Digitisation in Logistics

Answers to questions that concern companies

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Foreword

This paper addresses topical, fundamental questions that logistics managers are asking themselves with regard to the digitisation or the digital transformation of their business. There are concrete ideas and practical information that have emerged from the work of the "Digitisation" project group of Bundesvereinigung Logistik (BVL). More detailed multimedia content is additionally available on each question; the corresponding QR codes can be found at the end of the relevant section.

For all those who are interested in the scientific issues surrounding digitisation and "Logistics 4.0", a corresponding position paper by the Scientific Advisory Board of BVL has also recently been published[1].

Moreover, BVL recently also presented its latest study on "Trends and Strategies in Logistics and Supply Chain Management", prepared under the lead management of Prof. Wolfgang Kersten (TU Hamburg) and Prof. Mischa Seiter (IPRI, Stuttgart). This study has been published on a regular basis since 1988 and is an important touchstone study for specialists and management executives in industry, trade and services as well as their counterparts in academia and politics when it comes to international logistics structures and developments.

http://logistiktrends.bvl.de

The study describes external trends acting on companies. The list is headed by cost pressure, individualisation and complexity. Moreover, one finding of the study is that the digitisation of business processes, transparency in value added chains and greater interconnection of processes are of major relevance. 73 percent of study participants assess the opportunities for their company resulting from the digital transformation as being good to very good – but more than one in two respondents want to continue to wait until proven solutions are available.

While this need for security is understandable, it is not in keeping with the times. Waiting is the wrong this to do in this fast-moving era. Only those who understand the rules of the market and are happy to accept the accompanying challenges will enjoy digital access to customers.

New technologies are already available for changed business processes. In other words, it is technologically possible to cater to changed customer expectations. When it comes to creating the necessary transparency in supply chains, organic systems that have grown over time are reaching their limits. The IT landscape should be rapidly restructured so that it allows flows of vital data and the analysis of this data in real time. Strategically meaningful investments can create a genuine competitive edge.

This paper is a crossmedia paper: Simply scan the QR codes in the print version with your smartphone or click on the codes in the online version to obtain additional exciting content such as interviews or illustrations.

Introduction

In the era of digitisation, customers make extremely high demands in terms of levels of service and the flexibility of logistics services. The key market drivers of digitisation are increased requirements with regard to transparency, supply capability and delivery reliability as well as the desire for individualised products or services. The B2C segment is driving high expectations, and customers are now increasingly also voicing these expectations in the B2B environment.

The effects are felt along the entire logistics value added chain as well as in all associated sectors and areas – from the trading sector through to the companies that supply parts to the industrial production process. Logistics is facing new information technology challenges. The fast provision of information for the tracking and tracing of goods and products is just as much in demand as the integration of digital services in international networks. To meet this demand, digital logistics must operate and communicate more interactively, faster, more securely and more reliably. At the same time, many start-ups are currently being formed and offering new business models and services based on data and information. Many traditional logistics companies are asking themselves whether these services and be combined with their own offerings or whether this signals the emergence of a new competitor.

Whether start-up or established company, the entire industry is called upon to develop from a provider of services into a driver of innovations. The sector must not become the bottleneck in the process of digital development.

This makes logistics even more important for the overall economy, and its scope of responsibility is growing all the time. On the one hand, there will be new opportunities and business areas for the companies; on the other, traditional tasks and functions may well disappear from the market in the medium term. What is clear is that information technologies (IT) are fast becoming the driver and key element of new service offerings and solutions.

The majority of market participants consider the topic of digitisation to be important. But it is also a topic that raises many questions. Exactly what does digitisation mean for individual companies?

- Is digitisation still a vision? Will sitting back and first watching how others deal with it be enough? Or will those who don't jump aboard as soon as possible miss the boat?

- If companies want to engage the topic of digitisation and use it to benefit their business, what are the first steps they should take?

- Will IT become the core business of logistics and new digital business models?

- Does digitisation destroy jobs – or does it create new jobs?

- Will digitisation make my company more successful? Will it create new business areas?

The aim of this paper is to give practical answers to the questions about digitisation that are frequently being asked by logistics managers at the current time and to provide them with hands-on support and ideas.

Current questions

1 How will the role of IT change as a result of digitisation in logistics?

2 Will digitisation change the nature of cooperation between the IT department and the specialist departments in companies?
If so, how?

3 What needs to be borne in mind when embarking on a digitisation project?
Which approach is most suitable?

4 What challenges will companies face in the digital transformation?
What are the typical obstacles that need to be overcome?

5 What are the main advantages of digitisation for the logistics sector?

6 Will digitisation change the business area of logistics service providers and the logistics departments of shipping companies?
If so, how?

7 Do SME freight forwarders or shipping companies have any chance at all of joining in the process of digitisation –
or is this the exclusive privilege of large corporations?

8 How will digitisation change intralogistics?

9 How will digitisation change collaboration between the parties involved in the supply chain?

10 What role will data play in future, and what business models can be derived from this role?

11 How can companies determine the value of data and maintain their control over their data?

12 How can new, valuable information be generated from existing data?

13 Will digitisation make everything uncertain?

14 How will digitisation affect the working environment and qualification requirements?

1   How will the role of IT change as a result of digitisation in logistics?

IT is now playing an even more important role in logistics for companies who want to set themselves apart from the competition. IT not only paves the way for new, customer-focused solutions but is also the key instrument for the efficient, transparent and reliable implementation of these solutions. The closer the cooperation between all in-house and external parties, the smoother this process of implementation.

In future value added networks, therefore, digital processes for the interconnection and collaboration of all parties will become even more important and will make a key contribution to the success of logistics activities. Alongside the interconnection of participants in the value added chain (integration), one of the major challenges in the digitisation of logistics processes will be to depict cross-company business processes in front-to-end IT workflows.

As a result, IT will take on a leading role in logistics. It must be understood and used as a competitive factor, as it supplies innovative tools for a greater focus on the customer and extended service offerings. The options for shaping these processes are many and varied, and the following are just some examples:

- Individualisation of logistics solutions and the accompanying services for customers through flexible, individually configurable IT – this paves the way for such things as the development of customised mobile apps for shipment management or user-specific dashboards with logistics KPIs for the customer.

- Generation of new information through the systematic merging of previously disjointed data – this permits front-to-end risk management along the transport chain, for example, the prediction of problems (strikes, adverse weather, traffic congestion etc.) and the identification of options for action. At the other end of the process, logistics can also act as a data supplier by documenting real local data. This can significantly improve delivery reliability.

- More efficient provision of services and avoidance of waste (e.g. through automation, risk reduction and overriding, platform-based consolidation).

- Error reduction – with the help of sensors, "Industry 4.0" lays the foundation for better and faster alignment of the local reality and the progress of the process with the planning and control level.

All this can be achieved if IT is an integral part of the logistics solution. The result is far greater transparency and flexibility of the fulfilment process based on control of the real world with the help of its digital image. This means that IT penetrates ever deeper into logistics and also makes decisions – or at least supports the decision-making process – on sub-process level.
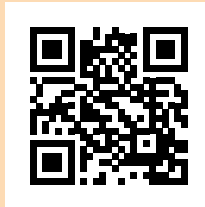
Industry 4.0 at Volkswagen:
Robots in production/
3D printing in tool construction/
Big data monitor in logistics

Dr.-Ing. Torsten Mallee,
AEB – Summary

The 2nd Machine Age –
computers are everywhere

(2) Will digitisation change the nature of cooperation between the IT department and the specialist departments in companies? If so, how?

Combination of IT know-how and process/market knowledge:

In the digitisation age, specialist departments and IT will have to cooperate more closely and more effectively in order to translate the high performance capability of technology into hands-on applications. Otherwise there is a risk that the technological options will develop faster than the relevant ideas and applications for business activities. Digitisation will not make a poorly organised process better; it will only turn it into a poorly organised digital process.

At the end of the day, it is still the business operations that will determine the success of a technology and not the technology alone. It is therefore important that the specialist departments (such as the operational departments of a logistics service provider or the logistics department of a shipping company) keep up to date with new technologies and think about how to deploy these technologies to improve delivery reliability processes or customer satisfaction. At the same time, the development of technology must not be allowed to take place in a technology-centred bubble. The development process must understand the business, the current problems and the challenges so that it can provide hands-on support and play a role in the creation of new ideas. It is important that IT is no longer a "closed book" and that it doesn't use a vocabulary that can only be understood by experts. IT must become simpler and easier to understand for the people who conduct business for the company.

Organisational measures:

Consequently, it is essential that the IT and specialist departments in companies work closer together. Companies must think about how they can support this cooperation, if necessary by implementing organisational measures. IT is increasingly the basis for and the driver of innovations. This is why it must be directly integrated in all projects and must be driven by the same goals that drive business. IT is developing from a pure provider of implementation services into a partner of the specialist departments, a supplier of both innovations and concrete advice and assistance.

One way of underpinning this cooperation in practice is by creating cross-departmental teams for specific tasks. A more radical approach would be to put in place a set-up where IT is part of other departments. The expertise of the conventional IT department would then increasingly focus on the interplay of the overall IT system, data security, data quality and data evaluation, while the process-based or application-focused IT activities would be more closely intertwined with the business function.

During the course of this process, it is also a good idea to consider agile strategies like "scrum" which focus on regular communication between specialist department and IT.

What is "scrum"?

The scrum method can be used to develop high-quality products and processes faster and more cost-effectively. The overall development goal is based on a vision, but the requirements are implemented one by one in a short-term process supplying concrete results. Complex, detailed specification manuals are replaced by specifically usable sub-products that are themselves ready for delivery. The implementation of a sub-product is followed by the next cycle in which product, requirements and procedure are reviewed, developed further and realised.

Volkswagen:
Intelligent collaboration between humans and robots

3 What needs to be borne in mind when embarking on a digitisation project? Which approach is most suitable?

The digitisation of production and logistics routines is an evolutionary process; it began back in the late 1950s and has been gradually advancing ever since. The major difference between then and now is that the speed of this process is now exponential. It is this pace of change that underlines the revolutionary, disruptive aspect of digitisation (see QR code A). There was always a gap between what was technically possible and what was actually put into practice in terms of digitised processes in companies across a broad front. Now that the speed of change is increasing so rapidly, however, there is a risk that this gap will become so big – particularly in SMEs – that some companies will be at a competitive disadvantage due to an inadequate degree of digitisation.

When there is a clear objective, a strategy of small but systematic steps is often more productive than striving form the outset for the big all-encompassing solution, as the latter approach runs the risk of never actually being completed (see QR code B). The small-step strategy also enables companies to react in a flexible and agile way to changes, to identify new insights, and to incorporate the resulting knowledge in the subsequent steps. In this way, this approach also reduces the risk for the company.

To view digitisation as a solely technology or process-driven project would be too one-sided, however. It is the employees who – more than in most other projects – are the drivers of successful implementation. In the era of digitisation, the goal is to break up existing organisational units, thereby paving the way for a greater degree of cross-functional and cross-company collaboration. At the same time, digitisation increases the pace and pressure of the decision-making process. This calls for a great deal of sensitivity on the part of management personnel while requiring employees to show the ability and willingness to take on responsibility.

The classic rules of IT projects apply when it comes to the preparation of projects within the context of the digital transformation – and this raises the following questions:

- What goal do we want to achieve?

- Which stakeholders – including those outside the company – are involved in the solution? (This question is particularly important in the area of supply chain management projects.)

- Are the involved parties pursuing the same objectives, and are they aware of their tasks and roles?

- What does the business process look like that is to be depicted via IT?

One meaningful approach may be to create a "digitisation community" within the company. To this end, each unit names an "officer" for digitisation who works with the other appointees in an agile company team (see QR code C). This team meets at the start of a "sprint" (= defined cycle segment of an IT project) to plan all the activities within the context of the sprint. The sprints each last between one and four weeks. Based in particular on in-house or public technology scouting findings, the team determines which unit (e.g. which function in a production network) conducts which pilot project. The aim is to avoid duplicated work and to allow the community to benefit from the specific piloted results that are available in the short term. If the pilots produce positive outcomes, concerted roll-out plans are then drawn up and implemented.

Within the framework of management target agreement processes, the shift in recognition emphasis drives a development away from "flash in the pan" innovation and towards sustainable implementation concepts. In principle, the organisation that receives the greatest reward and recognition should be the one that "copies" proven, successful innovations and then implements these innovations in a way that underpins long-term success.

Interview with Talking Logistics: "Companies have been using IT for a longer time - what's new and different today as it relates to digitising the supply chain?"

The evolution of digitisation using the example of the global production network

Additional information on working in agile company teams

④ What challenges will companies face in the digital transformation? What are the typical obstacles that need to be overcome?

Data quality

„The new saying is that "data is the new gold". New business fields or services like analytics build on data. This enables logistics experts to manage the supply chain more reliably and more efficiently. One key premise, however, is that the basic data is correct, validated and complete. And this is precisely where digitisation currently faces an obstacle – in that the available data (e.g. material master data, status data, order data) is often:

a) incomplete and sometimes even wrong, as it has passed through several pairs of hands or has still been documented manually; it is not uncommon to find, for example, that ETA data (ETA = estimated time of arrival) for one and the same shipment is different depending on the source of the data (ERP, freight forwarder, maritime shipping company, handling terminal, air freight carrier ...);

b) not available at short notice or is not made available to other process participants. This is often due to a lack of knowledge among participants as to which data the other "process colleagues" need in order to successfully complete a task. The internal routing of order data alone – from initial preparation through to availability for the logistics function – can take days. This is not due to the technology but to the lack of coordinated processes.

The willingness to share data

One important precondition for the success of the digital transformation is the willingness to share data. Companies who shut themselves off and are not willing to share their data don't have any data gold; all they have is small change.

Corporate culture

The history and tradition of a company are what determine its value. At the same time, history and tradition can also prevent a new mindset from becoming established in the company. It goes without saying that regulations, process rules, quality checks and stipulations play the key role in ensuring that today's companies achieve excellent results –

the only problem is that it often all happens far too slowly. The goal here is to secure processes that are critical for the company but to also create space for experimental processes. In the era of digitisation, disruptive ideas, a start-up mentality, the willingness to take risks and a "let's try it" attitude are an essential precondition for innovations.

You can read about how a start-up mentality can be integrated in an existing corporate culture in the "Recommendations" section.

Systematic implementation

The first step is to develop a good idea. But systematically putting this idea into practice is often difficult. This is particularly the case in completely new areas like digitisation.

Making sure employees are on board

The new paths will only lead to the desired destination if the employees are willing to go along on the journey. It is becoming ever more important to think and act in processes that are focused on the customer. The work of humans and machines will increasingly complement each other. The shift towards the more extensive use of data gives rise to new skill requirements and creates new workplaces. Against the backdrop of the personnel shortage – an issue that was also confirmed by the findings of the study on "Trends and Strategies in Logistics and Supply Chain Management" – this presents a very special challenge that companies can master by taking targeted further training measures.

Sound logistics know-how, language skills and IT expertise are just as necessary as a practically unheard-of corporate culture that includes the willingness – and the permission – to try out new ideas, even to make mistakes. It is encouraging to note that the polled companies confirm that most of these skills and the willingness to embrace change already exist.

The biggest qualification need with regard to IT skills is ensuring that specialists and management executives can use information technology intuitively. Moreover, the specialists in particular lack good programming skills: according to the respondents, these

skills only exist at a low level in almost half of all companies. The ability to collect, store and statistically analyse data in a structured way will become more important in future. This change in focus will also create many new challenges for HR professionals.

The conclusion drawn by the authors of the study is that logistics is entering a phase of historic opportunities that enable it to manage ever more complex flows of goods, to increase productivity with at least the same level of flexibility, and to meet the most individual preferences of the customer to a hitherto unheard-of degree. You can find analysis and inspiration for your own strategies at http://logistiktrends.bvl.de.

Interview with Talking Logistics:
"What are the biggest challenges or barriers that companies face in transitioning to a digital supply chain?"

## 5   What are the key benefits of digitisation for the logistics sector?

Most companies associate digitisation with the goal of greater delivery reliability. Digitisation provides various levers for this purpose, such as more transparency, better predictability and planning, risk reduction or customer-specific products. At the same time, modern IT enables companies to integrate greater flexibility and agility in their processes and therefore to react more promptly to customers and market requirements. A further advantage of digitisation is that it paves the way for better management of — as well as reduction of — the increasing complexity in the process landscape. This is an area in which digitisation permits improved interconnection and front-to-end automation. It creates greater transparency and supports smoother collaboration between the parties in the supply chain. The interconnection of the various participants and cross-company, IT-supported collaboration ensure comprehensive access to data, which in turn forms the basis for additional information and knowledge (allowing early prediction of risks in the supply chain, for example). This more comprehensive knowledge of the overall process is one of the key drivers behind the generation of further innovative ideas.

Other benefits like greater efficiency, risk minimisation, automation, error avoidance and improved decision-making based on more valid and more complete information help to ensure that costs are reduced. At the same time, new services in areas like the analysis and interpretation of data result in increased customer satisfaction. This can lay the foundation for new business areas and sales potential

Interview with Talking Logistics:
"Based on your experience working with clients, what are some of the benefits they are achieving?"

Diagram: The maximum "Industry 4.0" benefit potentials will be exploited above all by solutions than span multiple functions, departments and markets.
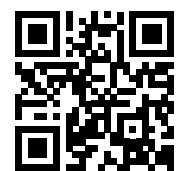
6 Will digitisation change the business area of logistics service providers and the logistics departments of shipping companies? If so, how?

In addition to transporting the good themselves, the logistics service provider can also handle the management of data along the supply chain. This could give rise to the tasks of planning, problem forecasting, improving delivery reliability or ensuring the intelligent bundling of shipments or loading of containers. Logistics departments of shipping companies acting like a 4PL provider can also handle these tasks. Moreover, logistics service providers with wide-ranging networks and global presence can also become content providers for other information and can feed this information into networks/content platforms (e.g. updated data on environmental conditions, traffic congestion information or live images).

Other opportunities for logistics service providers and the logistics departments of shipping companies would include offering services and solutions that

- reduce complexity – through automated processes, for example, that permit front-to-end transparency and visibility as well as collaboration

- increase efficiency – for example by reducing errors or avoiding risks by identifying them at an early stage

- avoid waste –by making better use of existing transport capacities, for example

- create flexibility – for example through the re-routing of shipments, later collection or the use of different modes of transport

- enable sustainable transport concepts – by using a flexible mix of modes of transport, for example, a process that would no longer be complicated by "black boxes" or a high administrative workload but that operates smoothly.

Logistics departments of shipping companies will also develop into 4PLs. The more the logistics department of a shipping company uses the potentials of digitisation, the more it will exclusively need transport providers – because knowledge of the modus operandi and the deployment options of digital supply chain management will enable the logistics department to organise the greater part of supply chains on its own. This means the logistics department will only buy in pure transport services, in other words the required truck capacity. Taking this one step further, this could also result in a new business area for truck manufacturers, namely the direct provision of free truck capacity which is then directly loaded with freight via the flexible scheduling systems of their customers. Here as well, it is necessary to factor in the future relevance of marketplaces, which will in some cases massively affect the business model of freight forwarding companies.

Not every logistics service provider will exploit the aforementioned opportunities or utilise the potential of the data. This is why other companies, such as IT providers, will also offer services that combine data with logistics expertise.

Interview with Talking Logistics:
"What are questions companies should ask themselves when it comes to digital supply chain enablement?"

(7) Do SME freight forwarders or shipping companies have any chance at all of joining in the process of digitisation – or is this the exclusive privilege of large corporations?

The ability to interconnect will be the core task of all companies in the supply chain, irrespective of their size. For whether it is an SME transport provider, a large logistics corporation or industrial or trading company, in the era of digitisation every company must be in a position to connect its internal systems with those of others (e.g. ERP with freight forwarding program or WMS). This means that integration skills are in high demand in each and every company.

Moreover, it is important that every company is interested in looking beyond its own confines and to think about how it can make better use of and support the processes of upstream and downstream partners.

Modern IT is available at an affordable price, particularly for smaller companies. New billing models – such as leasing of cloud-based solutions – offer an attractive and flexible pricing policy for small and medium-sized companies (SMEs).

Companies of all sizes can take advantage of the benefits of digitisation in order to make efficiency gains and, for example, achieve higher margins or become more competitive and generate higher sales by offering new products and services. The two approaches can also be combined.

Concrete examples of the benefits of digitisation for small companies include:

- More efficient business activity – thanks to:

  - Automation of manual processes

  - Avoidance of waste

  - Avoidance of mistakes

  - Reduction of complexity

  - Reduction of administrative workload

- Support for customer demands for greater interconnection and integration of IT systems

- Mobile access to data

8 How is digitisation changing intralogistics?

Digitisation will not turn intralogistics upside-down but it will affect it at virtually every turn. A pick list will remain a pick list, regardless of whether it is displayed on a smart device or a piece of paper. But the picking process itself can certainly be organised far more efficiently with the help of a smart device with route optimisation and integrated inventory and assistance functions. Digitisation is not an end in itself. On the contrary, if it does not bring any direct benefit, then it will be certainly not be used in intralogistics.

Large warehouses and distribution terminals often make major investments in hardware and software. In recent years, these high-level investments are taking place in an ever more dynamic environment; shorter operating and delivery times, bigger item portfolios and more demanding performance requirements combined with high service standards are reinforcing the call for more flexible solutions. And this is what intralogistics 4.0 solutions are promising: "intelligent" containers, smart devices and swarms of self-driving vehicles are designed to ensure more flexible and simultaneously efficient systems.

Indeed, the technologies that are available today provide a whole host of options for innovative applications— from simple digitisation through to the Internet of Things. It is a good idea to proceed step by step and from the small details to the big picture (bottom-up), from (part) automated recording of the material flow (tracking and tracing) through to the autonomous control of intelligent containers and autonomous vehicles.

Tracking and tracing using ident technology

Many of the technologies needed for efficient recording of the material flow have already been in place for years. Starting with simple ident technologies like the one-dimensional barcode, through two-dimensional codes like QR or data matrix all the way to electronic labels (RFID tags), ident technology has made major advances in recent years. Barcode scanners can record more than 100 codes a second, and 2D codes can be used to encode many hundreds of characters (QR code: > 4,000 characters) and read them in error-redundant mode. RFID tags can be scanned without sight contact

and, together with the corresponding data standards and services (e.g. EPC/EPCIS), permit precision unit-based and batch-based tracking of goods and products. In combination with suitable (cloud-based) software services and platforms, this enables companies to achieve a high level of transparency. This is the basis for any kind of logistical analysis, whether via a manual process or using big data software. High quality and as compact a possible sequence of data along the supply chain form the basis for effective digitisation. When introducing such systems, it must be borne in mind that the solutions used should be as standardised as possible[2], but also that the concept takes account of the specific range of services that are offered. There is not one single solution.

Ad-hoc interconnection and autonomous control

Digitisation of (intra-)logistics processes should not be equated with total automation. On the contrary, the idea is to interconnect machines and humans as well as to create autonomous "control loops" consisting of:

- Sensor technology or data recording

- Human beings as actors

- The operational machines

- Data processing

- Feedback to human or machine, thereby completing the loop

One good example are intelligent containers such as the iBin®[3], which is — first and foremost — a classic Kanban container for "C" parts like bolts or washers. However, the iBin®[3] is equipped with a camera unit that monitors the filling level in the container. It records the filling level as long as the bottom of the container is covered by parts. If only a few parts are on the bottom of the container, detection switches to quantity mode. For this purpose, the camera takes a picture, which is sent via the radio interface to a cloud, where the image is processed and the filling level calculated. If the system determines a critical threshold, it triggers a replenishment order or initiates the replace-

ment of the container. This creates a self-contained loop for container replacement ("Industry 4.0" — "Kanban[4]"). The advantage of this kind of solution is the autonomous control of each individual container inventory in near-real-time. In combination with an automated order function (eProcurement), this makes for efficient, flexible and autonomously controlled "C" part management.

Classic conveying technology also uses the options arising from the digitisation of intralogistics. Development work is focusing on the modularisation and standardisation of (part) automated modules that can rapidly and flexibly be arranged to create new material flow systems.

Very few topics are as closely associated with the digital transformation as that of autonomous driving. AGVs are already a reality in the field of intralogistics and provide a degree of flexibility that is impossible to achieve with conventional, fixed conveyor technology.

As is the case with tracking and tracing, the most important thing is to find the suitable solution rather than introducing digitisation or automation for the sake of it. Here as well, a promising strategy is to proceed step by step and from the bottom up. Above all, however, the motto should be "Just DO it!" in the most literal sense, which means adopting a genuine "hands-on" approach.

9 How will digitisation change collaboration between the parties involved in the supply chain?

The supply chain is a fragile and highly complex system. One of the challenges lies in the high number of participating parties and their IT systems that work together globally within the same supply chain. These parties include orderers, suppliers, freight forwarders, warehouses, hubs, customs, service providers and recipients. The Herculean task for logistics managers – on both the shipping and services sides of the market – is to bring together under one "roof" all the actors along the supply chain or even within one delivery network and to orchestrate these actors in such a way that supply processes operate smoothly and reliably. This is where collaboration plays a central role, and collaboration is only made properly possible at all by modern digital solutions.

Collaboration supported by digitised processes is about creating a common, cross-company digital platform incorporating all the parties along the supply chain. Be they shipping companies, logistics service providers, suppliers or recipients - collaboration actively integrates participants, processes and information in the overall process.

Particularly in view of the challenges the sector will face, digitisation supports the positive effects of collaboration along the supply chains, because it paves the way for:

- Flexible, cross-company integration of participants

- Interconnection of the processes of different companies

- Early insights into the processes of the upstream and downstream participants in a supply chain

- Automated data transmission

- Improvement and partial automation of decision-making processes through the provision of important information

- Increased agility and flexibility to permit fast reaction to changes

- Increased transparency through the derivation of information and knowledge from data

- Decentral, qualified decisions without the need for a permanent central instance; it is only IT that also permits the qualified making of decentral decisions
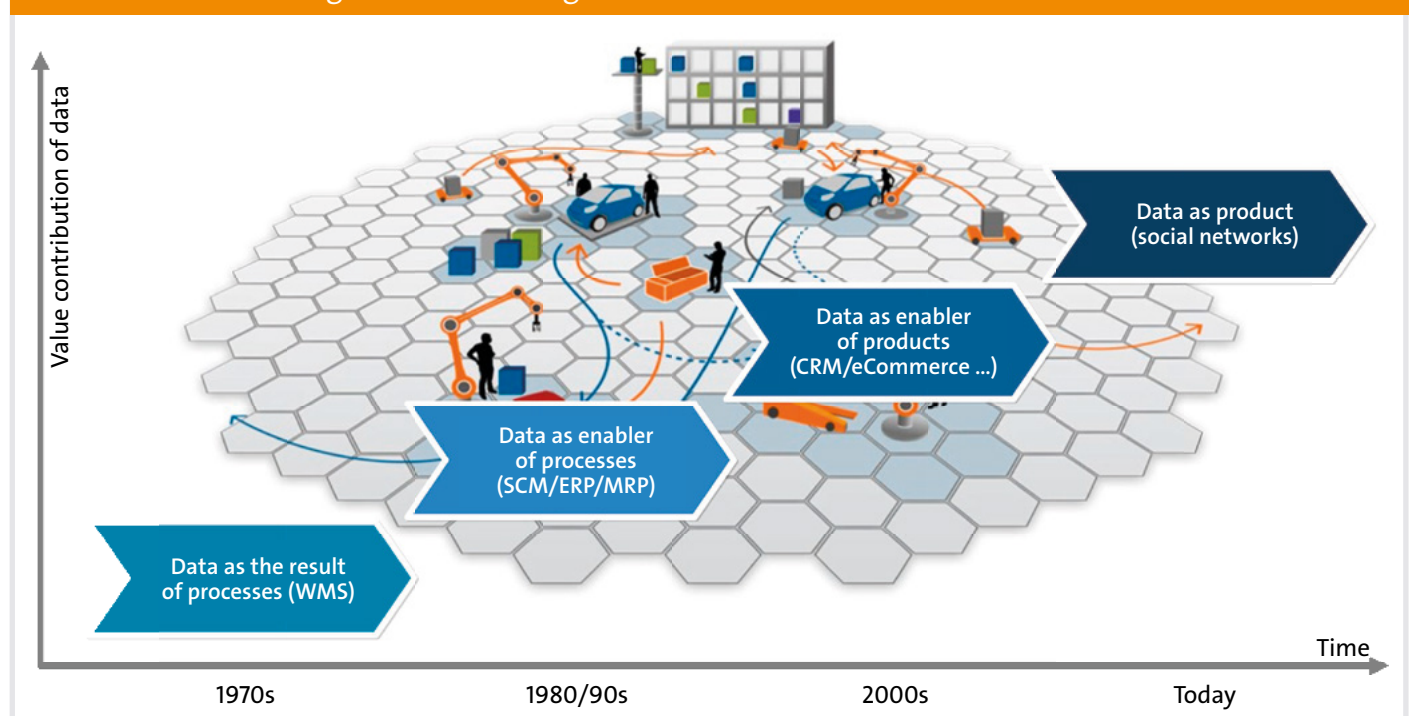
(10) What role will data play in future, and what business models can be derived from this role?

The importance of data has been steadily growing ever since electronic data processing was first introduced. This applies to the automation of production and logistics processes as well as, increasingly, to new business models and the success of modern companies in general. In the era of digitisation, experts are talking for the first time about "data-driven business". Digitisation and Industry 4.0 call for a new understanding of the way in which data is used.

- Data as a process outcome: although information systems were already in use in the 1960s and 1970s, back then the data had a primarily supporting function.

- Data as an enabler of processes: with the spread of manufacturing resource planning (MRP) and enterprise resource planning (ERP) in the 1980s and 1990s, data developed into an enabler of company-wide business process management. Without consistent data available in near-real-time, the introduction of globally or at least regionally standardised processes like order-to-cash or procure-to-pay would not have been possible in the first place.

- Data as an enabler of products: since the turn of the century, companies have increasingly been offering products that would be unthinkable without high-quality data. These products include smart fitness services like "miCoach" from Adidas as well as professional tools for fleet management using GPS trackers.

- Data as a product: in recent years, we have seen the emergence of marketplaces for data. Data is automatically retrieved via programming interfaces (APIs), evaluated and billed based on volume and unit of time. The data is no longer the enabler of products but is itself the product.

The individual developmental stages in the role of data are not disjointed but are reflected in the development of the company. We encounter the "data paradox": data is, one the one hand, the result of digitisation – machines, smart services etc. produce a growing amount of data (keyword "big data") – but is at the same time a resource for performance of the service or even the product itself.

The role of data during the course of digitisation[5]

Value contribution of data

Data as the result of processes (WMS)

Data as enabler of processes (SCM/ERP/MRP)

Data as enabler of products (CRM/eCommerce …)

Data as product (social networks)

Time

1970s   1980/90s   2000s   Today

11 How can companies determine the value of data and maintain their control over their data?

It is undisputed that data has a value and that the management of data entails certain costs. Data has been a for-sale commodity for some time now. But there are a number of differences between material assets and the immaterial asset of data. Here are some examples[6]:

- Wear: unlike material goods, data assets are not subject to wear and tear.

- Scarcity: unlike material goods, data is not a scarce asset in the literal sense, because the value of the data increases with use — and in many cases also with an increase in the number of users.

- Integration: the value of data increases through its integration with other data, as can be seen from the emergence of so-called "data lakes". In line with the principle "the more data, the better", these central data stores collect as much data as possible to ensure a process of big data analysis that is as effective as possible[7].

It is due to, among other things, these differences that there is still no uniform opinion of data in terms of its value in the form of data assets. However, this does not alter the fact that, in view of the development of the "smart service" world, it is urgently necessary — and basically also possible — to establish the value of data assets[8].

The precondition for this is the detailed analysis of data as an economic asset. Like economic assets in general, data can also be classified using a number of criteria, such as:

- Marketability or exclusivity: as with material goods, it is possible to distinguish between private data assets (e.g. product master data) and public data assets (e.g. geoinformation, addresses). There are also mixed types. One example of this are data assets that are treated as club assets — in other words, only made available to a certain number of users, such as tracking and tracing data in a specific supply chain.

- Production resource: by analogy with the material production economy, data can be interpreted as the raw material of information products. As a logical consequence, there are then also various production stages as well as entire "data supply chains".

- Demand behaviour: again, by analogy with the material world, there are substitution goods and complementary goods. Complementary data substitute each other, as is the case with data along a supply chain, for example. Substitution goods in this sense are data from different sources with the same data quality.

Depending on classification, data assets make different value contributions to innovative service offerings. This is also why the need to protect the said data can differ. Consequently, there is a lesser need to protect public data assets, which are available to all companies anyway, than is the case with private data assets or club data assets.

Just as there are different classification criteria for data assets, there are also different ways of assessing their value, such as[9]:

- Production cost method: many data assets, particular those in the early stages of a data supply chain, have no market value because there is no market for them. One example is master data relating to self-produced semi-finished goods. The value of this data can be calculated using the costs for procurement, filing and maintenance of the data.

- Utility value method: data has a utility value for many business processes, and this value is directly dependent on the quality of the data[10]. The more consistently and completely customer master data is maintained, and the more frequent the regularity with which this data is updated, for example, the more effective the sales controlling activities in industrial companies.

- Market value method: if there is a market for data, the value of the data is determined by its price. There are, for example, many commercial data providers for business partner data[11].

In the international competitive arena, it is important for companies not to be left "footing the bill" for data management and leaving it to other market participants to monetarise the data assets. A digitised industrial company must therefore be familiar with the various valuation procedures, must be able to measure and control the value of the data assets, and must understand the mechanics of digital business models.

The new role of data as a strategic resource and the growing collaboration of companies in business ecosystems gives rise to a fundamental conflict of goals that will also shape the digitisation of logistics. On the one hand, companies pursue the goal of exchanging data in business ecosystems in order to secure their competitiveness (indeed they are in many cases forced to do so due to external factors). On the other hand, however, companies are increasingly also aiming to protect their data precisely because of the growing importance of data.

This conflict of objectives will be all the more present, the more companies operate in business ecosystems and the more this results in the value of data for the success of their business activities. This conflict can only be resolved if companies succeed in retaining digital control of their data. This digital control also entails establishing a balance between the need to protect data on the one hand and the shared use of data in ecosystems on the other. Finding this balance will be a key "skill" for success in the data economy.

(12)   How can new, valuable information be generated from existing data?

Data that is created from an IT-supported process as a waste product, so to speak, can be used in other (new) processes as the basis for totally new applications. An example from a different field illustrates this point: the data recorded from the ski passes at the many ski lift turnstiles in all ski resorts worldwide can be used to derive both new services for "end users" (information on personal altitude metres covered on one day of skiing) and "swarm information" (e.g. movement profiles of entire skiing regions in relation to weather, traffic situation or train delays).

This strategy would also be conceivable in the context of both global and cross-company supply chain management. New, smart services could be created for participants in value added chains. The ever better availability of master and movement data opens up new possibilities for global management concepts. The global production network is developing away from the historical management concept (e.g. how many vehicles of what quality were built worldwide yesterday, and how should we react to this today?) and towards autonomous control, in which the network itself knows, for example, that a disruption in a plant in the USA today could occur in India tomorrow – and could then automatically remedy the problem without human intervention.

(13) Will digitisation make everything uncertain?

Data security was already an issue for companies before digitisation started to take effect. Security is a fundamental question that always arises in connection with IT solutions. To this extent, the questions on the issue of security are also of a general nature and are not only to be viewed specifically in the context of digitisation. The typical questions outlined below which companies have to consider are designed to provide ideas and assistance in this respect:

- Where are the solutions hosted (e.g. in the geographic area governed by Germany's Federal Data Protection Act)?

- How many high-security computing centres are there?

- Are redundant/dual-design systems in place?

- Is SSL-encrypted data transmission ensured?

- Is the system protected by multi-level firewalls?

- What kind of service levels are required for operation (e.g. reachability, reaction time)?

- Who is the data protection officer, and is he/she suitably qualified?

- How transparent are the availability parameters?

- In the software used, how do change management processes function?

Security is not only a question of IT/technology but also concerns the processes that are implemented in the company. This is an aspect that should always be borne in mind. For what use is the best IT security concept if employees stick their passwords to the PC screen or if the filing cabinets in the accounting department are left open so anyone can access the files?

One important security issue concerns the use of employees' private hardware in the office environment (e.g. smartphones). If it is simply the case that employees can access the Internet via the company network, then the measures that need to be taken are limited in scope. The situation is more complicated, however, if the aim is to make productive use of company software and data with this private hardware. Unlike the connections for home office workplaces, which generally involve remote desktop access via a firewall, the use of private devices in the company requires direct access to the company network (LAN). This creates challenges in terms of security, compliance and licence management. The questions that need to be addressed include above all the following:

- How is the maintenance of the mobile devices ensured (antivirus software, operating system updates)?

- How can threats be averted from possibly harmful third-party software that is installed on the equipment?

- How is the protection of personal data assured?

- How is it possible to prevent compliance violations due to the commercial use of third-party software that is only licensed for private use on mobile devices?

- Which corporate software licences are really needed for the mobile devices?

Ultimately, it is only possible to ensure a high level of security if the company retains a certain degree of control over private devices. This can in turn dampen the enthusiasm for the new flexibility.

(14) How will digitisation affect the working environment and qualification requirements?

It is predicted that advancing digitisation will have a major impact on the working environment. Among the positive aspects are the belief that far more varied communication solutions will permit far greater flexibility in terms of the place where work is performed and with regard to working time models. It also calls for greater agility, however, something that is to be achieved through more variable team structures.

According to a BVL study (Digitisation Report 2015), logistics experts assume that around one in two jobs in their department will undergo change due to digitisation. The majority predict positive effects, such as a more efficient working process, benefits due to central data management or better communication with locations, departments and employees. At the same time, however, just under one in two believe that work will be faster-paced and that work tasks will become more complex. A large majority are of the opinion that it will in principle be possible to master the coming challenges with the existing personnel, but roughly one in two experts say that further qualification measures will be needed for employees.

These assessments are supplemented by other studies that categorise many logistics activities as future "victims" of the digital transformation. Regardless of the extent to which they become reality, these developments cannot be stopped. But they can be shaped.

Even if the basic tasks of logistics will remain the same in future, the way in which these tasks are performed will certainly change. IT will increasingly become the key element of future occupational profiles, as logistics processes and IT services will merge with one another. Each and every employee will make a contribution – as a user or a specialist – to supporting these IT services as offerings that set the company apart from its competitors.

This means that apprenticeship courses and degree programmes must impart a higher level of IT skills. Entirely new occupations can then play a key role in the logistics of the future, jobs such as data scientist or data analyst. What is certain is that the competition for good employees ("war for talents") will become even fiercer in the context of digitisation – which makes it all the more important for logistics to position itself as an attractive employer with high-level future relevance creating modern work environments and appealing workplaces. The BVL "Image of Logistics" focus group has put together a guideline outlining measures companies can take to position themselves in this way as well as other useful information on personnel management, and this guideline can be downloaded from the BVL website at www.bvl.de/hr-leitfaden .

When it comes to the existing workforce, employee qualification is right at the top of the list of priorities that companies should forge ahead with. Qualification measures not only provide effective support for the process of digitisation, they also help to ensure that the potential negative consequences for the existing jobs are mitigated.

Explanation of the key terms

What does "Industry 4.0" mean for logistics?

The Fourth Industrial Revolution ("Industry 4.0") will affect practically all areas of logistics. It takes its place in the sequence of the three receding industrial revolutions, but it is the first one that was announced in advance (at the 2011 Hannover Fair[12]). It is driven by ongoing interconnection and digitisation – with which it is often falsely equated – and is closely interlinked with the ongoing "digital transformation" that will change many areas of our economy and our society.

The Fourth Industrial Revolution for logistics ("Logistics 4.0") is based on the assumption (a priori knowledge) that the logistics of the future based on autonomous entities (machines, vehicles, smart containers etc.) can be organised more efficiently than is the case today[13]. "Logistics 4.0" is an extension of the underlying idea of an Internet of Things, in which "intelligent" packages, pallets and containers will find their way from the production plant to the customer on their own, just as data packages do on the Internet[14].

In the case of logistics in particular, the assumption that a Fourth Industrial Revolution will occur is based on the realisation that there is no other way to efficiently master the constantly growing challenges. These challenges include:

- The individualisation of products and services and the accompanying mass production of individual parts ("batch size of one")

- The reduction in delivery times (same-day delivery) and the resulting minimisation of plannability ("no time at any time")

- The exponential growth of the structural and data complexity of the logistics networks and supply chains

- The call for flexibility in virtually all dimensions of supply chain management

At the same time, all the key technologies that can make autonomous control and self-organisation a reality in the spirit of "Industry 4.0" are already available: namely affordable and high-powered processors and sensors, as well as smart devices, AGVs or overriding cloud applications and much, much more.

A brief look into the past tells us that technical possibilities always made it to the application stage when they promised value added. In the same way, it is fair to assume today that the Fourth Industrial Revolution will become reality. This also means that new, non-sector players will appear in logistics who are in a position to generate tangible value added through new, digitised business models and products. Companies like Uber and Amazon show what digitisation – if it is systematically applied – can achieve in traditional sectors.

The logical consequence of this is the necessity to systematically and without delay address the question of what "Logistics 4.0" means for each individual and for the company. For one thing appears to be clear: we are heading for a rapid, revolutionary transformation – and we can't simply sit it out.

The transition from "Logistics and Production 3.0 to 4.0"[15]

Logistics and production today	Logistics and Industry 4.0
Central control, rigid, complex	Decentral self-organisation through ad-hoc interconnection
Deterministic decisions	Decisions are context-dependent based on real-time simulations
Established value added chains	Virtual ad-hoc organisations, value added chains
Pre-planned operational systems	Autonomous, self-organising logistics and production entities
Expansion through upgrading	Expansion through "upnumbering" (modularisation)
Load carriers/workpieces/products are passive objects	Intelligent load carries/workpieces/products actively support production and logistics processes
Rigid, compulsory presence at work for employees	Flexible deployment of employees (availability calendars, specialist knowledge catalogues)

The terms digitisation, analytics, collaboration and big data are often named in the same breath. So how do they belong together?

Digitisation, digitalisation, digital transformation

There are differences between digitisation, digitalisation and digital transformation, particularly in English. You can find a good summary of these differences at: http://www.i-scoop.eu/digitization-digitalization-digital-transformation-disruption/

Collaboration, big data and analytics are key enablers and cornerstones of digitisation and are briefly explained below.

Collaboration

Cross-company collaboration makes for more efficient processes. The collaborating parties work together smoothly, avoid waste and make fewer mistakes. Black boxes become transparent, and data is shared at an early stage in the process. Data is converted into information and information into knowledge. Collaboration and the transparency it creates would not be possible without digital support.

Big Data

Collaboration makes a key contribution to big data, because it interlinks multiple data sources that were previously singular and disjointed. Collaboration permits access to these different data sources, most of which are located in the in-house systems of the participating companies. The combination of the operational data of all parties involved in the supply chain (e.g. shipment data, packaging, time schedules, material master data) and the supplementation of this data with other general data on things like natural disasters, strikes, traffic congestion or weather forecasts creates a new information potential and therefore adds a new dimension to the predictive power of data. A further strength of big data is emerging from the Internet of Things, where IT is applied to objects and supplies additional important information.

Analytics

In turn, the evaluation of data masses generated by big data calls for analytics, so that data can be interpreted and key statements or deductions made. Analytics is divided into the following individual areas:

- Descriptive analytics: what happened? (e.g. historical depiction of delivery quality)
- Diagnostic analytics: why did it happen? (e.g. historical evaluation of the reasons for negative delivery quality – too late, wrong address, damage etc.)
- Predictive analytics: what will happen? (e.g. future-focused prediction: the shipment will not meet the precalculated ETA, as the supplier did not deliver on time, the shipment missed the connecting train etc.)
- Prescriptive analytics: how can we let things happen? (e.g. future-focused proposal of measures to avoid delays. The supplier may deliver the shipment late, so you choose the CEP service instead of the regular cargo service to ensure that you meet the delivery deadline.)

All three components therefore provide key functions in the digitisation process and are all closely interconnected.

Other important terms:

Cloud solutions: how do they support the collaboration approach?

Cloud technology is one of the cornerstones of successful collaboration. It supplies technological elements that match the requirements for collaboration between the various parties:

Cloud solutions	Collaboration
Central solution with decentral access	Joint, cross-company use of IT systems
Easy provision and easy retrieval of information by authorised persons	Location-independent sharing of information
Integration of participations at the press of a button – location-independent	Easy (global) roll-out
Internet access as the sole precondition for use	Easy access to the system
Central maintenance with decentral availability of the solution	Easy maintenance and further development
High agility through availability of hardware and software as needed	High agility necessary in order to react rapidly to changed framework conditions

Recommendations

Promoting a start-up mentality in your own company

Promote innovative ideas of your own employees. But beware: ambitious business plans and extremely short-term amortisation periods can nip any innovation in the bud. Create the necessary space for a start-up mindset in your company. Provide the necessary budget and rooms where creativity can unfold.

A little more courage won't hurt

It is often easier to name risks and have reservations than to see new opportunities. Be curious about new solutions, and try these solutions out.

Prototypes rather than theoretical specifications – small steps rather than a big leap

Given the rapid pace of development in the context of digitisation, specification manuals are often already outdated by the time they are completed. This is why you should use rapid prototyping when you create software solutions. This enables you to determine faster what a potential solution might look like. This is an area in which paper is often far too patient. Engage in pilot projects of limited scope, learn from them, and use what you have learned to continuously improve the solution step by step. This is the way to ensure that you are always on the ball and minimises the risk of developing solutions the market doesn't need.

Always bear in mind that the absolutely perfect solution doesn't exist. Whoever attempts to describe the perfect IT solution will never complete their task. The same applies to trying to fit all the requirements into one giant solution.

Try often, fail early!

Generating innovations means systematically working on these innovations – in line with the motto "10 % inspiration, 90 % perspiration". If you would like to gain experiences with digitisation, you should not approach the topic via long drawn-out theoretical concepts that never leave the concept stage due to the constant addition of new requirements. You should build on your own experience, your knowledge of the market and of processes. It goes without saying that companies have to think their ideas through in a structured way. But it's just as important to actually put them into practice (in a clearly defined scenario, for example) so that you can see if they work. In this process, you should think about how to identify at the earliest possible stage whether or not an idea works. IT provides an example for this: development used to be based on the waterfall principle. The disadvantage was that it was only possible to see whether the solution worked after implementation of a large-scale project – and this approach entails major risks. This is why modern software development is increasingly using rapid prototyping – also known as scrum. Development takes place in a high number of small steps. After each step, it is possible to determine whether the targets were reached, thereby permitting any necessary adjustments at an early phase in the process.

Don't own IT, use it!

"We have to own the solution!" or "We have to develop it ourselves." – Statements like this no longer apply in the era of digitisation. You don't have to buy a train to travel in one; and you don't have to be the owner of a house to live in it.

When deciding whether to develop IT inhouse or purchase it from external providers, companies shouldn't adopt an "ownership" point of view but should perform a factual analysis: is a solution available on the market? How fast is it being developed further and optimised? How easily can it be adapted? How fast is the time to market? Which community apart from my company is pushing ahead with the development of the solution? These and similar questions can help companies to make the right decision.

Recognising the potential of digitisation for your own company

What towers above everything else is the definition of the objective that companies want to achieve by entering the digital age. Digitisation offers a wide range of convincing opportunities: is the objective to provide existing customers with a better level of service or value added? Or is operational excellence the central aim? Should processes become leaner and therefore less costly? Or does the challenge lie in managing global growth?

In the next step, the goal is to define the solutions that are necessary in order to achieve these objectives.

In this connection, we also refer readers to the Position Paper of the Scientific Board of BVL entitled
"Logistics as a Science –
Central Research Questions in the Era of the Fourth Industrial Revolution".

Sources

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The Board of BVL

The Board of BVL in Frankfurt on November 17, 2016:
Prof. Thomas Wimmer, Josip T. Tomasevic, Prof. Werner Delfmann (Chairman of the Scientific Advisory Board),
Peter Gerber, Prof. Karl Nowak (Chairman of the Advisory Board), Prof. Katja Windt, Dr.-Ing. Torsten Mallée,
Dr. Karl A. May, Christian Berner, Prof. Robert Blackburn, Frank Wiemer, Dr.-Ing. Stefan Wolff, Joachim Limberg and
Prof. Raimund Klinkner (Chairman of the Board).
Other Board members (not shown):
Frank Dreeke, Jürgen Gerdes, Karl Gernandt, Frauke Heistermann and Prof. Michael ten Hompel