Emerging trends in e-logistics

Gea Miščević[1], Edvard Tijan[2], Dražen Žgaljić[3], Mladen Jardas[4]
[1] Franca Prešerna 50, 51000 Rijeka, Croatia
[2,3,4] University of Rijeka, Faculty of Maritime Studies, Studentska 2, 51000 Rijeka, Croatia
miscevic.gea@gmail.com, etijan@pfri.hr, zgaljic@pfri.hr, mjardas@pfri.hr

***Abstract* - In the recent years technological trends behind logistics processes haves evolved significantly, from traditional logistics to widespread use of e-logistics. This transition is of crucial importance for the competitiveness within the logistics market. Internet of Things and Internet of Everything have a strong influence on the logistics itself, though it may not be entirely visible to the end user. Supply chain management changes and evolves, just as much as 3rd-party logistics and 4th-party logistics expand towards 5th-party logistics. E-Logistics develops various disciplines in which cloud-based operations, m-logistics, as well as Mobile Supply Chain Management and augmented reality are important segments in the future of logistics. There are no visible limits to aforementioned development; we are witnessing a completely new paradigm of logistics and supply chain management.**

Keywords* - *e-logistics; future logistics; cloud logistics; supply chain management

I. INTRODUCTION

Information and communication technologies (ICT) are of key importance for development of the competitiveness of logistics enterprises. Traditional businesses, not enhanced by ICT, will find it difficult to respond to the needs of the modern market. The e-commerce has become very important because of its speed, cost-effectiveness, transparency, green orientation and the way in which it analyses and processes data. In parallel, logistics is evolving into e-logistics.

There are various definitions of e-logistics, but one all-encompassing is that e-logistics is actually a transformation of the classic tools used for logistics processes in a modern way, and backed-up by Internet based technologies. However, the use of the Internet technologies in logistics processes does not mean that logistics becomes „electronic". E-logistics is essentially a complex entity (system), which includes manufacturers (distributors), logistics centres, resellers, carriers, consumers among which there is an electronic exchange of data via Internet or dedicated electronic networks with the help of mobile (wireless) and wired communication technologies with the aim to reduce data errors and improve efficiency in decision-making and more [1].

Figure 1 shows four logistics development scenarios [2], with the greatest potential for development.

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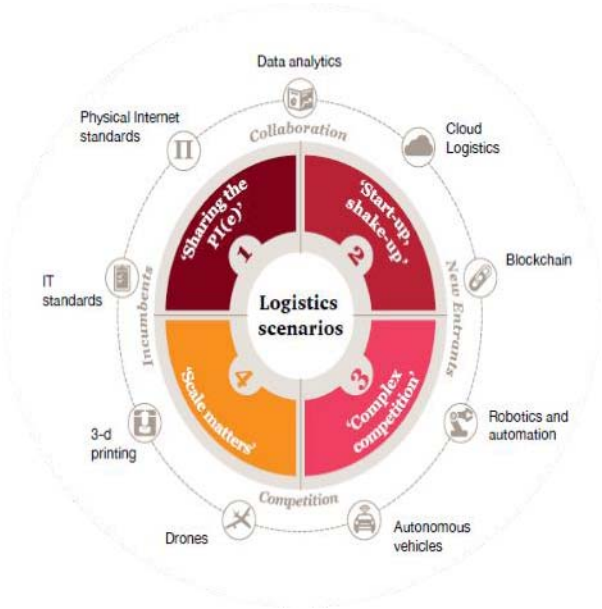

Figure 1. Logistics scenarios [2]

Some of these areas, such as cloud computing, robotics, automation and implementation and compliance with current ICT standards, are already largely implemented in logistics. For instance, the 'sharing' concept is currently thriving in logistics – from Uber-style approaches and last-mile delivery to more formal joint ventures and partnerships at the corporate level, the whole sector is redefining collaboration. But much of this is hampered by inconsistencies in for example shipment sizes, processes or IT systems. The Physical Internet promises great things for the sector, coming along with increased standardization in logistics operations [3].

II. E-LOGISTICS IN USE

In the next few chapters, some of the most used e-logistics tools or e-logistics sectors will be described and some examples of their use will be provided.

A. Cloud in logistics

Cloud computing is a term used to describe the usage of the Internet to access data, information or software. The idea behind this form of computing is that the user is no longer dependent on his PC (Personal computer), but (s)he can input and receive data independently of his

current location and distance from office and PC. This way all the information is accessible to the user regardless of used device, as long as the user is able to connect to the Internet (by laptop, smartphone, tablet etc.).

The most significant advantage of cloud computing is that it enables new platform-based business models and increases efficiency. On the other hand, cloud computing disadvantages are that the projection of costs can be unclear since once a certain scale is reached, physical data centers still tend to be cheaper for a larger company with massive demands. Also, a potential problem could be data security [4].

B. Mobile logistics

Smartphones have gained their popularity due to convenience and the possibility that the user is available everywhere and can attend to the tasks immediately. Smartphones enable product browsing, selection and shopping on-the-go. Similar to individual consumers, industrial customers expect to get shipments faster, with more flexibility and transparency at a lower price [5].

When someone, for example, buys a product through an online shop, they can track the entire course of the shipment starting from order, to warehousing, transportation, and final delivery at the door (last-mile delivery). The idea that private and corporate buyers want to keep track of what is happening with their shipment is not surprising. Such level of transparency and availability of information is required at B2B (Business to Business) and B2C (Business to Client) levels.

Mobile Solutions for Logistics offer the following features [6]:

- Mobile Warehouse Management Solutions: Know your warehouse in and out
- Door Delivery Mobile Solutions: Speed-up your door delivery services
- Mobile Asset Tracking Solutions: Know the location of every shipment
- Mobile Fleet Management Solutions: Get the most from your fleets
- Customer Servicing Solutions: Meet the needs of the modern-day customer

These features are recognized by some of the world's leading logistics companies that have offered their Android applications on Google Play (Figure 2: Transportation applications and Figure 3: Shippers' applications). The majority of applications are also available for the iOS operating system on App Store, maintained by Apple Inc.

Figure 2. Transportation applications available on Google Play

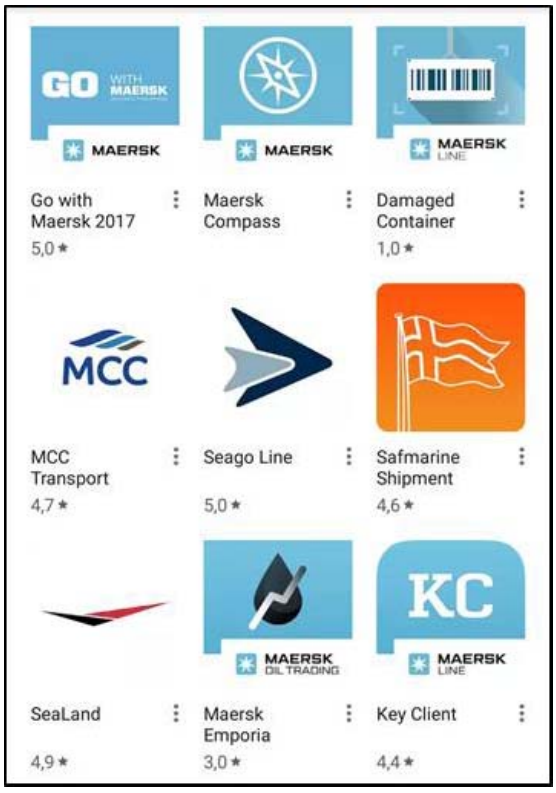

Figure 3. Shippers' applications available on Google Play

C. *Mobile Supply Chain Management*

Supply chain management intensively uses mobile devices for faster and better business process organization. For example, Oracle Mobile Supply Chain applications enable users to perform many common warehouse and shop floor transactions using wireless devices at the point of use, offering real-time transaction processing, improved data accuracy and increased mobility and convenience [7].

D. *Digital twins*

Digital twins are dynamic digital or virtual software replicas of the physical assets, products and constructions. Gartner predicts that by 2021, half of the large industrial companies will use digital twins, resulting a 10% improvement in effectiveness in those organizations [8].. As physical conditions change, the digital twin logs those changes in real time—whether it's a shipment of subassemblies delayed by a parts shortage, a delivery truck waylaid by a traffic hazard, a distribution center's operations threatened by extreme weather, or a service provider completing a maintenance job [9].

Digital twins in logistics already exist in some form. For example, Supply Chain Management uses software to simulate specific processes in order to test and analyze specific events under certain conditions, for the purpose of making the right decisions with minimum risk under controlled conditions. Such simulations could be considered as a version or type of digital twin of real production and supply chain that already exist. It is worthwhile noting that computer simulations are forerunners of digital twins that, unlike classic simulations, have far more potential for development. Simulations allow early detection of errors, proper optimization, and faster and better decision making that ultimately affects the competitiveness of the underlying business itself.

According to previously mentioned, this enables logistics companies to compete with each other in set up of a better product, i.e. a service, where each buyer/contractor could choose a future associate based on a digital twin presented.

Additionally, according to Supply Chain Quarterly, a 2016 Dotcom Distribution survey found that "almost half (47%) of shoppers said they had chosen not to order from a retailer again because of poor order transparency about their package status during the fulfilment and delivery process" [10].

Manufacturers, retailers, and other supply chain operators have some of the components of the digital twin in place—MES (Manufacturing Execution System), SCM (Supply Chain Management), ERP (Enterprise Resource Planning), and CRM (Customer Relationship Management) software to manage production; logistics and suppliers; procurement; and customer commitment. Some already use a geographic information system (GIS) to track assets and processes globally. But only a pioneering few are starting to fuse these systems to construct always-on connectivity that creates the real-time track-and-trace capability supply chain digital twin demands [11].

E. *Industry 4.0*

Just as Industry 4.0 is holistic, with a partial transfer of autonomy, intelligence and autonomous decisions to machines, supply chain and logistics in Industry 4.0 is very similar, albeit with, on top of the overlaps, different applications, technologies, human and business aspects and elements [13].

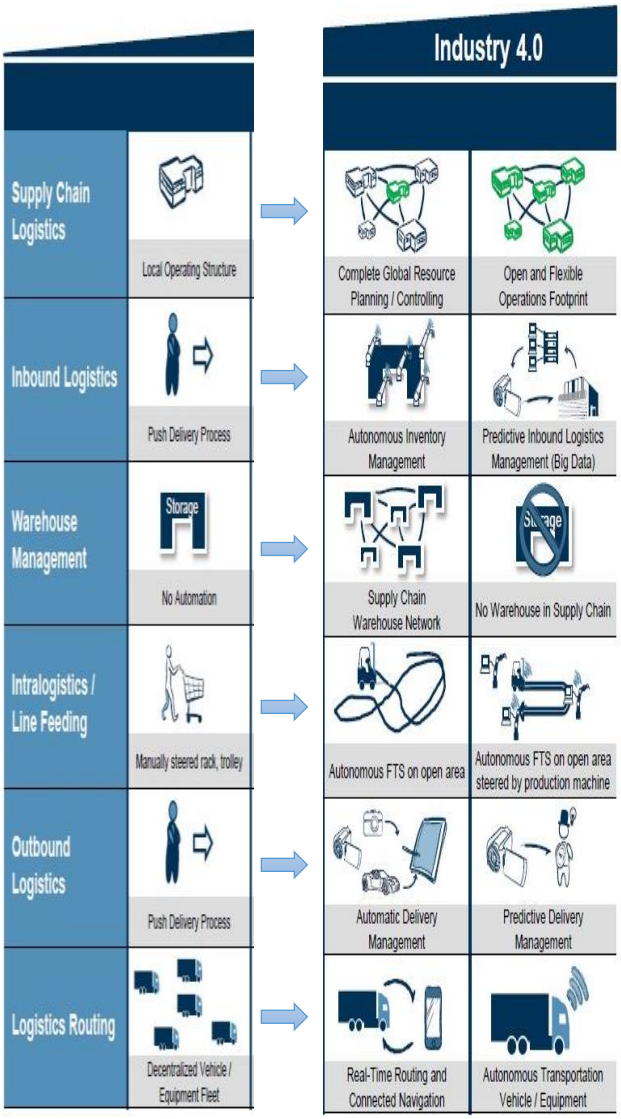

Figure 4. Evolution of Industry 4.0 [14]

Figure 4 shows the evolution of Industry 4.0. For example, warehouse management progressed from no automatization to semi- or fully automated, to finally no

warehouse at all. SCM started locally, as only locally operating structure and evolved to open and flexible operations footprint. Another example, which can already be seen tested on the roads, is logistics routing. New autonomous transportation vehicles and equipment are no longer part of distant future [14].

F. Autonomous vehicles

Autonomous forklifts and robot arms are common in modern warehouses. They load, unload and transport goods within the warehouse area, by connecting to one another and forming flexible conveyor belts. These tasks require advanced sensors, as well as vision and geo guidance technology. In addition to warehouses, autonomous vehicles are also used in airports, harbours, and yards. In the first stages of autonomous vehicle implementation, truckers' workplaces will not be endangered. The role of a trucker in the driving process will be similar to a ship's first officer. Their job will be to step in when conditions become difficult [15].

There are numerous applications of autonomous technology in modern logistics, providing further evidence that driverless vehicles are safe and successful in closed environments. It is the next evolutionary step to start applying this technology to outside premises and on public streets. Beyond warehousing operations, analysts expect many more applications in future along the entire supply chain, particularly in outdoor logistics operations, line-haul transportation, and last-mile delivery [16].

In Amazon, Kiva robots are another example of autonomous vehicle operation. On one edge of the cage, a group of human workers — the "stowers" — place products onto the shelves, replenishing the inventory. The robots whisk those shelves away, and when a customer order arrives for products stored on their backs, they queue up at stations on another edge of the cage like cars waiting to go through a toll booth. [17].

III. Innovations in Logistics

Innovation can be defined as a brand new product developed in order to respond to market needs. It can also be an already existing but improved product that was given a new, still non-existing purpose or value. Therefore, logistics has a lot of opportunities in the field of innovations. The following chapters provide a brief overview of the latest innovations in logistics.

A. Internet of Things and Internet of Everything

The industrial Internet of Things (IoT) market is estimated to reach $123.89 Billion by 2021 [18]. Internet of Things basically means connecting items or products over the Internet. IoT is a part of the Internet of Everything (IoE) or an extension of it. In this sense, it connects all of the M2M (Machine-to-Machine) communications involved in IoT, but also Machine-to-People (M2P) and technology-assisted People-to-People (P2P) interactions.

B. Start-ups

Start-up, shake up: in this scenario, new entrants in the form of start-ups make a bigger impact. The most challenging and costly last mile of delivery, in particular, becomes more fragmented, exploiting new technologies like the platform and crowd-sharing solutions. These start-ups collaborate with incumbents and complement their service offers [3].

Every five days, a digital logistics start up is born somewhere around the world. Five major start up clusters dominate the landscape: online platforms, asset management solutions, robotics/autonomous vehicles, shipping execution & tracking, and data and analytics solutions [19].

Shipping carriers, freight forwarders, and others in the supply chain struggle to deliver the right asset at the right place at the right time and reach the most optimal trade decisions. For example, ClearMetal is a start-up that generates highly accurate predictions to help the industry solve its most complex challenges, like how to efficiently place ocean containers and plan vessel space. ClearMetal's platform has shown millions of dollars of incremental savings potential and revenue generation for some of the largest logistics providers on the planet [20].

Darkstore is an on-demand delivery 3PL. They are enabling e-commerce brands to house inventory in major cities and offering on-demand and same-day delivery at low prices. Instead of owning fulfilment centres themselves, Darkstore uses extra space in storage facilities, malls, and bodegas. They don't charge e-commerce companies to store inventory but charge 3% per item that leaves Darkstore [20].

OpenSea is the first marketplace for ship chartering, enabling shipping agents to find the best matching vessels and cargoes at the best price – in effect connecting shipping agents and ship-owners [21], [22].

These start-ups are mostly producing innovations in shipping, SCM or the last mile delivery. These are some of the critical points that are still needing a better solution, speed and optimisation, because demand is focused on improvement in this areas.

C. 5th-party logistics

5th-party logistics (5PL) can be defined as broadening the scope of logistics further to e-business. [23]. A fifth party logistics provider will aggregate the demands for the 3PL and others into a bulk volume negotiation of more favourable rates with airlines and shipping companies. Non-asset based, it will work seamlessly across all disciplines [24].

The central ethos of 5PL is its commitment to collaboration and obtaining a higher degree of resource utilization in order to achieve savings and open up opportunities to secure the best possible solution at minimum financial and carbon cost [24].

D. 3D printing in logistics

Three-dimensional printing is increasingly being used in numerous business aspects, from toy manufacturing to logistics. For example, Mattel Corporation has partnered with a design software company to launch a Design App allowing users to intuitively design toys that can be connected to create larger toys. The 3D models can be created on a tablet or smartphone and sent wirelessly to the 3D printer [25].

3D printing technology can have a massive impact on how SCM works. Given that the impact on manufacturing is already apparent and cases already exist where people are printing the necessary parts (even the printed parts are already used for medical purposes), the question is when it will change the function of the supply chain we know today. DHL and DB Schenker are thinking in this direction and considering the option of the print-on-demand mode of business. Spare parts, for example, will be increasingly seen as a service with clearly defined lead time. Managing the complexity behind that service is where companies can leverage their capabilities. This will add value for the customers by reducing interfaces and complexity [26].

Thanks to 3D printing, companies may no longer need to store spare parts physically in a warehouse. Instead, they can print these parts on demand, where required, and rapidly deliver these items to the customer. In order to achieve coverage and efficiency in lead-time reduction, logistics providers could support companies in creating a dense network of 3D printers to print and deliver spare parts on demand instantly [27].

E. Drones

Logistics providers are experimenting with drone delivery to cut costs and ward off new competition from start-ups and technology companies, which have latched on to drone delivery as a potential path to disrupt (or partner with) traditional legacy logistics firms. However, delivering packages by drones to consumers' doorsteps is still years away from becoming a common occurrence. Important obstacles still need to be overcome relating to drone regulations, the development of autonomous flight and traffic control systems for drones, and consumer acceptance [28].

F. Virtual reality and Augmented reality

Virtual reality (VR) is an actual representation of reality in virtual space with the help of computer technology. Its full usage is assisted by the use of other technologies, such as a VR headset, for the user to accomplish a better sense of VR. Everything that users sees and hears impacts his feelings about the experienced VR. AR (Augmented reality) on the other hand does not simulate reality in virtuality, but instead combines them in one single experience. This way elements of VR are connected with reality simultaneously. The best example is game Pokémon GO, where the user uses the smartphone, which is an element of VR, in real life for catching Pokemon displayed on the smartphone, embedded in the real environment. Similar experiences can be implemented in several logistics processes such as transportation and warehousing.

As for Last Mile Delivery, it is the most expensive step for every e-commerce retailer. As customer bases grow and are more spread out, getting products shipped to customers cost-effectively has become a priority for many retailers. According to a DHL Trend Research report, it's estimated that drivers spend 40-60% of their time locating the correct boxes within their truck for the next delivery. For many, this process relies on their memory of how the truck is loaded. AR application could be used to streamline the time it takes to identify packages upon delivery and reduce the time it takes to figure out which package goes where [29].

G. Blockchain technology

Blockchain and Artificial Intelligence (AI) certainly made their presence felt in the logistics industry recently. With the security and transparency blockchain offers, it offers asecure and robust way to store and share transactional data, while improving credibility with a ledger of transactions that can be checked for authenticity. For example, if customer's ID proof is available digitally through a blockchain structure, it cannot be fudged by him at the time of delivery. Similarly, it's possible to map the unique blockchain-enabled registration number of every vehicle against the delivery job IDs. By 2021, as much as 25% of the large global companies will be using AI and blockchain-based automation in transactional procurement [30].

This recent technology is what drives bitcoin and other cryptocurrencies. However, the technology goes much further than a hack proof way of holding and exchanging money. Blockchain can be used for any kind of exchange, smart agreements or asset tracking. In a supply chain, it can apply to anything from self-executing supply contracts to automated cold chain management [31].

IV. CONCLUSION

As far as professions and jobs are concerned, trends suggest that the need for human workforce will reduce, but not immediately and drastically. Workers will be replaced, and already have been in the past, partially or fully, by automated machines and software. This is where the new potential and the need for development of the

specialized workforce occurs. This specialized workforce should aim to develop, maintain and improve such software and hardware. It is also essential to encourage the experts to continue moving the existing technological boundaries, which is the core foundation of all innovations.

By extending these boundaries, e-logistics will evolve, for example by 3D printing and new, virtual reality logistics where numerous tasks will be performed by software, spare parts will be printed out on the spot, and the transport process will be minimized. The idea of 3D printing will change the paradigm that cargo and goods must be transferred around the world to reach the destination. On the other hand, large orders from companies in B2B relations will be created in print shops. Those print shops would already have pre-programmed templates that are most often printed or templates prepared in advance for companies that contracted cooperation with them.

Industry 4.0 will result in the massive use of VR and AR, first in the manufacturing and then gradually in logistics. The costs of developing and implementing such technologies will initially be high. Therefore, the acceptance for the broader market will take longer. Unlike VR and AR, intelligent, independent automated vehicles and robots in distribution are already implemented in logistics. Amazon with its Kiva robots set off the market and raised the standards. Increased drone usage is closely connected with this forecast. They will be used mostly in outdoor environments with varying acceptance.

Start-ups will increasingly influence the introduction of innovations in all branches of logistics. AR, AI, the blockchain, and automated vehicles are developing independently, and their purpose and functionality in logistics are still being tested. It will take some time until their application becomes standardized. Until then, 4PL, m-logistics, MSCM, digital twins as well as cloud computing will be much more developed, and it is expected that their implementation will be globally faster and in all relevant parts of logistics, and in a standardised way".

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