New Technology Trends and Solutions in Logistics and Their Impact on Processes

Joanna OLEŚKÓW-SZŁAPKA^{1,a}, Piotr LUBIŃSKI^{2,b,*}

¹Poznan University of Technology, Department of Production Management and Logistics, Strzelecka 11, 60-965 Poznań, Poland

²WSB University in Poznań, Powstańców Wielkopolskich 5, 61-895 Poznań, Poland

^ajoanna.oleskow-szlapka@put.poznan.pl, ^bpiotr.lubinski@wsb.poznan.pl

*Corresponding author

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Abstract. One of the most distinct characteristics of today's world is technological advancement. Global Supply Chains and the Logistic industry are important beneficiaries of technological progress. This paper highlights the essential trends in logistics and supply chains in relation to technology and its very fast development all over the world. The Industrial Revolution 4.0 sees supply chains that are able to produce products from vast quantities to single items using flexible processes. Logistics companies should also be ramping up their investment in technology – to deliver Logistics 4.0. However we cannot stop changes. Instead of worrying about the new reality, we should know and understand its components. Already operating companies shall continually improve its effectiveness and implement the latest concepts and ensure business success. Authors except of trends and advantages of new technologies also indicate sample obstacles that limit application of Internet of things in logistics companies.

Introduction

The world becomes more and more digitally. This is the big potential of the future. The logistics trends predicted for 2017 and next years are more tangible. The development of Logistics 4.0 is creating huge changes within companies. Many researchers and companies are convinced that automation, networking and digitizing will become more and more important within the industry [1,2,3,4,5]. End-to-end visibility is a necessity, in fact, complete visibility of the entire supply chain could achieve true demand-driven planning, allowing efficient response to changes in sourcing, supply, capacity and demand.

It is said that the first industrial revolution came with the introduction of water and steam power. Then came mass production, followed by computerization. Now, the Internet of Things (IoT) is ushering in the fourth industrial revolution. Some call it the fourth industrial revolution, or industry 4.0, but whatever you call it, it represents the combination of cyber-physical systems, the Internet of Things, and the Internet of Systems.

Gartner analysts have identified ten strategic technology trends that will to have an impact on companies in near future and they will shape the digital business opportunities by 2020. Mainly these trends relate to connect the real world with the virtual one and the emergence of the digital connection. [6] Authors try to indicate and summarize all these trends.

Without doubt Industry 4.0, the Internet of Things and Big Data: especially in logistics, these topics are more than just megatrends. Along the entire value added chain, companies connect their systems, and all processes are interlinked and constantly monitored. Internationally, smart c solutions are already accepted and frequently used. Companies missing this trend will sooner or later be outdone by their competitors.

Frauthofer Institute defines terms Industry 4.0 and Logistics 4.0. Industry 4.0 is perceived as all developments towards smart factory. Whereas Logistics 4.0 is defined as Internet of things where everything is autonomous what is presented at figure 1.



Figure 1. Logistics 4.0 – Internet of things. [7]

The logistics sector is a key driver of EU economic integration and growth. Access to internal and global markets depends on efficient and cost-effective logistics throughout the EU for long-term economic prosperity. Under the EU Framework Programme for Research and Innovation, Horizon 2020 that has run since 2014, logistics related research shall concentrate on increasing the efficiency and sustainability of the logistics supply chain. Research focuses on developing innovative solutions to overcome the challenges arising from the increasing length, complexity and vulnerability of many supply chains [8]. Effective use of information technology offers a great potential for further logistics decision in internal and external range.

Technology Trends Impacting on Development of Supply Chains and Logistics

From personal computers to mobile devices, we know that technology can profoundly alter the way we communicate and interact with the world. New technologies impact almost every industry, and logistics is no exception.

According to Gartner we can distinguish ten fundamental technological trends that will affect on companies and their activities [2]:

The Device Mesh: trend concerns the growing set of endpoints people who are using mobile devices wearable, consumer and home electronic devices, automotive devices and environmental devices, such as sensors in the Internet of Things (IoT).

Ambient User Experience: a trend that refers to connect the virtual world with the real world. The ambient user experience preserves continuity across boundaries of device mesh, time and space. The experience seamlessly flows across a shifting set of devices and interaction channels blending physical, virtual and electronic environment as the user moves from one place to another.

3D Printing Materials: Advances in 3D printing have already enabled 3D printing to use a wide range of materials. These innovations are driving user demand, as the practical applications for 3D printers expand to more sectors, including aerospace, medical, automotive, energy and the military. In the next 20 years will increase either the demand for models and components used in 3D printing either materials used for printing.

Information of Everything: the amount of data is growing at an alarming rate, therefore in the nearest future the demand for analytical systems will increase. Information of everything addresses this influx with strategies and technologies to link data from all these different data sources.

Advanced Machine Learning: in advanced machine learning, deep neural nets (DNNs) move beyond classic computing and information management to create systems that can autonomously learn to perceive the world, on their own. The explosion of data sources and complexity of information makes manual classification and analysis infeasible and uneconomic. DNNs automate these tasks and make it possible to address key challenges related to the information of everything trend.

Autonomous Agents and Things: Machine learning gives rise to a spectrum of smart machine implementations — including robots, autonomous vehicles, virtual personal assistants (VPAs) and smart advisors — that act in an autonomous (or at least semiautonomous) manner. While advances in physical smart machines such as robots get a great deal of attention, the software-based smart machines have a more near-term and broader impact.

Adaptive Security Architecture: The complexities of digital business significantly increase the threat surface for an organization. IT leaders must focus on detecting and responding to threats, as well as more traditional blocking and other measures to prevent attacks. Application self-protection, as well as user and entity behavior analytics, will help fulfill the adaptive security architecture.

Advanced System Architecture: The digital mesh and smart machines require intense computing architecture demands to make them viable for organizations. Providing this required boost are high-powered and ultra efficient neuromorphic architectures. Fueled by field-programmable gate arrays (FPGAs) as an underlining technology for neuromorphic architectures, there are significant gains to this architecture, such as being able to run at speeds of greater than a teraflop with high-energy efficiency.

Mesh App and Service Architecture: Monolithic, linear application designs are giving way to a more loosely coupled integrative approach: the apps and services architecture. Enabled by software-defined application services, this new approach enables Web-scale performance, flexibility and agility. Microservice architecture is an emerging pattern for building distributed applications that support agile delivery and scalable deployment, both on-premises and in the cloud.

Internet of Things Platforms: IoT platforms complement the mesh app and service architecture. The management, security, integration and other technologies and standards of the IoT platform are the base set of capabilities for building, managing and securing elements in the IoT. The IoT is an integral part of the digital mesh and ambient user experience and the emerging and dynamic world of IoT platforms is what makes them possible.

In addition to Gartner Group recommendations, we can find many other guidelines for the development trends of supply chain and logistics in terms of technology. Research from McKinsey Global Institute [9] found that in 2025 IoT will have a total economic impact of between \$2.17 trillion and \$5.75 trillion across factories, retail environments, logistics and navigation – key supply chain areas. They also indicate three trends and how they will help companies boost efficiency, productivity and competitiveness. These trends are except of Internet of things, RFID, 3D printing and drones.

The rapid development of modern logistics used platform based on the RFID technology is the results from few things. RFID technology is a simple, cheap and secure solution. Internet of Things can go beyond it because can provide accurate flow of information of products in market to provide a reliable basis for logistics market analysis, forecasting and decision making.

Using mobile technologies and the Internet of Things, enterprises can accelerate productivity, profitability and operations with solutions designed specifically for their processes. Building solution where enterprises can connect all devices across a distributed network, capture and share their mission-critical data, allowing them to show real-time view of all operations (see figure 2).



Figure 2. Internet of things in the world of logistics. [11]

The organization of the supply from a technological view will mainly change due to the implementation of BI-technologies, Smartphone Apps, AIDC- and RFID-technologies and the miniaturization of electronics. However, structural changes to the organization are to be expected mainly in manufacturing processes. Impacting technologies are the M2M-communication, and Smart Factory including Smart Logistics. With the combined implementation of Smartphone Apps and Smart Data tools, the interaction of people within the supply chain will face a huge impact in the sales departments of companies, where the customer can be integrated and organizational borders are eliminated. [10]

Summary

Internet of things promises far-reaching payoffs for logistics operators and their business customers and end consumers. These benefits extend across the entire logistics value chain, including warehousing operations, freight transportation, and last-mile delivery. And they impact areas such as operational efficiency, safety and security, customer experience, and new business models.

As with most technology transitions, it is helpful to look at IoT in a broader context, and to consider some of the best practices from other industries. This can inform and inspire the use of IoT in logistics. With millions of shipments being moved, tracked, and stowed by a variety of machines, vehicles and people each day, it is no surprise that logistics and Internet of things is a perfect match. In logistics, IoT can connect different assets along a supply chain in a meaningful way, and then analyze the data generated from these connections to capture new insights. By doing so, IoT enables logistics providers to unlock higher levels of operational efficiency, while creating customized, dynamic, and automated services for their customers. Falling prices of device components (sensors, actuators and semiconductors), faster wireless networks, and increasing data crunching capabilities only compound the business benefits, ensuring that IoT becomes a disruptive trend in the logistics industry over the next decade.

According to recent calculations, the worldwide data volume will increase to 44 billion gigabytes by 2020. This is ten times as much as today. This makes data the most important currency of the industry. Only if companies make economic use of these data, for instance for optimizing their processes, they can achieve long-term success on the market. Internationally, smart logistics solutions are already accepted and frequently used. Companies missing this trend, will sooner or later be outdone by their competitors.

Increasing the visibility of products in the supply chain, IoT can improve their traceability from the farm to the consumer's table, reduce fraud, meet consumer expectations in terms of greater transparency and create new marketing opportunities. Plans of companies related to IoT are as follows: 83% - location tracking, 83% - Wi-Fi, 80% - GPS location, 79% - asset tracking [3]. On the way to take full advantage from Internet of things by companies laid some obstacles. One of the basic is date safety - data are owned by many users, hence the need to develop mechanisms to protect data and the credibility of their sources. Another obstacle is the lack of standardized solutions that combine data from different systems and their smooth integration. We cannot also forget about the cost barrier, limiting for many companies the opportunity to exploit the potential of IoT e.g. the cost of software, necessary equipment, licenses, installation, maintenance of equipment, training of employees. The logistics sector is inherently predisposed to implement the latest technologies. The greatest potential for growth brings IoT.

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