, and 44000 kilograms weight, the "Anki COZMO Robot" illustrates an insight of future logistics and expected warehouse mobility.[101] Despite the heavy trucks, Cozmo possesses only 25.4 cm height, 18.3 cm length, 12.7 cm width, and 1.36-kilogram weight.

Cozmo seemingly confirms a possible future for heavy truck transportation toward entirely autonomous driving circumstances. An astounding future in which conceivably the Artificial Intelligence (AI)[102] and Machine Learning[103] would support human beings to practice only her/his fingers (or neither that) for transporting the heavy goods and materials. AI's findings lend support to the claim that in future these High-Tech servants are not going to change only the way of transportation modes, but even the methods of Customer Relationship[104] within the aspect of logistics.[105] Cozmo propounds the view that the intelligent communication between human and logistics equipment is conceivable. In fact, when for the first time, Cozmo wakes up to the reality of the world, begins to learn about its environment (Fig. 3.5). Also, it will remember all interacted history of Cozmo with people (imagine such association with a warehouse manager or container terminal controllers), and it would build a particular relationship with each character (logistics actors).[106] Consequently, the prospect of internal warehouse logistics indeed could be an area of development for Deep Learning and Cozmo-tical Robotic Logistics.[107,108] Moreover, in close future, the warehouse operators will work with AI Lift-truck Machines, and it is going to be more interactive, intelligent, and advanced system.[109]

Fig. 3.5: Anki COZMO Robot © ANKI

In the conclusion of this section, another key thing to remember is that the Remote Controlling and virtual commanding have been developed simultaneously in a remarkable way. To give an illustration, the inhabitation of Toyota's new humanoid robot[110] declares an imagination of a future society in which ROBOT TRUCK DRIVERS will be used to work and to transport[111] goods and materials during the Long Distance Transportation.[112] Above all, it seems pertinent to remember that for the sake of efficiency, even in Future of Retail Distribution and forever beyond,[113] the optimization, automatization, implementation, control, and re-optimization are undeniable and repeatable sequences for logistics improvement.

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VIRTUAL REALITY & LOGISTICS

4.1 VIRTUAL REALITY (VR) & SCM

Virtual Reality (VR) is the term utilized to describe a three-dimensional, computer-generated environment which can be investigated and interacted with by a person. VR has started to creep into the everyday life of the human, and it is taking its part in the campaign of Digital Supply Chain Transformation (include technology of Radio-frequency identification (RFID), Cloud Data Storage, and Analytics Tools).[1] Along similar lines, a new generation of logistics equipment and transport services based on smart technologies is about to change the world around the logistics customers and logistics managers. Particularly, in case of intermodal freight transportation, these smart technologies connect objects, offer smart assistants, and exchange Sensors Data.[2] In fact, the Big Data,[3] Artificial Intelligence,[4] Virtual Reality,[5] and Blockchain Technology are revolutionizing not only logistics operations and business divisions but also the way supply chain managers will intermingle with an emerging world of the smart devices and the Internet of Smart Things (IoST).[6] This modern generation of logistics services, equipment, and apparently Blockchain-based applications will deliver a novel kind of experience so-called "Smart Experience", to the logistics employers and intermodal transport clients.[7]

Having said that, the first question is that, what is a "smart user experience" and how it will influence the intermodal freight transportation? Readily, it is simply a new range of experiences based on smart technologies.[8] Furthermore, Worden et al., (2003) denote the smart user experience as some technologies with the ability to sense changes in their circumstances and enhance their functionality under the new events.[9] Also, Krzanik and Ritola (2012) summarized evaluation of the Do-It-Yourself (DIY) smart experience activity and contributed basic resolutions regarding the process, method and provided supports.[10] Moreover, the research of Krzanik & Ritola has summarized a user interface for SafeTrip regarding the resulting mashup for a travel plan. Consider that the user (intermodal freight provider) could change the travel origin, destination, or transport modes (road, rail, sea, and air) in a smart (virtual) manner.

On the other hand, according to an intriguing analysis of the Statista.com, the worldwide market size of Virtual Reality (software and hardware) is predicted to reach 40.4 (in billion U.S. dollars) by 2020.[11] With this in mind, the technology of Virtual Reality, thanks to the AI's Tools, is notably advantageous and it sounds efficient to capture the attention of the giant and influential logistics companies around the world. Conceivably one of the significant examples is the case of "Vision Picking Driving Innovation For Modern Supply Chains".

In 2014, DHL Trend Research had published a report (Heutger & Kückelhaus, 2014) and publicly announced the new way in which DHL will comprehend logistics.[12] Also, the Intel company has introduced a new smart glass which could offer a possibility for car drivers to arrive at the grocery stores or a shopping list while they hold their hands on the wheel.[13]

However, the VR is recognized as a Background of Industry 4.0 and it would accelerates the fusion and amalgamation of the physical world and virtual world during the fourth industrial revolution. As Daan Horenberg (2017) has discussed, the logistics and freight brokerage companies (such as DHL, DB Schenker, Kuehne+Nagel, and Panalpina World Transport) are conducting the smart applications within Logistics 4.0.[14,15] In addition, this digitalization is not centralized only in some particular industries but is going to grow contagiously and conceivably the Nintendo Switch is an example of these kind of mobilized Smart Experiences with the availability to move and stimulate gamers.[16] Moreover, some logistics analyzers like Alan Amling (Global On Demand Manufacturing Manager from UPS) strongly believe that the "3D Printing" and Virtual Delivery are the future of logistics industry.[17] In fact, the analyzers of logistics spectrum are considering that while the 3D Printers are utterly capable of making many different items, perhaps in close future, they will work effectively as the Spark Plug for performance across supply chains. Also, 3D Printers will be able to match adequately the Supply with Demand in the level of the regional, national, and international supply chain. The need of 3D Printers is growing form the Printing Cement into the Food Delivery. The reason of this enhancement is that industries are working within an on-demand global society in which customers desire to decide "what they want", "when they want", and "what is the lowest possible cost". Furthermore, the increasing question is that how transportation and logistics companies can deliver this coveted services? The obvious answer is that the traditional manufacturing and conventional logistics are not geared for satisfying that criteria because the traditional manufacturing is all about rendering a lot of the same exact item. In opposite, the lovers of 3D Printers are looking at smaller lots of a distributed manufacturing system.[18,19]

In conclusion, reasonably the Virtual Reality will change even the way of the rail transportation and transport simulation in general. In this manner and regarding the rail studies, the AKKA Technology is an active player while the international railway sector keeps growing and the increasing demand for mobility solutions. As a central issue, the AKKA aims to find sustainable solutions for the public transportation during which the increase of urbanization and traffic congestion make railways a strong alternative to road transport.[20]

4.2 AUGMENTED REALITY (AR) & LOGISTICS

The study of Ruobing Yang (2011) have illustrated, the Augmented Reality as "an emerging technology of Virtual Reality, which has a great development and application prospects".[21] In fact, Augmented Reality connects technical awareness of Image Recognition, Computer Vision, Human-Computer Interaction, Sensors, Virtual Reality, and several other fields. Furthermore, Luke Nuber (Account Executive at Fortna) believes that AR in retail and distribution industries is basically "translated into the specialized headsets or glasses that place a glass in front of the wearer's eyes to project data" on top of what the logistics labors are looking at.[22] This insight, may open a discussion in which the academic institutes might concentrate on designing an open-source core business infrastructure that would perform the blockchain proper and fit for usage of virtual and critical Multimodal and Intermodal freight transportation missions.

Having said that, turing back to the DHL case study (Heutger & Kückelhaus, 2014), it is important to highlight that the report had described the perspectives of Deutsche Post DHL Group (DHL Express) as the world's largest logistics company, concerning the invention of AUGMENTED REALITY and its permissible applications in diverse segments of LOGISTICS. In fact, the German logistics giant, has practiced Augmented Reality to enhance the effectiveness and accuracy of the picking method. When the vast majority of warehouses in the developed world still use a pick-by-paper approach, DHL claimed that their Vision Picking innovation which works on the base of Augmented Reality (AR) technology, and it had increased the productivity of logistics operators by an average of 15% (DHL Supply Chain, 2017).[23]

In consequence, some studies illustrated that by possessing a Collaborative Governance Model and an innovative approach to decision-making processes for Smart Urban Freight Planning, the model would easily be transferred across urban areas while the capability of intermodality is taking into account.[24] Also, there seems to be no compelling reason to argue that the sustainable future of intermodal freight/passenger transportation might be achievable through the notable technology of Augmented Reality (AR). Moreover, the Augmented Reality seems to hold an extraordinary power to improve the performance of Intermodal Freight Transportation during the container exchange operations. For instance, Sigrid Wenzel, et al. (2003) offered a taxonomy of visualization techniques (e.g. dynamic techniques as 2-D or 3-D animation and Virtual Reality or Augmented Reality) for simulation in production, manufacturing, and logistics systems.[25] Also, Alexandre Pereira et al. (2016) have contributed their study concerning the Virtual Navigation Cues for forklift operators inside the warehouse environments. Their research was concentrated on investigating how different AR elements can support forklift operators and find pallets as quickly as possible in a logistics repository, and they have developed a simulated Augmented Reality environment to examine Egocentric or Exocentric virtual navigation cues.[26] Furthermore, Khaksari (2018) have benefited from the basic technologies and two available platforms [Augment and Aurasma] of AR and VR to propose a business model for diminishing the Idling Time of the Cross-modal and Intermodal Freight Logistics operations between the heavy trucks of carriers and freight trains in Dry Port Terminals (please review Fig. 4.1).[27]

Fig. 4.1: Artists Concept and 3D models of AR Application in a Dry Port Terminal

4.3 VOICE RECOGNITION & TRANSPORT EFFICIENCY

Logistics industry as all other industries, need a constant improvement. Nowadays, the Augmented Reality is a powerful technology that would overlap and might take an active part of virtual elements and settled them over the real world of work circumstances in a real-time. In parallel, the advanced technologies such as Voice Recognition could improve significantly the efficiency and performance of outbound & inbound logistics, parcel and also door-to-door transportation.[28] This technology is able to free-hands of truck drivers, carriers, middlemen, and many other inter-actors during the distribution of cargo and parcels.[29] Also, consider that the Voice Recognition technology is useful particularly in case of the urban express carrier services. Moreover, it would decrease the Truck Idling time (reduce the CO2 emission) and it might lessen the waste of time. Voice Recognition technology is an important development and it can diminish (or eliminate) the problems of dispatching operations. Eventually, the Voice Recognition technology and Speech Rhythm recognition systems are some vital timesaving technologies and they work better than the traditional input methods in which truck drivers or logistics operators are forced to press the keyboards or touching smart LCDs.[30]

4.4 QR CODES FOR TRANSPORTATION DOCUMENTS

Addressing the roads, places, locations, point of interests, and delivery points as some important things for human has a very old history. However, in despite of the vast industrial evolutions the Transportation Documents are still seems conventional. This traditional way regarding the Addressing of transport destination had increased the costs of logistics and transportation during the Last Mile of Urban Distribution, and it had complicated the accurate identification of warehouses and final client locations.[31] Previously in UNIT 2, the discussions concerning the costs of the conventional addressing have been criticized and some simplistic but innovative solutions such as ITALIAN COMPANIES' REAL ADDRESSES has been proposed. However, in this section, while the positive consequences of AR and VR have been discussed, perhaps it is suitable to highlight the inherent potentials of QR codes for improvement and enhancement of the conventional identification of the transportation documents. Furthermore, presumably the Blockchain technology is a practical solution to address these kind of problems (e.g. high-cost, low efficiency, and time consuming operations). Since, the following illustration (Fig. 4.2) represents a schematic picture of the Italian transportation documents (DDT) which is commonly in use and it is free of any QR code. The paging design of these documents maybe change but their ancestral structure is almost equal. In fact, all the information including the telephone numbers, financial and commercial IDs, shipper address, manufacturer data, carrier contacts, and typically the recipient and destination addresses are written in a traditional manner. In such conventional circumstances, anyone how needs to transfer information (e.g. insert the delivery address to GPS truck), is required to perform it manually by pressing the keyboards. This manageable problem causes enormous waste of time in national and international scale each year, and it is not efficient either because the results are not accurate and most of the satellite navigators are not able to indicate the exact location of the companies base on the civic addresses. However, the work experiences yielded by truck drivers and express carriers, provide some strong and convincing evidence that the fastest way to enter the destination address (one after another) into the GPS device would be the scanning of the QR code directly by the GPS device which is on the board of the truck. Another possible - and in case of some companies - current solution is to create a connection between the operation center of the carrier companies and the GPS tuck of the logistics fleet.

Fig. 4.2: A Schematic View Of An Italian Transportation Documents Devoid Of QR Code.

In addition, it is imperative to consider that the benefits of QR codes are not excluded in freight transportation but they are improving the lives of many humans as well. For instance, Bel2Go is an application that helps blind people via vibrating belt which is connected to a smartphone and provide audio messages, and a Bluetooth communication system between QR code reader and the user device. Hence, the system promotes the mobility of people with visual disabilities, and instead of utilizing GPS signals, it practices a system of accelerometers and gyroscopes for the localization of user. However, the truth is that even the trucks and containers are totally blindness. In fact, they strictly need the continuous insights to find their way, move around, and going forward to their final destination. The condition of a blind man is much better than a blind container because a man can talk or move autonomously but a heavy box can not.[32]

Therefore, the further studies concerning the effectiveness of the smartphones, smart GPS accessories, smart sensors, and smart QR Code Detectors/Extractors are essential to magnify the performance of the Dry Port terminal operations and intermodal freight transportations.[33] The following description (Fig. 4.3) demonstrates a schematic point of view in which the flow of materials (goods, cargo, freight, pallets, parcels, and containers) and their relevant information are flying simultaneously. In this model, the industry of retail and distribution is synchronized and the gaps or shortage of data and information is minimized and the system is transparent.

The aforementioned model is an ideal Blockchain-based model, and it aims to promote the real implementations and implications of the Logistics 4.0 through the epoch of digitalization and Augment & Virtual realization while the adoption and progression of the Information and Communication Technologies (ICT) in the industries have become inevitable.[34] In fact, the Industry 4.0 has referred as the “Fourth Industrial Revolution” in human history, and it is known as “smart manufacturing”, “industrial internet” or “integrated industry”.[35,36]

Fig. 4.3: A Schematic View Of A Blockchain-Based Distribution System

In conclusion, the Logistics 4.0 is perhaps the most-discussed topic through the innovation management of the industries that apparently possess the potentials to affect a wide range of entrepreneurs by transforming the way goods are designed, manufactured, delivered and paid. Hence, the further studies to discuss the opportunities of Industry 4.0 in the context of logistics management and its implications in this field are required. One of the goals of this section was to shed the light on the novel topic of the Industry 4.0 in the context of logistics management and intermodal freight/passenger transportation systems, thus follow a conceptual research approach.[37] Eventually, please review the Logistics Research by H. Kotzab et al. (2014).

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ADR

5.1 THE ADR TREATY

Agreements and accordances are crucial to improve the standards of the human life. Transport and logistics as many other serious matters are requiring their own specific rules. In particular, the transportation of hazardous substances needs an appropriate consideration because of its enormous potential power for destroying other assets or lives. Therefore, in such critical circumstances, the **ADR** treaty or "European Agreement concerning the International Carriage of Dangerous Goods by Road" which is stand for the abbreviation of "**A**ccord européen relatif au transport international des marchandises **D**angereuses par **R**oute" proposed to consider these important issues.[1,2,3] The ADR Treaty has settled in Geneva on 30 September 1957 under the aegis of the United Nations Economic Commission for Europe, and it entered into force on 29 January 1968. The agreement was qualified in New York City on 21 August 1975, and unfortunately its variations only took effect on 19 April 1985.

Later (after 26 years), on 1 January 2011, a new rehabilitated document called "ADR 2011" had entered into force.[4] Furthermore, the "Annexes A" and "Annexes B" of the agreement have been regularly amended and updated since the entry into force of ADR. As a result, to the amendments for entry into force on 1 January 2015, a revised consolidated version had been published as a unique document called: ECE / TRANS / 242, Vol. I and II,[5] while an additional amendment is implemented from 1 January 2017.[6] Finally, according to the report of UNECE, on 15 January 2018, the government of SAN MARINO (small country in Italy) has accessioned the ADR agreement.[7] Having said this brief introduction about the history and background of ADR, for the sake of this dissertation it is useful to mention that according to the ADR treaty, the dangerous goods are classified into nine (9) principle classes. The ADR classes are called "Hazard Classes or Division Number of Materials", and each hazardous substances in the different class is individually assigned by a four-digit number (the United Nations numbers) that identify its hazardous character in the framework of international transport. For instance the "UN 1203" is a division number of Gasoline (or Petrol).[8]

By the way, the identification numbers of dangerous materials and their technical identification or in another word their "UN Numbers" are an important issue for those are interested in safety, security, and protection of work environments.[9,10] Moreover, the "UN Numbers" are excellent for categorizing and identifying the characteristics of a particular good and knowing about how to work with/on a specific hazardous material. As mentioned before, all dangerous substances possess their own UN numbers (e.g. acrylamide holds UN 2074) while sometimes groups of chemicals or products with similar properties accommodate a same standard UN number.[11] Additionally, a compound in its stable state may receive a different UN number than

the liquid phase if their hazardous properties dissent significantly.[12] Moreover, the dangerous materials/products with various levels of pureness may also obtain different UN numbers.[13]

Concerning the identification of UN Numbers and technical description of hazardous goods, some Techno-Scientifically search engines such as HazMat Database and EzHazMat websites are available.[14,15] For instance, the HazMat Database is a tool search function through the information and databases regarding the hazardous materials, and it is useful for people with safety background. Also, HazMat offers an up to date News about the world of dangerous materials/goods. On the other hand, the EzHazMat platform has been designed for the trucking and shipping industries to help them be compliant with dangerous goods.[16] The software of EzHazMat emphasizes and features all ADR classes or divisions, and it identifies unlimited material inputs, displays required or temporary placards, shows required labels, promotes proper shipping description with alternative sequences, warns of segregation requirements and incompatibilities, saves multiple loads, and extends a hazardous materials table.[17]

Class 1: Explosive substances and articles.

Class 2: Gases, including compressed, liquefied, and dissolved under pressure gases and vapors, Flammable gases (e.g. butane, propane, acetylene), Non-flammable and non-toxic, likely to cause asphyxiation (e.g. nitrogen, CO2) or oxidizers (e.g. oxygen), and Toxic (e.g. Chlorine, Phosgene).

Class 3: Flammable liquids.

Class 4.1: Flammable solids, self-reactive substances, and solid desensitized explosives. Class 4.2: Substances liable to spontaneous combustion. Class 4.3: Substances which, in contact with water, emit flammable gases.

Class 5.1: Oxidizing substances. Class 5.2: Organic Peroxides.

Class 6.1: Toxic substances. Class 6.2: Infectious substances.

Class 7: Radioactive material.

Class 8: Corrosive substances.

Class 9: Miscellaneous dangerous substances and articles.

Fig. 5.1: Symbols of Hazard Classes

To summarize the "Hazard Classes or Division Number of Materials", the above symbolic structure (Fig. 5.1) illustrates the major ADR placards (Class 1 - 9). The Globally Harmonized System of Classification and labelling of Chemicals (GHS) possesses nine symbols used to convey specific physical, health and environmental hazard information.[18,19] The mentioned symbols are part of a pictogram which is diamond shaped, and it has included the GHS symbol in black on a white background with a red outline. Consider that the pictograms are part of the GHS labels those also include some important information such as Signal Word, Hazard Statement, Precautionary Statements, Product Identifier, and Supplier Identification (Fig. 5.2).

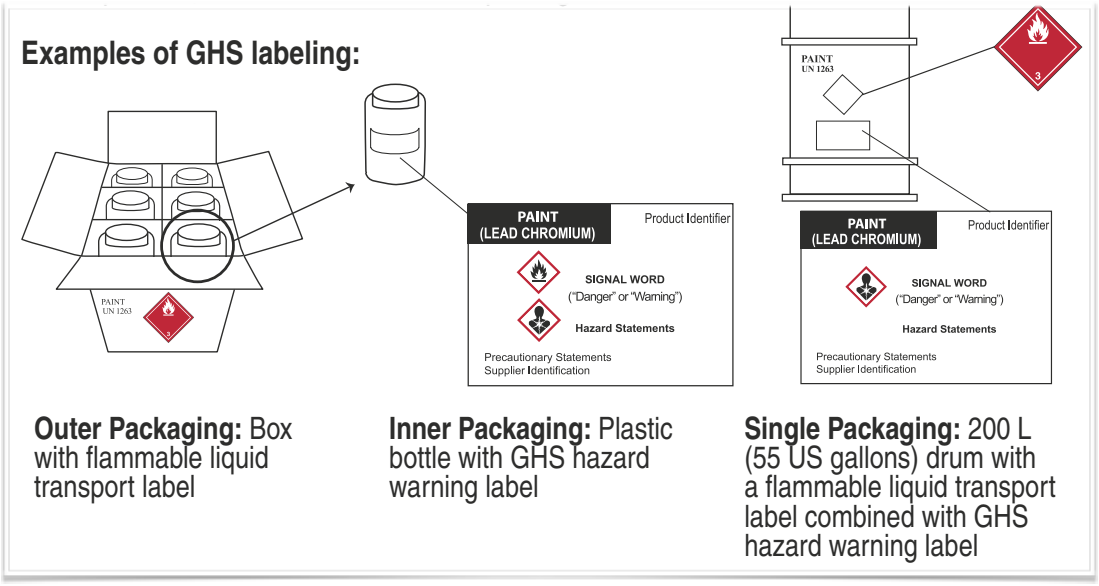

Fig. 5.2: Examples of GHS Labeling ©ERG2016, PP. 14

Eventually, in conclusion of this section, it is important to highlight that according to "PHMSA's 2016 Emergency Response Guidebook", the first 30 minutes are the most critical moments of the hazmat transportation accidents.[20] The aforementioned insight is opening a vital argument concerning the safety and security on the Transport of Dangerous Goods Models (in all levels of Mono-modal, Multimodal, and Intermodal Freight Transportation).[21] Therefore, if the first 30 minutes of an ADR accident is the most important instance of time, the Blockchain technology possesses the inherent capacity to synchronize, up-to-date, and alleviate all involved parties including authorities, traffic police, emergency agents, and shippers or carriers as well.

5.2 TRANSPORT OF EXPLOSIVE AND RADIOACTIVE MATERIALS

Obviously, as the "Things Are Not The Same", even the hazardous materials are not the same, and some of them possess a major capacity to damage or hurt people, goods, terminals, and facilities.[22] Reasonably, the Explosive substances (Class 1) and Radioactive materials (Class 7) are the most dangerous items.[23,24] In both circumstances (explosive and radioactive materials), the transportation of these dangerous substances requires the special ADR certifications while the basic HazMat Driver Training (ADR attestation) is not sufficient enough.[25]

In case of explosive materials, the violation or transgression of the regulations (Explosive Substances Law) might seriously consider all participants including the truck driver, carrier, shipper, and all involved parties.[26,27] Moreover, the explosive materials are largely using during the commercial applications such as mining. Therefore, the assessment and recognition of the use and/or presence of an explosive agent or radioactive material for predicting, avoiding, and preventing the criminal or terroristic use of chemical, biological, and radiological agents are commanded.[28,29] Also, the transportation of explosive material regarding its Threat Description and its Explosives Capacity requires a SAFE STAND-OFF DISTANCE.[30] In some cases (such as unreinforced building to withstand severe damage or collapse), the Mandatory Evacuation of the inhabitants is required with certain distances (please review Table 5.1).

	Threat Description	Explosives Capacity[1]		Mandatory Evacuation Distance[2]		Shelter-in-Place Zone		Preferred Evacuation Distance[3]	
High Explosives (TNT Equivalent)	Pipe Bomb	5 lbs	2.3 kg	70 ft	21 m	71 - 1,199 ft	22 - 365 m	+1,200 ft	366 m
	Suicide Bomber	20 lbs	9 kg	110 ft	34 m	111 - 1,699 ft	35 - 518 m	+1,700 ft	519 m
	Briefcase/Suitcase	50 lbs	23 kg	150 ft	46 m	151 - 1,849 ft	47 - 563 m	+1,850 ft	564 m
	Car	500 lbs	227 kg	320 ft	98 m	321 - 1,899 ft	99 - 579 m	+1,900 ft	580 m
	SUV/Van	1,000 lbs	454 kg	400 ft	122 m	401 - 2,399 ft	123 - 731 m	+2,400 ft	732 m
	Small Delivery Truck	4,000 lbs	1,814 kg	640 ft	195 m	641 - 3,799 ft	196 - 1,158 m	+3,800 ft	1,159 m
	Container/Water Truck	10,000 lbs	4,536 kg	860 ft	263 m	861 - 5,099 ft	264 - 1,554 m	+5,100 ft	1,555 m
	Semi-Trailer	60,000 lbs	27,216 kg	1,570 ft	475 m	1,571 - 9,299 ft	476 - 2,834 m	+9,300 ft	2,835 m

[1] Based on the maximum amount of material that could reasonably fit into a container or vehicle. Variations possible.

[2] Governed by the ability of an unreinforced building to withstand severe damage or collapse.

[3] Governed by the greater of fragment throw distance or glass breakage/falling glass hazard distance. These distances can be reduced for personnel wearing ballistic protection. Note that the pipe bomb, suicide bomb, and briefcase/suitcase bomb are assumed to have a fragmentation characteristic that requires greater stand-off distances than an equal amount of explosives in a vehicle.

Table 5.1: Improvised Explosive Device (IED) SAFE STAND-OFF DISTANCE ©ERG2016, PP. 374

On the other hand, in case of radioactive materials, it is important to consider that during the intermodal freight transportation their hazard identification numbers are 70 (in case of pure Radioactive material) and 78 (in case of Radioactive material which maintains some Corrosive characteristics either).[31] In addition, the radioactive materials are categorized as low-level radiation, low to moderate level radiation, low to high-level radiation, special form/low to high-level external radiation, fissile/low to high-level radiation, and corrosive (for instance the Uranium hexafluoride/Water-sensitive).[32,33] Moreover, regarding the national, continental, and European regulations concerning the transport of dangerous goods, the ADR Road Map (2013) has denoted that the ordinances "may be under the responsibility of different ministries/ administrations depending on the nature of the goods (chemicals, explosives, radioactive material, wastes, medicines, pesticides)".[34] Also, regarding the hazard wastes it is relevant to mention that the waste generation phenomena is an issue which has provoked wide public affair in modern societies,[35] not solely for the quantitative increase of the amount of waste produced but also for the mounting complexity of unusual goods and elements.

HAN and Cueto (2015) remarked that "waste collection is a highly relevant activity in the reverse logistics system" and how to collect waste efficiently and cope with the Waste Collection Vehicle Routing Problem (WCVRP) are some very important actions that require notable improvements.[36,37] Apropos, Jie Liu et al. (2010) concluded that the vehicle routing problem (VRP) with intermediate facilities those are involving in the transportation or collection of wastes (Class 9), would require an adequate design of a set of minimum cost delivery plans to serve a given set of customers by using a fixed fleet of vehicles.[38,39,40,41,42,43,44]

In conclusion of this section, it is imperative to remind that the precise discussions regarding the explosive and radioactive materials were fundamental to perform a comprehensive idea about the differences among the hazardous materials because hazardous substances should be safely transported to/from the industrial areas owing to their potential hazardous behavior. As a matter of fact, Luca Zamparini et al. (2017) have studied and analyzed the 21 years of data associated with unintentional hazardous materials hazmat that have been released by air, marine, and rail transportation modes reported in the United States of America.[45] Their study had investigated thousands of cases and the impacts of diverse transportation modes. The major impacts were included regarding the material losses, carrier damages, property damages, response costs, and remediation and clean-up costs. Their report suggested that "enhanced regulations and attentiveness have probably led to better reporting of hazmat occurrences". Besides, the Zamparini, L. et al. (2017) have remarked that the "developing and maintaining safer processes and designing safer products, containers, and systems can play an important role in minimizing hazmat releases".[46] Eventually, the aforementioned division perceptions of the Explosive/Radioactive materials and the ADR understanding would be helpful for software developers or anyone who is interested and involved in developing an adequate Blockchain-based platform toward the safe logistics and secure transportation of dangerous goods.

5.3 RID, IMDG, ADN, AND ICAO TREATMENTS

According to the Article one (1) of the "Legislation Decree 13 January 1999, n. 41" by the Italian Parliament, the RID Agreement signifies an international regulation concerning the international carriage of dangerous goods by rail, and it has referred to the Appendix B of the Convention on International Rail Transport (COTIF).[47,48] In a specific way, the rule concerning International Carriage by Rail (COTIF) implements in Europe, Maghreb, and the Middle East. Also, according to the penetration of the International Rail Transport Committee (CIT), "the contract of international carriage of freight by rail is governed by the CIM Uniform Rules in Western and Central Europe, Near p East and North Africa" while "in Eastern Europe and Asia, international carriage of freight by rail is governed by the SMGS".[49,50] Mindfulness, the RID aimed to improve, develop, enhance, promote, and facilitate the international traffic of the rail freight transportation in all its respects.[51,52] Moreover, the Intergovernmental Organization for International Carriage by Rail (OTIF) works to realize these improvements.[53]

On the other hand, the IMDG stands for the "(a) International Maritime Dangerous Goods Code (IMDG Code)",[54] and it has identified as the first transport legal international instrument for the transport of dangerous goods.[55] Moreover, other legal international instruments of the GHS which are implemented through the "UN Recommendations on the Transport of Dangerous Goods - Model Regulations" are including:

(b) ICAO Technical Instructions for the Safe Transport of Dangerous Goods by Air (ICAO TI);[56]

(c) European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR);[57]

(d) Regulations concerning the International Transport of Dangerous Goods by Rail (RID);

(e) European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN);[58,59,60,61]

However, for the sake of this dissertation, the items and concepts regarding the RID agreement will be discussed more in the following section.[62] Another reason is that the relationship between the European Union Railway Transport Law and its current Railway Protocol regarding the Intermodal Freight Transportations are important to be considered. In fact, this critical issue was the "second wish" of the Sandie Calme (2016) to "ensure that rail transport is regulated with harmony and effectivity in respect to other transport modes, not only in terms of competition but also as far as multimodality".[63] Also, according to the acumens of the BIFA®, the COTIF/CIM Convention contains a revised version of CIM Uniform Rules regarding the contract for international carriage of goods by rail.[64] Whereas, the COTIF Convention is similar to the CMR.[65] The proposals and novel ideas regarding the CMR, e-CMR, and advantages of Blockchain technology will be discussed in the PART II.

Having said that, regarding the transportation of hazardous materials in TANKER, it is useful to mention that, generally, there are three primary types of tankers: Bulkhead tankers, Baffled tankers, and Smoothbore tankers (please carefully review the Fig. 5.3). Also, it is important to consider that the bulkhead tankers possess several solid compartments (normally form 2 to 8) that separate each partition contents from the others. These separated parts have designed to offer some additional advantages to the tanker structure such as slowing down the forward and backward movements of the liquids, avoid the effect of the "Liquid Surge", and offer the possibilities to load some different liquids (of multiple ADR classes) on an individual truck or a single container (please review the items 117, 134, and 137 from Fig. 5.3). Hence, these constraints and different compartments of the tankers might require the major organizational attention and a qualified transport planning system by the logistics providers. Also, the carriers needs to be aware about the definition and destination of their duties.

These above-mentioned benefits of bulkhead tankers, have created some constraints (𝄐) and remarkable restrictions (⊳) as well. For instance, some hazardous materials are not allowed to be loaded on the same fleet/truck/container because potentially they could interact with each other and cause some powerful explosion or provoke undesired damages.[66] For example, the Oxygen as a fire-intensifying substance owns the risk of strong reaction in case of contact with the flammable materials while some other materials are water reactive and their transportation through roads and tunnels might be strictly dangerous.[67] Moreover, another critical pressure or coercion is about the operational order of loading/unloading approach.[68] Given an example, according to the regulation of the safety and security of the road traffic and transportation, for the sake of technical matters, the semi-trailers/tankers are required to be loaded from their anterior compartment.[69] Furthermore, they are required to be unloaded from their postural compartment. These loading/unloading orders and procedures will assurance the major equilibrium and superior safety and stability for movement of heavy goods vehicles (HGVs).[70]

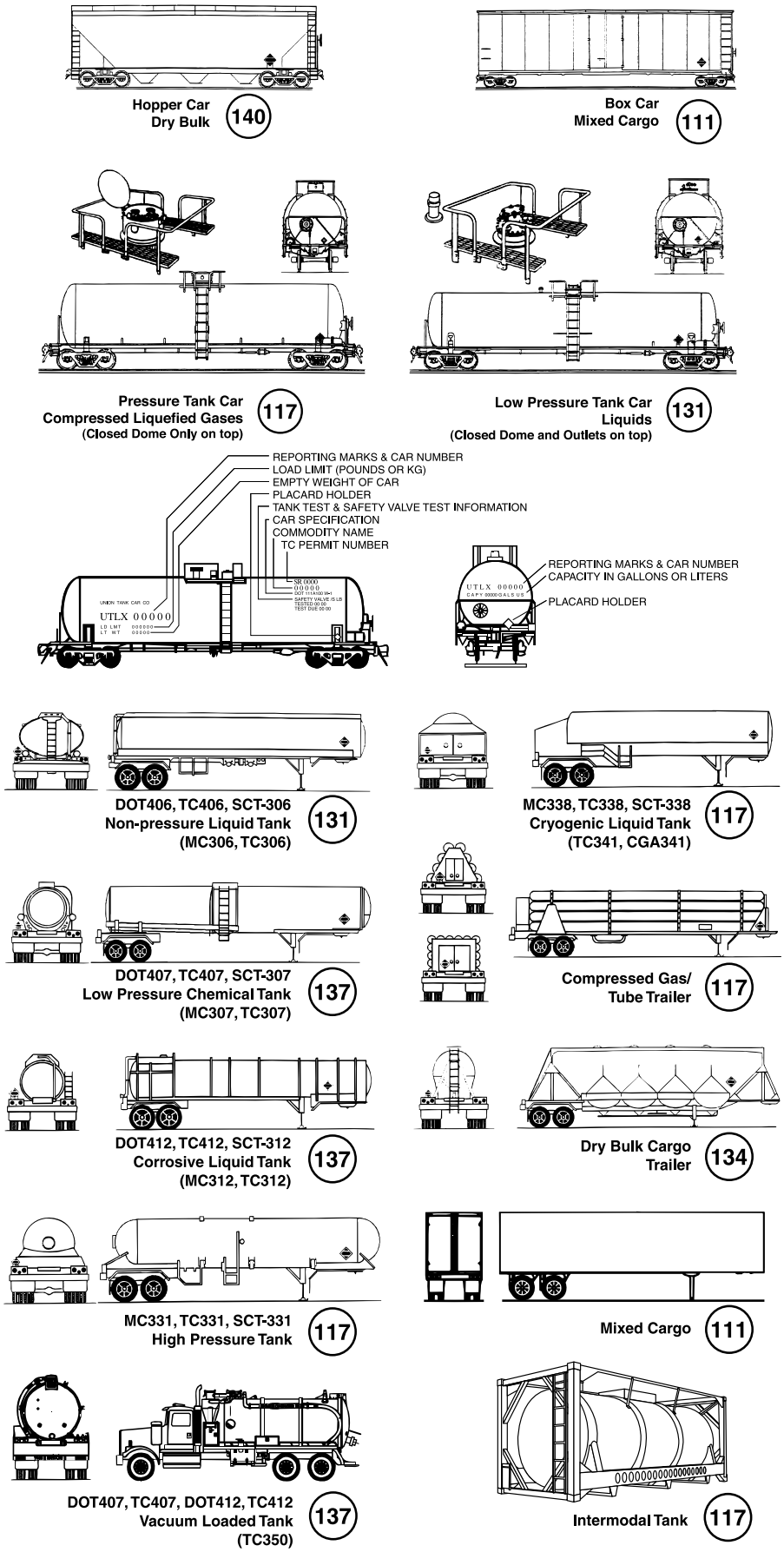

Fig. 5.3: Rail Car & Road Trailer Identification Chart ©ERG2012, PP. 8-9

Eventually, it is necessary to specify that, unfortunately in some cases, the circumstances of the Italian freight and passenger transportation by rail have occurred as kind of tragic situations.[71] Conceivably, the tragic accident of "Viareggio Derailment" on 29 June 2009, was one of the most ferocious derailments of the Italian freight transportation.[72] The subsequent fire of the Freight Train N° 50325 in Viareggio (Lucca) has killed thirty-two persons, and it had caused the injury of further twenty-six people.[73,74] The train was carrying fourteen (14) wagons of the tankers containing LPG gases during the official power of Prime Minister Silvio Berlusconi and his alliances Gianfranco Fini (President of the Chamber of Deputies) and Giorgio Napolitano (President of Italy). Sorrowfully, during the Viareggio Tragedy, thirty-two (32) children, women, and citizens burned alive and looking at photos of that tragic accident make spectators feeling maudlin.[75] Moreover, the accident has left nearby one hundred (100) people displaced.[76] In fact, the transport of petroleum products and oil transportation in general is a dedicated task and it needs particular attentions, risk prevention studies, and prevalent simulation analysis.[77] Also, please consider that the Train N° 50325 was transporting the Liquefied Petroleum Gases (LPG).[78] Wistfully, this fact once again illustrates the oil and petroleum dependency of Italian industries and Italian transportation system (APPENDIX II).

Unfortunately, the Viareggio Derailment was not the last dramatic event of the Italian freight and passenger transportation by rail. The accidents of the Moncalieri, Bari, Torino Stura, Caluso, Andria (Bt), Andora (Sv), Cisternino (Brindisi), Bologna, Bitonto (Bari), Filattiera, Roma, Laces (Bz), Bondeno (Fe), and Roccasecca (FR) are some recent cases of this drama.[79] Lastly, on 25 January 2018, another train derailment appeared near the Pioltello-Limito station, and three (3) women has died grievously while other 46 people were wounded.[80] Hence, according to the events mentioned above and regarding the amount of the road/rail hazardous goods accidents, it is possible to claim that, unfortunately in Italy, there is a lackadaisical attitude to the extension of the safety terms between some Italian logistics/transport companies. These companies in the majority of cases are not specialized or concentrated in the transportation of the ADR materials, but they involve casually or partially in the transportation of hazardous goods. These dangerous phenomena will be discussed in the following sections 5.5 (A Black Box called: The Container) and 5.6 (Corruptions during the Transport of Hazardous Substances). Inasmuch as, the continuous studies, research, and discoveries of some innovative possibilities to achieve more security and safety during the shipment, transportation, storage, package, and movements of hazardous materials and Spent Fuels are required as well.[81,82]

Finally, in conclusion of this section, it is important to highlight that in such dangerous working environment (working/transporting the ADR goods), according to Hajoon Ko et al. (2018), the industrial robots are in broad usage as they are fit for repetitive or hazardous tasks. Also, they are distinguished by high speed and great accuracy.[83] Moreover, Ulrich Berger et al. (2017) believed that by using suitable sensors their described problem of the "manhole cover opening in the hazardous zone" could be automated step by step.[84] Concerning the vision, background, and motivation of the "Handling Dangerous Goods" by "Using Industrial Machines", Ulrich Berger et al. (2017) denoted that dangerous liquid goods are transported to a large extent on railways while the traffic density, security aspects, and volumes are increasing as well.[85] On the other hand, despite the fact that the production of petrochemical products has been mostly automated still the loading of the hazardous materials in tank wagons so far is mainly executed manually. Consider that regarding the problem mentioned above (the lack of automation), sadly, the Italian transport is suffering from the fog stories of mortal injuries because the ADR substances are hazardous materials and their loading/unloading operations require completely safe and adequate environment.[86]

Dangerous goods are some extreme environmental hazards, and their toxic properties generate remarkable and constant threats to the health of the logistics and transportation personnel. Accordingly, to enhance ergonomic conditions and improve process reliability, the loading/unloading automation of hazardous materials is required while they are inevitable for healthful extension of logistics operations and transport performances. In such circumstances, the blockchain technology could shift up the levels of the logistics trust and the synchronization of the Intermodal Freight Transportation as an innovative "TrestleJack".[87]

5.4 INTERMODAL FREIGHT TRANSPORTATION & ADR AND RID

Intermodal transportation points to multimodal supply chains or logistics networks including at least two transportation modes and services (e.g. Road/Rail or Road/Sea). Furthermore, according to the Steinke & Fischer (2016), the extension of multi-commodity Closed-Loop Supply Chain Network (CLSCN) is crucial and it requires an adequate design through aggregate production planning.[88] Also, according to the European Conference of Ministers of Transport (2001), the main characteristic of intermodal freight transportation is that the assets are transferred in one (1) loading unit (e.g. Container), and they are not handled or touched when changing modes.[89] Moreover, Cavone et al. (2016) denoted that the Intermodal transportation consists in transferring commodities by Intermodal Transport Units (ITUs).[90,91] Mention that these transport units are included in ISO containers, ADR container tanks, chassis trailers, semi-trailers, open top containers, Dry freight (or cube containers), Insulated (or thermal containers), Reefer (or refrigeration containers),[92] and swap bodies. Also, any container owns its specific and meaningful Code, Identification, and Mark.[93]

The following schematic figure (Fig. 5.4) illustrates the precise meaning of the primary codes, constrains, and identification numbers of a container which was used during an Intermodal Freight Transportation of Hazardous Materials. Reasonably, the most important information to be considered for developers of Blockchain-based applications or any decentralized platform include the following concepts: Operational Characteristics, ADR placards, and the General Warning regarding the Dangers of Hazardous Materials for the Environment.

In fact, the aforementioned consideration regarding the GHS standards is vital because the Intermodal freight transportation contains in conveying with two or more transportation modes such as road vehicle combinations, river and canal barges, rail wagons, sea-going ships, and air.[94,95] According to these mentioned above interchanges, the ITUs transport are demanded to be synchronized. In this manner, Cavone et al. (2016) studied, designed, and used two subnets to model the two access roads, corresponding to the entrance and the exit of the semitrailers in the terminals, in conjunction with the semitrailers places (P_n) and their transitions (t_n).

Also, trailers posses different nature, and the manufacturing of trailers require specific aptitudes because the quality and design of trailers might influence the performance of logistics and intermodal operations undeviatingly (review SCHMITZ [CARGO BULL],[96] Maral,[97] BARKER,[98] DOLL trailers,[99] and SDC Trailers).[100] Besides, trailers and involved vehicles are classified regarding their work environment (e.g. Intermodal Transport, Timber Transport, Heavy Haulage Vehicles, Ground Support Equipment, and Authority Operations).[101] Furthermore, the logistics and supply chain scholars need to increase their communication values and improve their practical relation with the real world of the Transportation of Hazardous Goods.[102,103]

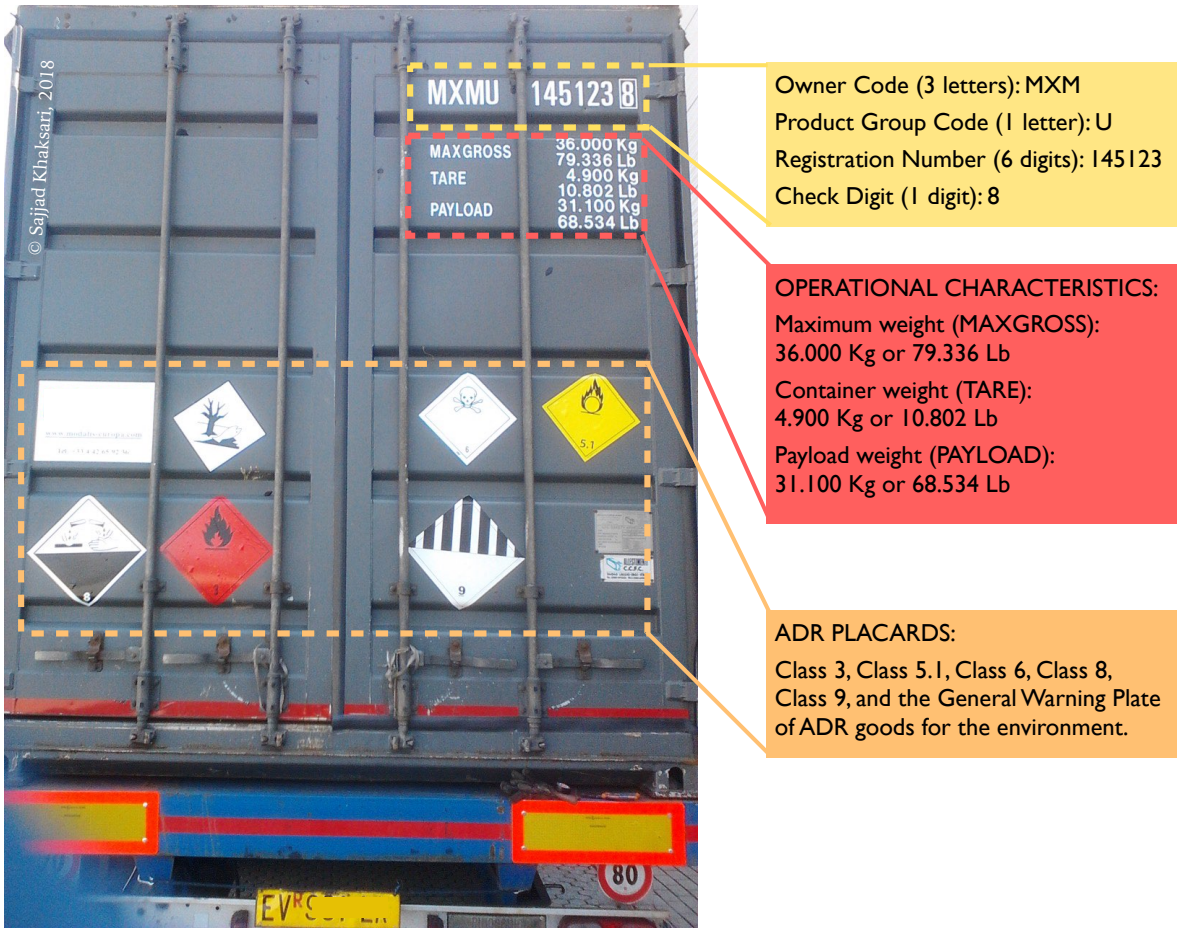

Fig. 5.4: ADR Containers & Coding, Identifying, and Marking

5.5 A BLACK BOX CALLED: THE CONTAINER

The term of Black Box lets readers roughly remember two words: darkness and lack of transparency. According to Amitabh Banerjee (2014), the Black Box's term is used to refer to the Flight Data Recorder (FDR), and it is valuable to collect data, record specific performance parameters, and help the investigation of any mishaps by the aircraft.[104,105] However, in this section, the term of Black Box has used to indicate the unfortunate lack or nonattendance of synchronized information (in real-time) during the Intermodal Freight Transportation.

That is precisely why the blockchain technology could make difference in logistics and distribution industries while it is playing an important role for improvement of the international transportation. In fact, considering blockchain as a decentralized technology, it possesses some extraordinary advantages concerning the transparency, safety, security, and sustainability of the intermodal logistics operations.[106] In view of the fact that, the Risk Communication Systems are required for prevention or blocking of health risks during handling of hazardous goods and fumigated containers in dry/seaports. According to Teresa Cardàs (2018), an example of a Hazardous Materials communication system which is currently operating on a city level is the GEGIS dangerous goods information system in Hamburg.

The communication system of GEGIS is made concerning the transportation of dangerous goods with safety and security in the port areas.[107] The method provides an overview of dangerous goods movements to/from/within the port quarters and terminals to the water police, authorities, fire brigades, emergency agents, and carriers (Fig. 5.5). The only problem is that the GEGIS is a centralized system.

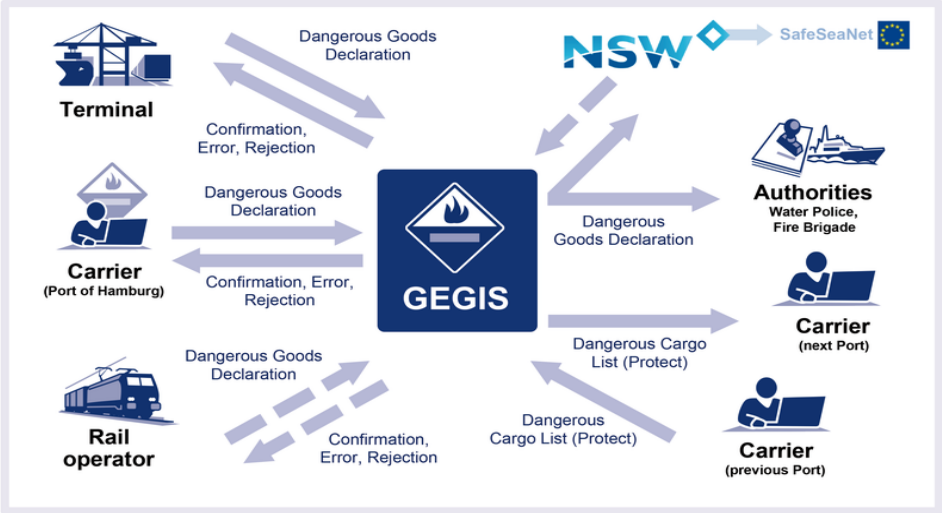

Fig. 5.5: The Gefahrgutinformationssystem (GEGIS) © Cardàs (2018)

Therefore, being a centralized and dispersed system might offer some critical possibilities for individuals those are not interested in being 100% transparence. Especially when the work procedures and work atmosphere encourage shippers, logistics forwarders, carriers, and truckers to increase their productivity. In such circumstances, some companies are not fit to attend all consideration and constraints, and they commence to abuse some profit from the shade of containers. This phenomena is look like a Bullwhip Effect phenomena which deceit the prediction of the system and it causes supply chain inefficiencies.[108,109]

To prove evidences, in the following paragraphs one example from hundreds of existing cases in Italian freight transportation will be discussed. The names, titles, addresses, and logos of the shipper, transport forwarder, carrier, and manufacturer have been hidden, not for the sake of their privacy (while they are publicly violating the safety rules and put the lives of people in the dangerous situation). The reputations of these companies have been dropped only because the Italian freight (especially on the road) transportation is somehow full of these kinds of infringements and irregularities. Unhappily, this phenomenon is not illustrated firmly in the academic papers because the majority of authors do not work at the tires level and they have not experienced dust on their hands. Moreover, the majority of literature is funded by businesses, and these funding companies are not interested in sharing the confidential information with authors. Therefore, the academic writers have not the admittance to the information regarding the transgressions of the shippers, carriers, 3LP, and the logistics providers. Another reason behind this poverty of literature is regarding the diversification of the Italian transportation companies. As mentioned previously, these logistics and transportation organizations normally are not concentrated only in the transportation of the hazardous materials because that is not their primary brand.

For instance, a transport company that has a main area of the transportation of perishable goods could be involved casually (on-demand) in the transportation of hazardous goods. In this occasion, they load the ADR materials inside their Insulated (thermal) or Reefer (refrigeration) containers and semi-trailers, and they transport the cargo. These events occur while their truck drivers do not hold the required certifications and demanded equipment.[110,111] However, containers or trailers are closed in the dark and no authorities know about the contents of that Black Box until someone arrives and open it.

This case study has registered by the author on 3rd August 2016. The dynamic of infringement was very simple to experiment. The carrier (which is the 1st degree accused of the case) has received an order from the logistics forwarder (which was at the same time an international shipper). The transport order was to load around 25 tonnes of the hazardous products (liquid and solid, flammable plastics products - Class 3 and Class 4) which were produced and manufactured by the client "F". The client who is the risk prevention actor of the case (at least at first phase), following by the conclusion of the loading operation and before the signature of the international documents (CMR), has required an ADR Certificate. Consider that Dangerous Goods Transportation Documents (DGD) is essential because according to the MAERSK LINE, the DGD legislation requires a declaration from the consignor (shipper) saying that the goods listed are classified and packed correctly. Moreover, a declaration from the person packing the container that it has been done remarkably accurately. These statements are considered as Dangerous Goods Declarations and the Container Packing Certificates.[112] This subject is indispensable and it needs to satisfy the sufficient requirements such as Dangerous Goods Note (DGN), Dangerous Goods Declaration (DGD), Multimodal Dangerous Goods Form (MDGF), Shippers Declaration, and Dangerous Cargo Declaration (DCD).[113]

Unfortunately, the truck (intermodal lorry) driver was not holding any certificate, and the client "F" (correctly) decided not to release the permission of the shipment. Later, when the client communicates the problem with the carrier (who was awarded of the problem from the very beginning), the carrier orders the truck driver to abandon the shipping area without carrying the semi-trailer. Then, the carrier transfers 2nd truck driver (who holds the ADR certification, and he had the adequate experience for transportation of hazardous good) but the carrier does not notify the truck driver concerning the classification of the service (ADR).

When the second driver arrives at the shipment area, and he observes the dangerous substance of the products, he immediately alarms the carrier concerning the lack of adequate equipment on board of his truck (please review the red highlighted lines in Fig. 5.6). However, in this point, the client "F" decides to be satisfied with the ADR certification of the 2nd truck driver because it was essential for them to overpass the bureaucratic issues and ship the shipments. Even because, their client is waiting to receive their final products. Accordingly, the carrier communicates again with the truck driver and asks him to not attach any ADR symbols or any ADR placards on sides of the container but keep them inside the truck's cabin. Correctly, the truck driver decides to be disobedience toward the irregularity of the carrier, and he appends all the required ADR adhesives on the sealed container. Once, the truck driver leaves the shipping area of the client "F", the carrier commands him to transport the trailer in an emergency parking of a Highway Tolls around the Milan. The carrier ordered the truck driver (with ADR certificate) to not transport the container into the final trip destination (which was an intermodal inland terminal in the north-west of Italy). Consequently, once the 2nd truck driver arrives at the temporary parking, the carrier directs him to unhook (or uncoupling) the semi-trailer. Up to this point, the logistics operation was quite regular (except the shortage of some ADR Safety equipment), and there was not any huge transgression.

However, the dangerous violation of The Highway Code appears when the carrier orders the 1st truck driver (without the ADR qualification who was already there waiting before the 2nd truck driver) to couples the semi-trailer and transport it to the inland terminal.[114] Regrettably, that was not the first/last time the carrier mentioned above implements the certain crimes.

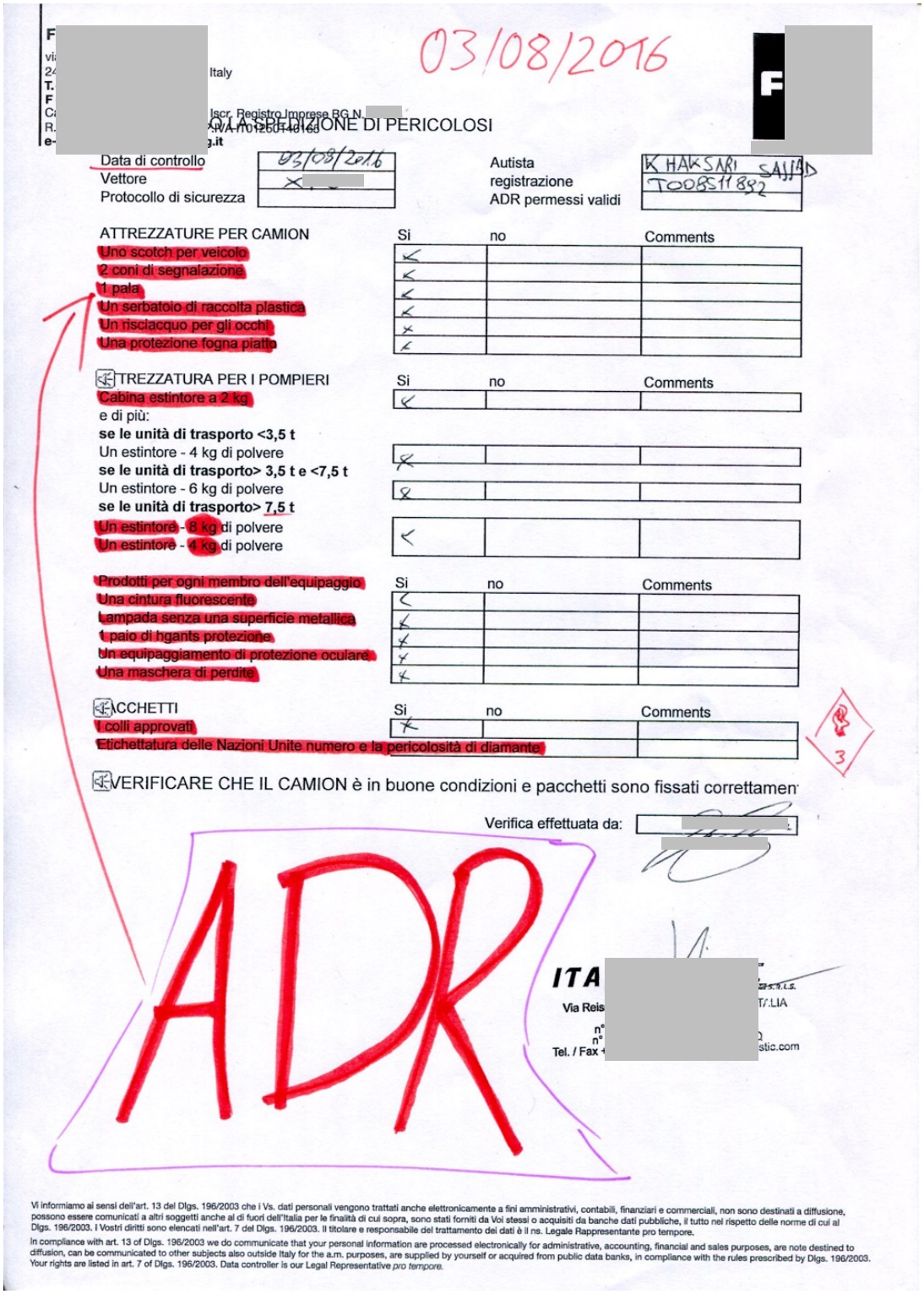

Fig. 5.6: ADR Violation during an Italian Intermodal Freight Transportation

Unfortunately, the dangerous behavior of this problematic use case and some other similar questionable cases are occurring every day during the Italian Intermodal Freight Transportation. The reasons are some perilous impulses and dark opportunities such as the lack/shortage of traceability, the centralization of supply chain participants, individuality and consolidation, hidden (not communicated) information, and conventionality of the Italian legal system and penalization. For instance, if during the above-mentioned case, the Italian traffic police decides to control the lorry and commands the 1st truck driver to open the sealed container, once they find out about the dangerous classification of the service (ADR) the mulct will be written in the name of truck driver (as the 1st degree accused). Meanwhile, the carrier, 3LPs, and shippers were involved directly and they have combined everything. By the way, this problem will be discussed in the forthcoming units and use cases of the PART II.

Eventually, it is important to emphasize that the induction of these conventional transport supervisors is egregious, and sometimes it is shocking and outstandingly dangerous (as mentioned previously in section 5.3). In fact, the safety terms cannot afford to be missed by transport and business organizations.[115] Moreover, the hidden black box of Container Shipping (as a concept) and its presumable corruptions in particular regarding the transportation of ADR materials, is a never-ending sick cycle until some distributed ledger technology such as Blockchain technology, totally disrupt these secret, surreptitious, perdu, and furtive glimpses.

Finally, in conclusion of this section, it would be useful to remark that in the history of transportation, two items have changed radically the way people and cargo move around. First, the invention of Bridge which helped human to cross rivers, watercourse, canyons, ravines, and valleys without getting wet or hurt. Secondly, the contrivance and contraption of the Tunnel which has supported human to create shortcuts and connect the detached neighborhoods or separated valleys concurrently without the need of walking or traveling on the surface of the mountains. These inventions have improved the transportation methods critically, and they increase the safety and security of the inland transportation for both passengers and goods. Moreover, the Tunnel and Bridge have benefited travelers by decreasing the Traveling Time as well. On the other hand, as a result of industrial growth, massive quantities of hazardous materials are transmitting in the national and international transportation networks every day. Regarding the case of ADR and Transportation of Hazardous Goods, it is very important to pre-study the desired route of trucks before their departure because some bridges and tunnels are prohibiting the transit of hazardous materials (or at least some for some of the ADR Classes).[116]

These transport limitations try to protect the atmosphere, climate, environment, and agriculture lands (e.g. liquid hazardous may contaminate rivers, surface waters, and underground waters).[117] Additionally, these transit restrictions have the goal to increase and develop the level of Road Safety (e.g. explosive goods may damage the road infrastructures or tunnels structures).[118,119] For instance, according to the RVTrip, the tunnels which go down the hill have restrictions to stop and make sure propane is turned off. By the way, in case of the Tunnel, the safety and security of its users is a major issue, and these items have not to be exposed and confused like The Tunnel of Ernesto Sabato.[120] Unfortunately, Tunnels could be fatal (e.g. Monte Bianco Tunnel Accident and Death of Wales' Princess).[121,122] In fact, the transportation of hazardous materials through the tunnels is a critical task. There are strict rules for such movements and official administrators or official commissions publish and prohibit the transport of dangerous or Explosives substances in specific tunnels of their district.[123] Consequently, there is an important task for freight planners and their Distribution Planning Software to investigate in advance the interdiction and obstacles of several tunnels which would probably include their fleet logistics and their Cross-modality trips.[124] Fortunately, these

kinds of information usually are openly available on the websites of the regional and national transportation directors, and by the juxtaposition of these couple concepts the transportation managers might find a better picture concerning the design of their freight network.[125,126]

5.6 CORRUPTION DURING THE TRANSPORT OF HAZARDOUS SUBSTANCES

Unfortunately, the Italian transportation of ADR materials (in some cases) is suffering from the decay of the legitimation and trust devastation. In addition, as discussed previously in a typical example of transportation of hazardous materials via Intermodality, some Italian carriers occasionally establish infringements and dangerous traffic violations while these transgressions are required to be reciprocated.[127] These threatening behaviors are against the strategic plans of UN (ADR), EU (Road Safety), and Office of Hazardous Materials Safety (OHMS).[128] However, as stated previously, these corrupt actions are hidden in the silos of companies. Perhaps, only by working inside these transportation groups the veil might be ripped. Another characteristic of these companies is that they complained a lot about Financial Crisis while they are actively taking part in the cyclical generation of the financial and environmental crisis. Once again to prove evidences and related documentation, two cases from Italian freight transportation will be discussed in the following statements:

The first Case regards the corrupt actions to obtain the ADR certificates from some east European countries (e.g. Bulgaria). In 2013, an Italian transportation company which is profiting from the EU regulation concerning the "Freedom Of Establishment Within The European Union",[129] sent its truck drivers to Bulgaria. This Balkan country which is a member of the European Union, NATO, and the Council of Europe, practically could issue the driving license, CQC, and ADR certificate.[130] These certificates are European documents, and they are valid in Italy as well. Therefore, the aforementioned transportation company used to transfer its truck drivers all together on a certain day, at a certain place, and the process of ADR gaining was finished on the same day as they arrived. Friendly, some of the truck drivers had confessed that within a few minutes just when they arrived at the driving school (which was an acquaintance of the company's owner), all of them enhanced as an ADR certificate holder. Consider that this transportation company is big enough to transport goods and material from Israel to England and from Italy to Africa.

The second case regards the real circumstances of another on-road transportation company in the north-west of Italy. The company is active in the national express and door-to-door transportation. Unfortunately, somehow they decided to ignore the ADR regulation during the day-by-day working experience of their truck drivers.[131] Additionally, please review the guidance of HUPAC regarding the safe and secure operations during the transportation of dangerous goods via road/rail combined modes.[132] However, the horizontal reality of this company and many other comparable cases are far away from the compliments that they actively propagate on their business website virtually. For instance, in one of their logistic warehouse in Milan, the author personally has observed how they hide some huge amount of chemical liquid (ADR Class 3 and Class 8) among the ordinary goods and loads (please review the Fig. 5.7). Furthermore, the majority of their truck drivers were not holding any ADR certificate, and they were not either interesting to learn about transportation of hazardous materials. However, the truck drivers have loaded hidden hazardous materials, and they did

not append the ADR panels. In their opinions, the disappearance of ADR placards was useful to prevent and inhibit the enhancement of the police's attention while they were afraid concerning their hidden dangerous goods.

Fig. 5.7: Overall Hidden Dangerous Goods under the Ordinary Materials

In conclusion of this section, as mentioned previously, it is needful to consider that the cases as mentioned earlier are only some samples of hundreds of contaminated circumstances, they have been observed directly by the author. Unfortunately, the exact size of the image about the real scale of the problem is beyond the imagination. Moreover, the operations and techniques of hook/unhook and coupling/uncoupling which are great opportunity during the Intermodal Freight Transportation, might be misused by some carriers and logistics forwarders. Eventually, the further studies regarding the corruption and depravity during the transport of hazardous substances in EU are required. Also, these advanced studies must contain some new methods and fashionable progress on the evaluation and simulation of Long Distance Transport of Hazard Materials in the atmosphere and environment as well.[133]

5.7 A HIGH-RELIABILITY NETWORK FOR TRANSPORTATION OF HAZARDOUS GOODS

After introducing a brief introduction about the transportation world of hazardous materials and by presenting some use cases of some mischief-maker companies in the previous sections, conceivably, it is the right time to ask two accurate questions: How is possible to stop the havoc of aforementioned shippers, carriers, 3LPs, and logistics forwarders? Is it possible to determine the problem of corruption and traffic safety violations during the transportation of hazardous goods by proposing a fully transparent supply chain management system?

The necessity of such system is obvious because the Carriage of Dangerous Goods (CDG) by road/sea/rail/air involves the risk of traffic accidents, and there is also the risk of spillage and leading to hazards such as fire, explosion, chemical burn or environmental damage.[134]

Thus, the improvement of that ideal model for offering the major visibility of ADR transport (probably via Smart Contract and other similar technological IT innovations) concerning any node and hub of the multimodal and Intermodal transportation is lacked.[135] Therefor, Don and Alex Tapscott (2016) believed that the Blockchain Technology is capable of creating this required Knowledge Networks.[136] Also, the risk factor during the transportation of hazardous materials is an important issue to be considered within such desired operation model.[137] The traditional risk assignment formula (5.1) which is in used in many studies could be utilized. Hence, the risk along the road ($\mathbf{v}_i$, $\mathbf{v}_j$) is calculated by multiplication of the incident probability ($\mathbf{\Omega}_{ij}$) and its consequences (D_{ij}). In such circumstances, Wang et al. (2017) have proposed and developed a bi-objective vehicle routing model for hazardous materials transportation with no vehicles traveling in echelon. Moreover, their model simultaneously minimized the maximum risk of each vehicle and the transportation cost.[138]

$$r_{ij} = \Omega_{ij} \cdot D_{ij} \qquad (5.1)$$

Only, it would be valuable to consider that the probable cases of the risks of hazardous material vehicles by estimating the risk of each Truck and the total risk of the logistics network. Moreover, please consider that the Truck term introduces to a complex of an articulated lorry, semi-trailer, container, and hazardous goods inside the container. These considerations and Resilience Assessments are vital for the creation of some reliable blockchain-based model.[139]

Some experts believe that the Blockchain Technology is a double sided sword. In fact, there is a high interest and high resistance against Blockchain on the practical front of industries.[140] However, in case of Italian intermodal freight transportation, despite the maintenance costs of blockchain, the reason for such unusual boycott by some logistics providers and transporters companies is what Blockchain offer accurately: The visibility and the Decentralization. As a matter of fact, and as a real example, the thimbleriggers of Italian ADR transport may arrange what they are performing, precisely because the current logistic system has some black holes. The lack of visibility and strict centralization help them doing their falsification and hide what is vulnerable and violating the safety regulations.[141] These companies desire to keep their secrecies and when fatal accident occurs they have possibilities to denied their responsibilities. The blackbox of containers (lack of transparency and lack of visible technology in real-time), had enabled the illicit transport of hazardous materials via the pillar of on-road transportation.

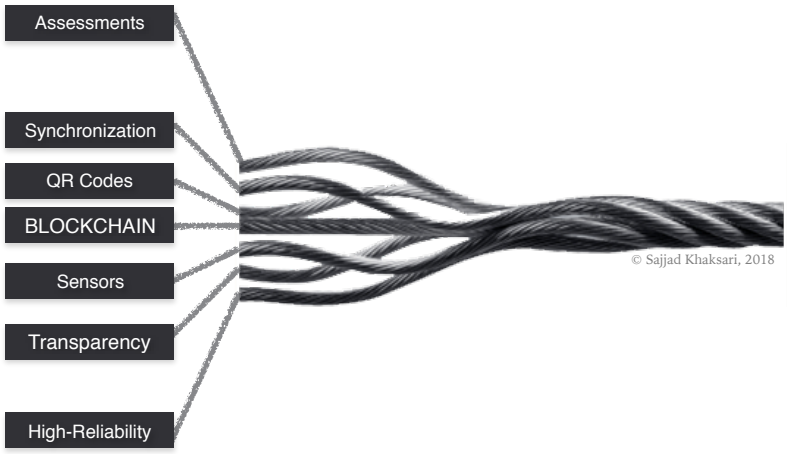

Fig. 5.8: The Blockchain Technology and Strands of ADR Logistics

Notwithstanding, it is important to ensure that the shipping system is configured to actively avoid common unrealized problems that result in added freight costs or environmental impacts. Thanks to such an interconnected model, logistics customers (in demand of transport services) and logistics authorities (in demand of control transport services) no longer will have to wait up for days or weeks, but they can order or control the flows of freight concurrently. In fact, the Digitizing Freight Forwarding in this third millennium is required more than ever.[142] Also, the Architectural Styles and the Design of the logistics network is an important issue,[143] and systems like Kubernetes, Docker, and INTTRA can make a difference.[144,145,146,147]

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SAFETY FOR PEOPLE AND GOODS

6.1 OHSAS VERSUS ITALIAN LOGISTICS

The safety of goods transportation requires the safety and health of people who work hard to transport those goods. Also, the healthy behavior of the persons can guarantee the fully safe transportation and management operations of the freight transport. Base on this philosophy, the OHSAS 18001, Occupational Health and Safety Assessment Series (officially called as: BS OHSAS 18001) implies an internationally applied British Standard for occupational health and safety management systems.[1] OHSAS endures for supporting all kinds of organizations to put in place the demonstrably of occupational health and safety performance.[2] For instance, the issue of the Load Securing is an important matter, and it requires sufficient knowledge, adequate equipment, and good practice.[3,4] In fact, according to the HSA (2016) report, the "vehicles carrying poorly secured loads pose a clear risk to their drivers, to workers involved in loading and unloading operations and to other road users".[5,6] Moreover, the unsecured loads can considerably increase the risk of vehicle instability, leading to load shed including possible rollover.[7] This issue is not excluded in Load Securing but that includes handling operations of pallets and entire loading/unloading processes.[8] Finally, in case of workers whose work in Dry ports (intermodal terminals) and Sea ports, they can be exposed to harmful levels of dangerous substances especially when they are dealing with shipping containers treated with pesticides.[9] According to the European Agency for Safety and Health at Work (EU-OSHA), unfortunately, the extent of the safety and security problems are underestimated, and not enough has been done to prevent the risks while each year, more than 600 million freight containers are shipped worldwide. Mindfully, EU-OSHA has highlighted that these containers are frequently treated with pesticides to prevent damage to the goods.[10]

In such circumstances, also when the usage of blockchain technology is not limited in finance, it can improve the health issues for logistics workers or even simply for safety improvement and insurance of food warranty. Moreover, the food safety has brought the upsurge of academic and commercial concerns. In supply chain area with the accelerated extension of IT, a lot of emerging technologies have been implemented in traceability systems. Unfortunately, the majority of these systems are centralized, monopolistic, asymmetric, and opaque. These characteristics could result in the lack of trust, possible fraud, corruption, tampering of data, and falsifying information related to logistics and transportation of intermodal freight. Furthermore, the centralized systems are vulnerable to collapse because a single point of collapse or failure will lead the whole system through a catastrophic crash.

Hence, blockchain as a new technology, is recognized a ground-breaking innovation which is a decentralized information technology and it represents a completely new passageway. Nevertheless, since Blockchain is still in its early stages, it possesses some inherent defects, in which scalability become a central and important thing when the industry faces the mass data in the physical world. In fact, Feng Tian (2017) denoted that building a food supply chain traceability system for real-time food tracing that is based on HACCP (Hazard Analysis and Critical Control Points),[11] the Blockchain, and the Internet of Things to provide information for all SC participants is crucial.[12,13] For instance, the gritty and cumbersome processes of the pallet movements could be observed under a decentralized and integrated system from the firm and production phases into the processes, warehouses, distributions, and retail operations. Another example is highlighted by Zhao et al. (2017) when they denoted that the healthcare is a huge application scenario of the blockchain and they used body sensor network to design a lightweight backup and efficient recovery scheme.[14]

Also, the City Logistics, Safety Alerts, Vehicle Technologies, and Drivers Education work in correspondences as four wheels of a reliable vehicle. Therefore, Neyens and Shen (2017) believed that if research workers and policymakers want to increase the safety of intermodal freight transportation, they first ought to know how the current technologies and EU traffic laws are shaping drivers' behavior. Later, they would develop the possible technologies around that human/firm behavior under a new dynamic regulatory adjustment process.[15,16] Unfortunately, in some circumstances, the situation and work conditions of logistics labors among Italian logistics industry are not safe and protected. As a matter of fact, the tragic death case of Abd El Salam (the GLS's logistics worker) is one of the recent cases.[17,18,19] Moreover, in another fatal case of Italian logistics in the real world of job and its daily work circumstances, the brutal loss of Mr Mauro Cagnoni has appeared. In his mortal case, the safety breaches from the side of involved carriers, logistics providers, 3PLs, freight forwarders, and the Italian administrators is explicated. Mr Mauro Cagnoni was sadly crushed to death by a long-haul against the wall of the warehouse before the accomplishment of an unloading operation.

The truck (semi-trailer & semi-articulated truck) was not an EFFICIENTLINE, and its total weight was presumably over 44 tonnes when it had pressed Mr Cagnoni on 9 May 2017 in Airasca.[20] Outrageously, the affiliated Italian transport & logistics company in which Mauro Cagnoni was punched like a piece of paper, has officially announced that they are completely innocent and they are strictly respecting the rules of employment safety and labour protections as always.[21] However, Mauro Cagnoni was pressed to death while he was even deprived of some simple Protective Waistcoats,[22] and he had not an opportunity to wear an adequate working suits. Also, worse than everything, the Loading Bays[23] of the company's warehouse was divested of any safety facilities such as Yellow Lines, Rubber Wheel Stops,[24,25] Truck Wheel Guides,[26,27] Truck Wheel Stops,[28] Truck Parking Blocks,[29] or any restraint equipment. The Fig. 6.1 illustrates a scene of confusion and uproar of the stuffs on the day of the tragic accident. Considering that the price of a Heavy Duty Rubber Wheel Stop/Block on Alibaba website is just $2.85; this fact illustrates that perhaps "a labour life" has not $2.85 of value to encourage the before-mentioned logistics company and other hundreds of similar corporations to spend money and protect their workers.[30] Furthermore, it is interesting to mention that the monthly turnover of the company above that has claimed its impeccability was about €1.2 million.

By the way, the reversing operations are always critical and reversing vehicles can be extremely dangerous. In fact, Reversing Safely in the workplaces is an important issue to be considered by logistics managers. Also, according to the HSA, truck drivers and transportation managers "should be mindful of doorways, walkways, disabled access, fire escapes, height restrictions

with clearance physical obstructions, and other parked vehicles."[31] Moreover, the HSA stated that an approximately 20% of all non-fatal injuries reported to their entity is involved vehicles by nearly 1000 injuries from the transport sector alone. The injuries frequently occurred during delivery and collection operations and especially during the manual handling of loads/unloads or as the consequence of falls from trucks and vehicles.[32]

Fig. 6.1: The Condition of Loading Bays in which Mauro Cagnoni had Punched to Death

Conceivably, one of the solutions to fighting with this fatal problem is to inform personnel by offering free short online courses (Moodle or MOOC based programs),[33,34] and encourage employers to manage work-related vehicle safety (e.g. hsalearning.ie).[35] However, in the opinion of the author, an effective education system can make significant changes if the legal, judicial, and administrative environment of the functions effectively support the safety makers and retaliates against the principal safety brokers in logistics and transportation context.

Indeed, unfortunately, the fatal experience of the whole Italian inland transportation is quite far away from what is portrayed in luxury brochures of those transport companies. Furthermore, the majority of the Italian mass media outlets never described the speculations behind the mortal accidents sincerely. Also, the thick sadness concerning these disturbing hardships and authentic tragedies turns back into the gratification of many dependent academic papers. In fact, the majority of academic articles and high cited literature never criticized the source and the origins of the above-mentioned fatalities inside the Italian logistics industry. The foremost causes for this lividity are reasonably two (2) basic facts:

1. Academics have not enough access to the ground information of Italian heavy truck logistics because they usually never worked as a truck driver or as a simple logistics worker.[36] In fact, the pure academic researchers perpetually work in their office or classrooms, and they have not any practical impression concerning the illegal activities and suspicious combinations of some logistics landlords. They desire to analyze the transportation by sitting behind their desks in their reposed faculty buildings while

some logistics and freight/passenger transportation companies, actively attempt to hide their irregularities. Summarizing, the counterfeit companies never try to demonstrate the real circumstances of their business situations, or their non-standard facilities before and during that such fatal events. However, after the appearance of a mortal accident they try their best to wash their hands and their dirty feet.

2. Somehow academics are not anymore scientifically independent because in many cases they are funded, granted, and sponsored by industries and business organizations. However, the academic studies suppose to research and investigate following complete independency circumstances. There may in fact be episodes in which the monetary awards of sponsors could formulate powerful barriers between the presentation of the literature and the reality. Obviously, if logistics and transportation organizations finance the academic authors and give them just a portion of the whole information, the final arrangement will not criticize the payer certainly (please review Fig. 6.2).

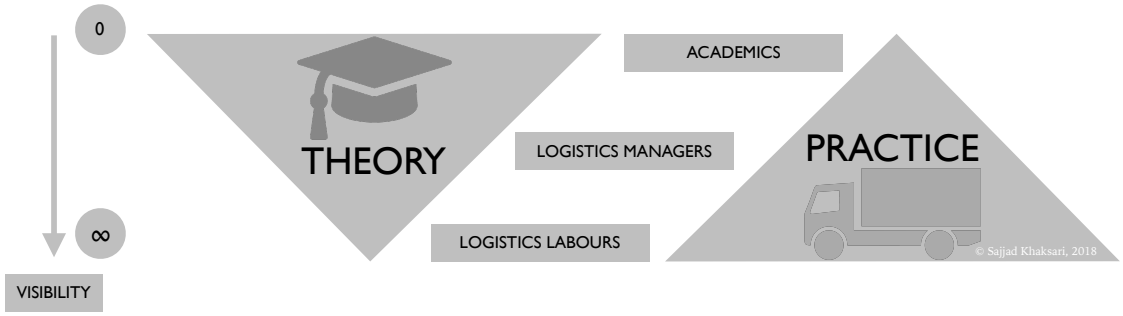

Fig. 6.2: Conflicts and Contradictions of the Academic World and the Practices of Logistics Industry

By the way, the complicity and complexity of logistics issues are apparent, and the author of this dissertation is not evolved to recognize guilty only one individual company exclusively. The following research represents the broad range of deductions and inferences concerning the tragic loss of Mauro Cagnoni [Please review the Fig. 6.3 and note that in .pdf version of this essay it is easily possible to zoom on the figure. Otherwise, the RBS Excel file format would be available in supplementary file attachments]. The Problem Tree of Fig. 6.3 (Risk Breakdown Structure - RBS) has illustrated the complexity of theses kind of the cases.[37] Moreover, it has demonstrated the external and internal circumstances those are (directly or indirectly) have been involved in the Mauro Cagnoni's fatal accident. In fact, these risky situations or dangerous conditions are included Managements, Work Environment, Human Resources, Technology & Design, Suppliers, Clients, Sub-contractors, Financial, Social and Political Policies.[38]

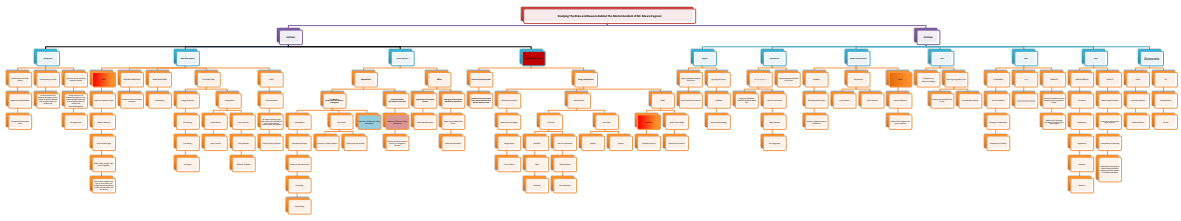

Fig. 6.3: The Risk Studies & Infringements Behind the Mortal Accident of Mauro Cagnoni

To offer an added evidence, maybe it could be interesting to discuss that on 8th of May 2017, indoors a Dry Terminal of an Italian multimodal/intermodal freight transportation corporation, a lift-truck got fire and burnt (Fig. 6.4). The opportune thing was that the flames, sparks, ashes of the lift-truck were not in the vicinity of hazardous materials (**ADR** goods). This event happened while the engineers and safety experts literally (in oral discussions and via emails) have alarmed the operation managers. The funny thing is that they always responded: "Don't worry, everything is under control". Fortunately, the firemen of the logistics site, hauled hoses and released the foam of fire extinguishers in a desperate bid to quench the lift truck's flames.

Fig. 6.4: A Fire Event Inside An Italian Multimodal Terminal

Unhappily, his evidence once again has illustrated, the black box of the Italian logistics industry (in a particular state: the inland transportation) is underestimating the risk factors. Moreover, this threatening behavior of its "logistics managers & policy makers" is postponing the sustainable development of logistics and transportation industry, and lead it into the further tragic events. These aggressive behaviors from aforementioned companies are including the underestimating the risk factors and neglecting the warnings *before* the occurrence of the tragedy; then *after* the appearance of a fatal tragedy, instead of accepting their responsibilities, they will try their best to establish all the responsibilities on the shoulders of a drivers or others.

In conclusion of this section, it is opportune to consider that, the more supportive law concerning the safety and security of logistics & transportation work environments, and some precise administration arrangements to control and warrant the comprehensive alleviation of human/assets resources in freight logistics industry is required. Conceivably, the Blockchain as a decentralized technology might sustain the further computational/labour law. Moreover, concerning the safety and sustainability of the EU transportation, the research observation and literature proceedings of highly influential national, international, and European conferences

(e.g. EWGT and City Logistics Conference) are strictly required.[39] These research ecosystems possess the potential strength to target and influence the interest of academic researchers and encourage them to provide a forum of critical knowledge and constructive criticism. Also, they might promote both academics and employers to share and distribute remarkable transparent information regarding the substantive problems of the European transportation. For instance, the studies of Luca Urciuoli et al. (2014) have purposed and enhanced the understanding about how energy supply chains work, and it has built "resilience against exogenous security threats and thereafter what support mechanisms should be introduced or improved by the European Union".[40] Having said that, the author of this essay does not agree with the description of Luca Urciuoli et al. (2014) when they stated: "crude oil commonly originate from are politically unstable and foreign companies are at constant risk of terror attacks, and wars, e.g. in Qatar, Nigeria, Algeria, and Egypt."[41] Unfortunately, the second part of the above expression does not reflect the reality of the Crude Oil's History, because the so-called: "foreign companies" [e.g. Anglo-Iranian Oil Company (BP), Shell, and ENI], are precisely the source of Political Instability and the generator of "Constant Wars" in the Middle East (e.g. BP was involved in 1953 Iranian coup d'état) and Africa (e.g. Shell was involved in the assassination of Ken Saro Wiwa).[42,43] Hence, these giant international companies constantly supported/supporting/will support the petroleum' dictators.[44] Moreover, they are the creators / supporters / and determinators of the Middle East monsters for the sake of the Crude Oil and its inferior price.[45,46]

6.2 THE ITALIAN DECREE 81/2008

The term of "Decreto Legislativo n°81" stands for the "Legislative Decree Number 81/2008". It is an official document of the Italian administrative and legislative decree which has initially published by the Ministry of Labor and Social Policy on 9 April 2008.[47,48] The Decree 81/2008 re-organize and update important issues regarding the comprehensive provisions those are associated with health and safety at work. Also, it includes newnesses and supplementary obligations for all Italian institutions, industries, businesses, and organizations. Moreover, the Legislative Decree Number 81/2008 is applied to all variety of enterprises and their estimated risks, as well as, it is would be involved to any business operators, companies, and dependent employees or self-employees. In Italian enterprise legislative environment, the control and administration of emergency circumstances are regulated by Article 43-46 of the Section VI of the aforementioned decree so-called: "Gestione delle Emergenze".[49]

Also, regarding the Act on Health and Safety in the Workplaces, the Employer (Datore di Lavoro), should prepare and perform the Emergency Management Team, with particular allusion to the First Aiders and for personnel, those are qualified for the Fire Prevention, Fire Fighting and Emergency Evacuation. Furthermore, the "Emergency Management Team" need to receive proper training, appropriate information, and periodic updates. Theoretically, all workers must be involved in periodic emergency inspections and during the simulation of potential hazard situations (e.g. explosion, earthquake, flood, treatment injuries in confined spaces, evacuation from places of work at height and any other possible danger conditions connected to the exercises of specific companies). Meantime, this issue deserves specific consideration also within the circumstances such as safety and security in public places (e.g. schools, hospitals, stadiums, and government buildings). On the other hand, the Decree No. 81/2008 for guarantee the total safety has recognized and introduced another figure so-called: RLS (Rappresentante dei Lavoratori per la Sicurezza).[50] In fact, the Representative of Workers' Safety (RLS) must be selected by the employer, but it is up to select between the company's

workers. Consider that the RLS is a workers' delegate concerning all of their arguments related to the Health and Safety at workplaces. Also, in some companies, there are existing some trade unions or syndicate federations,[51] and in such status, the designation of the RLS might be enrolled inside the union. The RLS as all other resolutions of the Security Organogram must be appropriately trained and acquainted as well. The initial preparation for RLS should persist not less than 32 hours while the duration of the Annual Update would be diversified according to the business. However, in no circumstances, the Annual Update should not be less than four (4) hours per year for companies (those with up to 50 labors), and not be less than eight (8) hours/year for enterprises those employing more than 50 workers. Whenever, if workers do not present themselves to the personal selection or because no craftsman candidates to fill that position, the RLS skills shall be exercised by a Workers' Representative from the Homeland Security. The matter of keeping safe and secure a work environment is a very important issue,[52] and company owners are not allowed to underestimate any possible risk factor. According to the HSE (2018), during 2016 - 2017, one hundred and thirty-seven (137) workers were killed at work in England.[53] Hence, a response strategy requires an adequate knowledge, sufficient possibility, and some appropriate personal protective equipment to minimize any exposure time and maximize the self-protection.[54] In case of intermodal freight transportation, trying to keep safe and protect both goods (containers) and personnel (logistics workers, truck drivers, and locomotive conductors) is an important responsibility of terminal managers. With that being said, Richard Sennett (2009), in his thought-provoking book, investigates the work of craftsmen in past and present and he tried to identified deep connections between material consciousness and ethical values. Moreover, Richard Sennett (2009) has challenged the received ideas about "what constitutes good work in today's world".[55]

However, after all, there are some academic critics concerning the contemporaneity and modernity of Decree 81/08. Some scholars believe that D.Lgs 81/08, has born in a particular social period and it is often unclear or incongruent with real difficulties. Admitting, the primary purpose of the Occupational Health Physician during the matters such as: risk assessments, risk prevention, and health promotion in the workplaces (Gili et al. 2010).[56] They have denoted that their paper aims to report and discuss critically the daily practice of D.Lgs 81/08 regarding the risk assessment, health surveillance, health promotion, and the tools given by the Italian law. Gili et al. (2010) believe that an improving prevention in the workplace is possible if strictly linked to simpler and cleaner decisions.

6.3 VEHICLE, TRAINS, AND CARGO SAFETY

The vehicle accidents cause fatal losses every day, and they are one of the major causes of human death around the globe. According to the ASIRT report, "nearly 1.3 million people die in road crashes each year, on average 3,287 deaths a day", and "an additional 20-50 million are injured or disabled".[57] Also, it costs "USD $518 billion globally".[58] In case of the Italian inland transportation, according to the Confetra (2012),[59] in 2011, Italy has suffered by lost of 236 persons (171 in Light Vehicle accidents and 65 in Heavy Vehicle accidents).[60] Moreover, regrettably, just in 7 years (from 2005 to 2011), two thousand four hundred and forty-four seven (2447) people past away in the Italian motorway networks (please review the Table 6.1).

Mention that according to the AISCAT statement, the number of traffic accidents (injured and dead) in the Italian motorways has decreased but the number of death are still significantly high, frustrating, and not acceptable. Furthermore, the statistics of road crashes and the report

of ASIRT are mind-blowing, but the unfortunate reality of the inland transportation does not care about this catastrophic phenomena as it is supposed to be. In fact, some Italian freight transportation companies, heavily accentuate and constantly stress their truck drivers to drive fast and violently. Therefore, an effective up-down control system to constrain companies, and further investigations regarding the Safety and Crashworthiness are required.[61,62]

Anno	Incidenti con feriti e/o morti						Incidenti mortali					
	Leggeri	var.% su anno prec.	Pesanti	var.% su anno prec.	Totale	var.% su anno prec.	Leggeri	var.% su anno prec.	Pesanti	var.% su anno prec.	Totale	var.% su anno prec.
2005	8.393		2.118		10.511		254		124		378	
2006	7.851	-6,5	2.064	-2,5	9.915	-5,7	254	0,0	122	-1,6	376	-0,5
2007	7.437	-5,3	2.109	2,2	9.546	-3,7	233	-8,3	124	1,6	357	-5,1
2008	6.748	-9,3	1.721	-18,4	8.469	-11,3	203	-12,9	103	-16,9	306	-14,3
2009	6.762	0,2	1.506	-12,5	8.268	-2,4	165	-18,7	74	-28,2	239	-21,9
2010	6.477	-4,2	1.493	-0,9	7.970	-3,6	176	6,7	74	0,0	250	4,6
2011	5.890	-9,1	1.395	-6,6	7.285	-8,6	140	-20,5	62	-16,2	202	-19,2

Anno	Feriti						Morti					
	Leggeri	var.% su anno prec.	Pesanti	var.% su anno prec.	Totale	var.% su anno prec.	Leggeri	var.% su anno prec.	Pesanti	var.% su anno prec.	Totale	var.% su anno prec.
2005	13.987		3.057		17.044		305		146		451	
2006	13.704	-2,0	3.084	0,9	16.788	-1,5	313	2,6	139	-4,8	452	0,2
2007	13.066	-4,7	3.114	1,0	16.180	-3,6	278	-11,2	139	0,0	417	-7,7
2008	11.557	-11,5	2.527	-18,9	14.084	-13,0	237	-14,7	121	-12,9	358	-14,1
2009	11.596	0,3	2.218	-12,2	13.814	-1,9	175	-26,2	83	-31,4	258	-27,9
2010	11.315	-2,4	2.194	-1,1	13.509	-2,2	195	11,4	80	-3,6	275	6,6
2011	10.226	-9,6	2.087	-4,9	12.313	-8,9	171	-12,3	65	-18,8	236	-14,2

Anno	Percorrenza (veicoli-km in milioni)					
	Leggeri	var.% su anno prec.	Pesanti	var.% su anno prec.	Totale	var.% su anno prec.
2005	60.221		19.184		79.405	
2006	62.124	3,2	19.764	3,0	81.891	3,1
2007	63.558	2,3	20.229	2,4	83.789	2,3
2008	63.266	-0,5	19.806	-2,1	83.072	-0,9
2009	64.554	2,0	18.364	-7,3	82.920	-0,2
2010	64.498	-0,1	18.773	2,2	83.271	0,4
2011	63.574	-1,4	18.751	-0,1	82.323	-1,1

Fonte: Aiscat

236

1-DAY 1-VICTIM

2,447

Table 6.1: Accidents With Injured And / Or Dead © originally by Confetra (2012)

In addition, regarding the cargo safety in international level of studies, Kevin Tierney (2015) solved an open problem from the field of Container Ship Stowage, which affects itself with the safe and efficient loading of containers on to container ships.[63] Also, an adequate education system for qualifying truck drivers and logistics operators (in all levels) is demanded. To satisfy this requirement, the INAIL and its European partners have lunched a series of video campaign (Napo) to offer some useful information regarding the safety and security in workplaces.[64]

On the other hand, as mentioned previously in Unit 5, increase/guarantee the maximum safety and security among the railway networks are vital. For instance, the tragic accident of Viareggio Derailment was a fatal disaster. Hence, regarding this matter, the SNCF (the French Railways Operator) is trying to use the IBM Watson IoT platform to deliver better customer experiences, heightened operational efficiency, and enhanced its rail safety and security for its 13.5 million daily passengers.[65] Along similar lines, by IBM's Cloud-based Watson IoT Platform, the SNCF can connect its entire rail system (trains, railroad tracks, and train stations), including 30,000 kilometers of track, 3,000 stations, and 15,000 trains to gather insights from the real-time information updates. Therefore, these penetrations will allow railways operators to manage their equipment and thus enhance quality, availability, and security of their train movements.

6.4 PEOPLE HEALTH & FOSSIL FUELS

The people health presumably should be considered as the most important concern in the world. However, this very important issue is under a massive attack by the expansion of CO2 emissions.[66] In fact, Léonardi & Baumgartner (2004) had measured a CO2 efficiency (before and after the introduction of fuel utilization and transport performance system) through the road freight transportation.[67] Moreover, the green investments concerning the joint optimization of logistics infrastructure and emission reduction (in regional, national, and international logistics networks) are strictly required.[68,69]

Hence, the principles and applications of smart cities should not excluded in Cyber-Physical Systems, Big Data Analytics Processes, Multi-Scale Computing, Wide-Area Monitoring, or Autonomous Radios and Open Spectrum, but they need to include the important concepts such as Smart Ecology and Smart Ecosystem as well. For instance, regarding the CO2 sequestration, Song, H. et al. (2017) denoted that the combination of both LiDAR datasets and 4-band QuickBird imagery provides for the generation of multiple maps displaying ecosystem service preparation and particularly the carbon sequestration.[70]

Having said that, unfortunately, the Trucks' History (since 1770) has illustrated that the number of heavy trucks those consume natural fuels are still very low.[71] In fact, diesel is "by far the most dominant powertrain for trucks, vans and buses".[72] According to the EPA report, "a typical passenger vehicle emits about 4.6 metric tons of carbon dioxide per year".[73] In fact, the Carbon Pollution from Transportation is certainly notable. Burning fossil fuels (e.g. gasoline and diesel) releases carbon dioxide as a greenhouse gas into the atmosphere. The EPA highlighted that the increase of "carbon dioxide (CO2) and other greenhouse gases like methane (CH4), nitrous oxide (N2O), and hydrofluorocarbons (HFCs) is causing the Earth's atmosphere to warm",[74] and it is resulting in climate changes, cancers, and environmental catastrophes.

Also, according to the UNECE report, the "climate change is at the top of UN priorities"[75] while Carbon Dioxide (CO2) as a greenhouse gas contributes principally to global warming. Approximately, 30% of the total man-made CO2 emissions worldwide is generated by the transport sector. During the recent century, the traditional (fossil fuel based) transportation has

caused climate change, global warming, and the vast range of fatal diseases. Besides, almost 65-billion parcels are delivering in the world over every year while the e-grocery, e-marketing e-shopping habits are growing as well.[76] On the other hand, according to the Ashby (2012), the future discovery of crude oil's reserves and natural gas will diminish dramatically within the next 20 years. It will cause the reduction of the oil exploitation, and in sequence, the shortage of oil production will cause the Oil PRICE to rise overwhelmingly (please review Fig. 6.5).[77,78]

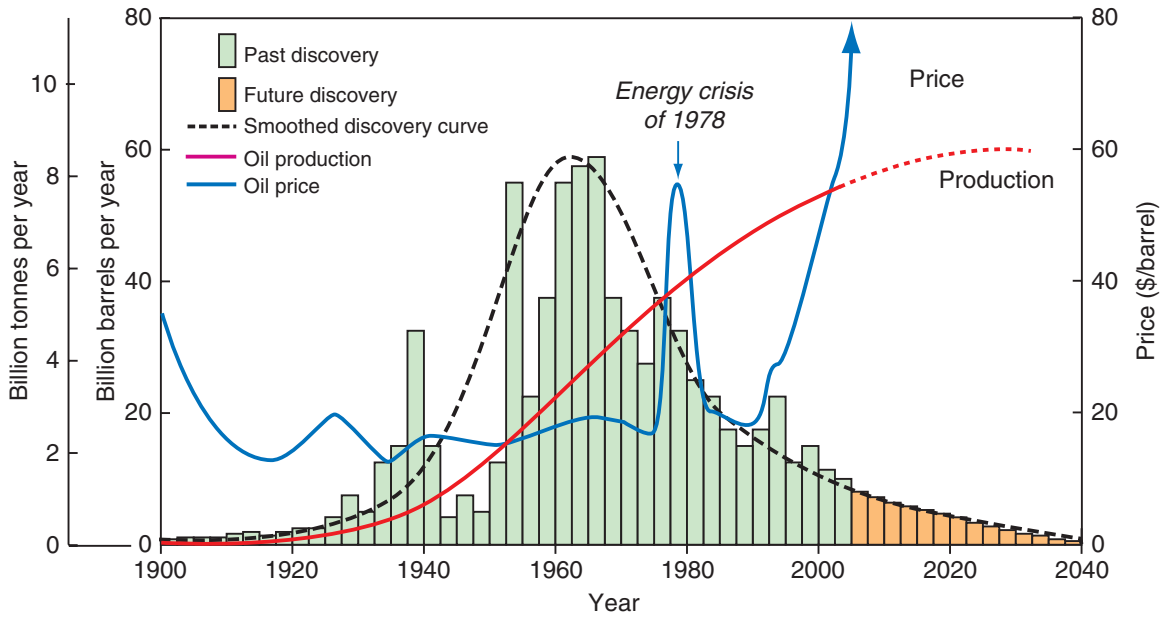

Fig. 6.5: Evolution and Rates of the OIL Discovery & the Price of Crude Oil © Ashby (2012)

Eventually, on 2 May 2018, the European Automobile Manufacturers' Association (ACEA) has officially announced that "from 2019 onwards, all EU manufacturers of heavy-duty vehicles will use the same calculation tool (VECTO) to declare and report the CO2 emissions from a wide variety of trucks".[79] Consider that the VECTO will present a regulated, standardized, certified classification for estimating the CO2 emissions and fuel efficiency of the entire truck and trailer configurations.[80] Hopefully, this statistically-solid baseline could promote the truck manufactures to verify their CO2 reduction capacities while on another hand the Multi-Criteria Analysis of Electric Vans regarding the City Logistics is required as well.[81]

Besides, Jeff Berman (2018) remarked that it is time to "stop talking about raising the gas tax" and just "go do it".[82] Moreover, according to the investigation of Cui and Notteboom (2017), the modeling emission control taxes in port areas and port privatization levels and in port competition through a Game Theory approach is an essential investment.[83] Additionally, eight (8) metric evaluation criteria have been defined by Caplice and Sheffi (1994) to develop and elaborate the performance measurement among the logistics functions.[84] Having said that, we are still waiting for the Future of the 50s, and logistics and transportation industries still need a lot of improvement.[85] In fact, the principal works of European Commission regarding the Motor Vehicle Safety bargain with critical challenges such as the safety of drivers, passengers, and especially children in vehicles. The Commission is also focused on road safety for pedestrians and their works cover safety studies concerning the light-duty (cars, vans) and heavy-duty vehicles (buses, coaches, and trucks). Also, in an extraordinary act, the European Commission

publicly announced that from 1 November 2015, all new trucks and buses must also be equipped with advanced Emergency Braking Systems as well as Lane Departure Warning Systems (LDWS).[86] According to the "Addendum: 129: Regulation: 130" of the UNITED NATIONS, the "Lane Departure Warning System (LDWS) means a system to warn the driver of an unintentional drift of the vehicle out of its travel lane".[87] Notwithstanding, this European command does not effect motorhomes, and vehicles with a minor weight of 3.5 tonnes.

Furthermore, there are also many hurdles to overcome the challenge of how to accommodate children and small or long persons, or disabled and elderly persons. These arguments are some open dialogue discussions among the realm of safety and the kingdom of science of human factors and ergonomics.[88] Consequently, the key activities of European Commission regarding the Motor Vehicle Safety are dealing with the decided requests such as the safety of drivers, passengers, and in particular the safety and security of children inside the vehicles. In fact, the EU laws require that seat-belts in vehicles must be used by all passengers and that approved the Child Restraint Systems have to be used when children are on board.[89] Also, the systems need to meet the stringent safety requirements laid down by UNECE Regulation No. 44 for conventional seatbelt mounted (or ISOFIX child seats). Please review the final report of EC and Transport Research Laboratory about the New Un Regulation On Child Restraint Systems.[90] Moreover, for the i-Size compliant the child seats, they must satisfy Regulation No. 129.[91]

Some researchers believe that, it seems Blockchain technology has potential power to perform a better transportation system for handicaps and in particular for Ambulances or emergency vehicles those are actively involved in civil protection or in an emergency circulation (road/rail/air/sea accidents, earthquake rescues, etc.). Perhaps, by establishment of such decentralized platforms, the humanitarian organizations such as Handicap International Organization, might receive technical benefits from the Blockchain technology. It is impressing to consider that the Handicap International Organization is implements "emergency response missions, develop programmers and actions against mines and cluster bombs" and "campaigns to ensure the rights of the most vulnerable populations are acknowledged and upheld".[92]

On the other hand, the government policies could constrain and restrain the struggles against the climate change.[93] For instance, according to the Paris Agreement on Climate Change, "with the election of a new (U.S.A.) administration in 2016 (Donald J. Trump), climate actions nationally may, however, be constrained, considering recent approval for the construction of the Keystone XL and Dakota Access oil pipelines and the potential for undoing and easing legislation on coal mining, methane emissions, carbon pricing, and vehicle fuel economy regulations."[94] Also, the Paris Agreement highlighted that "the discussions on adaptation under the Convention and the Kyoto Protocol were further complicated by the link made to the impacts of response measures, with some 'oil producing' countries demanding parity in the consideration of the two issues. This further slowed down progress on adaptation over many years."[95,96] Therefore, it means the political decisions of the financially dominated countries might influence the GHG-emissions and behavior of so-called: 'oil producing' countries.[97]

In conclusion of this section, it is relevant to mention that, according to the technical report of Giovanni Rinzivillo (2018), the Italian 2018 Budget Law (Legge di Bilancio 2018) has modified the regulation of refueling for businesses and professional organizations.[98] The new law has introduced the obligation of Electronic Invoicing and the traceability of the payment for the determination of the deductibility of the refueling supplies.[99] Thereupon, the traditional fuel card (Scheda Carburante) and the conventional payment method (cash), starting from the second half of 2018 (1st of July), are officially terminated.[100]

6.5 ELECTRIC VEHICLES AND FUTURE OF LOGISTICS

According to the ACEA, in the first quarter of 2018, the strongest growth in the selling of electrically-chargeable vehicles (ECV) has been registered (in total, 69,898 ECV from January to March by +47.0% of extension).[101] As the 2018 suite of new vehicle models performs visible, electric vehicles are eventually gaining substantial traction in the European market. However, the Battery technology seems to be an Achilles' heel of technological science for the industry of electrically-chargeable vehicles. Further, Karsten and West (2015) denoted that the newest innovation in battery technologies are Lithium-Ion Batteries, Solid State Batteries, Aluminum-Ion Batteries, Lithium-Sulfur Batteries, and Metal-Air Batteries.[102]

Therefore, several automobile manufacturers, including Tesla and Nissan, have invested heavily in technology of Lithium-Ion Batteries (LIBs). In December 2017, the Financial Times has announced that the world's biggest lithium-ion battery by Tesla has begun dispatching power into Australia's energy grid.[103] Historically, one year later, in July 2016, Tesla announced to build "the world's largest battery factory to accelerate a sustainable energy future", and soon after, Elon Musk (the CEO of giant American car manufacturer who is famous for its Battery Electric Vehicles) had opened the door of the Tesla Gigafactory.[104] Also, he proclaimed that the Tesla company had tentative plans to unveil its first battery-powered Class 8 tractor in late October 2017 [please review The 2018 22nd Annual Third-Party Logistics (3PL) Study].[105,106] Moreover, on 21th of November 2017, the FERCAM Group officially announced the acquisition order of the Tesla Electric Truck (Class 8 tractor) as the first European logistics operator.[107,108] Regarding this innovative procurement, the Hannes Baumgartner (the new CEO of FERCAM after his father Thomas Baumgartner) declared that the technological innovation is undoubtedly the best ally for FERCAM to address environmental issues. He said: they have been waiting for this electric truck (by TESLA) for a long time because this e-truck (with 800 km of autonomy) might be the ideal combination among FERCAM Intermodal services.[109]

After all, the Tesla electric vehicles are the Lithium-Ion Batteries (LIBs) based technologies, and the needs of LIBs are increasing quickly. In fact, according to the STATISTA, Panasonic Sanyo is expected to remain the top manufacturer of lithium-ion cells in the world.[110,111] However, unfortunately, the strict dependency of LIBs to the Cobalt as a fundamental element in the Lithium-Ion Batteries is rigorously large. On the other hand, the population in the urban areas is growing fast, and needs for smart/electric vehicles are flying as well.[112] Advertently, Mark Dummett (the Business and Human Rights Researcher at Amnesty International) denoted that "electric cars may not be as 'clean' as you would think". He added: "customers need to be aware that their green cars could be linked to the misery of child laborers in the Democratic Republic of Congo (DRC)".[113] Also, the Amnesty International has highlighted that "more than half of the world's cobalt, which is a key component in the lithium-ion batteries which power electric vehicles, comes from the DRC, 20% of which is mined by hand".[114,115,116] So, the cobalt-based batteries do not seem sustainable solutions because of the shortage of available Cobalt and the dishonor exploitation of the Cobalt Minerals from the DRC.[117]

In fact, the supply chain of the electric cars is strictly required to work under scrutiny. Amnesty International has identified five (5) car manufacturing companies at risk: GM's Chevrolet Volt, Renault-Nissan's Twizy and ZOE, and Tesla's Roadster model have been supplied their cars battery demands form the South Korean battery manufacturer (LG Chem).[118] Moreover, other two European players BMW (i3 EV, i8 PHEV, and C evolution) and Fiat-Chrysler (500E EV) have been supplied by Samsung SDI.[119] Also, the primary international brands including Apple, Samsung, Sony, and Volkswagen, have allowed cobalt mine by children into their merchandises.[120] So, the sector of electrically-chargeable vehicles lacks transparency.

Here once again, the need of a decentralized peer-to-peer system has reappeared, and imagine if the entire SC of the cobalt in Democratic Republic of Congo was fully transparent. Hence, regardless the way in which the electric energy is stored, or it would be stored in the future, the Electric Vehicles (EVs) by themselves are still advocated via various performers as an important component for diminishing the CO2 emissions. For instance, they do not burn fuels in traffic congestion, and they are Zero-CO2 in traffic jams. Consider that the CO2 threat is an urgent problem. Justin Worland (2016) remarkably highlighted that the "Air Pollution Kills More Than 5 Million People Around the World Every Year".[121] Also, the research and investigation of Dan Greenbaum (president of Health Effects Institute) and its research co-workers have asserted that the "air pollution kills more than 200,000 in Europe and nearly 80,000 in the U.S. each year".[122,123] Prominently, nowadays, in the critical circumstances in which the available reserves of the fossil oil/fuels are declining, simultaneously, the needs of mobilization and transportation of freight/passengers are growing rapidly around the world.[124] Furthermore, some very important question remain open for discussions: how gonna be the mobilization/transportation of human been and its goods in the future? Moreover, what might be the powertrain options for the commercial vehicles? what about electric traction and its thematic perspective in the agriculture industry?

Obviously, the sustainable future of the city logistics (e-Buses) and IoT (e-Trucks) need some alternative source of energy resources rather that having a strict dependency on the fossil fuels (please review the SILENSE project).[125] Therefore, establishing more e-car affectionate battery charging stations, might create some competitive advantages for manufacturers of the BEVs (please review Fig. 6.6).[126] The electric vehicle charging infrastructures (e.g. ABB's EV-charging) are crucial for any improvement for a Smarter Mobility.[127] According to the Porter (1985)'s model, this strategy might create and sustain a competitive advantage in the strategic core management of the electric vehicle manufacturers.[128,129,130] Additionally, concerning the strategical determinations of the e-Truck manufacturers, it is noteworthy to consider the electric truck (Class 8) of Nikola Motor Company as an ongoing freight logistics solution.[131]

Also, the sustainability in logistics and supply chain management requires deep understanding of Deep Learning,[132] a full assessing of the Intermodal Freight Transportation,[133] and the broad knowledge of City Logistics System's diffusion based on low emission vehicles.[134] On the other hand, further studies regarding the management of the electricity grid networks and Electricity Distribution is required. In fact, if some decentralized renewable energy would installed into the existing electricity grid, millions of customers will be able to interact each other over the power network. Kenji Tanaka et al. (2017) investigation denoted that the future electricity grids "should be a bi-directional system with interconnected using distributed energy management software", once in a while, "being able to provide a secure and decentralized control to these autonomous, peer-to-peer exchanges is one of the biggest challenges". Also, they proposed to utilize a Blockchain-based electricity trading system with Digitalgrid router as a fundamental platform because it could fit the above requirements (and Energy Internet).[135,136] Also, regarding the new era of Electric Vehicles and pathway to the world of Zero fossil fuel Emissions, in 2nd of October 2017, Mary Barra (Chairman and CEO of General Motors Company) has outlined the GM's production strategies concerning its all-electric paths to zero emissions with at least 20 new all-electric vehicles by 2023.[137] Sadly, this rather late initiative can not be appreciated nevertheless because the General Motors Company was formed on 16th of September 1908,[138] and the unpropitious and the violate exploitation of the petroleum had addressed the majority of the GM's innovations in the absolute direction of fossil fuel commercial exploitation.[139,140,141] In fact, the All-Electric event of the GM initiative had taken place with an approximate 100 pollution years of overdue. However, surely "late is better than

never". Especially regarding the freight transportation via heavy-duty trucks. In this area, GM has introduced SURUS (the Silent Utility Rover Universal Superstructure).[142]

Fig. 6.6: A TESLA Battery Charging Stations In Germany

The SURUS is a fuel cell powered, and its platform has leveraged by GM's Chevrolet Colorado ZH2 experience in fuel cell technology. It is a four-wheel steer concept vehicle on a heavy-duty truck frame, and two electric motors drive it. GM believes that the capability and the flexible architecture of SURUS could be utilized as a delivery truck, an ambulance, or (in opinion of the author: sadly) as a military truck which is all emissions free.[143] In the course of these developments, on 24 Jan 2018, The Guardian announced that the world's first electric container would barge to sail from European ports in summer 2018.[144] The report affirmed that the unmanned vessels would operate on Dutch and Belgian waterways, and it aims to reduce diesel carriers and CO2 emissions considerably while the estimated total cost of the Port-Liner Project is about €34,893,003. The Innovation And Networks Executive Agency (INEA) has declared that the Port-Liner Project will be realized through "the construction of six container barges, with full electrical propulsion, taking the required energy from containerized TESLA batteries".[145] Moreover, "upon completion, the ships will service key sections of the Core Network Corridors, in the Rotterdam, Antwerp and Duisburg area".[146]

Nevertheless, the Charging of an Electric Vehicle (EV) or an e-Vessel still is an overnight endeavor challenge. However, on 24 January 2018, the ABB Group in Zurich (Switzerland) announced that the ABB's charging stations could reduce the charging time of an EV into a matter of minutes.[147] Also, an overview of battery EV's industry illustrates that charging an EV in North America with 110 volts AC needs more than 12 hours, while the charging time might reduce to 3.5 hours in case of Home Charger (with 240 volts).[148] However, the ABB as a famous robotic company, has denounced that their "ABB Ultra-Fast Charging" infrastructure could charge an electric vehicle in 12 minutes.[149] Consider that a 12-minute charge can figure 300 kilometers of driving range. Moreover, ABB announced the installation and operation of more than 6,000 charging stations (including 1,000 high-power stations) across 57 countries.

Unfortunately, the misuse, mismanagement, degradation, abuse, and somehow, the persecution of crude oil has shut down plenty of available innovation concerning the innovative mobility and alternative technologies. For instance, in 2009, a light Battery Electric Vehicle (just 650 kg weight - battery not included) has been introduced by AKKA Technologies and CRDTA. The car

was called ASTUTE, and its remarkable solution was not its particular body design or its wire system, but its core competitive advantage was its chassis.[150] Furthermore, ASTUTE held an extraordinary possibility to extract, separate, remove, transfer, and exchange its containerized battery block. In the opinion of the author, thanks to this versatility, the "waiting time" to fully charge the electrically-chargeable vehicles might reduce to zero (0).

6.6 BLOCKCHAIN, FOOD SAFETY, AND PUBLIC HEALTH

The human safety is very related to the food she/he received. Also, in past years, food safety has become an important issue for many individuals and many regional, national, and international companies. One of the outstanding problems within the current supply chain of agri-food is associated with the lack of traceability. Interestingly, regarding the implementation of the Blockchain in the food chain, Deloitte (2016) asked: "Is blockchain a game changer in Agrifood?".[151] Fortunately, the answer is "yes". For solving this problem, blockchain-based companies such as Foodchain® SpA work to change the world of foods and its traditional features for the better lives of human.[152] The safety and transparency among food supply chain is the most demanded function for these companies. Besides, Feng Tian (2017) has studied the capacity utilization and improvement status of Radio-Frequency IDentification (RFID) and blockchain technology. The study has analyzed the advantages and disadvantages of adopting RFID and blockchain technology toward an agri-food supply chain traceability system.[153]

The transportation of food or perishable products need a specific treatment. Foods are required to be handled and transported in a certain temperature.[154] This issue promote SC and logistics industry, and it create jobs. For instance, Kalimuthu et al. (2012) denoted that Supply Chain of vegetables in India has generated high income and employment opportunities, particularly for small farmers.[155] However, fulfilling this duty requires an adequate qualification and qualified employees, warehouses, trailers, and trucks.[156] In fact, the ATP terminology is standing for the "Agreement for Perishable Transport (ATP)". The "ATP Trailers" and "ATP Containers" are the special equipment for carrying perishable foodstuffs abroad in road vehicles (as Driver and Vehicle Standards Agency have described it).[157,158] Furthermore, the UNECE has regulated the transportation of perishable products via reefer containers and ATP Trailers: "Agreement on the International Carriage of Perishable Foodstuffs and on the Special Equipment to be Used for such Carriage (ATP)".[159] In Italy, many inland transportation companies such as Brivio & Viganò, Battaglio, Tark, Riboni, and Esselunga are the active players in this growing industry.

Accordingly, the industry of fruit and vegetable has extraordinary market power, and transportation of fruits and legumes within certain safety and security circumstances is an important concern.[160] However, sometimes the working conditions of the workers whose work in this field, in some isolated (or controlled temperature) workplaces, are hard to imagine. For instance, almost all of the perishable products are required to be conserved in the certain range of temperature (usually from -5° to -25°) regardless of their transportation mode (mono-modality/multimodality/intermodality). Hence, this obligations generated the necessity of some Cross-dock Warehouses or some Hub Centers. These warehouses are specialized in performing such controlled operations, and they are qualified for keeping in range the temperature of the perishable goods even during the loading, unloading, handling, and movement of any single pallets.[161,162] Here in this point, base on personal experience of the author, two (2) kind of unwanted problems would appear in Italian freight transportation.

First, logistics workers are obliged to work in a cold confined space. For helping readers to visualize such workplaces, perhaps the term of "working inside a huge freezer" would be helpful. Secondly, some transport managers or carriers, somewhat do not respect the entire aspects and complete features of the obligation. For instance, in one case, a logistics provider has loaded a Full Load Truck (FLT) of controlled temperature products inside an ATP trailer which was predetermined to join an eastern European country. Once the truck had left the Logistics Hub, the carrier has ordered the truck driver to carry his full load trailer to the temporary warehouse of another inland transport company. Later, the new carrier has opened the trailer, modified the CMR documents, and dropped all pallets in the corner of their ordinary warehouse (please review Fig. 6.7).

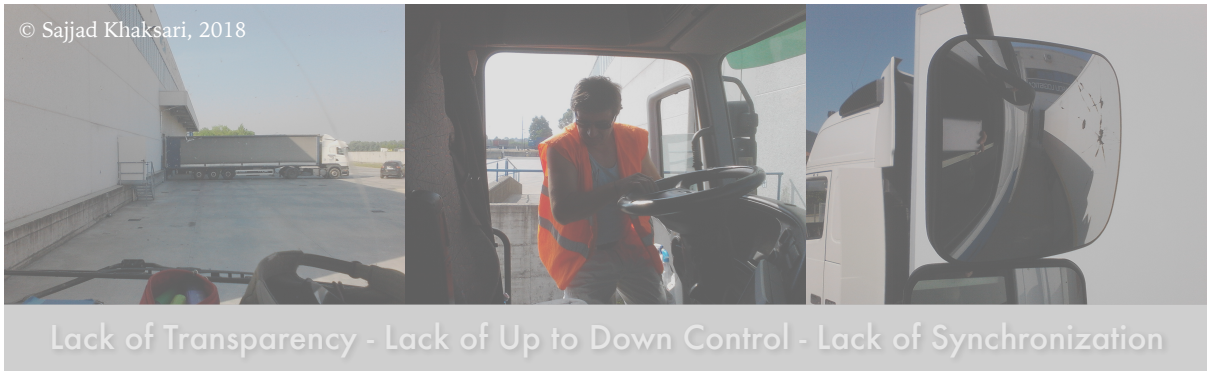

Fig. 6.7: A Schematic Representation Of Temperature Violation During The ATP Transportation

Then, after half an hour, the semi-truck and ATP trailer of the new carrier has arrived at the warehouse, and they loaded all pallets (as they were positioned before). The whole operation was organized and happened under the full awareness of the carriers and logistics providers, but the client never received any notification about this contract violation. This case just was one of the hundred similar cases those are happening every day inside the logistics and transportation industry. In the opinion of the author, these two (2) above mentioned problems are needed two (2) sufficient solution. Regarding the first case (labour condition), an industrial digitalization and atomization of the warehouses might eliminate the direct contact of logistics workers with cold pallets, and it would decrease the need of manhandling and man-loading/unloading operations. This solution needs a promotion or an obligation from the ministry of work and occupational health. Otherwise, the prevailing logistics owners are not motivated to decrease or eliminate the health threats of their low paid workers (please review Fig. 6.8). On the other hand, regarding the second case (violation and infringement during freight transportation), a reliable system which is decentralized and synchronized is strictly required. Hence, transportation nodes would be verified, and the accuracy of movements will be synchronously updated. Furthermore, the whole transportation data and their related steps will successfully be stored in a public chain.

In conclusion, it is important to consider that the involvement of Blockchain technology in Food Safety is expanding. IBM has indicated that "Blockchain makes it possible to quickly trace food products to their source for enhanced food authenticity and safety".[163] Therefore, the Italian mono-modal/multimodal/intermodal food (and perishable products) transportation strictly need to receive benefits from a decentralize and P2P information mechanism.

Fig. 6.8: The Reasonable Requirement Of Robots In ATP Logistics Centers ©DHL ©RIA

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PART II

Overview

7 Case Studies

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MARINE TRANSPOT INTERNATIONAL

7.1 MARINE TRANSPORT INTERNATIONAL (MTI)

The Marine Transport international (MTI) is an international Maritime Transportation[1] company which is located in NEW JERSEY (USA).[2] MTI is specialized in moving cargo around the world, conducting technology and logistics contemporaneously,[3] and keeping shippers in control of their cargo through their low cost and high performing software products.[4] MTI vision is to significantly reduce the additional cost associated with general freight forwarders and provide fair, market-related prices, giving the customers control of rates, operations and documentation at the click of a button.[5] In fact, the MTI business model tries to offer a fully transparent shipping procedures to the end users and logistics specialists.

Sequentially, on October 19th, 2016 the Global Trade announced the First Shipping Use of Public Blockchain Technology by MTI.[6] Global Trade stated that MTI is practicing the TrustMe public blockchain technology and the services from predictive analytics expert Black Swan Data Limited.[7] The MTI blockchain will be used within its SolasVGM product offering to facilitate the protected and open dissemination of shipping container information. Jody Cleworth (CEO of MTI)[8] considers that the Blockchain has the ability to empower the logistics industry into a truly digital age. Also, he believes that Instead of a VGM message being delivered sequentially to SC parties, a Blockchain platform can implement a decentralized passageway to delivering VGM messages (please review APPENDIX III, MTI).[9]

Later on 30th August 2017, the Cision PR Newswire Association[10] announced the MTI's successful pilot of blockchain technology, validated by the University of Copenhagen[11] & BLOC[12] (Blockchain Labs for Open Collaboration).[13] The article declared the conjunction of MTI with Agility Sciences and delivered of a white-paper in which MTI was detailing the deployment of their Container Streams system in a supply chain environment.[14] Furthermore, Jody Cleworth commented that "the results of this successful pilot demonstrate the strengths of blockchain technology when deployed to link the various actors in the supply chain."[15] Besides, he highlighted that the business case for connecting supply chains using blockchain is solid, and the interface is readily adaptable to existing systems. In fact, Jody Cleworth believes that there is a low barrier to entry, and any supply chain business (marine, air, or land-based) can take advantage of Blockchain systems. Also, he stated that the cost savings that MTI envisage are as high as 90%, as a result of substantially streamlined processes.[16]

Regarding the MTI initiative, Karim Jabbar (CTO of BLOC)[17] declared that the pilot demonstrates excellent potential for distributed ledger technologies to be used in improving supply chain processes.[18] He believes that "the Container Streams System is unique in the fact that it does not require the complete replacement of existing systems – instead, MTI's solution allows complete interoperability with existing legacy infrastructure."[19] Besides, the MTI case teaches the shared data might offer the greater trust among supply chain partners. In fact, the "system combines data on suppliers, shippers, load points, customs and terminals on a shared blockchain ledger, drawing that data from a wide range of data sources, including legacy systems, and making it available to all parties involved."[20] This blockchain technology would entirely replace or reduce the spreadsheets, cumbersome logs, data intermediaries, and private (black box) databases significantly (please review Fig. 7.1.1).

Additionally, the Journal of Commerce (JOC) notice that the SolasVGM software which has created by Marine Transport International (MTI) is able to facilitate the sharing of container weights which is required by international regulations.[21] Also, SOLAS awards a way to correlate a Blockchain system with a variety of existing or legacy or subsisting technologies. SOLAS offers the possibility to input information into the system from multiple supply chain sources, including shippers, suppliers, Multimodal terminals, and national or international customs. In addition, regarding the aforementioned characteristics, the SolasVGM software provides an appropriate interoperability framework. The JOC maintains that the Blockchain supporters believe the Blockchain technology could demonstrate meaningful in sending cargo around the world because it collects information on several computers, and authorizing users to access information individually.[22] Simultaneously, the software is providing a constant and secure record because the information of the containers cannot be retroactively modified. In fact, a bill of lading or a statement of freight could not be secretly altered during the office or shipping process. Eventually, Jody Cleworth said 256 companies had used the MTI system in the pilot period, mostly from the commodity sector, with the bulk of transactions, and the system handles about 6,000 containers per month, but MTI expects that once the product is officially launched the container numbers increase to 50,000 per month.[23]

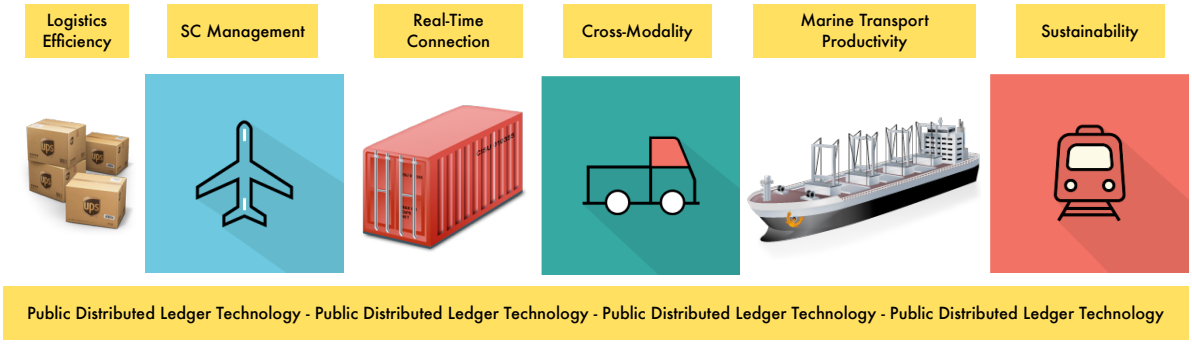

Fig. 7.1.1: Schematic Chain and Advantages of MTI Blockchain System

On the other hand, the CMA CGM Group announced that the Verified Gross Mass (VGM) is the key and they are using the SOLAS (Safety of Life at Sea) - VGM Management at CMA CGM.[24] Also, the CMA CGM Group notes that the International Maritime Organization (IMO) has amended the SOLAS convention under regulation two of chapter VI which mandates the declaration of the VGM of a packed container (TEUs) before loading on board vessels within a prescribed cut-off date/time to the shipping line and port terminal authorities.[25]

Note that the CMA CGM S.A. is a French container transportation and shipping corporation, and it is one of the principal worldwide shipping organization. Currently, the CMA CGM is headed by Rodolphe Saadé,[26] from its base in Marseille. The CMA CGM Group is present in more than 160 countries through its network of over 755 agencies, with more than 29,000 employees worldwide.[27] CMA CGM posses 489 vessels and serves over 420 of the world's 521 commercial ports. The CMA CGM navigates through more than 200 shipping lines, and it operates on every one of the world's seas.[28] Also, in 2017, CMA CGM launched its SERENITY project to serve its customers' expectations and their security needs. Also on the other hand, several logistics start-ups have received financial assistance from CMA CGM shipping line, which will also supply advice and business development support.[29] Also on the same year, the CMA CGM group signed a joint venture agreement to promote a new container terminal (CT4) in Adani Port of Mundra.[30] However, still, the output of "Blockchain" keyword search appears as No Results (Fig. 7.1.2) in official website of CMA CGM (Accessed Dec. 2017).

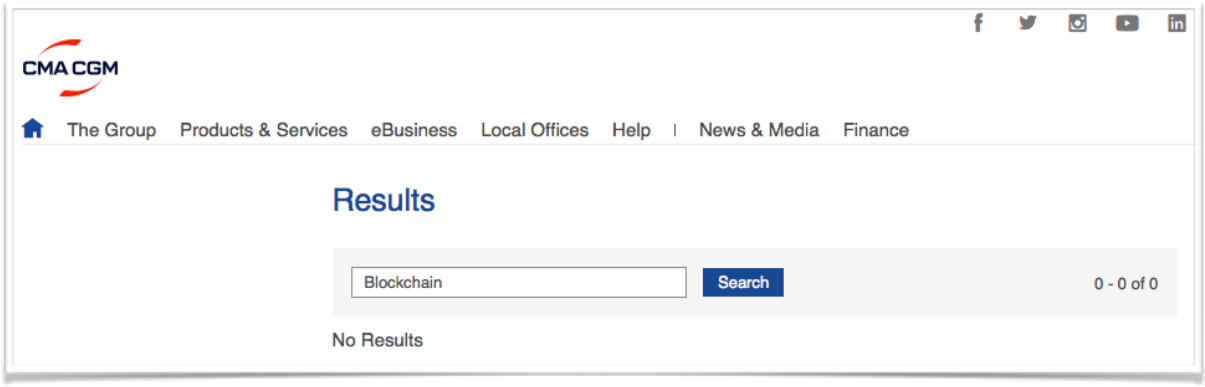

Fig. 7.1.2: The CMA CGM website Screenshot regarding the Blockchain keyword

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[2] MTI website: http://www.marinetransportint.com

[3] MTI - LinkedIn. The Company Type of MTI is Sole Proprietorship, and its Company Size is around 2-10 employees. In addition, the company is specialized in Logistics, Software Solutions, Supply Chain, Freight, International Consultancy, and Customs.

[4] MTI (2018), About Marine Transport International. (Assessed on 8th of January 2018)

[5] Ibid.

[6] Peter Buxbaum (2016), First Shipping Use of Public Blockchain Technology: Freight Forwarder Uses Data Structure to Streamline VGM Process, Global Trade. [Online] Available: https://goo.gl/RkRbR3

[7] Black Swan Data Limited: https://www.blackswan.com

[8] CEO of MTI: Jody Cleworth

[9] SolasVGM: http://solasvgm.com / Note that the SOLAS is standing for the International Maritime Organization (IMO) regulation under the Safety of Life at Sea Convention (SOLAS) which requires shippers to provide a Verified Gross Mass (VGM) for every packed container as a condition for vessel loading. This international regulation appropriated from July 1, 2016.

[10] Cision PR Newswire Association: https://www.prnewswire.com

[11] UNIVERSITY OF COPENHAGEN: http://www.ku.dk/english/

[12] Blockchain Labs for Open Collaboration: https://www.un-bloc.com / Note that the "Blockchain Labs for Open Collaboration", is a service provider for digital solutions that bridge the digital and the physical divide and work for global challenges confronting critical infrastructure. The BLOC Lab's area of specialization is in "framing problems and connecting the relevant stakeholders across the value chain" to improve solutions through "collaboratively prototyping and validating blockchain applications to then be accelerated and scaled together" with their business partners.

[13] Cision (2017), Blockchain System Successfully Deployed to Revolutionize the Logistics Industry, © 2018 PR Newswire Association LLC. Aug 30, 2017. [Online] Available: https://goo.gl/aex5C8

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[16] Rebecca Moore (2017), Blockchain system deployed has 'far-reaching consequences' for box shipping, © 2018 Riviera Maritime Media Ltd. [Online] Available: https://goo.gl/QZ87Wt

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[20] Ibid.

[21] JOC (2017), Container weight blockchain shows tech's potential, The Journal of Commerce (JOC).

[22] Ibid.

[23] Ibid.

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[28] Ibid.

[29] Alexander Whiteman (2017), CMA CGM and DP-DHL get behind the development of logistics start-ups, Published on 08/06/2017 by © The Loadstar.

[30] Jason Jiang (2017), CMA CGM signs landmark box terminal deal in India, Splash News.

CARGOCHAIN

7.2 CARGOCHAIN

CargoChain is an application that develops a Blockchain-based backbone for international trade which provides real-time visibility of products in the global supply chain. In fact, CargoChain is a proof-of-concept that was performed at a Hackathon[1,2] to illustrate how to diminish paperwork, such as purchase orders, customs documentation, bills of lading, and certificates. Dominik Schiener, an entrepreneur from Südtirol (Italy) is the CEO of CargoChain, and he works on Blockchain, Smart Cities and IoT, and he currently lives in Berlin (Germany).

Moreover, Dominik Schiener is the co-founder of the IOTA as a distributed ledger platform (https://iota.org), and he works on Tangle as a part of IOTA's application.[3] Tangle validates node transactions through consensus finding, but without the typical Blockchain.[4] Consider that IOTA suggests using the Markov Chain Monte Carlo (MCMC) algorithm, and the application is intended to run on devices and to streamline processes. Coupled with that CargoChain aims to reduce or eliminate the currently large amount of duplicate paperwork during International Trade Practices. Also, it aims to significantly digitalize all aspects of international trade (trade documents, payment escrow, and ownership) including thus makes the overall process further efficient, cheaper, and more secure.[5] CargoChain works through the utilization of hardware which connects shipments equipped with an RFID chip including the Blockchain technology. Also, it can provide real-time perceptibility of shipments and obtain the data and make available the collected data on the Blockchain (smart oracle).[6]

In addition, CargoChain is a settlement platform that implements a secure, trust-less and efficient Chain of Custody.[7] Besides, CargoChain intends to promote international trade, particularly regarding the shipping industry. The application grants importers, exporters, couriers, shipping companies, Logistics Service Providers (LSPs), transporters, carriers, customs, and port authorities an easy to use interface to observe the necessary information associated with cargo and flow of intermodal containers.[8] According to the CargoChain presentation, the biggest advantage of CargoChain is that it offers a single point of review for all involved parties. In this way, the essential documents do not have to be assigned to all supply chain parties but are alternatively uploaded to the Blockchain / InterPlanetary File System (IPFS) for further verification and review. Therefore, this feature will significantly increase efficiency, reduce freight transportation & logistics operation costs, and increase the rate of shipping. Moreover, these characteristics would preclude the potential waste of the time of international logistics operators and bypass many paper works.[9] Provided that, along a similar line, concerning the Stack technique of CargoChain, it is necessary to mention that the application is built with Meteor by using Ethereum and IPFS daemon server as the underlying technologies to handle contractual relations and the "Eternification" of documents.

Also, in the future, CargoChain intends to include Factom (https://www.factom.com) as an additional reference to store document hashes at for further security/verification.[10] Also, according to the CargoChain open data, the application needs some prerequisites such as Ethereum (need to have Ethereum Node with RPC running and unlocking the main account), the IPFS (for running the daemon IPFS daemon), and the Meteor (https://www.meteor.com). Eventually, the CargoChain is under development application (http://cargochain.com).

However, in 2016, the presentation of CargoChain states that the application aims to reinvent international trade, save trees, lower pollution, and save time via Blockchain technology. In fact, CargoChain is a Blockchain backbone application for International Trade and Trade Finance concerning the Internet of Things (IoT), Logistics, and Supply Chain. Moreover, CargoChain provides a simple chain of documents regarding the custody of trade documents and offers the following advantages: Transmission of reliable documents, Data communication without delays, and Reduction of frauds. Also, CargoChain provisions Automated Payment Release for producing the required documents (Such as BOL) including the Automated Escrow mechanism to guarantee the payment of logistics operations.[11] Furthermore, CargoChain possesses a simple Graphical User Interface (GUI) in which all supply chain actors could navigate simultaneously and manage the logistics operations.[12] Having said that, in the literature Bocek et al. (2017) has expressed CargoChain as a start-up that holds a proof-of-concept, and it has created at a Hackathon[13] to showcase how to reduce purchase orders, invoices, bills of lading, customs documentation, and certificates of authenticity.[14]

Furthermore, In 2016, concerning the actors who involved in the CargoChain project, Schiener had declared that it would be amazing to help reshape the backbone of the world economy with a Blockchain-based system that benefits all the actors involved in a trade, and he functioned the same idea, to build the CargoChain. Besides, Wanxiang Blockchain Labs and Shanghai Blockchain Hackathon are involved in the project which attempts to accommodate all the supply chain players in control process of worldwide businesses.[15] Also, it should be stressed that concerning the usage and position of CargoChain inside the supply chain, in particular, the application has been introduced to assist the Financial part of the Supply Chain during international trade. Additionally, Schiener concludes that the current global business is incompetent and still relies on physical documents. In fact, these physical papers sometimes are being sent back and forth between supply chain parties again and again. Consequently, CargoChain endeavors to eliminate these documents related to the freight paper-based transportation, and it aims to avoid any losses because of stolen payments or seized cargo.[16]

Moreover, concerning the performance or usage of any Smart Contracts within CargoChain, Dominik Schiener declared that he had truly created an automated escrow system based on Smart Contracts. Also, he uttered that the buyer of a product upon agreeing to the shipment terms is required to send money via Smart Contract's escrow system. Succeeding, the Smart Contract will then maintain the funds in escrow until the buyer has either released the money. Finally, the money is released automatically once certain conditions are satisfied.[17] In fact, as an example for illustration of this aforementioned importance, In 2007, in 2008, and in 2009, the Memphis International Airport has ranked as a first worldwide airport regarding the movement and transportation of goods with 3.697,1 (thousands of tons) in 2009.[18,19] Therefore, any improvement in cargo logistics processes considered by Blockchain technology or similar CargoChain application might facilitate the transportation of goods and persons via air/rail/sea/road, and it would reduce the CO2 emissions and decrease the delivery time.

Moreover, to answer the question how is the Blockchain used in CargoChain, it is useful to mention that CargoChain is an end-to-end data verifiability application, and it possesses just 77

lines (67 sloc) of code. Sequentially, more precise and technical information are available on https://github.com/domschiener/cargochain. Please review the following figure (Fig. 7.2.1).

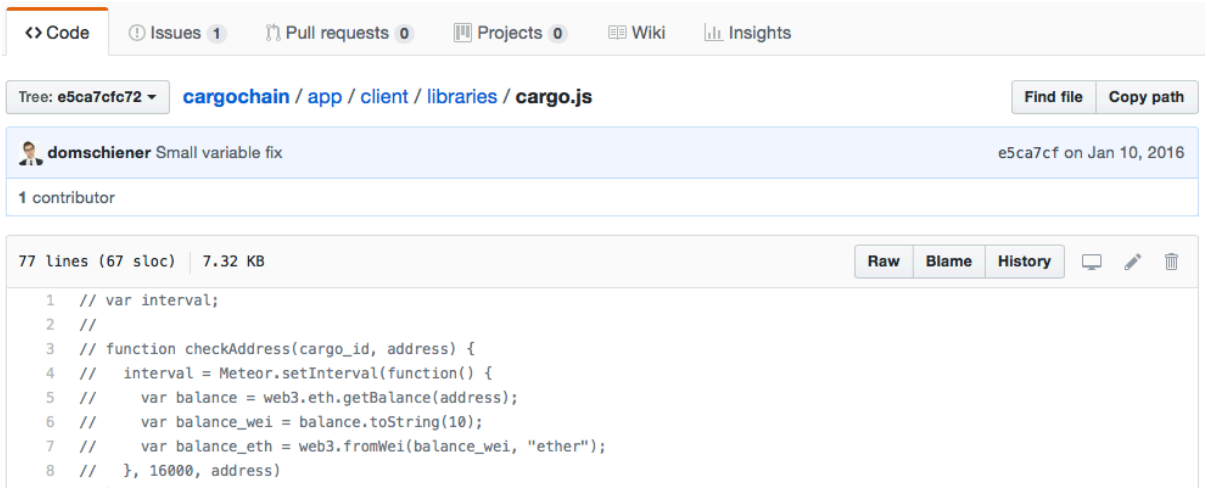

Fig. 7.2.1: A Screenshot of CargoChain Libraries (Cargo) on GitHub

Additionally, the available evidence seems to suggest that the rewarding mechanism of CargoChain has not explained clearly, but it appears to be the Ether tokens. However, in case of IOTA (application in which Dominik Schiener is co-founder),[20] according to its WhitePaper, all of the tokens were created in the Genesis transaction. Moreover, no tokens will be created in the future, and there will be no mining in the sense that miners receive monetary rewards. Besides, the Genesis transaction will send these tokens to several other "founder" addresses. In conclusion, from the evidence currently available, it seems fair to insinuate that the payments among CargoChain's gainers will be established as a peer-to-peer payment channel system. Sequentially, all supply chain players of international trade are required to pay their liabilities, and presumably, the establishment of a machine-to-machine micropayment system is plausible. Consequently, the users and cargo providers of CargoChain will be able to resolve the problem of mass documentation and Payment Upon Production. Ultimately, shippers can practice the trust-less escrow system for conditional payment release.[21]

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REPLY

7.3 REPLY

Reply company is a corporation that is specialized in consulting, system integration and digital services, with a focus on the design and implementation of solutions based on the web and social networks.[1] Since 2006, the Reply has developed its operations in Europe, especially in England and Germany, and by opening some new offices as well as relying on existing acquisitions. Also, REPLY investigates, designs and implements solutions based on novel communication channels and digital media.[2] The company was founded in 1996 in Turin (Italy) and worked to utilize a network model consisting of companies operating in different sectors such as big data, cloud computing, digital media, and ultimately the Internet of Things (IoT).

Tatiana Rizzante is the CEO of Reply S.p.A.,[3] and she works in the area of experimental and research activities proceeding the Internet, in collaboration with the Polytechnics of Turin and CSELT.[4] Moreover, Reply company cooperates with Oracle Corporation, and the IT group of *Red Reply* is specialized in Oracle solutions.[5] Red Reply is a business organization to install and operate Oracle's flagship product such as "Oracle Cloud Machine X6" in Germany for a customer.[6] In 2017, REPLY has launched "COMPREHENSIVE INDUSTRIE 4.0 SOLUTIONS" for "FLEXIBLE" and "CONNECTED MANUFACTURING". Sequentially, REPLY complemented the range of Industry 4.0 specific software in the areas of system integration, digital services, cybersecurity and consulting.[7] Moreover, with over 20 years of experience in leveraging technology and data in a manufacturing and logistics context, Reply is tackling the challenges of Industry 4.0 such as Controlling, Execution of Manufacturing and Plant Maintenance, coupled with Quality Control and Supply Chain Management.[8]

Moreover, the strategic competencies of REPLY's technology include the areas of Cloud Computing, Artificial Intelligence (AI),[9] Internet of Things (IoT),[10] and Virtual Reality for Additive Manufacturing by using 3D printing technologies.[11] In general, the MARKET FOCUS of REPLY as an IT company is composed as the following:

- TELCO AND MEDIA
- BANKS, INSURANCE AND FINANCIAL OPERATORS
- MANUFACTURING AND RETAIL
- ENERGY AND UTILITIES
- GOVERNMENT AND DEFENSE

However, by expanding the Blockchain technology into the IT markets, the interests of Reply company has risen swiftly regarding the novel aspects of this novel innovation. Along similar lines, the ample but very specific market focus of REPLY company (concerning the BLOCKCHAIN technology) encompasses the following areas (please review Fig. 7.3.1):

- BANKING
- INSURANCE
- HEALTHCARE
- ENERGY
- TELCO
- RETAIL
- REAL ESTATE

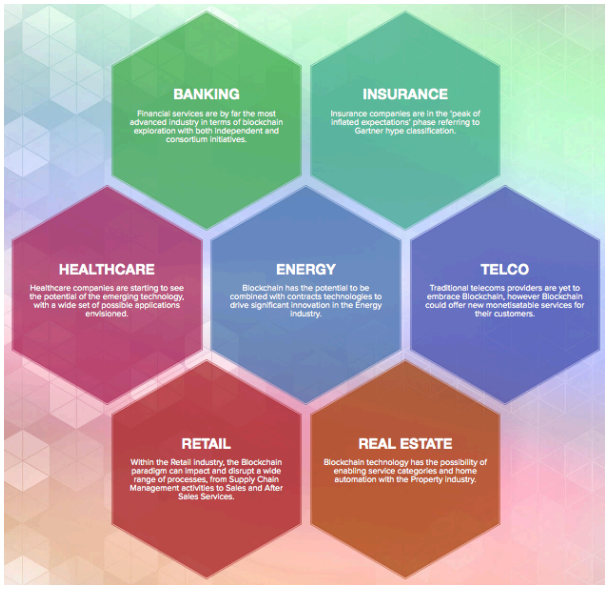

Fig. 7.3.1: REPLY Blockchain Areas

The underlying argument in favor of blockchain is might be the purpose why Reply is engaging in the retail industry. In fact, concerning the RETAIL industry, Reply is merely looking to find some novel blockchain standards which can impact, influence, and reshape the industry. Another key thing to remember is that these Blockchain paradigms can disrupt a wide range of processes from supply chain management up to the sales/after-sales activities. Therefore, the Reply's RETAIL projects are striving to promote goods or containers distribution and enhance user experiences through interoperable services and exchangeable data settings.[12] Nevertheless, in 2016, the REPLY's Blockchain Observatory Report denoted that according to the Google Trends Avg Score Per Industry (Apr15-Apr16), the Retail industry was at the end of all Search Keyword concerning "Blockchain + (an) industry".[13] This illustration once again demonstrates the infancy and novelty of Blockchain Implementation among the industries of logistics, transportation, supply chain, and distribution (please review Fig. 7.3.2).[14,15]

Consecutively, Reply has distinguished the MAIN AREAS of its interest regarding the retail business and distribution industry:

- FRICTIONLESS PAYMENTS
- PURCHASING EXPERIENCE
- PROOF OF AUTHENTICITY
- PROVENANCE
- SUPPLY-CHAIN TRANSPARENCY
- IDENTITY, LOYALTY AND TRUST

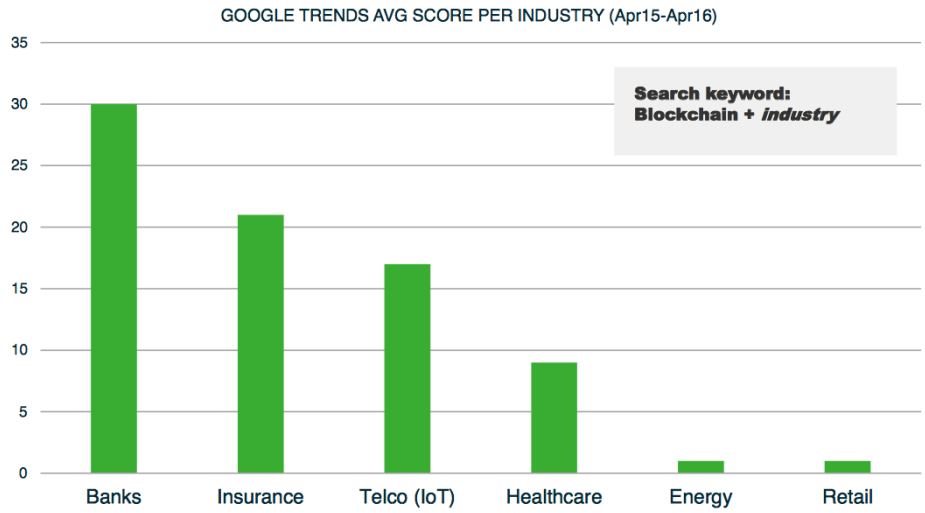

Fig. 7.3.2: Google Trends AVG Score Per Industry

Coupled with that the positive culmination of supply-chain transparency, glassiness identification, loyalty, and trust would confront the Intermodal Freight Transportation. The underlying arguments have motivated Reply to prepare various blockchain-base applications, and offer sustainable solutions for retail and distribution industry. Moreover, REPLY proposes some BLOCKCHAIN APPLICATIONS and software solutions concerning the problems above, particularly regarding the dilemma of long payment terms and the obstacle of "lack of transparency" among the supply chain actors. The data gathered in the pilot studies have suggested that the Reply's applications are contemplated in the following areas:

- SUPPLY CHAIN TRACKING
- CERTIFICATE OF AUTHENTICITY
- SMART LOYALTY PROGRAMS
- ENRICHED PURCHASING EXPERIENCE
- P2M PAYMENTS

However, regarding the SUPPLY CHAIN TRACKING application, Reply company has stated that "Blockchain transactions make trades indisputable and guarantee information payload integrity". Also, the counterfeiting risk is thus mitigated, and thanks to the application, the final consumers can verify in each moment all product characteristics. The application can indicate the important data such as the origin and the provenance of the good/container, characters of materials, and related components specifications. Moreover, concerning the CERTIFICATE OF AUTHENTICITY, Reply has expressed that while "Blockchain redefines contract instruments and negotiation processes, it could streamline authenticity verification mechanisms for supply chain actors". Also, the plausible impact could be recorded on trade instruments such as Incoterms, customs declaration of goods or containers, and international trade registries.[16]

Moreover, concerning the SMART LOYALTY PROGRAMS, the Reply company has designed a Blockchain-base application that would work by enabling trade processes and promote funds transfers via Blockchain programmability and the logic of Smart Contracts. These facilities will empower traditional loyalty programs by smart incentive mechanisms, leveraging both user involvement and trademark ownership. Furthermore, regarding the ENRICHED PURCHASING EXPERIENCE, the company has introduced an application which assists users via tracking and proof of authentication mechanisms. This Blockchain-base application enables buyers and customers to experience and discover the stories and legends behind a product. Additionally, contactless payments and mobile (hand cell phone) services will enrich the real experience of in-store purchasing, and could support the purchasing procedure.[17] Moreover, concerning the P2M PAYMENTS, the Reply company has produced a Blockchain-base application that would streamline the Blockchain payments via the transactions of Person to Merchants (P2M). The application will allow "both customers and retailers to benefit from cost-cutting payments technologies and improving trusted relationships between both business parties".

Eventually, REPLY invented several Blockchain-base applications those serve in different sectors. The data appears to suggest that, the Reply company believes that the That's Mine is the solution that allows anyone to register and verify the ownership of an asset.[18] This application is designed to identify with extreme certainty who are the current owners of assets. That's Mine has been outlined to be potentially applied to all types of assets, both tangible and intangible. Moreover, Reply concludes that vehicles realize an extremely widespread asset with a high associated unit value while there is a notable occurrence of ownership exchanges associated with vehicles (e.g. in 2014, in Italy 3.5 million trades took place).[19] As well as, regarding the change of vehicle ownership, the requirement to verify ownership for the sake of warranty provision or servicing is distinguished. Therefore, REPLY decided to develop a service dedicated to one of the specific areas in which the certification of ownership has a great value associated with it: the automotive market. In addition, REPLY has designed several Blockchain-base applications by focusing on Vehicle registration, Change in ownership, Verification of the actual ownership of the vehicle, and Car scrapping. These showcase Blockchain-base applications are titled as the following:

- BALLOTCHAIN
- BLOKCOM
- CLOUDCHAIN
- SECURECHAIN
- AUTHENTICHAIN
- INSURECHAIN

These applications provide confirmatory evidence that Blockchain-base requests are increasing rapidly, and an application like CLOUDCHAIN is an example of this germination. Having said that, CLOUDCHAIN operates concerning the enhancement in world of retailing and Ticketing For After-Sales Services And Coupons/Vouchers. Besides, ticketing and coupling systems are highly complex, and the risk of distributing counterfeit tickets is a major problem even for the more advanced and modern systems. Consequently, CLOUDCHAIN is a cloud-based ticketing platform for the management of e-tickets that guarantees maximum security and flexibility. Moreover, it might minimize the possibility of counterfeit tickets, yet without making the system complex or complicated for its end users.

On the other hand, the 4RETAIL Blockchain-base application is accomplished in the business environment of Integrated Supply Chain Management Distribution. The application is designed to verify and proof the authenticity and acts against counterfeiting mechanisms. Individually, in case of Supply Chain Management, the 4RETAIL allows the actors of a supply chain ecosystem to rely on a shared information layer from other logistics parties. Further, supply chain companies and logistics service providers can achieve full item tracking, advanced proof of authenticity, and interoperable provision of after-sales services. Consider that the automatic provision concerning after-sales services and loyalty programs are essential for improvement and enlargement of the logistics companies. In this particular theme, SMART BOND as a Blockchain-base application delineates digital assets and risk management factors in decentralized information layers. Plus, it is enabled for an interoperable control concerning trading and post-trading activities, which are typically related to financial assets lifecycle. Finally, SMART BOND aims to map a meaningful scenario regarding the process automation and the dematerialization opportunities.

Eventually, in 2017, Thomas Schmiedel (the Data expert of Reply-Germany)[20] in occasion of Reply's event has introduced the following presentation: "Blockchain meets Machine Learning: how to develop your own Smart Contracts Systems". The open source materials and the general idea of Schmiedel are available on GitHub. He stated that the core feature of decentralized (Blockchain-base) applications includes the idea of "universal storage of ownership", and Smart Contracts play the role of "ruler of transactions".[21] In conclusion, another key thing to remember it that, the Reply's Blockchain-base applications offer a notable empowerment concerning the improvement of logistics, intermodal freight transportation, and supply chain industries. Moreover, the profound studies regarding the following applications and their potential performances is required: BALLOTCHAIN, BLOKCOM, CLOUDCHAIN, SECURECHAIN, AUTHENTICHAIN, and INSURECHAIN.

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PORT OF ROTTERDAM

7.4 PORT OF ROTTERDAM

Recently, numerous transportation and logistics companies have emerged to experiment and applicate the usage of Blockchain technology and Blockchain-base applications toward their business. As an example, Port of Rotterdam is steadily developing its Blockchain-base logistics system to maintain the ranking level of its port as the Largest Sea Port in Europe.[1] Moreover, Port of Rotterdam is investing in strategic partnerships all over the world including expanding boundaries with innovative partners for the high-grade effects.[2] Along similar lines, Port of Rotterdam is an automated port and it is using robotics equipment and robotics vehicles like Automated Guided Vehicles (AGVs),[3] automatic gantry systems, automated stacking cranes, electric shuttles, and automatic elevators.[4] Another key thing to remember is that the business division of Rotterdam's Port is Maritime Logistics which includes logistics via inland waterways while it is recognized as an important transportation mode for the sake of sustainability.[5]

The underlying argument in favor of container terminal automation[6] is the distinguished case of Rotterdam's Port because it is the busiest port in Europe according to the Hamburg-Le Havre range in 2014.[7] The Port of Rotterdam is the largest European seaport, and the port owes its leading position thanks to its accessibility for sea-going vessels (19-meter depth, suitable for huge container ships over 14,000 TEU by size). Moreover, the success secret of Rotterdam's port remains on its extraordinary intermodal connections and because of the 180,000 people whose work in and for the port and industrial area.[8] In addition, according to the report of Rotterdam's Port, the port is continuously concentrating on reliable, efficient, and sustainable activities of which intermodal transport is a key ambition while containers are often transported by trucks from and to the port's hinterland (modeled via the port-city interface).[9]

However, despite the extraordinary achievement of 2014, the Throughput Hamburg - Le Havre range of 2015 demonstrates a decrease of 63 thousand TEU in the total number of Incoming & Outgoing containers in Port of Rotterdam.[10] On the other hand, concerning the technical report of (Appetecchia, 2015), the Port of Rotterdam has registered the percentage of total 11% rail traffic, 59% road traffic, and 30% barge (flat-bottomed boat) traffic of unloaded goods.[11] Furthermore, in 2011, the Port of Rotterdam moved goods and materials around 370,3 (millions of tons) via fluvial and maritime fluvial, maintained its dominant position as a first ranked fluvial port.[12] Having said that, in 2016, the turnover of the Port Authority remained somewhat stable at € 675.4 million. In fact, the Rotterdam Port Authority believes that as a result of costs being under control, they have gained a healthy profit growth, with profit increase by 5.0% to € 222.2 million.[13] Furthermore, in 2016, the Port of Rotterdam moved total 305,820 (Gross weight x 1,000 metric tonnes) of bulk and 155,356 of general cargo.[14]

Having said that, according to the report of the Rotterdam's Port, in 2017, the sale of bunker oil - fuel for shipping - in the Rotterdam bunker port decreased from 10.1 million m^3 to 9.9 million m^3. Moreover, the throughput of bunkered liquefied natural gas (LNG) - liquefied natural gas - rose from less than 100 tonnes to 1500 tonnes.[15] This information according to the report has encouraged contest on the environment reverences by Rotterdam's Port clients.

Additionally, concerning the Blockchain project, in December 2016, Kelli Saunders noticed that the two-year plan undertaken by Port of Rotterdam would give insight into the scope of the profits, but the Blockchain Technology has previously shown commitments. Also, project is supported and emphasized by more than fifteen public and private sector companies based in the Netherlands.[16] Furthermore, Ronald Paul (COO of the Port of Rotterdam Authority), stated that Digitalization is a worldwide trend that the Port of Rotterdam also needs to embrace.[17] Also, he expressed that in this century, the Port Authority already invested more than 100 million euro in its digital infrastructure,[18] and an extensive investment is the ultramodern port community system Portbase.[19] Furthermore, Ronald Paul appended that the Port of Rotterdam, as initiator and facilitator desire to encourage the use of data in the field of logistics, sustainability and safety. Moreover, the Port does this by launching and stimulating diverse projects alike InlandLinks and the online intermodal platform.[20] Having said that, the available evidence on InlandLinks website seems to suggest that the Italian inland terminal (CIM S.P.A.)[21] has a strong work relationship with Port of Rotterdam, including description rate of 36 and 100% of rail connection to/from Rotterdam.[22] Finally, coupled with all arguments mentioned above, Port of Rotterdam has revealed its Blockchain Objectives as the following:

- Customers will be able to observe their container trajectory
- Network behind the SC will no longer be covered
- Allowing the FLPs to make genuine decisions
- Transparency for SC auditors
- Make scale among SC players
- Perform a more effective and productive SC method
- Enable shippers and authorities to identify attempted frauds
- Make available and accessible all information that leads cargo,
- Foundation of so-called "Digitalized Port"
- PortXL

Please consider that the "Digitalized Port" aims to monitor the existing and attainable data regarding containers, goods, bulks, and materials to all relevant supply chain parties. In fact, in September 2017, the Rotterdam's Port Authority and Municipality of Rotterdam have launched a Blockchain Technology Field Lab (so-called: BlockLab).[23] The field lab has launched for the development of concrete applications and solutions based on blockchain technology.[24] BlockLab is an initiative of the Port of Rotterdam Authority and the Municipality of Rotterdam as its fundamental founders.[25] Also, the lab is supported by the regional development corporation InnovationQuarter.[26] On these grounds, Allard Castelein (CEO of Port Authority), Maarten Struijvenberg (Rotterdam's Deputy Mayor for Economic), and Rinke Zonneveld (Director of InnovationQuarter) have demonstrated the first practical applications of Lab which were developed during the start-up phase.

Moreover, Struijvenberg stated that BlockLab aims to realize some fully functional Blockchain-base applications, and they need real innovations to launch the Next Economy. Furthermore, the initiative is not intended to create just a single application but different applications to resolve different problems concerning the logistics and energy industries.[27] Therefore, the BlockLab purpose to design some effective applications in the following areas and strategies:

Energy Transition: by allowing users to set up a finely meshed decentralized power network.

Cargo Flows: numerous applications that can be realized within logistics chains and allow users to organize cargo flows more efficiently for the sake of smartest port' ambitions.[28]

Stock Financing in the Port Logistics Sector (in partnership with Exact and ABN AMRO).

Eventually, according to the evidence currently available, it seems fair to suggest that the ENERGY business and LOGISTICS enterprises are the principal research area concerning the BlockLab investigations. Also, the lab works as a knowledge center for the regional private sector and works with Rotterdam University of Applied Sciences. Furthermore, BlockLab started to operate with a core team of five, who work from the - https://cic.com - Cambridge Innovation Center (CiC) in Rotterdam with respect to the following steps:

Theoretical Blockchain ideas develop,

Test,

Work out into concrete opportunities in a real-world.

Moreover, several actors are involved in the BlockLab project. According to the data yielded and provided by BlockLab website, Port of Rotterdam, City of Rotterdam, InnovationQuarter, TUDelft,[29] Rotterdam Roadmap NEXT ECONOMY,[30] BeSCOPE Solutions,[31] Studio WOLF PACK,[32] TKI DINALOG,[33,34] Rotterdam University of Applied Sciences,[35] Smart Industry,[36] STC Group,[37] and CiC for the Innovators are the main business partners to the BlockLab project.

There seems to be no compelling reason to argue that the Port of Rotterdam points to make it possible (via Blockchain) to structure large-scale networks, chains and markets without the need for a dominant or a third regulating party. In fact, BlockLab applications are proposed to support the Supply Chain regarding Port Logistics Stock Financing and Energy Transition during the national and international trade operations.[38] Also, BlockLab's blockchain-base applications revolve throughout the following themes:

- Increased Compliance and **Transparency**
- Better **Tracking** of Orders and Assets
- Resolve **Trust** Issues

Also, BlockLab has mentioned that the actual implementations of blockchain technology had been limited while the technology allows the considerable potential to change the way companies manage supply chains. Furthermore, BlockLab applications propose to be available in a distributed and a decentralized way for all supply chain members in a secure way. Proverbially, the TradeCloud is an example of this enterprise strategy. Consider that according to the company report, the TradeCloud is a supply chain platform for manufacturing and wholesale businesses. Customers would rely on TradeCloud to obtain their global supply chain more predictable, automate operational methods, and focus on exceptions.[39]

Additionally, regarding the objects in logistics industry, BlockLab pointed on a particular but virtual eco-system including a policy that supports cross-chain collaboration during the transportation of containers (De Kok et al., 2014). This eco-system offers a possibility to observe both Real and Virtual World of intermodal freight transportation in a real-time (Fig. 7.4.1).[40]

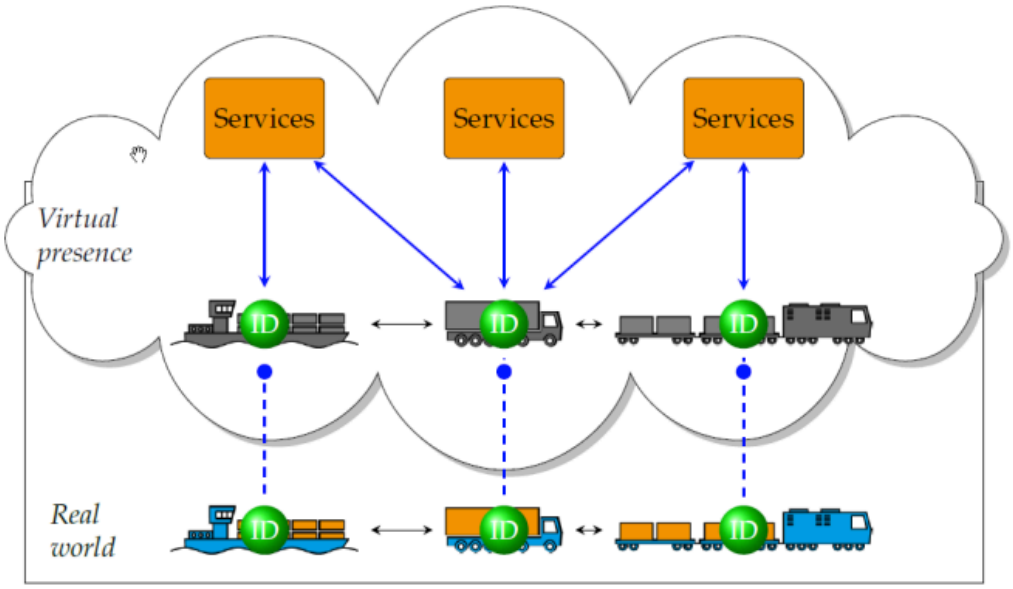

Fig. 7.4.1: Virtual Presence of the Intermodal Freight Transportation © De Kok et al., 2014

Moreover, concerning the performance or usage of any Smart Contracts within BlockLab Blockchain-base applications, the company expressed that while the logistics and intermodal transportation are a complex framework, the Smart Contracts are defined as a third pillar and third key principles of blockchain's strength.[41] Additionally, BlockLab has considered, without Smart Contracts the blockchain would just be a pretty nifty way of recording and sharing records in a decentralized database. Having said that, Smart Contracts allow BlockLab to program (on the blockchain) the automation of supply chain transactions. On the other hand, notwithstanding the online research, the rewarding mechanism of the BlockLab applications is not specified explicitly, and further research is required. However, regarding the BLOCKCHAIN LAB from the Delft University of Technology, the information are more accessible. Consider that the blockchain laboratory of TUDelft collaborates with Rotterdam's Port, and some relevant codes and appropriate data are established on the Github of the Lab. In fact, in case of the Tribler application that is designed by TUDelft blockchain laboratory, it appears that the reward mechanism is as earning tokens and rewarding content creator.[42]

Lastly, the BlockLab has declared a Post Shipment Financing system concerning the desired payment system. Also, a virtual eco-system is currently piloted by a consortium of ABN-AMRO (third-largest bank in the Netherlands), TransFollow, and TKI DINALOG in combination with blockchain technology. As mentioned previously, the BlockLab partners are lined up. Moreover, all these roles are on-board, and they are actively involved in payments and (international) supply chains, and for more information review Partner page.[43]

On these grounds, it is vital to mention that TransFollow comprises the standard for the digital consignment note, and it promotes the faster work, extra efficiency, moderate IT-costs, and decrease the time needed to do administration works.[44] Furthermore, another striking feature of the TransFollow is concerning its particular advantage about E-CMR, while the conventional European international transportation is currently wasting a lot of time, energies, and materials (papers and inks) for traditional paper-based CMR documentation.[45]

In addition, in February 2018, port of Rotterdam has announced the yearly scouting phase of the PortXL (http://portxl.org) project, while from September 2017 to January 2018, the acceleration plan scouted one-thousand start-ups and scale-ups appropriate for the sector.[46] The search was global to get the qualified companies to Rotterdam, as well as, 25 promising start-ups and scale-ups were invited to participate in the PortXL Selection Days. Moreover, according to the report, the project of PortXL is a start-up acceleration program for port innovators located in the world's smartest maritime cluster. Also, the report denotes that the following companies and their technologies are selected to collaborate with PortXL. These business companies are categorized into the following three divisions:

Maritime & Logistics:

Bunker Connect (www.bunkerconnect.com) - digitalisation bunkering

DockTech (www.docktech.net) – predictive maintenance (Tel Aviv-Yafo, Israel)

Explect B.V. (www.explect.com) - digitalisation logistics

Ionada Incorporated - emission reduction

Marine Bubble Flow B.V. – fuel reduction

Shipskart Marine Private Ltd. (www.shipskart.com) - digitalisation logistics

The Big Smile – cargo efficiency

WhaleWashing (www.whalewashing.com) - (predictive) maintenance

Energy:

BDB Greenpower (www.bdbgreenpower.nl) – sustainable energy

Ondavia, Inc. (www.ondavia.com) - Safety, Quality, Health & Environment (SQHE)

All Sectors:

CargoLedger BV (www.cargoledger.nl) – blockchain

ECOncrete Tech Ltd. (www.econcretetech.com) - sustainability

MapGage (www.mapgage.com) - asset maintenance[47]

Threatspan (www.threatspan.com) - cyber security

However, the use case of CargoLedger lies at the heart of the discussion and it is important to note that CargoLedger is a blockchain-base application, and it was admitted to the PortXL World Port Accelerator. Moreover, CargoLedger aspires to transform and digitalize the world of Supply Chain by applying the blockchain technology.[48] Having said that, CargoLedger is a distributed system with immutable data which securely share data across the entire chain by timely supporting and by the instant settlement. Besides, Tridens (introduced by ThreatSpan) is the cybersecurity platform designed to help shipping and maritime enterprises manage and control nautical resilience in an age of rising cyber threats.[49] Eventually, in conclusion of this use case, for those who are interesting to find out more information concerning the Port of Rotterdam and its Blockchain's strategies, reviewing the studies of Weernink et al. (2017) and Mattia Francisconi (2017) are strictly recommended.[50,51]

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[47] Note that Roderick Ruhl is the CEO and Founder of MapGage.

[48] CargoLedger B.V. (2018), About Company, AMSTERDAM. [Online] Available: http://cargoledger.nl/site/about/ (Accessed on 21th of February 2018)

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WALMART

7.5 WALMART

Wal-Mart Stores, Inc., is performing business as Walmart, and it is an American multinational retail corporation that runs a chain of hypermarkets,[1] grocery stores, and discount department stores.[2] Sam Walton founded the company in 1962 and incorporated on October 31, 1969.[3] The Walmart's Headquartered is located in Bentonville (Arkansas), and it might be interesting to acknowledge that Samuel Moore Walton (March 29, 1918 – April 5, 1992) at one point in his life, he was the richest American businessman in the world.[4] After all, in this recent years, Walmart aims to disrupt the Last Mile Problem and design a better way for final delivery of small parcels. Therefore, in 2017, Walmart has submitted a patent application for a Drone Delivery System that concentrates on how packages will be delivered. Also, instead of just delivering goods to the doorsteps of the clients, drones would drop packages into secure boxes (Lockers) that interact with drones. According to the insight of Kelly McSweeney (2017), the Walmart's application describes a smorgasbord of technology that could be used to guarantee Secure Drop-Off, including geofencing and a blockchain technology system for package tracking and container identification.[5] The patent includes a schematic image of the system in which the drone (12) transports the parcel (13) from the Store (11) into the client (15) in an autonomous manner. Please review the following figure (Fig. 7.5.1).

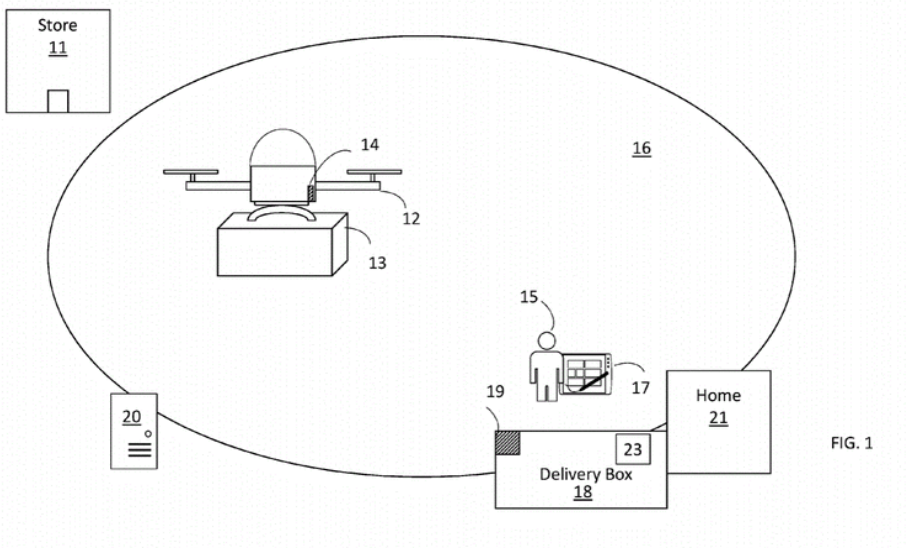

Fig. 7.5.1: Walmart's Drone Delivery Plan ©Image: US Patent & Trade Office

Additionally, the package tracking via blockchain technology might include data and critical details including location, SC transition, authentication of the courier and customer. Moreover, the tracking technology may comprise information regarding the ambient temperature of the parcel (or container), the temperature of the product, adequate thresholds for the ambient temperature of the product, and location of the package in the TEU containers.[6]

Along similar lines, on October 19, 2016, Walmart announced that it would partner with IBM and Tsinghua University to track the pork supply chain in China by using transaction security, authentication technology, and the Blockchain technology (Daniel Roberts, 2016).[7] Besides, the application was developed within an IBM blockchain project called: Hyperledger Project.[8] In fact, Hyperledger Project is an open-source group formed by the Linux Foundation in which IBM was a founding member. Moreover, (Prisco, 2016) denoted that Walmart is going to use a technology platform that was based on IBM's technology and developed blockchain-based application (Hyperledger Fabric) by Linux Foundation.[9]

Having said that, Hyperledger Fabric is a DLT, Smart Contract, and Engine type application, and it is a blockchain framework implementation.[10] Furthermore, according to Frank Yiannas, Vice President of Food Safety at Walmart and director of the blockchain attempt, the pilot project will provide Walmart with a sense of whereby blockchain technology works and how properly it will balance. The partnership of IBM and Walmart is one of the largest Blockchain functional tests, and it aims to contribute a way for extensive groups of unrelated companies to maintain a secure and reliable record of their transactions simultaneously. The argument mentioned above propounds the view that the Walmart's Problem was the Walmart Requirement and that technical solution demand has motivated Walmart to participate the blockchain pilot project.[11] In fact, Yiannas declared that it often took weeks to trace where the bad ingredients came from?[12] Consequently, in November 2017, the OriginTrail was granted the "Food Safety Innovation Spark Award" by Walmart's Food Safety Collaboration Center in China.[13,14] Namely, OriginTrail is a statement of belief within the Blockchain-base application products, and according to the OriginTrail website, the OriginTrail application comprises the first purpose-built protocol for supply chains based on Blockchain technology.[15] Thus, according to the Sean Bradley (2018), OriginTrail (TRAC) is attempting to solve a very real problem, in a very large industry (review Fig. 7.5.2).[16]

Moreover, the fragmentation and retardation of data from primary producer of pork (farm) into the final Walmart retailers was a critical problem against the productivity and efficiency of Walmart's supply chains. In fact, the OriginTrail protocol is designed to eliminate the main barriers that hinder the efficient exchange and verification of data in supply chain management. These characteristics are indispensable for protecting the logistics and supply chain of Walmart food stores. On the other hand, the first volume of OriginTrail's White Paper has affirmed that their Blockchain application attempt to provide a high-performance traversing and high flexibility concerning the data models and high agility among all supply chain players.[17] As a result, the application is already utilized in enterprises like Walmart, eBay, the Adidas Group and many other companies for various use-cases involving online retail.[18]

In brief, it would be possible to express that the Wal-Mart Stores, Inc. is the main actor or principal client of IBM which is involved to track the pork supply chain in China by using the Blockchain technology.[19] Also, a group of leading companies announced a major blockchain collaboration with IBM intended to further strengthen consumer confidence in the global food system. The consortium includes Dole, Driscoll's, Golden State Foods, Kroger, McCormick Corporation, McLane Company, Nestlé, Tyson Foods, Unilever and Walmart.[20]

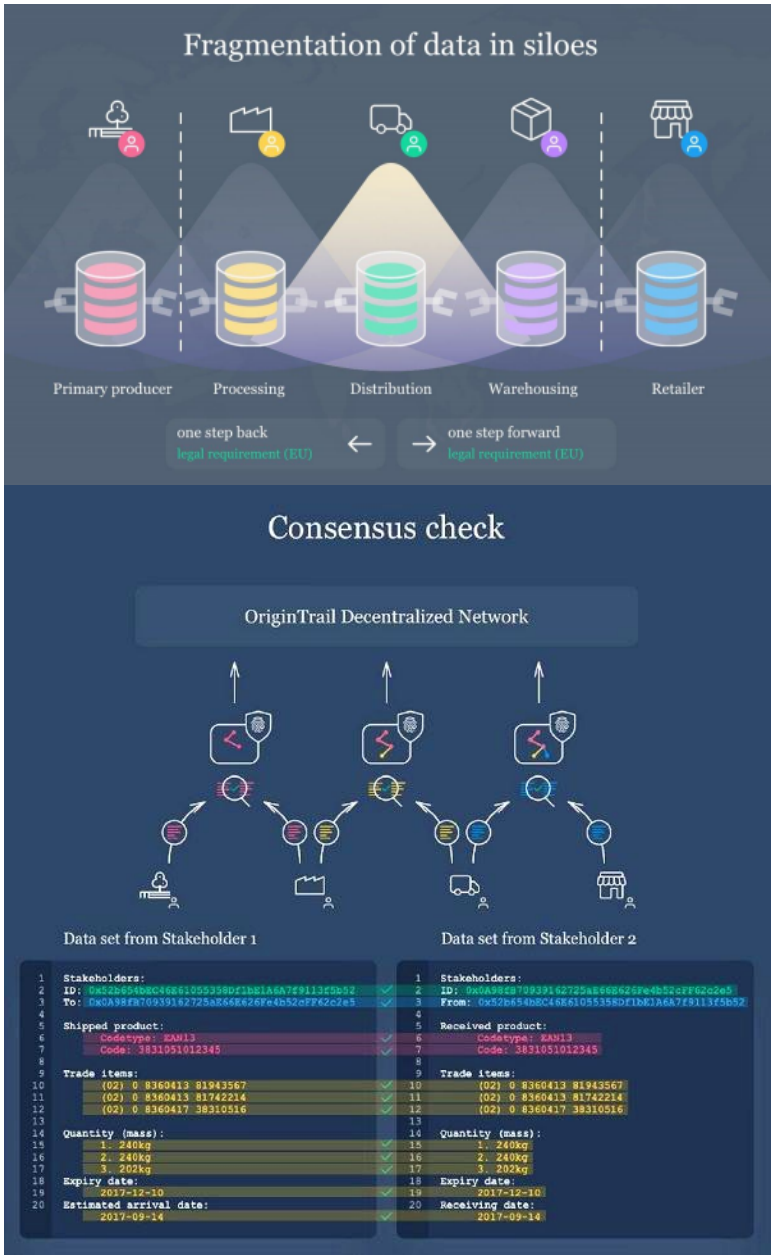

Fig. 7.5.2: Fragmentation & Consensus © White Paper

Hence, the "Food Safety Collaboration Center" of IBM in Beijing is the main technology provider and principal contributor, and the Tsinghua University is the partner of the project (WSJ, 2016).[21] Concerning the contention of the food safety along the supply chain flows, Frank Yiannas said that he had spent years looking in vain for a better way to track lettuce, steaks and snack cakes from farm and factory to the shelves of Walmart (Nathaniel Popper, 2017). As a consequence, the main part of Walmart's Supply Chain problem occurred when the company dealt with Salmonella outbreaks, and it often took weeks to trace where the bad ingredients originated. Acknowledge that the Salmonella is a bacterium that occurs mainly in the intestine, especially a serotype causing food poisoning, and it indicates that why and how the Real-Time detection of the food supply chain (inside ATP Container) is vital for Walmart.[22],[23]

Furthermore, regarding the use of Smart Contracts, the guidelines laid down by IBM, is illustrating the features of the IBM Blockchain Platform involve in three phases: Develop, Govern, and Operate. During the second phase, the platform offers all participating members a level of control, while preventing any member from having exclusive control.[24] Also, a new class of common tools is designed to help the improvement of productivity across the organizations by using a process that collects data from all SC actors to conduct the logistics operation by the distribution of smart contracts and creation of transactions channels. To summarize, the rewarding system seems not to be declared clearly, but Walmart and IBM hope to reward their project by food safety for all their stakeholders and collaborators. Exclusively in case of OriginTrail application, the White Paper of the company denotes that the "OriginTrail is not a company, but it is an ecosystem, and it is based on a token economy" with direct relations between users and network nodes free of arbitrary fees. Thus, the amount of tokens to be awarded for the nodes providing the service is a function of supply and demand between nodes and users. Besides, data authors will not be required to pay any additional arbitrary fees apart from what they agree to pay to the nodes. Rather, nodes will receive full payment of what they have agreed with and provided to the user. Ultimately, Yiannas has reiterated that Walmart does not believe traceability is the purpose but the transparency is the ultimate goal.[25]

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IBM INTERNET OF THINGS AND BLOCKCHAIN

7.6 IBM CASE

IBM is a huge IT company, and it offers a wide range of IT products and IT solutions. IBM provides and manufactures computer hardware, middleware and software. IBM or International Business Machines Corporation, is headquartered in Armonk (New York), and it was founded in 1911.[1] In 2017, according to IBM Annual Report, the IBM's revenue rise to the $79.1 billion.[2]

These products cover the various areas including Analytics, Blockchain,[3] Cloud, Collaboration Solutions, Industry solutions, Internet of Things (IoT),[4] IT infrastructure, Mobile, Security, Watson, Watson Customer Engagement, and Watson Health (review the following screenshot Fig. 7.6.1). As a consequence, the IBM divisions regarding the Blockchain technology are involved in the following parts: IBM Blockchain, Blockchain industry solutions, Blockchain platform, and Blockchain workshop. Also, on page of Get Started With The IBM Blockchain, some open source products and tutorials are available for students and IT leaners.

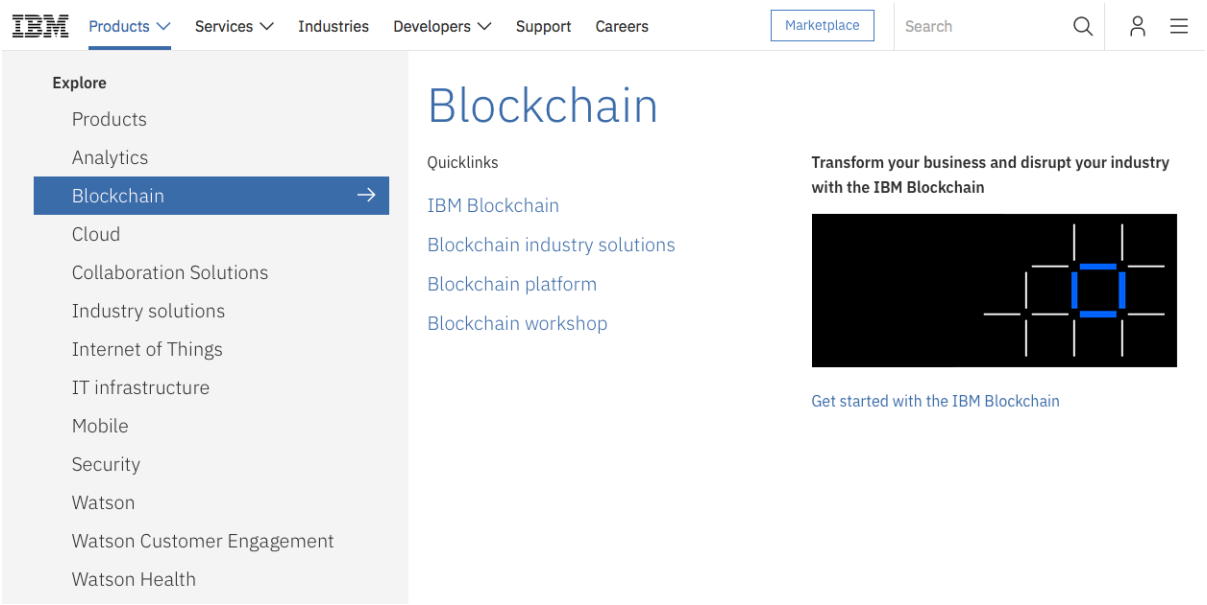

Fig. 7.6.1: A Screenshot of IBM website

Furthermore, IBM offers an opportunity for business companies via IBM Bluemix Garage for Blockchain. In practice, these Bluemix Garage are centers for blockchain technical expertise and designed to work with customers and co-workers to experience blockchain and create valuable production use cases.[5] Moreover, as a similar line, another popular application of IBM which is quite similar to the REPLY [in case of vehicle transferring and public ledger], is called Hyperledger Composer.[6] It is a set of collaboration tools for developing blockchain business networks that make it simple and quick for business proprietors and developers to design Smart Contracts and blockchain applications to resolve business quandaries.[7,8] Furthermore, regarding the IBM Bluemix, the further shreds of evidence and relevant information to get busy with Bluemix (or IBM Cloud) are supported and they might be found in book of Laurence (2017).[9] Besides, in case of the shipping industry, Laurence (2017) stated that IBM is working with the GBC to use blockchain technology for advanced freighting and logistics. He expressed that the IBM's program aims to promote regional supply chain players to collaborate on how they trade goods and exchange containers. Laurence (2017) declared that Smart Contracts would be utilized as sustainable resolutions for acquiescence, compliance, yielding, and settlement concerns.[10,11] Consequently, IBM dedicated a distinct division of its website to the concept of Blockchain for Supply Chain. The IBM's division endeavors to add greater visibility and efficiency over the entire supply chain via Blockchain technology, to deliver higher and immeasurable value to the logistics customers and wholesalers.[12] Also, IBM believes that transparency and traceability are some of the most influential foundations of logistics, and IBM Blockchain proposes to optimize and adjust business transactions and trading relationships by robustly secure enterprise networks on blockchain in both regional and global scale.[13] For instance, in February 2017, the government of Dubai announced that they are working with IBM to trace the goods flowing through the Dubai's ports.[14]

Having said that, by coming back to the idea of Hyperledger (or Hyperledger Project),[15] it is serviceable to mention that IBM is an early member of the Hyperledger initiative together with some well-known technology platform and financial companies such as Fujitsu, Intel, Cisco, NEC, Red Hat, NTT DATA, VMware, Hitachi, SAP, ABN AMRO, ANZ Bank, BNY Mellon, CLS Group, CME Group, the Depository Trust & Clearing Corporation (DTCC), Deutsche Börse Group, J.P. Morgan, State Street, SWIFT, and Wells Fargo.[16] On the other hand, regarding the importance of Blockchain technology, John Cohn (the IBM Fellow and Chief Scientist for Internet of Things) finely formed that in his 35 years working experiences within IBM as a scientist, he has never seen anything come from such obscurity. Cohn said Blockchain was a technology developed to exchange money and it is developed into such a center stage. Furthermore, at its bases, blockchain is a shared cryptographically unalterable ledger for recording the history of transactions.[17]

These characteristics once again highlight the utilities of Blockchain inside the logistics industry because it cause lower friction and it enhances trust and accountability between supply chain members, and above all, Blockchain increases the transparency among the logistics parties. Hence, Karen Lewis (2017) expressed that "one of the biggest challenges in the logistics and transportation industry is the protection of its assets and cargoes".[18] Thus, moving freight with multiple transport companies and inside an intermodal freight transportation mechanisms are some combined responsibility. Alternatively, a blockchain-based application might ensure transparency and timely delivery because it would correctly monitor and track all transactions from so many different charges and parties. Besides, Karen Lewis (2017) continued that for serving transport organizations to overcome the logistics challenge, AOS SAS (AOS) and IBM are collaborating to improve efficiency in the logistics and transport industry. Consequently, the new truck-tracking solution has integrated IBM Blockchain and Watson IoT, leveraging the

Internet of Things (IoT) services on IBM Cloud for trucks and loads mapping, with the aid of blockchain technology to manage transactions between carriers, local authorities and clients.[19] For instance, in August 2017, the JOC has announced that Singapore carrier (Pacific International Lines - PIL)[20] and port operator (The World's Port of Call - PSA)[21] are exploring blockchain technology with IBM as the IT giant.[22] Plus, consider that Singapore possesses a unique geo-strategic location concerning the international hub and international sea shipping. Moreover, IBM believes that a digitized transaction cycle will minimize error and risk amongst supply chain transactions.[23] Also, IBM maintains that by digitizing supply chain processes and by using blockchain and IoT, the related information might capture directly from the sensors placed on the trucks, and entered onto the blockchain system. Consequently, it will create a single, shared repository that all authorized members can obtain and it will be altered with consensus from all participants.

Along similar lines, IBM Think Academy believes that "blockchain will do for business what the internet did for communication" while it can create novel ways of working and give more time for innovation and creativity.[24] Besides, approaching literature, Li & Zhang (2017) believes that the widely used Internet of Things (IoT) network models are usually in two styles. First one is to use cloud platforms as the data processing centers to correlate all things such as Azure,[25] PREDIX, Watson,[26] and the second one is to use blockchain technology to support point-to-point network (like ADEPT, AllJoyn, and Filament).[27] These models possess their strengths and weaknesses, and they have potential possibility to influence (both positively or negatively) their application within the logistics industry.

However, Omrani et al., (2018) expressed that given the inadequate computation resources of IoT objects, the mechanisms and techniques employed to secure data exchange in these circumstances should consider several constraints such as power consumption, size, and execution time. Therefore, the Omrani et al., (2018) have been proposed new lightweight encryption systems to cope with these constraints.[28] On the other hand, Kshetri (2017) highlighted IBM is using its large cloud infrastructure to accommodate blockchain services for tracking high-value items as they relocate across supply chains.[29] Also, the IBM Watson IoT Platform's built-in capability similarly enables users to add selected IoT data to private blockchain ledgers that can be accommodated in shared transactions. Another possibility would be, according to the Kshetri (2017) insight, the platform translates the data from connected devices into the blockchain required API format . Hence, it is not necessary for the blockchain record to comprehend the specifics of the device data while the platform filters device events and transmits only the data that is needed to satisfy the contract.[30]

Coupled with that, Harrison (2017) expressed that when a company think about blockchain, it is a system of record and this system stays around for decades. So, she believes that IBM is an appropriate co-worker for logistics companies because it knows all about transaction processing and supply chains, and it comprehends all about the core systems that drive each of these businesses.[31] Hence, that is important to know how enterprise blockchain is applied to business networks.[32] Moreover, Harrison (2017) denoted that what separates IBM from its competitors is because the IBM's opponents are coming at Blockchain technology from a very different angle. She considers that some of IBM's competitors provide a cloud platform where clients can try and sandbox while others are blockchain startups and Proof of Concepts (PoCs). Plus, very often they practice some of the public blockchain platforms like Bitcoin or Etherium which do not propose the scale or security. Harrison (2017) argued that IBM's competitors do not offer the permission qualities that HyperLedger Fabric delivers, and then they do not possess the end-to-end support once the client gets its project up.[33]

In conclusion of this use case, the accessible evidence resembles to consider that MAERSK as a giant Danish shipping corporation joined IBM to develop the Maersk's container shipments through the blockchain.[34] Moreover, comprehensive analysis and incremental investigation concerning Maersk's case are available in the following section (please review Unit 7.7).

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MAERSK LINE

7.7 MAERSK LINE

The case study of MAERSK is considered individually and separately form the IBM case, because of the particular Maersk's role in international trade. Maersk is an important freight transporter among the globe and many Italian shippers, FLPs, carriers, and intermodal terminals work with Maersk and carry its huge fleet. In addition, Maersk owns offices in Genoa, Milan, Venice and Naples, and it operates among Italian businesses and connects them to key global markets since 1987.[1] Also, it possesses a full inland network stretching across Italy which connects seamlessly with MAERSK's ocean fleet. The giant shipping company believes that the "Shipping is not just about ships" because most cargos also require to be carried inland, often at both ends of their journey. Maersk stated that its logistics squadron is ready to pick up clients goods from their production site and deliver them harmlessly to their final destination.[2]

Additionally, shipping companies like MAERSK and CSCL Globe plays an important role in the global transportation of millions of containers. These companies even sometimes face serious operational risks concerning their container fleet duty. One of the recent cases has announced on February 3, 2016, while the CSCL Indian Ocean reported the failure of her steering gear on the North Sea lane of the Unterelbe close to Lühesand island in the Elbe river (nearby the famous EUROGATE Container Terminal of Hamburg).[3] Another example of these kinds of risks and restrictions might concern the U.S. Sanctions on the Iranian regime.[4] According to the FoxNews, in 2011, Maersk has decided to suspend business ties with several Iranian ports after the Obama administration blacklisted port operator Tidewater Middle East Co.[5,6,7,8]

However, according to the Alphaliner information,[9] in 2016, the APM-Maersk (or A.P. Moller–Maersk Group) was the busiest operator of the container transport in the world with the movement of corresponding 3.277.243 TEU.[10] Also, Maersk group extracted the 15,8% of total TEU traffic at the global level in 2016.[11] With this in mind, the MAERSK has a lot of excellent stories concerning the industry of container transportation. Furthermore, it was on the top ranking of TEU operators and container transporters from 2000 and 2006 to 2013.[12,13] Having said that, according to Annual Report 2016 from A.P.Moller & Maersk has highlighted that, in 2016, A.P. Moller & Maersk has delivered an unsatisfactory loss of $1.9 billion (profit of $925 million) negatively impacted by post-tax impairments of $2.8 billion ($2.6 billion) primarily relating to Maersk Drilling of $1.4 billion ($27 million) and Maersk Supply Service of $1.2 billion ($0 million).[14] However, Despite this lose, still the giant MAERSK shipping company which is headquartered in Copenhagen (Denmark), strongly employs around 88,000 employees across 130 countries, and its invested capital in 2016, was around 42,808 USD million.[15] All things considered, Annual Report denoted that Maersk is collaborating and investing on Drewry maritime research as a leading international provider of research and

consulting services to the shipping and maritime industry.[16] Also, according to the Drewry report and its launched rigorous analysis of the listed bonds of the three major container shipping companies (A.P. Moller Maersk, CMA CGM and Hapag Lloyd AG), the Drewry's service offering will expand to comprise other maritime sectors including port operators, dry bulk, tanker and gas shipping.[17] Consequently, in March 2017, along with the similar line of research and development, IBM and Maersk started a joint-developed project to create a blockchain platform for storage of cargo and container information.[18] Erik Hofmann et al. (2018) believe that it was as the first commercial application project that gains traction while IBM announced that it is teaming with Maersk Line as one of the largest logistics service providers in the world, to create a new solution to digitize the global,[19] cross-border supply chain through Blockchain technology.[20] According to the IBM presentation, nowadays, almost 90% of goods in global trade is carried by the ocean shipping industry, but the supply chain is slowed by the complexity and sheer volume of point-to-point communication. Information and data related to containers, needs to across loosely coupled networks of land transportation providers, intermodal terminals, freight forwarders, carriers, customs brokers, governments, ports and ocean shippers. On the other hand, the critical problem is that since the introduction of container shipping in 1956, unfortunately, hard-papers and manual paper-based processes are still common and information about these statuses of containers and goods is locked away inside the silos of all individual supply chain players.[21]

Therefore, IBM and Maersk attempted to address this problem with a distributed, permission platform that is accessible by the supply chain eco-system, and it is designed to exchange events data and handle document workflows. The project's report denoted that Maersk and IBM are applying blockchain technology to create a global tamper-proof system for digitizing commerce workflow and tracking shipments end-to-end. Also, the frame points to eliminate logistics frictions including costly point-to-point communications. The collaboration of Maersk and IBM has launched with the potential ability to track the journey of millions of containers per year and to integrate with customs authorities on decided trade lanes.[22]

The underlying argument in favor of digitalization has encouraged the Maersk to perform a test, and the recent results of the experiment illustrate that shipping a single container of flowers from Kenya to the port of Rotterdam appeared in a stack of nearly 200 communications. Notwithstanding, it was investigated how blockchain has been executed to create trust and security in the digitized document workflow, and development of the efficiency concerning the global supply chains.[23] The IBM presentation regarding the Maersk's Blockchain platform illustrates how all distinct entities of cross-border logistics are concerned in the transaction. Moreover, all of the supply chain actors are aware concerning the containers locations and its real-time circumstances. These logistics parties and business entities include customers (farmers or manufacturers),[24] export and import authorities, carriers, terminals and ports supervisors, customs, and shippers. All these objects are involved in Maersk's platform, and they tack part in transaction and transportation of container. For instance, shipping a container from the port of Mombasa demands signatures from three (3) different agencies approving the export and six (6) documents that describe the origin, chemical treatments, quality of the produce, and customs duties (review the following frame Fig. 7.7.1). In practice, initially, the farmer submits the packing list through a PC or a mobile device which will be visible to all participants simultaneously. This procedure launches a Smart Contract product and an export approval workflow between three (3) agencies. As each agency signs the contract, the information will be updated for all supply chain players to comprehend. Concurrently, data about the inspection of the flowers, the sealing of the refrigerated container, the pick up by the truckers, and the final permission from customs is communicated to the port and allowing them to

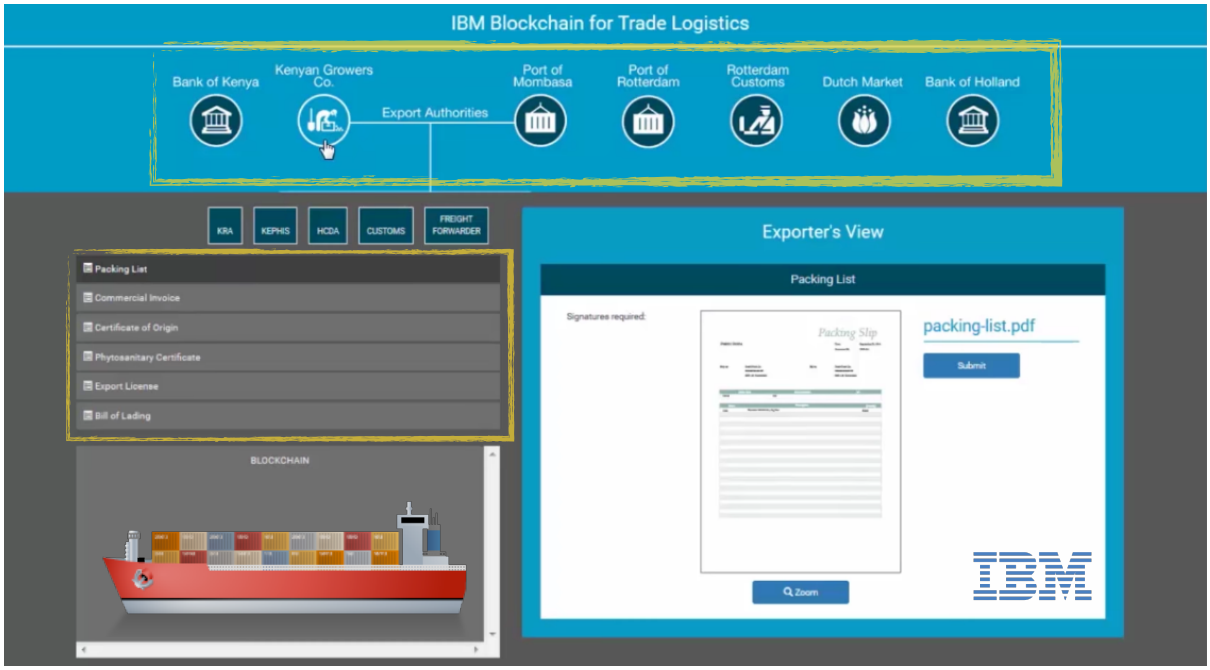

Fig. 7.7.1: A Screenshot of IBM Blockchain for Trade Logistics & Maersk

prepare for the container. All transactions relating to the documents and the physical goods are captured and shared while information concerning which documents were submitted, when and by whom, and where are the goods and who is in possession of them, are entirely distributed. IBM maintains that blockchain provides secure data exchange and a tamper-proof repository for logistics documents and shipping events. IBM stated that Maersk's blockchain-based system could significantly reduce delays and fraud. For instance, in case of flowers or foods, these goods are perishable, and it is crucial that there are no delays or missteps. Additionally, IBM believes that blockchain technology might save billions of dollars annually by reducing the paper works,[25] pauses, obstructions, delays, frictions, and failures. IBM expressed that according to the analysis of The World Trade Organization (WTO), reduction of barriers within the international supply chain would increase the worldwide GDP by roughly %5 and total trade volume by 15%.[26,27] Coupled with that, Michael White the CEO-designate and IBM-Maersk Joint Venture believes that the Maersk's Platform is all about reducing global trade barriers and increasing efficiency across international supply chains, and bringing to market a trading platform for containerized shipping and connecting the entire supply chain ecosystem.[28] Review the following picture (Fig. 7.7.2) from the Maersk's Platform.

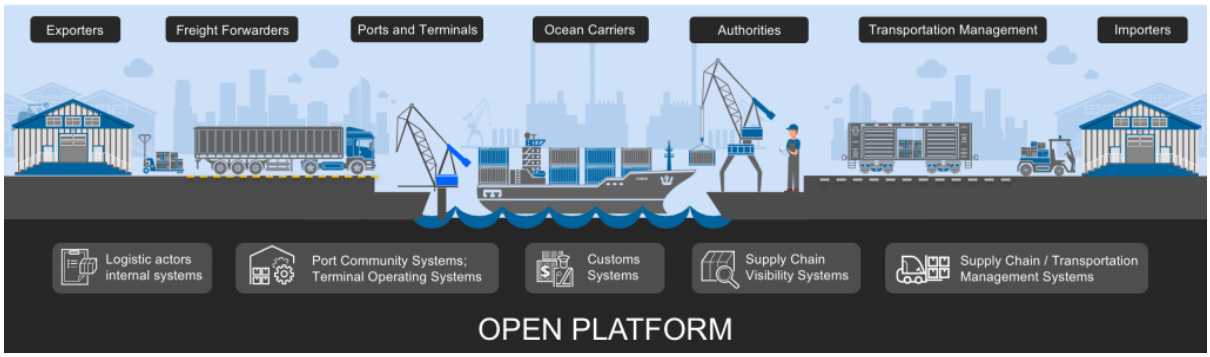

Fig. 7.7.2: All about Maersk's Platform ©Michael White

In light of this, Jakob Stausholm, the chief financial and technology officer at Maersk, revealed that Maersk's blockchain project needs to have something in it for all stakeholders, to arrange the whole supply chain proceeding, and he believes that "That is the difficult part".[29] Hence, in literature Mario Gerla et al., (2014) expressed that in an intelligent home (or warehouse), the IOT formed by the myriad of sensors and actuators that comprise the house internally and externally can manage all the utilities most economically, with maximum comfort to residents (or logistics operators), including virtually no human intervention.[30] This would argue once again the importance of blockchain technology and its required synchronization with IoT. Moreover, Marcus Hand (2017) has illustrated a remarkable infographic on how Maersk and IBM recognize blockchain and attempt to improve the international shipping method.[31] Also, he believes that the collaboration with IBM is the latest effort by the Maersk as the largest container cruiser to digitize the container shipping process. Additionally, regarding the security and safety, Martyn Wingrove (2017) underlined that if Blockchain technology would have prevented the Maersk cyber attack while the latest cyber attack on Maersk was most likely destructive wiper malware, according to the EC Council.[32]

In conclusion, Rebecca Moore (2018) from Riviera Maritime stated and asked if Maersk's blockchain platform could lead Maersk to develop a new business arm which is an IT venture firm and not a transportation firm.[33] Besides the IBM platform, Maersk also tested a blockchain-base application for Shipping Insurance with Microsoft. Maersk believes that perhaps thanks to the blockchain technology the disruptive innovation may arrive sooner than what logistics industry estimated. In fact, according to the insight of Robert Hackett (2017), Maersk has completed a 20-week blockchain proof of concept trial for marine insurance. The Maersk's partners include EY, Microsoft, Willis Towers Watson, and several insurance companies. Thus, the trial aimed to secure the information sharing and shipping data via blockchain.[34,35]

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FURTHER CASE STUDIES

7.8.1 HYPERLEDGER

Since readers have observed in previous case studies, the comparison of current applications concerning the implementation of Blockchain technology in the logistics industry is an essential investment. There is ample support for the claim that the implementation of a workable application needs a comprehensive investigation, reflection, and examination of the prevailing market. Analysis are essential to appreciate if the market conditions are favorable for the financial investment of the transport and logistics providers. However, as mentioned previously in 1st PART of this dissertation, despite the various Start-Ups of Blockchain in IT and finance businesses, there is still some uncertainty about some aspects of blockchain's dominance within the finance, logistics industry, and intermodal freight transportation.[1] According to the Morgen et al. (2017) study, some of these uncertainties and questions include "What can the blockchain do better than conventional databases? Can it keep track of property titles, academic transcripts, energy market credits, and state licenses for health care providers? Can it check the status of airline flights-and make reparations the weary travelers if their flights are delayed?".[2] Notwithstanding, the academic literature concerning the implementation of Blockchain Technology through the Logistics and Cross-modality, have not reached an eminent amount of publication. Having said that, in the following section, readers can review some other cases about some popular applications concerning the likely aptitude of Blockchain Technology for blossoming of the Blockchain in logistics.

Perhaps after this brief preamble, it is time to express that probably the Hyperledger Project is the most influential open source platform to support blockchain developers. Having said that, Hyperledger Project is an open-source group formed by the Linux Foundation in which IBM was a founding member. Moreover, (Prisco, 2016) denoted that Walmart is going to use a technology platform that was based on IBM's technology and developed blockchain-based application (Hyperledger Fabric) by Linux Foundation.[3] According to the Simon Stone (2017), Hyperledger Fabric Composer is a framework to accelerate the development of applications built on top of Hyperledger Fabric.[4] Moreover, the Fabric Demo illustrates the Fabric as a freeform exchange of digital assets between companies approaching a permissioned blockchain network by employing Hyperledger Fabric.[5]

Also as mentioned previously during the IBM's case study, the giant IT company (IBM) is an early member of the Hyperledger Project initiative, together with some well-known technology platform and financial companies such as Fujitsu, Intel, Cisco, NEC, Red Hat, NTT DATA, VMware, Hitachi, SAP, ABN AMRO, ANZ Bank, BNY Mellon, CLS Group, CME Group, the Depository Trust & Clearing Corporation (DTCC), Deutsche Börse Group, J.P. Morgan, State Street, SWIFT, and Wells Fargo.[6,7]

Moreover, Hyperledger Project incubates and promotes a wide range of business blockchain technologies, including distributed ledger frameworks, smart contract engines, client libraries, graphical interfaces, utility libraries and sample applications. For instance, The "Composer Play-ground My Blue Mix" is the platform powered by hyperledger.org with various open source materials concerning the Blockchain programming shared on GitHub.[8] The Composer offers an outstanding Playground Tutorial to build Blockchain applications and business networks in an individual way.[9,10] Besides, for knowing more about the general strategies of HL, watching the Brian Behlendorf (2017) interview is recommended. Brain Behlendorf is the Executive Director of Hyperledger Project and he denoted that the Hyperledger Project is a collaborative effort designed to advance blockchain technology by identifying and addressing critical features for a cross-industry open standard for distributed ledgers that can reconstruct the way business transactions are managed globally.[11] Furthermore, he leads a strategic blockchain collaboration among leaders in finance, supply chain, banking, manufacturing, IT, and technology.[12] To summarize the case, according to Linda Hardesty (2017), focused projects of The Linux Foundation's Hyperledger Project, are divided into the following five sub-projects: Fabric, Sawtooth, Indy, Burrow, Iroha.[13]

7.8.2 FOODCHAIN®

Since the beginning of the human life on this planet, the fight against hunger has motivated human beings to discover foods, prepare them, and transport that final foods to the desired destination or craved location. Along similar line, nowadays, the observation of food industry has increased. According to this attitude, Foodchain® SpA works to improve the world of foods and all its aspects throughout the human lives.[14] In fact, Foodchain® works for the safety and transparency among food supply chain. According to the company report, Foodchain® blockchain-based application provides some tools to achieve traceability of materials and products securing the origin, attributes and compliance of the foods including standards through forcing accountability along the foods' supply chain.[15] Historically, Foodchain® was founded in 2016, and it is an Italian company which is headquartered in Lomazzo (Como).

Foodchain® is using a distributed ledger technology, and its network can interface with third parties supply chains providers, and it will have the ability to monitor physical items and transmit data associated with them. Moreover, the application will enable transparency at any point in the supply chain, and it allows all supply chain players (buyers/sellers) to be engaged at the point of sale. Additionally, the network of Foodchain® collects data from sensors and tags like QR codes, RFID and NFC and guarantees the full integrity of the deliveries and compatibility with third parties subsisting software. Moreover, the transmission of the information collected across the network is powered by a method called the Food Token, to consolidate transactions.[16] Additionally, Foodchain® possesses a protocol to track objects throughout any supply chain cycle, and it proposes to support the management of digital assets such as banking transactions, digital ID, and Cloud data storage.[17] Overall, Dominik Schiener (founder of CargoChain & co-founder of the IOTA) denoted that FoodChain is an interesting project because it places the entire origin of food production on the Blockchain, making it

possible for consumers to find out more about the origins of their food.[18] To conclude, it is important to highlight that Foodchain® has a close collaboration with universities and research centers in Italy, and it organizes various events to promote the innovations of food SC.[19]

7.8.3 T-MINING

T-Mining is the start-up of "Port of Antwerp", and it develops Blockchain-based solutions for transportation industry and container logistics in sustainable, reliable, effective, and productive manner. The Port of Antwerp has a geostrategic location to link the world trade with the European commerce. It is co-working and contributing with 150,000 people, and it possesses a close co-operation with private enterprises, the authorities and the Port Authority.[20] In June 2017, Port of Antwerp announced that T-Mining is currently working on a pilot project that will advance container handling more efficient and secure in the port of Antwerp. The report stated that thanks to the blockchain technology the processes that involve several parties (carriers, terminals, forwarders, haulers, drivers, and shippers) would be securely digitized without the need of engagement of any central middleman.[21]

Consequently, in December 2017, Port of Antwerp and Nico Wauters (CEO of T-mining) stated that "Smart Port" is part of a five-pronged program being promoted by the city of Antwerp to become a European leader for the Internet of Things (IoT). The interview has proved that the Antwerp start-up (T-Mining) has already taken its first concrete step towards Smart Port including a security system for collecting containers in the port.[22] In addition, according to the presentation of Nico Wauters (2016), the T-Mining offers a sustainable solution to ensure that containers are arriving at ports and they are handed over to the right party including truckers, barges, and rail transport providers.[23] Moreover, T-Mining has awarded the 2nd Prize in Singapore's Smart Port Challenge 2017, by its maritime-related proof-of-concept application to increase the visibility of the maritime logistics supply chain and relevant data from ships, freights, and containers to increase the performance of the global trade operations.[24]

7.8.4 TECHRACERS

TechRacers is a blockchain solutions provider, and it contributes trustworthy and proven blockchain-based applications to businesses promptly through maximizing the return on investment of the customers.[25] The company is based in Lehi (Utah), and it was founded in 2012. Initially, the TechRacers was established by a group of engineers from India, and it offers co-operation and application development concerning the ICO Launch, Smart Contracts Development, Smart Contract Audit, Cryptocurrency Development Services, Cryptocurrency Wallet Development, Developing Cryptocurrency Exchanges, and Private Blockchain.[26]

7.8.5 CHRONICLED

Chronicled Inc. works toward the Trusted Internet of Things (IoT) and Supply Chain Solutions. The company was found in 2014, and it is Headquartered in San Francisco (California).[27] The Chronicled company size is between 11 to 50 employees, and it extends smart solutions to solve problems of supply chain via Blockchain technology for the protected exchange of physical assets. According to the company announcement, Chronicled is the first company to leverage AI, IoT, and Blockchain technologies to empower smart end-to-end supply chain.[28] Moreover, Chronicled offers an Open Supply Chain Network which is designed to automate traceability, promote the financial transactions, and improve the business logic. The platform

helps trade partners to join the network and meet their regulatory requirements.[29] Eventually, Chronicled Inc. is the Founding Member of the Trusted IoT Alliance, and its platform builds blockchain-based supply chain networks with open platforms and protocols.[30] In conclusion, Chronicled Inc. believes that its team has paved the way for how enterprises and supply chain users engage with both Blockchain and IoT technologies.

7.8.6 FEDEX

FedEx Corporation or "FedEx - Federal Express" is an American multinational courier delivery services.[31] The company is headquartered in Memphis (Tennessee),[32] and in recent years it engages in the expansion of blockchain technology through the logistics and distribution industries. Besides, FedEx has a powerful collaboration with Milan Malpensa Airport and intermodal freight transportation through Italy (FedEx - Malpensa).[33] Consider that, The Milan Malpensa Airport has an appropriate role in Italian transportation of goods via air, and it is the busiest Italian airport regarding the cargo logistics. According to the report of Confetra (2012), in 2011, the Malpensa Airport transported the approximate amount of 450.446 (tons of goods) include the goods aviation from truckload, goods surfaces, and post parcels.[34]

Consequently, in 2017, the FedEx Express announced that the FedEx Corp. (NYSE: FDX) as the world's largest express transportation company, proclaimed that its new international gateway to Southern Europe is now fully operational at Milan-Malpensa airport.[35] Along similar lines of improvement, FedEx has interested in Blockchain technology and set up multiple workshops, events, and talks.[36,37,38] Besides, FedEx leads the FedEx Institute of Technology in Memphis, and it has a smart research collaboration with the University of Memphis.[39] Henceforward, the research, investigation, characterizing, and modeling of package dynamics in the network of express shipping services are required while FedEx and all other shipping companies are playing an increasingly important role in the prosperity of the market economy.[40]

Moreover, FedEx company through its 2017 Access FYI, has described how decentralized collaboration (Blockchain Technology) is becoming a central idea for FedEx.[41] Eventually, in October 2017, FedEx company join the Canada-based blockchain research centre [Blockchain Research Institute] which is originally founded by Don Tapscott and his son Alex Tapscott.[42] FedEx assumes that the institute maintains a reliable platform for logistics companies to pursue their Blockchain research projects. In fact, Blockchain Research Institute provides a blockchain platform for its members such as FedEx, KPMG LLP, Loblaw Companies Limited, and MKS (Switzerland) to promote their businesses.[43] Eventually, in January 2018, Vishnu Rajamanickam from the FreightWaves reported that FedEx plans to create common logistics standards in association with Blockchain in Transport Alliance (BiTA).[44,45] Consider that BiTA was formed by experienced tech and transportation executives to design a forum for the expansion of blockchain standards and education for the freight industry. The BiTA purpose is to "bring together leading companies in the freight technology industries that have a vested interest in the development of blockchain technology".[46,47]

7.8.7 MODUM

Modum is a data integrity system for the devices of the Internet of Things (IoT) and Supply Chain (SC) operations while it is empowered by the Blockchain technology.[48] Modum works as a supply-chain monitor for the pharmaceutical sector that allows companies to comply with legislation from the European Union concerning the delivery of medicinal stocks. Modum consolidates IoT sensors with blockchain technology and strives to provide data integrity for

transactions including physical products. Moreover, Modum provides a passive monitoring solution to streamline the supply chain processes in several divisions of the distribution and retail industries. Additionally, the Modum sensors record the environmental conditions of the goods during their transition, and when cargo or containers change their ownership.

Moreover, the sensor verifies data and protect goods against predetermined conditions in a smart contract in the blockchain. According to the CWB (2018), Modum implies a passive monitoring device that places with freight to monitor the temperature, and during the shipment, the goods' temperature and container position are monitored.[49]

Furthermore, when freight is received by the customer, the data is reported back to the blockchain platform, and it is publicly viewable to the shipper, logistics service provider (LSP), customs broker, distributor, carrier, and the consumer. According to the Modum's White Paper, the first product of Modum has designed to offer an efficient eco-system to comply with recently tightened regulatory provisions for the transport of medicinal products for human use in the European Union.[50] In fact, Chapter nine of the Good Distribution Practice regulation (GDP 2013/C 343/01) instantly requires proof that shipped medicinal products have not been opened or endangered that may have compromised their quality, in particular, regarding their required regular temperature.[51] Besides, the White Paper declared that during the Modum's extensive proof-of-concept phase, the pilot projects with various clients have ascertained that the Modum solution has achieved its highest value as a Last-Mile logistics services and within the Pharma SC.[52] Hence, Modum offers its solution in a "pay-per-shipment" standard.[53]

7.8.8 TILKAL

The trade slogan of Tilkal is "let your products tell their story", and this motto properly explains what is Tilkal all about.[54] Along similar position, Tilkal is a blockchain platform that provides secure and provable traceability across the customer's end-to-end supply chain. According to the Tilkal Solution Overview, the Tilkal blockchain platform enables the secure collection of data from any number of supply chain participants, software systems, and the Internet of Things (IoT) sensors.[55] Tilkal permits a decentralized approach to end-to-end traceability that grants unprecedented transparency while maintaining cast-iron accountability and data confidentiality. Further, an Immutable Digital (ID) for every element of the supply chain would approve a comprehensive record of every update or logistics action even for large-scale production volumes.[56] So, the Blockchain platform of Tilkal is focused on:

- Highly secure, permission-based access
- Assured confidentiality
- Distributed and resilient infrastructure
- Built for high throughput

Furthermore, the partners and members of Tilkal platform include companies like MultiChain, Agoranov, Fédération Des Tiers De Confiance Du Numérique (FNTC), and GS1 France. Having said that, MultiChain is an Open platform for building blockchains, and it supports many B2B and C2B organizations to build, develop, expand, and deploy their blockchain applications

speedily. The core competencies of MultiChain include Rapid deployment of blockchains for cross-chain applications, Unlimited asset tracks, Data streams and creation of multiple key-values, and subsequently control on the Fine-grained permissions.[57] Hence, it would be useful to mention that Tilkal, like many other blockchain-based platforms, utilizes the Digital ID to determine the unique story of products and promotes transparency, sustainability and ethical behaviors, and to bring it into the digital fabric of the supply chains' actors and transforming the goals of logistics industry into an actions that encourage business differentiation.

7.8.9 USPS

The United States Postal Service (USPS)[58] also acknowledged as the U.S. Mail, Post Office, and Postal Service is an independent agency of the United States federal government.[59] USPS is responsible for implementing postal service in the United States, and it is headquartered at L'Enfant Plaza in Washington, D.C. In May 2016, CoinReport announced that USPS is examining the potential postal performances of blockchain applications through the logistics and retail industries.[60] In fact, the report of USPS declared that a verified digital ID would allow USPS users to identify the peers with whom they are interacting and possess the proof of ownership. Sequentially, the USPS's Postal Services could confirm IDs in person at the adequate post offices by using the ID cards or a biometric identifier.[61,62]

The report summarized the potential powers of a postal Blockchain-based application in four major business areas: Financial Services, Device Management, Identity Services, and Supply Chain Management. In addition, the report recommended that USPS could leverage the blockchain to build and manage the "Internet of Postal Things" which will reduce the cost of conventional and centralized logistics operations. To conclude, the report expressed that the Blockchain technology, as a decentralized information system and value transfer platform, has the potential to disrupt sectors that depend on intermediaries to complete verification and track projects. The report continued, the USPS could benefit from blockchain technology in the short term by investigating the technology and likely experimenting with blockchain-based solutions for financial duties. Then again, over time, these experiences and experimentations with blockchain could develop into other sectors, such as identity services, device management, and it would increase the control over the e-commerce supply chain.[63]

7.8.10 VECHAIN 唯链

VeChain (唯链 or Only Chain) is a blockchain platform that offers Blockchain-as-a-Service to enterprises, to promote their productivity and aid them with exchange of information by leveraging on blockchain technology.[64] VeChain or also listed as Shanghai Weilian Information Technology Co. Ltd (Shanghai VeChain) was founded in 2015 and it was registered in 2017.[65] Besides, VeChain attempts to build a trust-free and distributed business ecosystem, which is self-circulated and it is scalable for all users. According to the social webpage of the company, the VeChain Foundation is a non-profit entity, and it is established in Singapore.

Furthermore, according to CWB (2018), the "VeChain has developed a powerful blockchain-enabled enterprise software platform",[66] and it allows manufacturers to select products with a unique identity, which then allow companies, supply chain partners, and customers to interact with the product through the VeChain's platform. Alternatively, the application of VeChain practices blockchain technology to ensure the security of the data which is collected and allocated via private keys to every member of the supply chain.

Additionally, VeChain denoted that the logistics industry has evolved very quickly, but each supply chain member is involved in operation individually, and its information and data are apprehended in the separate silos of the company. This detachment results in incapability and unproductively, which is recognized as a bottleneck for the logistics industry. Further, VeChain believes that VeChain Logistics Platform would provide customers with the reliable services and accurate logistics information of every single product, and develop the logistics networks and business models of the enterprises.[67] In conclusion, in May 2017, the PwC China and PwC Singapore announced that VeChain as an incorporated blockchain service provider becomes a portfolio company of PwC's incubation program.[68,69]

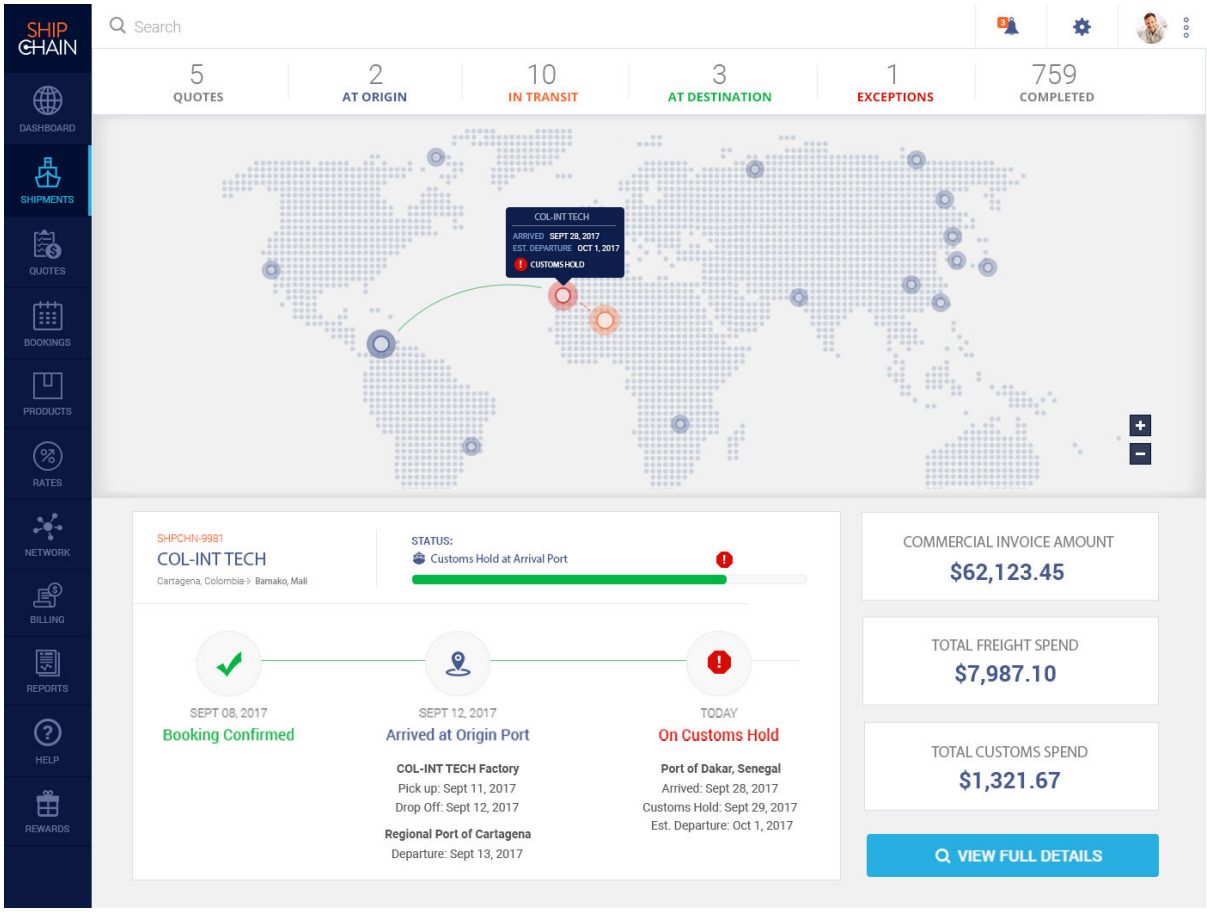

Fig. 7.8.1: A Screenshot of ShipChain Platform © Image: SHIPCHAIN White Paper

7.8.11 SHIPCHAIN

The ShipChain[70] company was founded in 2017, and it is headquartered in Los Angeles (California).[71] ShipChain works concerning disrupting transport and logistics approaching the Blockchain, and the company is specialized within the fully integrated IT systems concerning the integrations and performances in the logistics industry, shipping, and freight transportation. ShipChain aims to integrate operation systems across the entire supply chain, from the moment a cargo leaves the warehouse, to the final delivery on the doorstep of consumers. It aims to satisfy the needs of logistics customers via a trust-less and transparent blockchain arrangement.

According to the website of the company, the platform is based on a simple but powerful solution so-called "Track and Trace".[72] Also, the ShipChain ecosystem would encompass all methods of freight, and it would include an open Application Programming Interface (API) architecture that can combine with existing freight management software.[73]

Additionally, according to the White Paper of ShipChain, despite the revolution brought on by the advent of the truck, the ship, the engine, and the airplane, unfortunately, the shipping industry was slow to adapt and evolve over the past century. Hence, now it is time for a breakthrough in how shipping industry handles freight, and ShipChain attempts to resolve the major bottlenecks of the Supply Chain (SC) by offering a unified communication platform in which the several players of SC can interact efficiently.[74] To summarize, it is useful to mention that the ShipChain is an extensive case for whom is interested in the implementation of blockchain technology in shipping services and freight transportation (also review Fig. 7.8.1).

Eventually, in conclusion of this Unit, it would be reasonable to mention that the Blockchain technology and its relative applications are growing rapidly in various section of businesses and industries. Some of these blockchain-based applications/platforms/initiatives are including Skuchain,[75] Blockfreight™ (for global freight and bill of lading),[76] Penske Truck Leasing Co.,[77] Wave™,[78] Block Verify (for item verification and product traceability),[79] SONM,[80] TallySticks (Import/Export Solutions),[81] Kubernetes,[82,83] JD (京东),[84] Waves Platform,[85] Chain of Things (process automatization),[86] Chroma Way,[87] CONSENTIO,[88] Fluent (for international trade),[89] Gatechain,[90] Mendix (an IoT Application),[91] Docker,[92] Open Trade Docs (OTdocs),[93] Acorn (Open-Access),[94] Battaglio,[95] Caravaggio,[96] Cognizant,[97] Kouvola Innovation,[98] SYNECHRON,[99] Zerado (for the technology consulting),[100] INTTR,[101] Everledger (A Digital Global Ledger),[102] Filament,[103] CHAIN CORE,[104] and PROVENANCE.[105] Therefore, the author would like to express that aforementioned introduced case studies are only a few drops from an infinite ocean. Hence, the further research and investigation are recommended.

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[91] Mendix: https://www.mendix.com. According to the Mendix company description, the Mendix is "the fastest and easiest platform to build and continuously improve mobile and web applications at scale".

[92] Docker: https://www.docker.com

[93] Open Trade Docs (OTdocs): otdocs.com. It aims to accelerate and secure the trade finance ecosystem by removing redundancy and by reduction of bottlenecks or unnecessary compliance costs.

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[97] Cognizant (Nasdaq-100: CTSH) is a professional services company (LinkedIn), and it has developed a platform to change the way companies transact with each other (https://www.cognizant.com/blockchain)

[98] Kouvola Innovation (https://www.kinno.fi/en) is a project partner of SmartLog which is a Proof-of-concept project for IoT blockchain solution in the logistics industry (https://www.kinno.fi/en/smartlog).

[99] Synechron (digital business consulting): https://www.synechron.com/finlabs/blockchain. Synechron Blockchain has designed to provide an accelerator which can reduce cost, increase security, enhanced transparency, improved efficiency and enriched customer experience.

[100] ZERADO: http://zerado.com/en/. It is a technology consulting and product development company that accommodates its clients to develop and implement blockchain technology through their businesses.

[101] INTTRA: https://www.inttra.com. INTTRA is an electronic transaction and information provider platform concerning the ocean industry digitization, shipment, and technologies.

[102] Everledger: https://www.everledger.io. Everledger is a London-based startup and it is focusing on the utility of distributed ledger and consensus-based technologies. Moreover, the Everledger uses emerging technologies including blockchain, smart contracts, and machine vision to support the reduction of risk and fraud for banks, insurers and open marketplaces. In conclusion, Leanne Kemp (the CEO & Founder of Everledger) believes that its provenance platform is a digital global ledger that tracks and protects items of value (review: https://www.youtube.com/watch?v=VnVgf1W0FB0)

[103] FILAMENT: https://filament.com. Filament aims to enable the future of IoT, and it tries to maximize the potential of connected machines and devices to transact and exchange their value via blockchain. Also, it aims to aid and benefit enterprises and industrial IoT by connectivity and data sharing (White Paper). In fact, Filament's software and its Blocklet Chip™ hardware solutions allow devices to securely interact and transact with blockchain platforms. Consider that the Blocklet Chip™ will "allow industrial corporations and enterprises to seamlessly extract the value of recording and monetizing data assets".

[104] CHAIN CORE (Financial Services): https://chain.com. It develops cryptographic ledgers that empower breakthrough financial products. CHAIN CORE is an enterprise-grade blockchain infrastructure that allows organizations to establish trustworthy financial services from the ground up.

[105] PROVENANCE: https://www.provenance.org. The social enterprise of Project Provenance Ltd. describes that the PROVENANCE is "a prototype that uses blockchain technology to enable secure traceability of certifications and other salient information in supply chains". According to the PROVENANCE's White Paper (2015), everyone on PROVENANCE has a profile accessible with a private key, and profiles can be public or private depending on use case and permissions while some of the profiles are rich with information, whilst others simply contain an anonymous ID.

ANALYSIS OF CASES

7.9.1 ANALYSIS AND COMPARISON OF PREVIOUS USE CASES

Throughout the previous seven (7) sections of the 2nd PART, seven (7) use cases have been explained comprehensively. However, in the following brief review, readers would be able to comprehend heedfully an overview of aforementioned blockchain-based applications, and they can compare them one with another. The impression of make comparison between the Blockchain-based applications is an outstanding issue because of its value to marshal the influx of the new Blockchain-based applications through the logistics industry. In this circumstances, some proposed criteria are including: objectives of the applications (or platforms), involved actors (carriers, logistics providers, 3LPs, shippers, and port authorities), use of the blockchain technology (why blockchain is used?), rewarding mechanism, its position in Supply Chain, and how is the blockchain used? or if is there any use of Smart Contracts?

Therefore, the following table (Table 7.9.1) represents these similarities and diversities within a single framework. Apparently, the most similarities are concentrated around the concept of the utilization of Smart Contracts. As a matter of fact, all mentioned Blockchain-based applications are beneficing from the extraordinary capacities of Smart Contracts. Hence, this argument is very important for enhancement of all aspects of all industries such as: logistics industry, retail industry, international shipping industry, intermodal freight transportation, and the optimization of distribution organizations. Having said that, Smart Contracts are owning some remarkable advantages and they could offer a crucial technological assistance for the procurement of legal settlements and development of logistics performance. Moreover, the replacement of the conventional paper-based CMR documentation with the novel E-CMR convention is strictly required as well.[1,2] According to the IRU's history, the Convention on the Contract for the International Carriage of Goods by Road (CMR) is signed in 1956, and it is time to update the traditional CMR from a paper-based contract into a novel blockchain-based contract.

Having said that, another important issue that describes the Table 7.9.1, is its principal information regarding the objectives of the use cases and their practical applications. First, all of the cases have been worked to promote and support a significantly wide range of industries and businesses. Also, they strived technically and strategically to serve the international trade, and they tried to settle it among their developed core competencies. Secondly, almost all applications attempted to offer a fully transparent procedure to all nodes of the supply chain; from the overseas shipping companies into the agents whose work concerning the authenticity certifications and dematerialization of transactions.

BLOCKCHAIN App.	Objectives	Actors	Usage	Rewarding Mechanism	Position in SC	Private, Public, or Consortium	Smart Contracts
MTI (SolasVGM)	Fully transparent shipping procedures	Various actors	Shipping industry	-	Between vessels and terminals (ports etc.)	Public	Yes
CargoChain	Promote international trade	Dominik Schiener, Wanxiang Blockchain Labs and Shanghai Blockchain Hackathon	Assist the Financial part of the SC	Presumably Ether tokens	Financial transactions	Public	Yes
REPLY	Mapping business scenarios, process automation, Authenticity certification, and dematerialization of transactions	Supply chain ecosystem, REPLY pilot studies, and Red Reply	Vehicle registration, Change in ownership, Verification of the actual ownership of the vehicle, and Car scrapping	Depend on application	In various areas	Private, Public, and Consortium	Yes
Rotterdam (BlockLab)	Monitoring the attainable containers or bulks' data	Several actors	SC and Intermodal Freight Transportation	Not specified explicitly	Sea and fluvial port	Public, and Consortium	Yes
Walmart	Food supply chain transparency, and Disrupt the Last Mile Problem	IBM and Tsinghua University	Track the pork supply chain in China	Not declared but seems OriginTrail is based on a token economy	Logistics and supply chain of Walmart food stores	Private and consortium (e.g. Hyperledger Fabric and OriginTrail)	Yes
IBM	Promote regional, national, and international supply chain	Various business companies and administrators (e.g. government of Dubai)	support point-to-point network and add selected IoT data in various businesses	Relevant	Over the entire supply chain	Private, Public, and Consortium	Yes
Maersk	Secure the information sharing and shipping data via blockchain	All logistics parties and business entities	International trade and international freight shipping	Not specified explicitly	Sea shipping and Intermodal freight transportation	Private and consortium	Yes

Table 7.9.1: The Summary of Blockchain-based Use Cases

Conclusively, the usage and implementation of the Blockchain technology toward the intensification of the Financial Supply Chain, shipping management, and intermodal freight transportation is in the center of all actors' consideration (please review Fig. 7.9.1).[3]

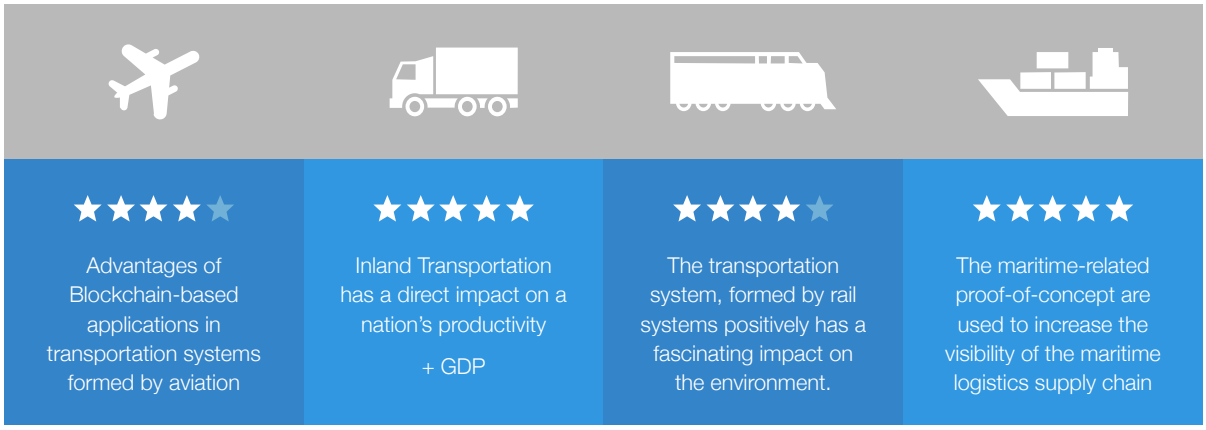

Fig. 7.9.1: The Spectrum Of Blockchain Technology Through The Transportation Modes

Additionally, comprehensive studies concerning the cyber-security and privacy issues during transportation cyber-physical systems (TCPSs) and the data security of the supply chain actors in entire chains of the blockchain-based network are required.[4] These studies are essential to examine theories and various technologies and methodologies concerning the smart-transport-system architecture which would be designed based on advanced platforms such as IoT and cyber-physical systems. Also, the review of the intensification of research concerning the "machine learning model-driven adaptive approach",[5] Big Data,[6] Artificial Intelligence,[7] Sensors Data,[8] and "RFID in the Internet of Things (IoT)" by CISC might be beneficial.[9]

Furthermore, it is accurate to mention that in case of OriginTrail (Built Protocol for SC), their platform does not follow a sinuous trail through the outside world of the Supply Chain Management (SCM) but it is a straightforward protocol. Moreover, it encompasses a Rewarding Mechanism which is based on a token economy. Having said that, probability it is useful to look back in 2008, in initial definition of SCM by Keith Oliver (Senior Vice President of Booz Allen Hamilton) when he denoted that the "Supply chain management (SCM) is the process of planning, implementing, and controlling the operations of the supply chain with the purpose to satisfy customer requirements as efficiently as possible".[10] Also, Keith Oliver has considered that the "Supply Chain Management spans all movement and storage of raw materials, work-in-process inventory, and finished goods from point-of-origin to point-of-consumption". This remarkable insight might refresh the mind about the objectives and goals of SCM which could be apply nowadays through the novel technology of Blockchain and its ample platforms.

In conclusion, it is important to mention the influential contribution of these three prominent realities: IOTA, Hyperledger Project, and BiTA. Firstly, IOTA needs to be mentioned because it is a real distributed ledger platform and it is practical to redefine the trust and transparency.[11] Secondly, the Hyperledger Project which is conceivably the most opulent open source platform to support the blockchain developers. It is formed by the Linux Foundation in which IBM was a founding member. Moreover, transportation and retail companies such as FedEx and Walmart are using/participating some technological projects, and they endeavor to develop their desired platforms/applications based on Hyperledger Fabric.[12]

Eventually, it is important to highlight the remarkable role of standardization for any industry. By including this feature, Blockchain in Transport Alliance (BiTA) aims to create some common logistics standards as an association formed by experienced tech and transportation executives. BiTA works to outline a forum for the expansion of the blockchain standards and guidance for transportation, logistics, and shipping industries.[13] Also, it purposes to "bring together leading companies in the freight technology industries" for "development of blockchain technology".[14]

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PART III

Overview

APPENDIX I: Bike sharing & Future of Sharing Containers

APPENDIX II: Crude Oil Price & European Logistics

APPENDIX III: MTI & SOLAS VGM Software

APPENDIX IV: Verona Terminal Peak Time

APPENDIX V: Evolution Of Container Fleet

APPENDIX VI: USA GDP & Italian PIL

APPENDIX VII: Oil Prices & European Transportation

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APPENDIX I: BIKE SHARING & FUTURE OF SHARING CONTAINERS

Obike Advantages:

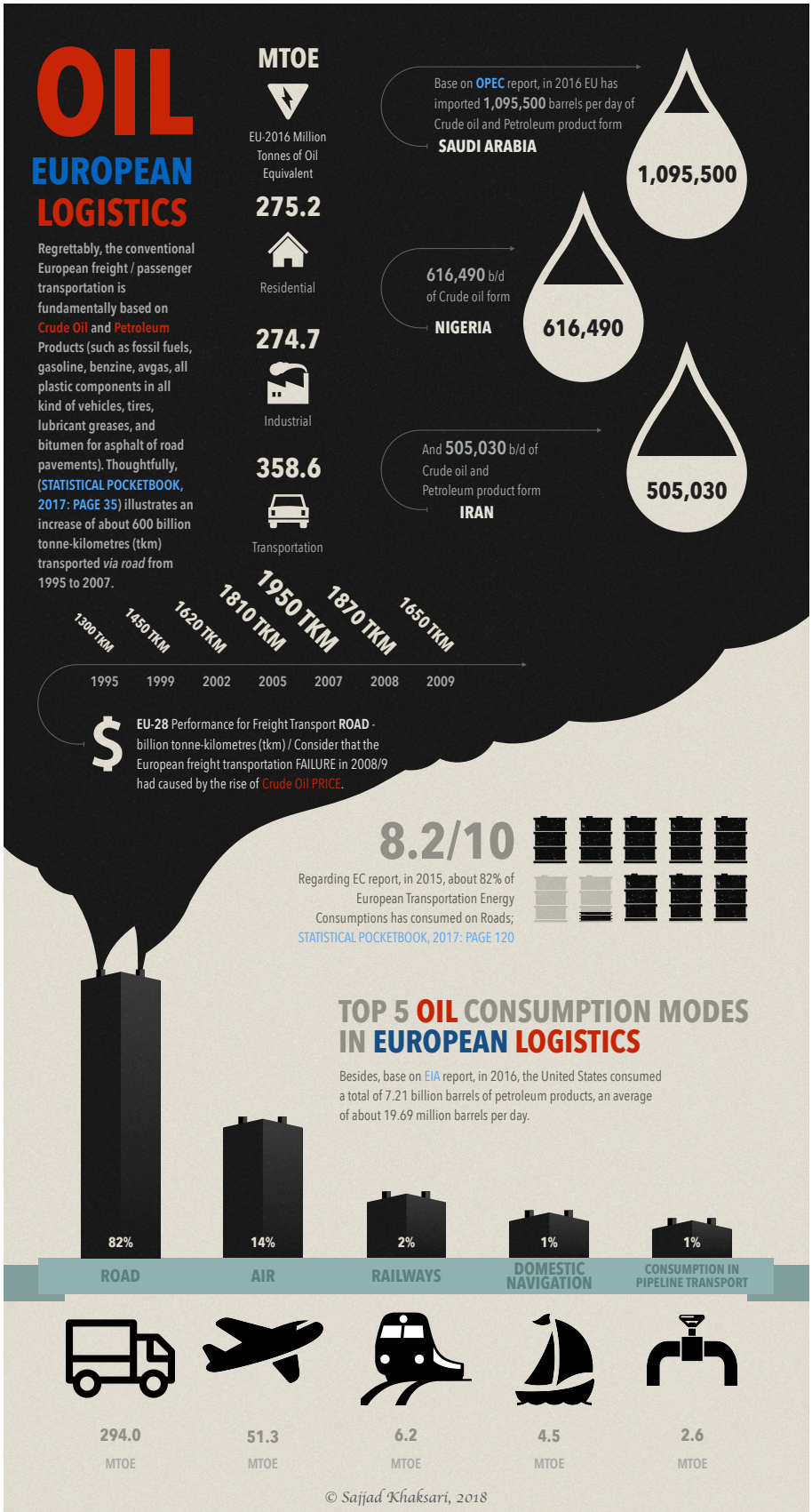
* Easy picking up with simply scan the QR code of the bike.
* Security and GPS track of bike concerning the geo-location technology.
* Possibility to leave the bike in any public place.

Gobee.bike Advantages: **1**. Find a Bike **2**. Scan & Ride **3**. Lock

Container Sharing Advantages:

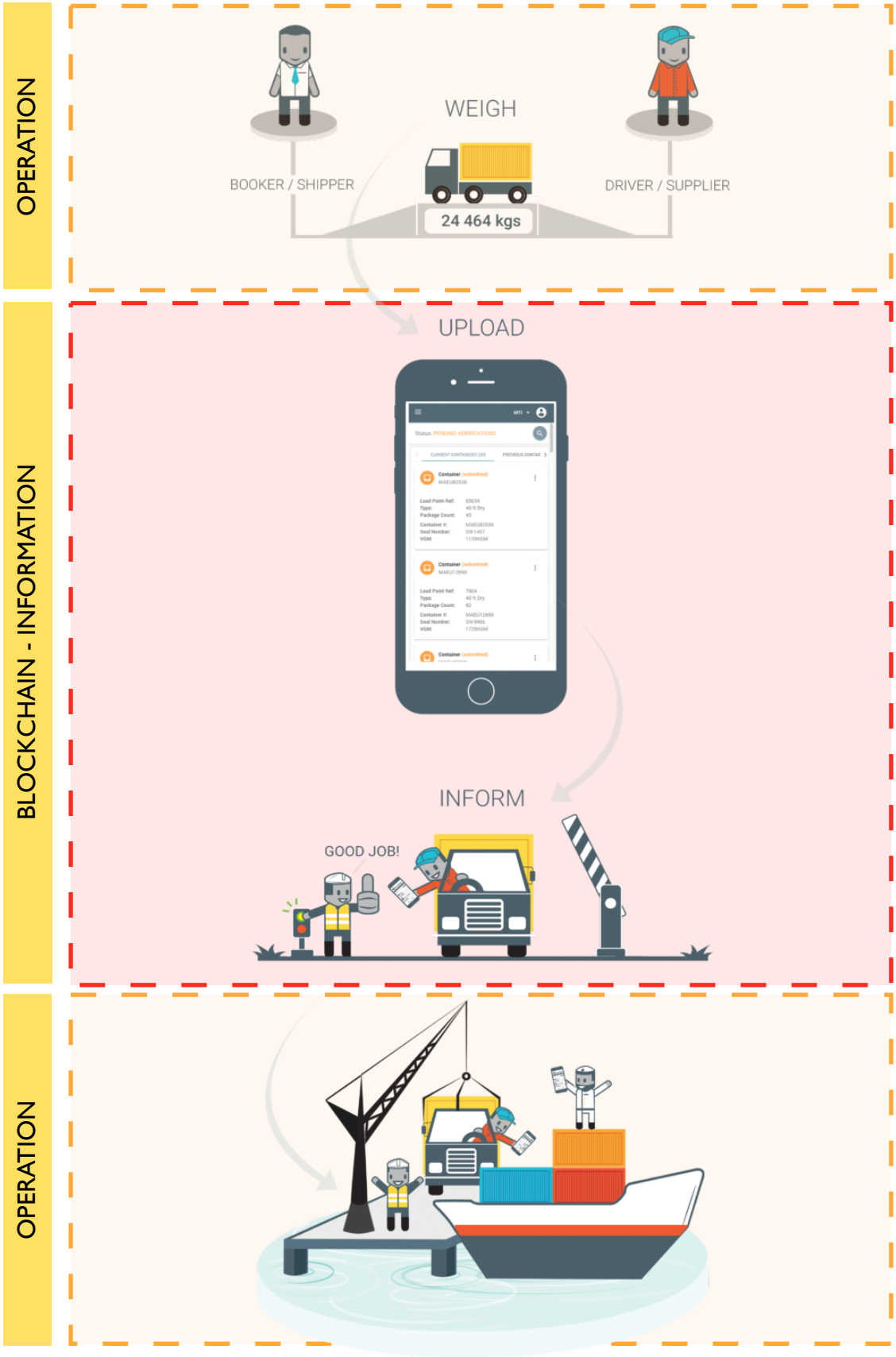
* Possibility to park the Container everywhere.
* The possibility of picking up the Container everywhere.
* The transparency and assurance by BLOCKCHAIN.
* Easy access by scanning the QR code of the Container.
* Increase the approachability of Supply Chains and Multimodal transports.
* Decrease of Truck Idling.
* Reducing the carbon footprints - Less CO2.
* Increase of sustainability.
* Improvement of productivity.

APPENDIX II: CRUDE OIL PRICE & EUROPEAN LOGISTICS AND TRANSPORTATION; INFORMATION RESOURCE STATISTICAL POCKETBOOK (2017): SECTION 2.2.1: EU-28 PERFORMANCE FOR FREIGHT TRANSPORT 1995–2015 – BY MODE, PAGE 35; AND SECTION 3.1.5: FINAL ENERGY CONSUMPTION 2015 - BY SECTOR (MTOE); PAGE 120.



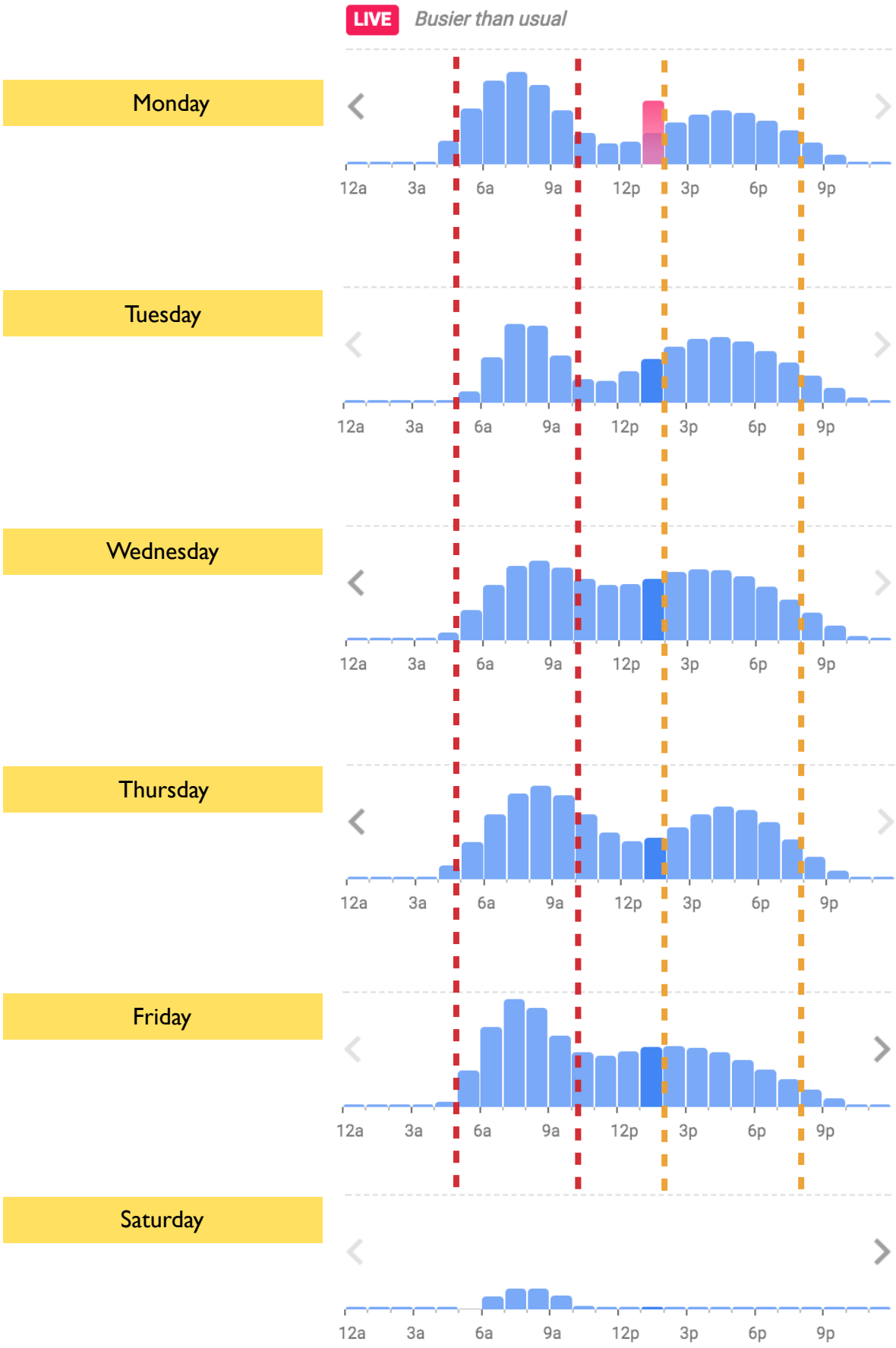
APPENDIX III: SOLAS VGM SOFTWARE

Note that the SOLAS VGM is a fully BLOCKCHAIN application.[1] The following picture (originally from the SolasVGM website) schematizes the SOLAS VGM solution starting from shippers into destination.



[1] SolasVGM: http://solasvgm.com

APPENDIX IV: PEAK TIMES - TERMINAL QUADRANTE EUROPA - VERONA



Note: The case of "Terminali Italia S.R.L." in Verona which has analyzed base on information and Business Analysis of Google Maps concerning the number of visits, reveal a notable traffic of visitors in every working day (except Saturday) from 5 am to 10 am. In another side, despite the early morning Peak Time, the traffic of visitors shows nearly a smooth curve of influxes between hours of 2 pm and 7 pm.

APPENDIX V: EVOLUTION OF CONTAINER FLEET

Note that the table is prepared and released by (Confetra, 2017). The source of information and the international examinations are based on BRS-Alphaliner reports.[1] The table precisely illustrates the evolution and aggregate increase of container fleet from 1.718.367 TEU in 1990 to 19.914.293 in 2016.[2]

EVOLUZIONE FLOTTA PORTA CONTAINER

Anno	Numero	Var % anno su anno	Teu	Var % anno su anno
1990	1.240	-	1.718.367	-
1991	1.312	5,8%	1.857.503	8,1%
1992	1.399	6,6%	2.016.710	8,6%
1993	1.490	6,5%	2.213.008	9,7%
1994	1.593	6,9%	2.396.537	8,3%
1995	1.739	9,2%	2.662.761	11,1%
1996	1.912	9,9%	2.990.979	12,3%
1997	2.107	10,2%	3.369.265	12,6%
1998	2.336	10,9%	3.877.262	15,1%
1999	2.516	7,7%	4.298.643	10,9%
2000	2.615	3,9%	4.528.051	5,3%
2001	2.730	4,4%	4.957.928	9,5%
2002	2.894	6,0%	5.569.104	12,3%
2003	3.031	4,7%	6.137.345	10,2%
2004	3.179	4,9%	6.683.146	8,9%
2005	3.344	5,2%	7.326.204	9,6%
2006	3.599	7,6%	8.267.501	12,8%
2007	3.938	9,4%	9.593.904	16,0%
2008	4.306	9,3%	10.925.419	13,9%
2009	4.657	8,2%	12.367.723	13,2%
2010	4.719	1,3%	13.057.788	5,6%
2011	4.895	3,7%	14.331.573	9,8%
2012	4.960	1,3%	16.334.345	14,0%
2013*	4.985	0,5%	17.375.220	6,4%
2014	5.088	2,1%	18.687.429	7,6%
2015	5.156	1,3%	19.909.366	6,5%
2016	5.116	-0,8%	19.914.293	0,0%

* i dati 2013-2016 derivano dagli ordinativi in corso

Fonte: BRS-Alphaliner

[1] BRS-Alphaliner: https://www.alphaliner.com / "Alphaliner is tailor-made for use by liner shipping executives, shipbrokers and other shipping professionals. The vast majority of liner operators and container ship owners as well as leading shipbrokers use it daily."

[2] Confetra (2017), Evoluzione Flotta Porta Container, Confetra - Confederazione Generale Italiana Dei Trasporti E Della Logistica - Via Panama 62, Roma. [Online] Available: https://goo.gl/LgQBua

APPENDIX VI: USA GDP & ITALIAN PIL (GDP) - The original diagram had been illustrated by Prof. Piercarlo Ravazzi (1998), Complementi di economia, CLUT, Polytechnic of Turin.

USA Economy anticipate EU Economy !!!

1.7 Economia internazionale: confronti con U.S.A., Giappone e U.E.

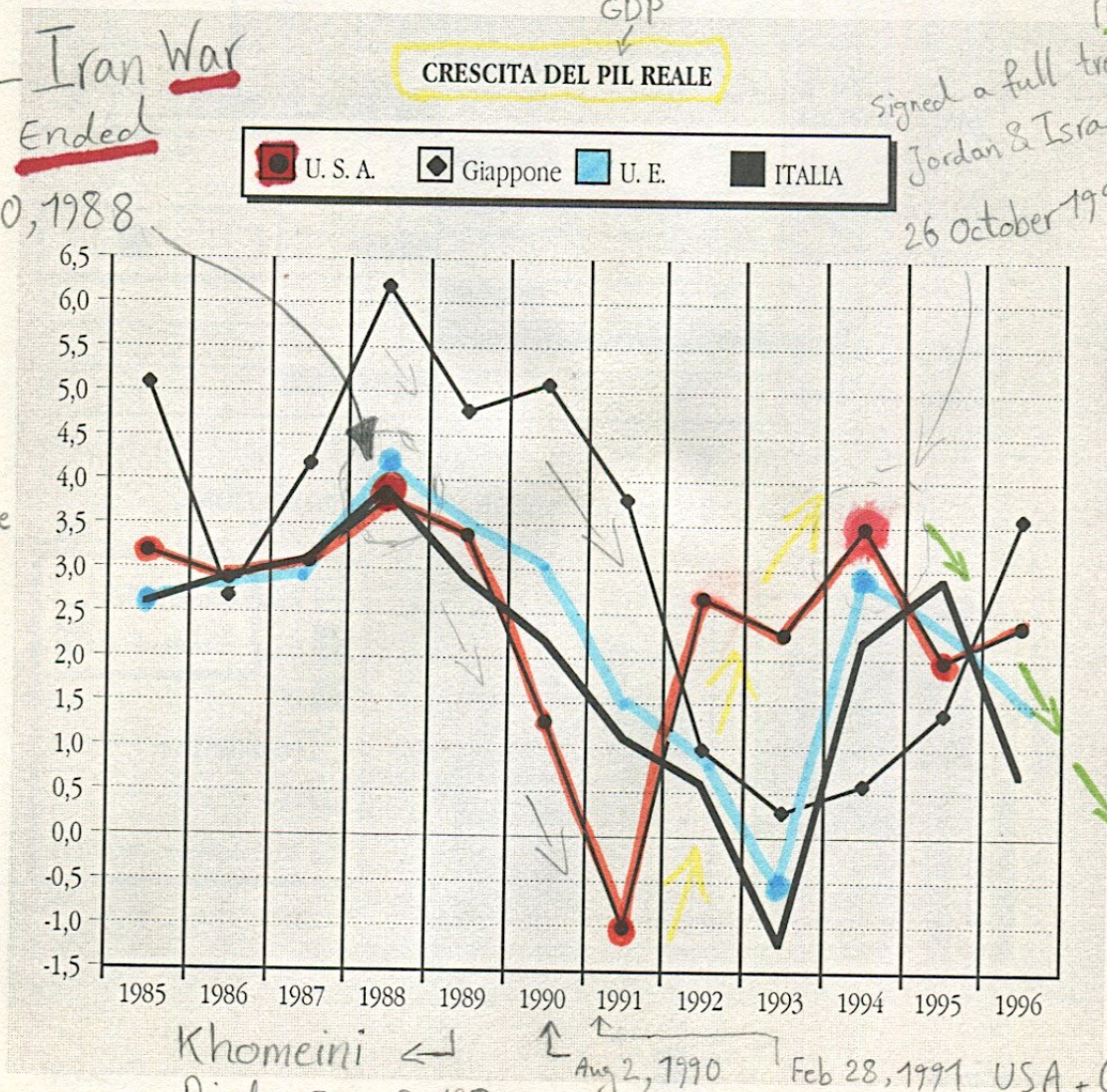
1.7.1 Crescita (valori percentuali)

Based on Crude Oil!

GDP

Iraq – Iran War Ended → Aug 20, 1988

Peace! Signed a full treaty of Jordan & Israel 26 October 1994



Oil Price ↓ GDP ↘

Khomeini ← Died: June 3, 1989

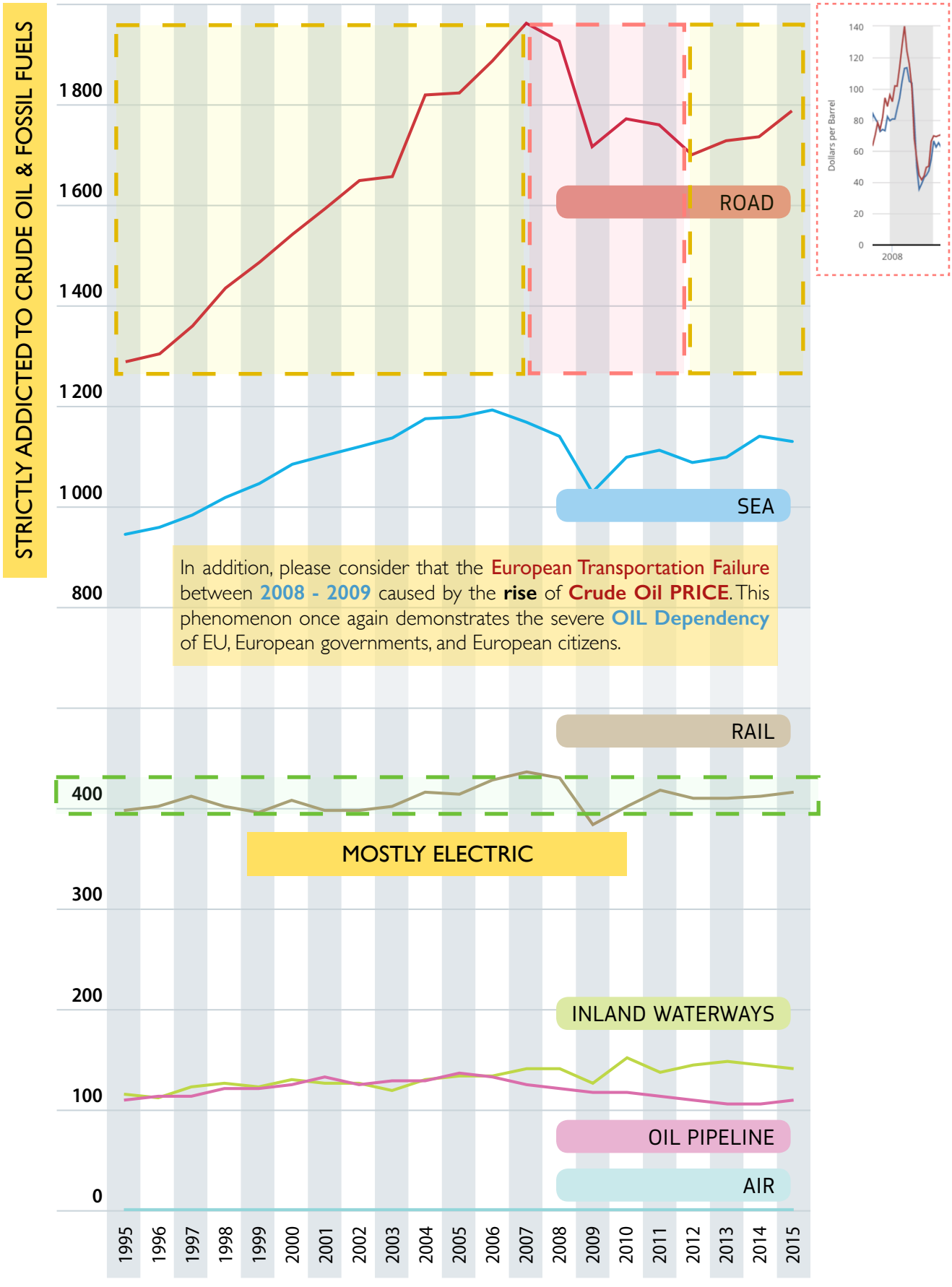
Aug 2, 1990 Gulf (persian) War

Feb 28, 1991 USA + GB are war winners!

Osservazioni:

1. si rileva palesemente il fenomeno della *trasmissione* e *ripercussione* del ciclo economico;
2. il ciclo italiano è sincronizzato su quello dell'U.E. ma la sua *performance* è stata mediamente peggiore;
3. il ciclo U.S.A. a volte anticipa (1-2 anni) quello dell'U.E.;
4. il tasso medio giapponese si è gradualmente allineato a quello U.S.A.

APPENDIX VII: EU-28 PERFORMANCE FOR FREIGHT TRANSPORT 1995–2015 BY MODE - BILLION TONNE-KILOMETRES (TKM) - (Originally from EUROSTAT, 2017)



PART IV

Overview

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About the Back Cover Photo:

The picture illustrates an intermodal terminal in Frankfurt (Germany). The image aims to denote some physical and analytical gate barriers among European intermodal freight transportation, including the shortage of Synchromodality within logistics functions (EU authorities, containers, trucks, dry/sea terminals, train, and cargo vessels). The picture has positioned intentionally in the vertical state to indicate and consider a virtual reality-based future for the sustainability of the European Intermodal Freight Transportation.

DISTRIBUTED LEDGER TECHNOLOGIES APPLIED TO LOGISTICS SYSTEMS

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