Digitalization in Logistics

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Abstract

As a cross-sectional function, logistics touches industry and commerce in equal measure—and in all sectors of economy. In this respect, the digitalization of logistics is a topic that is of enormous importance for the entire economy. This has been evidenced not only by the intensive technical discussions, but also by the broad interest shown by the general business press. The debate as to whether the digitization of logistics is imminent in the coming years is anything but controversial. The advantages of networked and integrated supply chains over the current situation are obvious. Although a lot has already happened, especially in intralogistics, companies still have to deal with inadequate transparency, information deficits, and fragmented transport chains in many areas. The use of digital technology can solve many of these problems—in addition, newcomers from the technology industry can efficiently replace some outdated business models.

Hence investing in digitization is worthwhile. Or is it not? Indeed, according to an annual study by Capgemini, almost half of companies increased their IT budgets in 2017, a quarter of them by more than 10%. Given the considerable challenges of digitization, this seems more like a drop in the bucket. A true revolution looks different—especially since a significant portion of the additional budget flows in updating the legacy systems rather than in innovation projects. In addition to this, the digitization of logistics competes with digitization projects from other areas of the company.

The sluggish investment behavior reflects the fact that the digitization of logistics is about detailed work that has slowed down not only due to small

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budgets, but also due to a wide variety of technical, commercial, and legal risks and, last but not least, the lack of skilled IT staff. None of this will stop the digitization trend. However, it can be assumed that it is progressing more slowly than many technology providers, in particular, would like to admit.

7.1 Origin of Terms: What Does "Digitalization in Logistics" Mean?

The term "digitization in logistics" has been used to a considerable range in companies. Many logistics professionals equated digitalization with almost any IT or automation project. However, since the use of software has been advancing in transportation and logistics for several decades, digitization would just be a new term for the long-established use of software in warehouse management, picking, ordering and providing logistics services, and many other standard processes.

The definition by Kersten et al. (2017a, p. 47) is more target oriented. It describes the digital transformation of companies as "the change in value creation processes through further development of existing and implementation of new digital technologies, adjustments to corporate strategies based on new digitalized business models, and acquisition of necessary competencies or qualifications." This definition also has been used in the study by the German Logistics Association "Trends and Strategies in Logistics—Opportunities of Digital Transformation."

Even more pointed explanation of the term "digitalization" refers to those measures that lead to Logistics 4.0. Logistics 4.0 is derived from the buzzword Industry 4.0, which describes the autonomization of industrial manufacturing. The Industry 4.0 platform, which is run by German Federal Ministries for Economic Affairs and Energy (BMWi) and for Education and Research (BMBF), defines Industry 4.0 as follows. "In Industry 4.0, production interlocks with state-of-the-art information and communication technology. The driving force behind this development is rapidly increasing digitalisation of the economy and society. It is permanently changing the way in which production and work will be carried out in Germany in the future. Technical basis for this are intelligent, digitally networked systems, with the help of which largely self-organised production would become possible: People, machines, plants, logistics and products communicate and cooperate directly with each other in Industry 4.0. Production and logistics processes between companies in the same production process are intelligently interlinked to make production even more efficient and flexible."

Translated into logistics, this means that logistics processes are being developed further in the direction of self-control with the help of digitally networked systems. Orders and goods find the most efficient route through an intelligent logistics infrastructure to the recipient on the basis of target specifications.

An example should clarify the underlying vision: An online order triggers the production of a certain product. Based on analysis of the historical order data and other data, such as marketing campaigns and weather conditions, the parts required for production are available in the factory. Based on the order data, the routing of the goods to the recipient is calculated. The goods then book themselves onto a suitable load carrier together with other goods for same destination using RFID chips. The load carrier in turn books itself as a suitable means of transport. The “transfer” of goods in transshipment centers and further loading is supported by fully automated conveyor technology—without any manual sorting. The same applies to deconsolidation of load carrier and final distribution of goods to the delivery address. An autonomous delivery vehicle then delivers the goods to a delivery facility, where the recipient can pick them up using an electronically sent code.

The technical innovation potential lies primarily in cross-company networking along the entire supply chain. Most basic technologies have long been in practical use on logistics islands such as fully automated high-bay warehouses or automated port terminals (DIE WELT, 2002). This also includes the use of driverless transport systems.

However, according to Kersten et al.’s definition, the innovation potential of digitization does not lie solely in the use of technology. It is also about the development of new digital business models and the disruption of traditional structures. Newcomers in logistics such as Freight Hub or InstaFreight are challenging the intermediaries in particular. Attempts are being made, for example, to automate pricing, booking, and documentation of transport and thus to take over at least part of value creation of traditional freight forwarders. Another field for innovation is data-based services from the area of predictive analytics. The targeted analysis of consumption and production data as well as historical delivery data could further optimize the utilization of means of transport, routing, and inventories.

7.2 State of Research

As an industrial and social megatrend, digitalization, in general, is naturally also focus of science and research. A lot of research has already been done and published on the digitization of logistics and supply chains. Strong impetus was given in the years 2010 to 2015 when the EffizienzCluster LogistikRuhr won the German government’s Leading-Edge Cluster Competition and, equipped with substantial funding, carried out basic work in many areas on which numerous current projects are based. The website of the Efficiency Cluster (http://www.effizienzcluster.de/de/index.php) contains an extensive list of scientific papers that have been produced within this framework.

An important and high-profile impulse was given by Prof. Michael ten Hompel, who took up the buzzword Industry 4.0 and translated it for logistics. “Logistics and the Internet of Things are considered outstanding application domain of the fourth industrial revolution. In no other industry is such a fundamental change expected in near future. On one hand, this is due to rapid technological developments; on the other hand, many of the essential technical and societal challenges are directly or indirectly connected to logistics and efficient supply chain management,” wrote

Michael ten Hompel and Michael Henke in their technical essay “Logistics 4.0.” (ten Hompel & Henke, 2014)

Some essential elements of digitalization were already being researched well before “Logistics 4.0.” This includes one of the most challenging concepts: the self-control of logistical units. As early as 2006, Prof. Katja Windt presented radio identification technology as a key driver of change in logistics (Windt, 2006).

Benoit Montreuil, Professor of Material Handling and Distribution at the Georgia Institute of Technology, coined the term “Physical Internet,” in which the self-control of logistical objects forms an overall system. Intelligent transport containers communicate with the available means of transport and autonomously select the optimal means of transport on the basis of predefined goals (transport price, transport time, etc.). In practice, this concept is not yet implemented, at least in external logistics (Ruf, 2018).

The study “Opportunities of digital transformation” by Wolfgang Kersten, Mischa Seiter Birgit von See, Niels Hackius and Timo Maurer, which appeared in the series “Trends and strategies in logistics and supply chain management” published by the German Logistics Association (Kersten, et al., 2017b), provides a current stocktaking. The study identifies 15 trends in digitization, uses a survey to measure the penetration of new technologies in practice, and provides concrete recommendations for action for companies.

The Logistikweisen, a think tank of experts from science, industry, trade, the technology sector, and logistics services, examine the market relevance of digitization in logistics in their 2017 report on results and identify a high potential for change in the next few years (Backhaus et al., 2017). The logistics experts see the vision of an integrated and fully networked supply chain as the driving force behind digitization. The key development drivers here are the Internet of Things, cloud computing, mobile devices, autonomous vehicles, use of robots, 3D printing, augmented reality, and predictive analytics. In addition, the logistics experts cite several prerequisites for success, such as “decentralization of systems and business processes, willingness to invest, new management models (digital leadership), and advances in data security.”

7.3 Overview of Fields of Application

Digitalization is a topic for the entire supply chain and thus for all logistics processes. The current status in the individual logistics field differs significantly. In the warehouse sector, automation and even autonomization began as early as the 1980s when companies such as Beiersdorf or ESSO AG put fully automated high-bay warehouses in operation. But even today, there are still numerous analogue, isolated processes along the supply chain. Although transport logistics has long ceased to be a black box, end-to-end systems that network shippers, forwarders, transport companies, and consignees are in practice the exception rather than the rule. In general, it can be said that digitization triggers noticeable improvements, especially where it is a matter of cross-company or cross-modal processes.

7.3.1 Intralogistics

In no other field of logistics has automation and, to some extent, autonomization progressed as far as in intralogistics. Due to the interaction of warehouse and conveyor technology, material flow computers and powerful warehouse management systems (WMS) by means of a logistics interface, all conveyor and transport processes within a warehouse can technically be mapped highly efficiently without human intervention. However, the limits are set by economic efficiency. The efficiency advantages of automated solutions are offset by considerable investment costs. The investments obviously pay off particularly quickly for fast-moving or small-part storage goods (automated small parts warehouses).

In recent years, many innovations have focused on reducing the distances warehouse personnel have to travel in the warehouse. This was achieved by goods-to-man solutions, such as those designed by SSI Schaefer. Warehouse robots from Kiva today Amazon Robotics (Spiegel online, 2012), which transport the complete warehouse shelf to the picker, became relatively well-known. Other means of increasing efficiency are picking systems such as pick-by-voice, pick-by-light, and pick-by-vision, which reduce the search times of the picker.

Not yet in sight on a broad front is complete replacement of human order pickers by robots. The flexibility of the human senses coupled with the hands is not yet achieved by machines, especially with heterogeneous order picking goods. Magazino GmbH has launched a highly regarded attempt to challenge human dominance in order picking with the TORU Cube model (Magazino GmbH, n.d.). TORU Cube stands for fully automated robot-to-goods picking with piece-by-piece access to individual objects.

A current trend is the use of artificial intelligence and machine learning in intralogistics. "Today, the focus is on linking IT systems with machine learning algorithms. Thanks to complex computing operations, our warehouse systems acquire the know-how to recognize patterns, regularities and correlations from unstructured data collections and adjust independently and dynamically to new situations within entire logistics system," states the website of intralogistics provider Swisslog (Swisslog, n.d.). The approach is plausible. WMS and material flow computers provide a mass of data that can be linked, for example, with customer sales actions, delivery, and order data. The benefit lies, for example, in better capacity planning, faster response to orders, or the smoothing of work peaks. The use of robots and augmented reality would help to ensure that intralogistics continues to play a leading role in digitalization in the future.

7.3.2 Autonomization of Means of Transport

Until well into the 1990s, transport logistics was considered a black box of logistics. Once the truck left the yard, there was no way for the sender or the recipient of the goods to get in touch. The breakthrough of mobile communications and positioning technology has long since solved this problem. The focus is now on autonomization of transport. The vision: Instead of human truck drivers, pilots, ship's officers, and train drivers, the means of transport of the future could find their way to their destination autonomously. In the area of road freight transport, in particular, this is not only being researched, but also eagerly discussed. The focus is not only on technical issues, but also on legal questions—for example, liability in the event of an accident.

The technology is relatively advanced: Daimler presented the Mercedes Future Truck at the IAA back in 2014, which then drove semi-autonomously (self-driven, but monitored by a driver) on public roads for the first time in 2015. In 2016, the management consultancy Roland Berger commented on questions regarding the economic viability of autonomous driving (Russo, 2016). According to this, depending on the degree of automation, additional costs between US$1800 (phase1) and US$24,300 (phase 5) are to be paid for additional vehicle equipment including software, which are to be financed through low fuel consumption, lower insurance costs, and reduction in driver costs.

"A rapid payback on technology investments is achievable in early stages for only a few applications, most notably platooning (convoy formation). Significant savings in long term can only be expected from driverless trucks; these could reduce driver costs by 90%," it says in a summary. "The long payback period prevents greater demand from the transport industry." Autonomous trucks are most likely to pay for themselves in long-haul transport, it says. There are also corresponding research projects for the other modes of transport—and in some cases even use cases (drones)—although mostly outside the transport logistics.

7.3.3 Ramp Interface

The situation at the loading and unloading ramps in the logistics centers of industry and, in particular, the retail sector has been subject to reporting in the trade press for several years. In a survey conducted by SCI Verkehr as part of the logistics barometer in 2016, two-thirds of transport service providers surveyed stated that they have to wait at least one hour on average. One in five even puts the waiting times of more than two hours (Lauenroth & Semmann, 2016).

According to a 2018 survey by Federal Office for Freight Transport (Federal Office for Freight Transport, 2018), 46.7% of drivers surveyed even said that waiting times had increased on an average in the past 5 years, with only 15.4% noting an improvement. Among ramp operators surveyed, the picture was opposite. Only 16.3% spoke of longer waiting time 43.0% of them being shorter. Since waiting times mean a high degree of wasted capacity and ultimately drive up logistics costs, many industrial and retail companies are trying to improve processes at the loading bay with the help of digitalization. Time window management systems are used, which primarily equalize the time peaks.

As the study of BAG (German Federal Office of Goods transportation) shows, this approach does not solve all the problems. The time slot systems can be improved by not only booking a slot at the ramp, but also by booking loading staff and/or loading equipment at the same time. Another improvement of this approach is to make the systems more dynamic. For example, by using position data from the vehicle or an estimated time of arrival to update the time slots to the minute. A cumulative total of around 60.8% of the drivers surveyed and 59.5% of the ramp operators stated that information about the estimated time of arrival of vehicles never or rarely flowed. Some companies are now taking advantage of these dialogue opportunities with truck drivers and assigning ramps or waiting positions to drivers via messaging. Geofencing is also being used by some companies. A plant of a large automobile manufacturer in southern Germany monitors just-in-time transport in this way. If the truck reaches within a pre-specified distance from the plant, the dispatcher is automatically notified. The dispatcher then sends an SMS to driver, directing him to correct plant gate and unloading ramp.

Loading control projects at large chemical plants have been very successful, with more than 2000 trucks being routed to several hundred loading points where they are loaded and unloaded in predefined slots. The BASF site in Ludwigshafen, for example, created cost savings of ten million EURO annually with such a concept (Backhaus et al., 2017).

7.3.4 Documentation and Waybills

A key area of confirmation in the digitalization of the supply chain is the digitalization of transport documentation. To this day, the paper consignment note accompanies almost every transport in road freight transport. The main reason for this is that the legal requirements for a digital consignment note have been in place for a short time; in some cases, they are yet to be created. The legal basis for Germany has been found in the German Commercial Code (HGB) since 2013. "An electronic record fulfils the same functions as the consignment note and is equivalent to the consignment note, provided that it is ensured that the authenticity and integrity of the record are maintained," states Sect. 408 (3) of the HGB. For more details, reference is made to a statutory instrument. "However, this ordinance does not exist to date," says Thomas Wieske, Head of the Institute for Logistics Law & Risk Management at Bremerhaven University of Applied Sciences (Helmke, 2017).

As a result, the electronic consignment note has so far come to nothing. A second legal snag concerns the electronic consignment note for cross-border road freight transport. As early as 2008, the 56 Member States of the CMR Agreement (International Convention on the Contract for the International Carriage of Goods by Road) set the course in an Annex to the Agreement. Eleven states, including Denmark, the Netherlands, France, Spain, Switzerland, and the Czech Republic have already ratified the protocol. Germany has not yet signed.

The advantages of the electronic consignment note lie in the digitalization possibilities of processes relating to transport. An electronic consignment note enables information such as the receipt or acceptance of goods to be passed on in real time. In addition, there are lower costs for archiving and sending documents.

According to the TLN, the logistics sector in the EU could save EUR 180 million with the e-CMR. This is equivalent to approximately EUR 4 per consignment note.

Until this money can be saved, there are a few hurdles to overcome. The authenticity and integrity of the consignment note must be ensured. The issuer of the consignment note and its details must be identifiable. In addition, third parties must be able to record any changes, such as damage or quantity discrepancies. Drivers or control officers must be able to inspect the document. After all, the consignment note is also an instruction document, notes transport law expert Wieske.

Concrete solutions already exist in the Netherlands. The carriers' association TLN and the shippers' organization EVO have together launched the TransFollow platform, which is to become a standard for electronic waybills. Every party involved can connect to the TransFollow platform and exchange data, set digital signatures for receipt or delivery and track the status of shipment from their own operating software.

In other modes of transport, the status of electronic freight documentation looks completely different. In air freight, e-freight is already in relatively advanced stages. This is not the least due to the manageable number of carriers and their almost uniform representation by IATA, which is the driver of digitalization projects. The goal is to reduce the incredible number of 24 million air waybills per year. The first successes are there, albeit less so in Germany, where the e-freight usage rate is less than 30%. The benchmark is Dubai Airport, where the utilization rate is close to 90%. The problem is that in order to fully exploit the efficiency benefits of e-airwaybills, all those involved in the airfreight chain would have to get on board: Shippers, consignees, forwarders, service providers, airlines, and authorities. Even if one party demands paper, the dream of paperless airfreight is shattered. Consequence: According to IAG Cargo CEO Drew Crawley, the average for a shipment in 2017 is still 40 papers (Helmke, 2017).

In sea freight, a comprehensive changeover to electronic documentation is particularly complicated. This is due to the fact that the bill of lading is not only used as a transport document, but often also as a commodity document. This makes banks and insurance companies as additional stakeholders. It is not uncommon for a bank to irrevocably and on its own responsibility payout amounts of EUR 100,000 and above when a letter of credit is presented. The bank will do so only if its confidence in the electronic freight document is as strong as in the printed and stamped paper. The industry is still a long way from achieving this, even though a number of major container shipping companies are actively pushing the issue. The issue of forgery protection and encryption plays a particularly important role in sea freight (Helmke, 2017).

7.3.5 Autonomization of Booking, Dispatching, Routing, and Accounting

The supply chain is highly fragmented in the area of transport logistics. In most somewhat complex transports, other parties are involved in addition to the carrier—for example, one or more forwarders as well as sub-carriers. This fragmentation quite often leads to efficiency problems. Examples:

- In ocean freight, shippers complain that on a request it can take 3 days to receive a door-to-door price quote for a container shipment.
- An air freight shipment from Europe to Asia often takes 5days. Most of this time is not transportation time but waiting time before and after the flight, customs clearance, etc.
- On the spot market for road haulage, the search for the cheapest supplier very often requires a manual price query by e-mail or telephone or a tender via a freight exchange.

At a time when private individuals can book flights and other passenger transport within minutes via the Internet, these are antagonisms that virtually challenge companies with IT backgrounds to seek their opportunity with disruptive business models. Traditional freight forwarders have so far shown relatively little interest in optimization. After all, they profit from the price intransparency of the transport market and use waiting times at the interfaces of transport to consolidate shipments and thus transport them at lower costs.

Newcomers such as Freight Hub and Instafreight are filling precisely this gap. As Internet freight forwarders, their business model consists of agreeing on prices with various carriers and making them transparent and bookable for shippers through Internet-based booking engines. In addition, many Internet freight forwarders also offer additional services for insurance and customs clearance—often in cooperation with established providers.

Some logistics service providers have now recognized this strategic danger and are trying to adapt to it. Dr. Hansjörg Rodi, former CEO of Schenker Deutschland AG, divided the range of services offered by a 3PL logistics service provider into three segments of brokerage, consolidation, and supply chain integration in a highly regarded presentation on September 08, 2015, at the Zukunftskongress Logistik-33rd Dortmunder Gespräche. In an interview with the trade journal "Logistik heute," Rodi predicted that the brokerage segment—i.e., the provision of transport services—would be covered by Internet platforms in the medium term. For the consolidation sector, the freight forwarding manager sees the application of big data technologies as a great opportunity to improve transport capacity utilization and routing. Rodi also sees the role of logistics service providers being strengthened in the area of supply chain integration—better dovetailing with shippers through IT systems would enable better and additional services (Logistik heute 2016).

Whether the newcomers will prevail in the brokerage sector or classic forwarders will save their business with the help of new technology is not yet foreseeable. It will depend to a large extent on how the Internet freight forwarders position themselves in terms of customer service and how they deal with service disruptions during transportation. In this respect, established providers due to their long-standing contracts with the carriers are in a better position to intervene in the interests of their customers. It is foreseeable that pure freight brokers, who have built their business model primarily on the basis of nontransparency in freight purchasing, will lose their position in most transport segments. The strategic way out for these providers would be to secure a significant advantage in the purchase of freight space as freight consolidators by bundling large volumes. However, in view of the great competition this is a rocky road in the transport market and also low margins.

Other examples of possible applications of digital technologies in transport execution are dynamic route optimization and automated freight billing. In contrast to static route optimization, dynamic route planning with real-time data, e.g., on new orders, order changes, and disruptions (truck breakdown, traffic jams), ensure that scheduling is permanently adjusted to current situation in accordance with the objectives. This is based on highly developed algorithms and the ability to process large volumes of data in real time. Artificial intelligence will play an increasing role in dispatching and route optimization.

Automating freight cost accounting is a classic IT project with a high-impact lever. According to a study by the Aberdeen Group (Ball, 2017), an average of 8.8% of freight costs can be saved. Freight invoices are complex, the auditing effort is high and there is often lack of logistics expertise in the auditing departments. In many companies, therefore, only random samples are checked. Experts estimate that 8% of freight invoices are incorrect (Meißner, 2012). High savings can be achieved for companies in the shipping industry by means of an automated complete check or by switching to a credit note procedure.

7.3.6 Monitoring and Alerting

Electronic tracking was developed by FedEx back in the late 1970s and has since long become a standard service in the CEP sector and most other transport markets. Attempts to use tracking data as a building block for the autonomization of transport chains are still relatively new. For this purpose, standard events are defined for the individual shipments, such as pickup, arrival at the transshipment center, departure at the transshipment center, and delivery. These events are assigned a time target. If an event misses the time limit, a reaction is automatically generated. This can be an e-mail to the MRP controller responsible or to the ship-to party if, for example, a pallet has come to standstill in the logistics center. However, a reaction can also be triggered automatically, such as ordering a replacement delivery by air freight or courier. Proactive alerting is an important building block in the development of self-controlling supply chains.

7.3.7 Customs Declaration

In the EU, the customs administration of the Member States stipulates on the basis of the Union Customs Code (UCC), which has been in force since 2016, both customs declarations and customs returns are to be transmitted in electronic form. In Germany, the General Directorate of Customs provides the IT procedure ATLAS (Automated Tariff and Local Customs Clearance System) for the German customs administration in accordance with Article 6 (1) of the Union Customs Code, which is the prerequisite for the largely automated clearance and monitoring of cross-border goods traffic.

The German customs website states (Zoll.de, 2018): "ATLAS is used to electronically process declarations for introduction of goods and their subsequent placement under a customs procedure, as well as administrative acts. This means that the person involved has the possibility to process his entry and exit summary declarations, presentation notifications, and summary declarations for temporary storage as well as customs declarations for release of goods.

- For release for free circulation.
- Into inward processing.
- Into a customs warehousing procedure.
- Under a transit procedure.
- In the context of the export procedure.

electronically and transmit it to the customs office. He then also receives the decision of the customs office and the notice of import duties or the determination and recognition of assessment bases in this way. The presentation of documents such as invoices or proof of preference can be dispensed with as far as possible at the time of clearance.

In the next few years—2020 was the first target date set by the ECC—the customs authorities in the EU Member States will continue to expand the electronic systems in accordance with the ECC requirements. Delays are likely to occur in this process.

For companies, customs processes offer high automation potential. Today, good customs solutions already offer the possibility of transmitting customs declarations to customs completely automatically. Data from the upstream systems (e.g., ERP system) is used and enriched with the help of algorithms, rules, and templates.

One problem with the automation of customs processes is different detailed regulations even within the EU. In the meantime, however, it is possible to map customs processes in several countries from one customs system. In third-world countries, the customs regulations naturally differ even more. Another area of work in automation is the interaction between customs participants and their customs service providers (customs agents and forwarding agents). IT solutions for the automated or partially automated classification and tariffing of goods are of great practical value to companies. Reason: This is the only way to create a uniform master data framework in companies with multiple locations, which is a crucial basic prerequisite for the automation of customs processes (Lison, 2018).

7.3.8 Last Mile

The boom in Internet retail (B2C) has meant particularly large amount of research and writing has been done on delivery and the last mile to the customer. However, delivery robots and drones are more likely to help produce headlines than mass parcel delivery operations for foreseeable future. So far, smaller process innovations have proven to be much more efficient. These include notification of shipments via text message or email and ability for consumers to specify a different delivery date or location. Considerable efforts are being made in the area of dynamic route optimization. Here, the many successful projects have been established—with the goals of increasing the stop density, reducing the distance travelled, and reducing the delivery time window through better predictability of the routes.

7.4 Opportunities and Risks

From the perspective of logistics service providers and companies in the shipping industry, the digitalization of logistics offers considerable opportunities (see Fig. 7.1). In the case of shippers, there is first of all possibility of using data analysis to predict customer demand more accurately and, based on this, to dimension the entire supply chain more precisely. Specifically, inventories could be reduced and transport capacities ordered more precisely. By linking historical order and delivery data with other information, forecasting models can be created that significantly improve demand and logistics planning. A few years ago, when Amazon published a rather incomprehensible press release stating that the company could ship goods

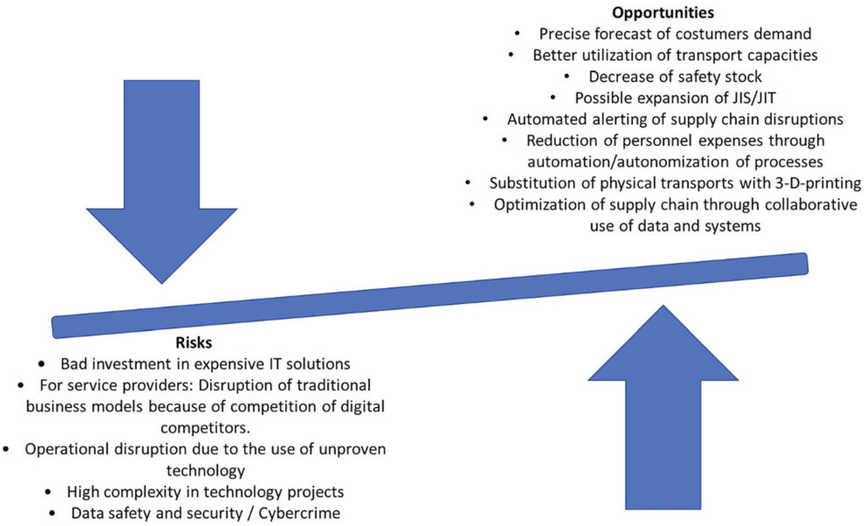

Fig. 7.1 Opportunities and risks of neutral platforms

even before they were ordered, the logistics industry was in pure disbelieve. But it is of course anything but implausible, for example, to establish a connection between, say, weather data and ordering behavior for barbecue supplies or soft drinks, and to implement this in a logistics plan. There are many, less obvious correlations that can be explored with modern analysis tools and implemented in intelligent delivery concepts.

The integration of existing tracking solutions into cross-company monitoring and alerting platforms also offers opportunities. The seamless monitoring of goods flow across company boundaries helps to detect delays in transport at an early stage and to counteract these in good time. This allows logistics concepts such as just-in-time or just-in-sequence to be extended to longer transport distances or intermodal transports. Long-range JIS processes are already being used in the automotive industry. For example, Dräxlmaier delivers vehicle-specific cable harnesses just-in-sequence from Romania to the Porsche plant in Leipzig (Keil, 2012). This makes it possible to take advantage of the labor cost benefits of the Romanian location without having to forego inventory-optimized supply chains or customized production. Due to availability of transparency across the entire transport chain, it would also be possible for other industries with a lower level of logistics maturity to use such processes in future.

A high potential for efficiency is offered by autonomous scheduling, booking and billing and customs clearance procedures. Here, companies still employ a considerable number of employees for processes that could easily be taken over by the IT systems.

It would take considerably longer before the opportunities offered by two key digitization technologies can be exploited in companies. For transport in self-controlling transport containers that autonomously search for the cheapest or fastest route to their destination and independently book the corresponding transport capacities, the infrastructure and, in some cases, the legal bases are simply lacking at present. The substitution of physical logistics—for example, for spare parts—by new production processes such as IT printing on a significant scale will also take some time. The question here is when 3D printers will be fast enough to generate significant time advantages over optimized physical logistics. Likewise, it is still unclear what ROI 3D printing brings in comparison with conventional production as well as storage and transport.

The risks from the perspective of the shipping industry lie primarily in the area of investments. Comprehensive digitalization projects, in particular, are extremely expensive and success is by no means guaranteed. After all, in some cases little-tested technologies are still being used, and the networking of a wide variety of IT systems also poses a major challenge. Even with traditional IT projects, the risk of failure is not insignificant. According to a survey by the Standish Group, 52% IT projects fail to meet the client's wishes and requirements, at least in part. One in five projects is even a total failure (Standish Group, 2015). The failure risks for large-scale digitization projects are likely to be rather high.

For logistics service providers, the opportunities for digitization lie first and foremost in the strategic area. Those who can keep up with their customers' requirements in terms of digitization may stand out from the competition. They will continue to have the opportunity to conclude direct contracts with the shipping industry and are not solely dependent on maintaining their position in the market by offering low-priced physical logistics services. In the operational area, digitalization offers opportunities to make services more efficient and intelligent and to offer data-based value-added services. In road freight transport and also in railways, companies are looking with interest at the development of autonomous vehicles. These vehicles could help to alleviate the problem of the shortage of professional drivers and train drivers.

The risks for logistics service providers lie primarily at the level of business models. Particularly in the area of freight brokerage, newcomers with IT background could challenge the traditional freight forwarders' traditional business, the value of which depends above all on the contact network and the exploitation of price intransparency in transport sector. The mere creation of price transparency would increase the already existing pressure on margins. In their role as consolidators of loads, on the other hand, freight forwarders could benefit from digitalization—and have done so in the past via freight exchanges and freight allocation platforms. In general, it is crucial for logistics service providers to build their own IT expertise in order to remain on an equal footing with their customers. Given the shortage of IT professionals, this would tend to be easier for large logistics groups than for medium-sized companies. One risk for both sides is the issue of data security. Without data exchange and cloud-based IT architectures, there would be no networked supply chain. However, this also provides a target for various forms of cybercrime.

In terms of the economy as a whole, better planning and utilization of transport capacities, route optimization, and a more intelligent transport infrastructure tend to reduce the burden on the environment through lower energy consumption (and thus pollutant emissions). Lower land consumption by relieving the burden on warehousing industry and more intelligent management of the transport infrastructure can be expected. A negative labor market effect remains a risk. The logistics industry is currently one of the few sectors that reliably offers jobs to semi-skilled workers or workers with basic qualifications. As a result of autonomization in intralogistics or even in transport logistics, these jobs are at risk in the medium to long term. This also applies to simple office work and commercial tasks.

7.5 Success Factors and Obstacles

"Digitalization of the supply chain: Overstretched logisticians?" was the title of a March 2018 article in the trade magazine MM Logistik. "By all accounts, technologies are developing so quickly that many companies can barely keep up with the digitalization of the supply chain," wrote the editors, referring to a study by the consulting firm Lharrington group LLC commissioned by DHL. The study shows that new technologies are transforming entire industries on several fronts—

with supply chains, in particular, facing massive adaptation problems (MM Logistik, 2018).

To counter this, a focused supply chain digitization strategy is essential as a success factor, says Lisa Harrington, president of Lharrington Group. “To evaluate the new technological possibilities for themselves on one hand, and to find a way to make the best use of advantages on the other, and thus stay one step ahead of the competition.”

However, digitization works according to different rules and in some cases requires a completely different way of thinking than companies are used to. That presents many challenges. “A decisive criterion for successful digitization is, above all, the culture and the human image of a company, first and foremost trust in its own employees,” says Daniel Terner, member of the management board of the software provider AEB (Verstaen & Helmke, 2018). “And of course, they then need appropriate freedom and necessary support to drive forward new ideas, technologies and concepts.” Because often employees are simply too caught up in day-to-day business.

A strategic approach to digitalization must also be aligned with the customer, the company’s goals, and the added value to be generated, and take into account topics such as methodological skills, innovations, and technologies. However, Robert Recknagel, Vice President, Manufacturing & Logistics at IT specialist flexis AG, warned at AEB’s get connected festival against placing too much emphasis on technology in digitization projects. “It’s not about attaching as many sensors as possible and then networking them,” said Recknagel. Instead, he says, it’s about understanding the opportunity that comes with digitization and implementing this knowledge in the processes in a business-driven and step-by-step manner. In plain language: First, a concrete benefit must be recognizable and the path to it must be clear. Only then it is a matter of which technology is used to achieve the goal (Recknagel, 2018).

Of course, this also applies to data-driven business models. Under the guise of the Big Data trend, a data collection frenzy has set in many companies, but this tends to drive up the demand for storage media rather than value of the company. However, it only becomes exciting (and profitable) when data-based business models or streamlining measures are defined as part of a data strategy.

One of the success factors in digitalization is the willingness to share data with customers, suppliers, or service providers. Only then do purely internal measures open up to optimization of the entire supply chain. This is often countered by the desire to preserve actual or perceived trade secrets. At this point, opportunities and risks must be carefully weighed against each other.

Digitization is facilitated when the company’s IT strategy is based on open standards that enable or facilitate efficient data exchange. However, the prerequisite is the possibility for an efficient and secure data exchange between companies, which at the same time ensures data sovereignty of those involved. Against this background, the development of Industrial Dataspace by a consortium of Fraunhofer Gesellschaft as well as industrial companies and associations is also being closely followed in logistics.

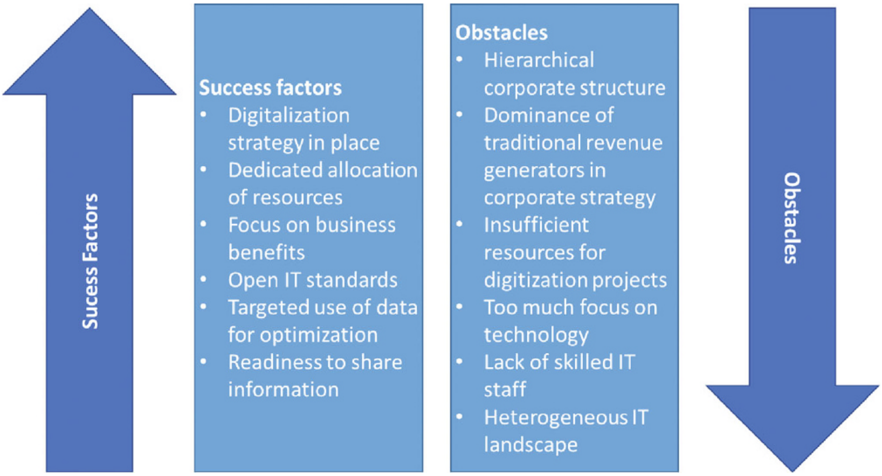

Fig. 7.2 Success factors and obstacles

Another crucial prerequisite for success is sufficient availability of IT specialists. This is likely to remain a serious obstacle to digitization for many companies and projects in logistics for some years to come.

Another major obstacle is lack of legal prerequisites, such as the electronic consignment note. However, this issue can be solved at least in the medium term. In May 2018, the EU Commission submitted proposals for digitalization of freight documents as part of the third “Mobility Package.” This is also seen as an important impetus for projects at national level.

A major internal obstacle in many companies is dominance of previous revenue generators over new digital business models, which are deprived of important resources. This lowers the chances of competing with start-up entrepreneurs, who are sometimes well-financed and fully focused on the new business models.

Another significant obstacle to digitization is the heterogeneous IT landscape within a company. This is particularly a problem for many large European logistics service providers (but also for medium-sized corporates). In an effort to achieve comprehensive coverage in network logistics, powerful regional providers were bought together. These logically worked with different IT systems. For financial and other reasons, it was not possible in many cases to roll out a uniform Europe-wide system. In addition, different divisions (land transport, sea freight, and air freight) within a national company also work with different IT programs. This makes it difficult for service providers to offer digital products from a single source. This is true even for actually industrialized CEP industry. With the exception of large US integrators, cross-border cooperation with a service provider often means several integration projects with different national companies for the shippers. Integration platforms from neutral IT providers are a frequently used solution to this problem (see Fig. 7.2).

7.6 Selected Digitization Projects in Logistics

"The" showcase project in terms of digitalization does not exist in logistics—and it probably cannot exist. Given the high level of complexity, it would be too much for any organization to adapt business models, comprehensively modernize IT systems, and then seamlessly link these with the IT systems of customers, suppliers, or partner companies while operations continue. As a warning against going too far, 2014/2015 failed New Forwarding Environment (NFE), with which DHL wanted to introduce a unified IT system for ocean and air freight worldwide, can serve as an example. "We wanted too much at once," commented Deutsche Post CEO Frank Appel during a press conference (Maruhn, 2015). Adopting new technologies and adapting processes is a task that should not be underestimated. Start-ups with a greenfield approach, which do not have to cope with any logistical legacy, find it relatively easy. In companies that have been operating in the market for some time, there are many smaller and medium-sized projects that have successfully digitized parts of supply chain or prepared them for digitization.

7.6.1 Schenker AG: Participation in the Online Platform Uship

Schenker AG has acquired a stake in the US start-up Uship. The aim is to "learn from company's digital DNA" (DVZ, 2017a). The cooperation should also help to make Schenker's transport management simpler and more efficient more quickly. Schenker is very much involved in supporting dispatchers with IT systems with the aim of creating digital transparency. Apparently with success: "A dispatcher used to route 30 to 40 vehicles. Today he can do it with 90 vehicles" says Erik Wirsing, Head of Innovation, to the trade journal DVZ (Fresh, 2018).

7.6.2 Porsche: Spare Parts in 3D Printing

3D printing is a production process that can have a disruptive effect on logistics. One obvious use case is spare parts logistics. Instead of storing spare parts that are rarely needed and shipping these in a package when needed, for example, only the data is stored. When needed, the part is printed out via a 3D printer as close as possible to where it is needed. The automobile manufacturer Porsche produces 9 parts for its classic car division with the help of selective laser melting. The company is examining whether 3D printing is suitable for production of further components (Semmann, 2018).

7.6.3 BASF: AGV Instead of Works Railway

The chemical company BASF plans to completely replace the conventional plant railway on the Ludwigshafen site with Automated Guided Vehicles (AGV) within next 5 years. Transponders and sensors will be used to guide the AGVs across the site to their destination. After a test phase, live operation has been announced for July 2018 (Struß-von Poellnitz, 2017).

7.6.4 KWS: Connection of Transport Service Providers via Portal

The seed producer KWS has set up a Carrier Management Portal (CMP) together with Stuttgart-based software house AEB. KWS uses this portal to automate order placement and the entire flow of information with its transport service providers. The portal stores the pick-up time and delivery time for each transport. If the transport service provider misses these "milestones," automated warnings are sent out by e-mail to KWS' logistics experts and forwarding agent's schedulers. Both sides then have time to clarify the reasons for delay and initiate countermeasures. The data generated by CMP is also used to measure performance (DVZ, 2017b).

All of digitization projects described above are characterized by a focus on a clearly defined part of their supply chain. The benefit expectation is also clearly formulated in each case and the benefits are measurable. New technologies are introduced cautiously and tested carefully. Learning from start-up companies, as practiced by Schenker, is a promising way to study new business models outside the core business first.

7.7 Lessons Learnt for Project Management

Very often, digitization projects are classic IT projects. Due to the scope, the complexity and the desire to nevertheless quickly achieve usable results, elements of agile project management are increasingly used.

In start-up companies, in particular, a new method of product development and innovation generation can also be identified: design thinking. Design thinking differs from classic process of product development in its approach. The conventional process starts with a product idea, which is then verified through market research. Design thinking goes one step further and first analyzes the needs and pain points of future users.

Terry Winograd, Larry Leifer, and founder of the innovation agency IDEO, David Kelley, are considered the inventors of the innovation method. There is now a dedicated institute at the elite American university Stanford. In Germany, the School of Design Thinking was launched at the Hasso Plattner Institute in Potsdam in 2007.

The design thinking process (see Fig. 7.3) is divided into six steps (School of Design Thinking, 2018):

1. The first thing is to understand the problem. What are the needs of the users, where are the challenges of the project?
2. The second step is about observing. Design thinkers do intensive research to understand the project and define a status quo.

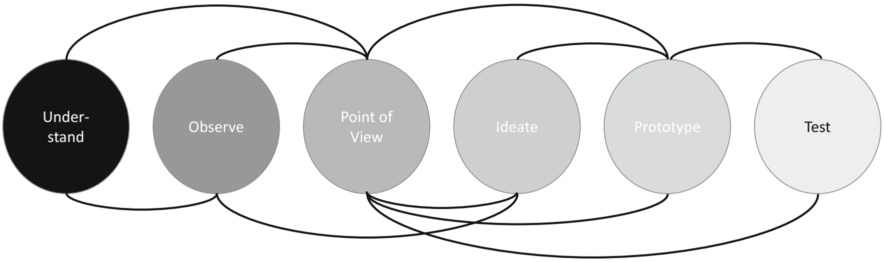

Fig. 7.3 Design thinking process according to Markovic

3. Step three seeks the "Point of View": All observations are broken down to one user. His needs result in a single brainstorming question.
4. Step four is idea generation, one of the core elements of Design Thinking. In the team, the participants develop different concepts and solutions.
5. Subsequently, first prototypes are developed to illustrate the ideas.
6. The test at the end of the process chain examines how the prototypes are received by the target group. The insights gained help to further improve the concept/ solution. At the end of the process, there is an optimal, because user-oriented product.

In design thinking, an essential prerequisite is to form interdisciplinary teams. Young people come together with experienced colleagues, women with men. It is also beneficial for the process if the participants come from different professional disciplines or have different cultural or national roots. Diversity is needed to create special innovations.

The principle of "fast failure" also comes from the start-up culture. This means as soon as it is foreseeable that a product/service will not provide the expected benefit, it is discontinued to save the resources. This principle can also be applied to IT projects that are threatening to get out of hand.

Now a frequently recommended and used approach for introduction of new, digital business models is temporary establishment of parallel organizations outside (cooperation with start-ups) or within the company (corporate start-ups) (Boblenz, 2018).

7.8 Outlook: Digitization of Logistics 2025

The term Logistics 4.0 is based on the term Industry 4.0 and is often mentioned in connection with digitalization. The term Industry 4.0 indicates that we are talking about the fourth industrial revolution. The first Industrial Revolution started around 1750, driven by the development of the steam engine. The second Industrial

Revolution was characterized by mass production based on the division of labor with the help of electrical energy. The third Industrial Revolution was driven by electronics and IT and resulted in rationalization through automation and multi-variant series production (Bauernhansl, 2017).

The Industry 4.0 platform initiated by the German government describes the content of this fourth industrial revolution as follows: "In Industry 4.0, production is interlocking with state-of-the-art information and communication technology. The driving force behind this development is the rapidly increasing digitalisation of the economy and society. It is permanently changing the way production and work will be done in future in Germany: After the steam engine, assembly line, electronics and IT, intelligent factories (so-called "smart factories") are now defining the fourth industrial revolution." This leap directly affects industrial supply chains and logistics.

The term "revolution" implies that predicted developments in logistics would take hold with disruptive force at high speed. So will we see a largely automated and autonomous logistics world in 2025? After all necessary technologies have already been researched, developed, most tested, and in some cases already in practical use. Nevertheless, there is some evidence to suggest that Logistics 4.0, as a description of overall state of the logistics industry, is more a matter of decades than years:

- The successful implementation of digitalization along the entire supply chain is a demanding IT project with significant budget requirements. At present, it is not foreseeable that there would be a corresponding increase in IT budgets. Digitalization follows normal or at best slightly accelerated investment cycles. The budgets for the digitization of logistics are competing with other requirements—for example, from production.
- Even if enough money was available, the lack of IT specialists would slow down an industry-wide digitization after many years. Data analysis specialists, in particular, are in demand throughout the market—and the logistics industry is absolutely not the first choice as an employer.
- In many areas, significant legal questions remain unanswered. Examples: Liability for autonomously driven vehicles or the electronic issuing and transmission of freight documents.

Nevertheless, by 2025, digitization will have made significant progress:

- Advances in identification technology and ever-improving global coverage through telecommunications networks will further improve transparency of supply chains.
- Increasingly better integration platforms will significantly improve connectivity of individual players in the supply chain.
- There will be first use cases of autonomous vehicles in external logistics.
- Artificial intelligence and data analysis will significantly change scheduling in transport logistics. Here, IT systems will support humans more comprehensively than before and partially replace them.

- Transparency about loads and prices of transport will significantly change freight brokerage. Internet-based freight platforms will replace the traditional freight forwarder. It is unclear whether providers from the technology sector will be able to assert themselves here or whether established logistics service providers will "buy in."
- Cloud-based and multi-enterprise data storage and sharing services would have established themselves in the market.

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