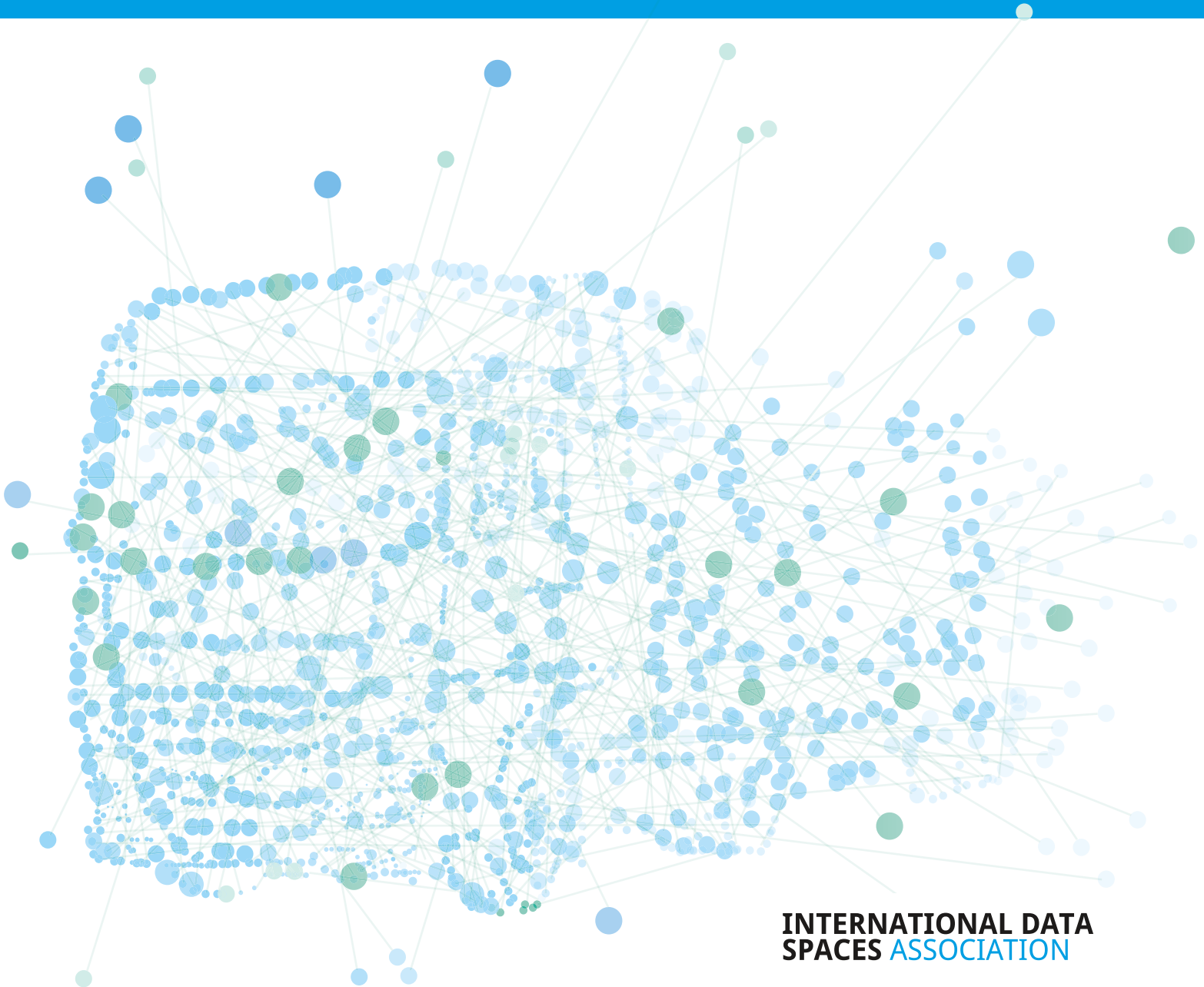# Fraunhofer
IML

FRAUNHOFER-INSTITUT FÜR MATERIALFLUSS UND LOGISTIK IML

CHALLENGES AND POTENTIALS OF A LOGISTICS DATA SPACE

INTERNATIONAL DATA
SPACES ASSOCIATION

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Leveraging data in logistics

Why consider the Industrial Data Space in Logistics?

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Nowadays, managing data is a major success factor for logistics companies. As logistics represents a key discipline for implementing Industry 4.0, it needs to become more even digital and data-driven than it is today. This involves effect for example by means of data science and machine learning, allowing logistics companies to optimise both their internal processes and their customers' supply chain.

However, the data infrastructure of the logistics industry is characterised by a large number of local data ´islands´, making it difficult to integrate the data and create business value from it.

As a result, a lot of potential in cross-company or collaborative processes in the supply chain cannot be leveraged.

The aim of the International Data Space (IDS) is the establishment of virtual space for the standardised, secure exchange and trade of data while keeping full sovereignty over it. For this purpose, a scalable and secure architecture, that is based on modern IT technologies, has been proposed.

Because logistics creates and connectes global value chain, its need for standardized and secure infrastructure to exchange data is extraordinarily high.

Leveraging the Industrial Data Space for the logistics industry demands for a domain-specific instantiation that addresses the characteristics and complex nature of global supply chains and transportation networks. This is why a Logistics Community was founded, in the International Data Spaces Association. The community aims at adopting and extending the general concepts of the IDS to provide a specific implementation of a Logistics Data Space.

Leveraging data in logistics

What is the Industrial Data Space?

The Industrial Data Space (IDS) is a secure peer-to-peer data network, allowing companies to share data without giving up their sovereignty. It represents a virtual data space using standards and common governance models to facilitate the secure exchange and easy integration of data in business ecosystems. The IDS thereby provides a basis for creating and using smart services and innovative business processes.

By participating in this data network, companies bind themselves to jointly defined rules with respect to security, interoperability, data security and contract design. This ensures an authenticated level of commitment to a common policy, enabling effective and secure data transfer and usage.

Networking in the industrial data space takes place via special software to ensure a secure gateway to the network. For this purpose the participating companies use the so-called Connector, with which both the data use and the desired security level can be controlled.

Every company willing to participate can become both a data provider and a data user. Since infringements of the common policy are explicitly regulated by clear liability rules, the data provider has the certainty that his data may only be used in accordance with his specifications. In this way, data Users are only able to access the data according to the data Providers' conditions.
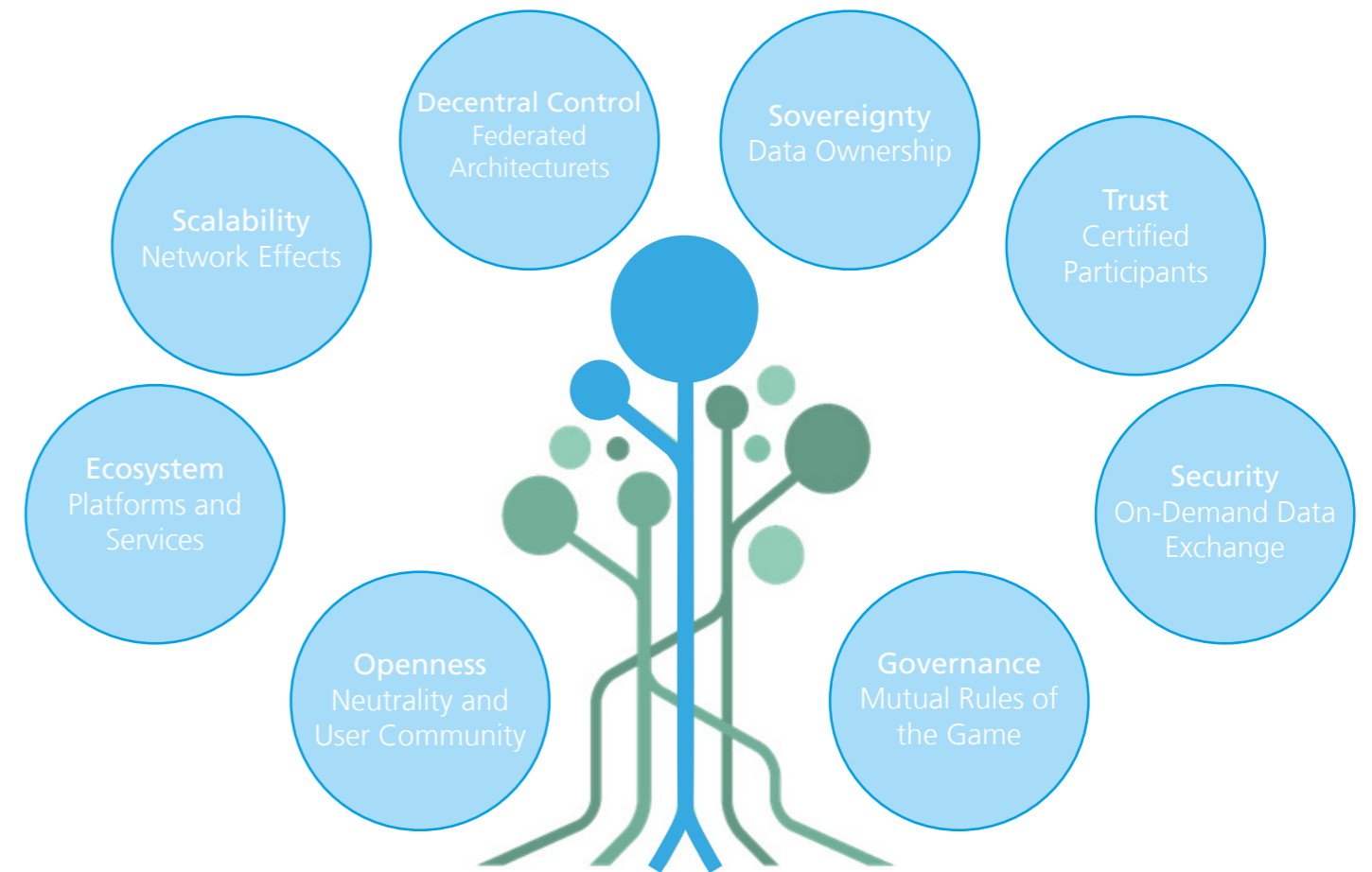

Figure 1: Key elements in the Industrial Data Space

Leveraging data in logistics

What is the Industrial Data Space?

Data sovereignty is carried out by three aspects: [1]

Data sovereignty is a key principle of the IDS and ensured by three aspects:

- Decentralisation of data – if desired, data remains at the connector of the respective data owner without being integrated into a joint data pool

- A precisely graded certification concept, differentiating between the profiles of each participant – guaranteeing necessary levels of security

- A secure infrastructure using new technological solutions and established security functions – encryption, access control, identity management and many more

Collaboration in the IDS is realised by means of specific roles. An important role is played by the broker, who acts as an intermediary between the data providers and the data users who request data. In addition to that, the broker provides a data source registry, allowing for identification and traceability of data. The broker's key activities involve the provision of functions to publish data sources, functions to search through these data sources, and functions to make agreements on the provision and use of certain data. In addition, the broker monitors and logs data exchange transactions and thus acts as a clearing house. [2]

Leveraging data in logistics

Challenges

Today companies are facing a multitude of new challenges. With recent developments in both technology and business economy, existing business structures are in a process of extensive transformation. Digitisation, automation, individualisation and decentralisation create new requirements that need to be tackled decisively. [3]

The digital transformation of processes, products and business models increases immediacy, leading to developments like platform economy. Platform economy is characterised by three-sided markets, where a platform operator functions as an intermediate instance between market participants, allowing them to interoperate directly without specialised mediators. As intermediaries of economic and social activities, platforms offer a completely new business opportunity where growth and size are more important than short-term profitability. [4, 5]

In addition to that, existing business structures loosen – with Industry 4.0 and its decentralised systems, compartmentalisation and division of labor increase. This leads to an enormous rise in collaboration and coordination, a multiplication of participants and a growing decentralisation of company infrastructures. Scalability and an alignment of information networks with decentral structures are heavily required, but traditional ERP systems provide limited tools for these scenarios. [6]

New demand arises for individualisation, on-demand delivery of products and services and hybrid products.

These combinations of physical products with digital services influence business models, production and supply chains. Moreover, with data becoming the focal point of business, its role changes from a process outcome and product enabler to an independent asset. Data has become a distinct product itself, oftentimes not even referring to a physical object anymore. This leads to far-reaching changes in the handling, maintenance and exchange of data that require special treatment. [7]

These new developments come with business cycles becoming shorter, requiring companies to decrease their reaction times.

Especially in logistics, the growing uncertainty, volatility, complexity and ambiguity of processes become more and more challenging. Today, global requirements are more unstable and change faster as disruptions accumulate. The complexity of modern logistics systems and global supply networks makes forecasting difficult, resulting in less deterministic workflows.

Leveraging data in logistics

Potentials

While businesses face a multitude of new requirements, these developments give rise to sizable potentials. A current PwC study shows an estimation that Robotic Process Automation (RPA) will be able to automate 45% of work activities, achieving a business potential of 2 trillion USD. [8]

The fundament of making use of technology like RPA are services that allow the provision and usage of knowledge in forms of data and documents. The machine learning and Big Data algorithms needed for this task require specified infrastructures to operate, allowing them to create their maximum value. The progress of Industry 4.0 in production and logistics comes with an exponential growth of sensor performance, computational power, storage capacity and broadband real-time networking. Nowadays, computational power is not the key issue anymore – instead, the focus lies on the development of precisely fitting algorithms, platforms and distributed IoT devices as well as the sophisticated artificial Intelligence (AI) technology. An informed understanding of data and the ability to sovereignly share it are prerequisites for leveraging these technological advances. On this basis, logistics has the potential to provide visibility, transparency, predictive capacity and adaptability for global supply chains. [9]

Figure 2: „Big Picture" of a Silicon Economy

An integrating picture of the entire ecosystem is needed to connect the different participants, elements and influences that a silicon economy must absorb. For this purpose, the entire data value chain has to be considered: from generation and trading of data to the organisation of (logistical) processes. This can be realised by a particular infrastructure involving an IoT Broker, a Blockchain Broker and a Logistics Broker.

IoT Brokers represent significant data sources in the Internet of Things. They connect cyber-physical systems such as intelligent containers and pallets as well as intelligent machines via 5G technology, Narrow Band IoT or conventional networks and provide adequate data

via the Internet.

Blockchain Brokers can conclude Smart Contracts, providing payment methods for logistic services according to newest standards like crypto currency and micropayments.

Logistics Brokers are software companies that organise logistics services and their processing. In turn, they are connected to logistics service providers and shippers, creating a dense network. Typical providers offering their services through a Logistics Broker are transport platforms, supply chain companies or fourth party logistics providers (4PL). These overlapping platforms enable new business models for a future data economy by merging additional data

and refining them with AI and Big Data algorithms. Data functions as the basis for all of these activities, which makes it necessary to maintain sovereignty over it. In this way, data and its use in conjunction with distributed ledger technologies can be securely exchanged and used. [10]

Volker Kraft
Fraunhofer IML

Initial situation / problem

Transportation in an urban context is highly influenced by different sides. Customers expect prompt deliveries in ecommerce – in combination with low emissions, low noise and no additional traffic. Municipalities have to combine requests for a continuous development of urban structures on the one hand and the citizens' needs and expectations on the other hand. I.e. they have to hold a balance between economic growth and sustainability. Finally, logistic companies have to match all these expectations, too – while having the strong need for a reasonable economic base.

Due to this setup, new concepts in urban delivery are necessary to make it more efficient and to meet the expectations named before: technical ones as well as conceptual ones. One of these (conceptual) approaches is 'dynamic collaborative planning'.

Approach

The core idea of dynamic collaborative planning is the adjustment of processes in logistics that have to have contact or rather crossing points. These transport processes are reacting to each other, e.g. as interconnecting legs of transport chains or loops of delivery routes.

These points of interaction or contact may be physical ones (e.g. mobile CEP cross-docks, lockers) or just ones that have been temporarily set up on parking lots, company sites etc. Another process in logistic chains that needs to be supported is the alignment of intra-logistic as well as external transports. In the near future, new technologies in urban distribution (e.g. autonomous vehicles, micro hubs) have to be included and facilitated for these collaborative concepts.

Vehicle routing and transport chain planning algorithms are in the process of being adjusted to these interacting processes. To realize this, a wider range of sensitive information has to be exchanged. Furthermore, often information has to be exchanged in near real-time since the alignment of processes is time-sensitive but influenced by numerous (unforeseen) events.

For this reason, a virtual logistic data space is required that is seamlessly accessible.

Added value of IDS

First, the Industrial Data Space guarantees the data sovereignty of each partner providing sensitive information for processing these interacting transport chains. Furthermore, data policies can be negotiated and defined between

Uses cases and examples
of a Logistics Data Space

Dynamic collaborative planning

partners of logistic chains.
Each partner can determine which partner is allowed to use which data for which purpose and, in particular, how long he may use it.
In logistic application this means that shipment data provided just covers all information needed for the matching of transports of partners and for guaranteeing the exchange of the appropriate goods or loading units.

If lockers are used to exchange goods, access codes can be provided via the Industrial Data Space.
A basic requirement that has to be met is a decentralized access and identity management.

In addition, different information service providers may offer dedicated data that is helpful for the planning and execution of collaborative transport chains. Using the Industrial Data Space for this purpose facilitates the provisioning of high-quality and case-related data for these chains.
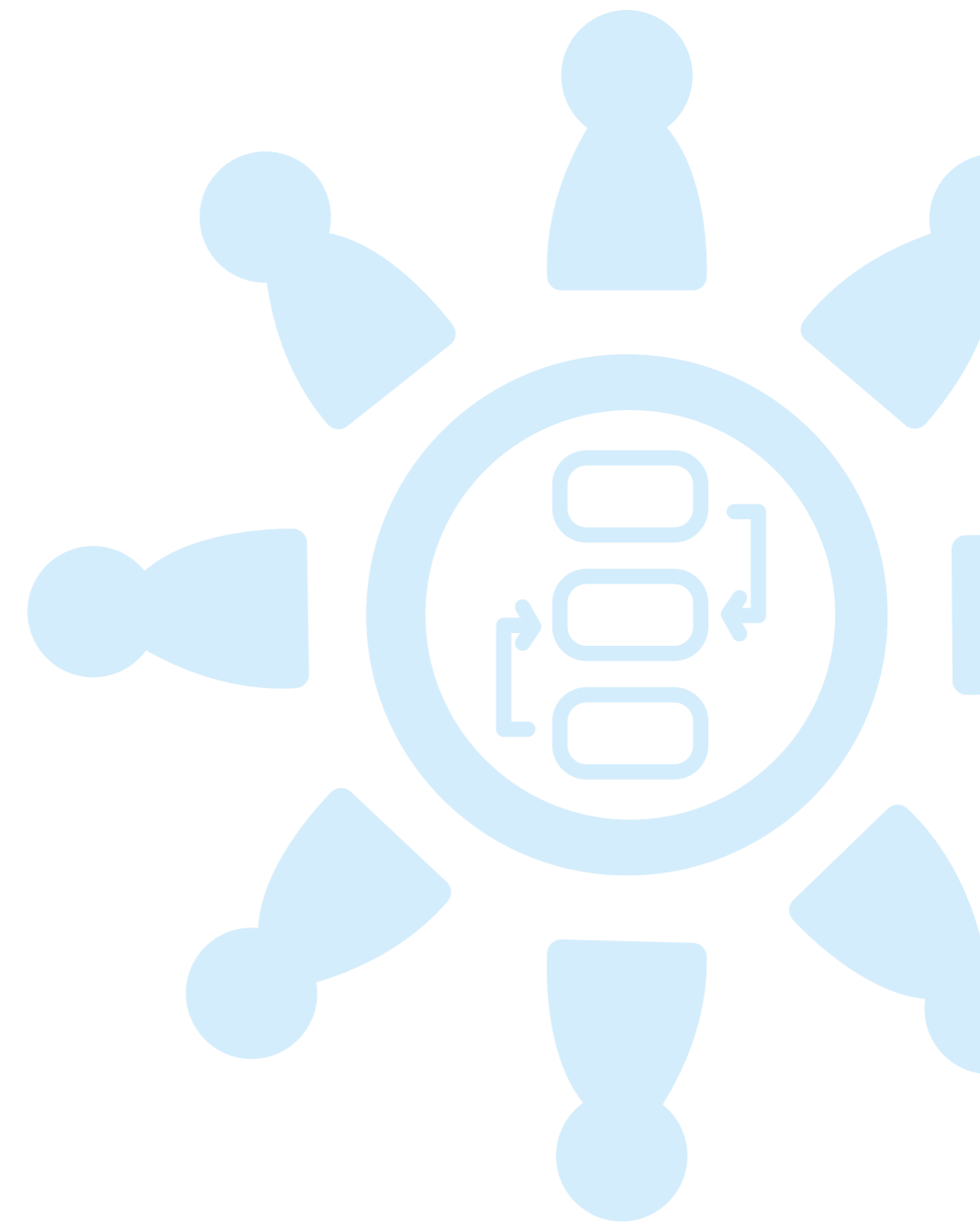
Johannes Zrenner
Audi & Graduate School of Logistics

Florian Bächle
Bosch

The use case „Collaborative Supply Chain Risk Management (CSCRM) "was carried out by the Original Equipment Manufacturer (OEM) "Audi AG" and the first tier supplier "Robert Bosch GmbH". In the time period from March 2017 until April 2018 both companies conducted two phases of the CSCRM use case. Phase I focuses on the disruptive supply chain risks like natural disasters or breakdowns of a whole supplier location. In phase II operative supply risks are addressed by means of shared container tracking. The benefits from both phases are a faster introduction of measures ensuring supply and therefore avoiding bottlenecks and raising transparency along the supply chain in case of risks. The Fraunhofer ISST, IML and IESE supported the use case.

Phase I

Hazards like hurricanes, earthquakes or bankrupt supplier companies often lead to breakdowns along the supply chain between suppliers, transporters and manufacturers. This can seriously disrupt the production of goods. However, when such risk events occur, communication between the participants is often inefficient, incurring high costs for time and resources. The "Collaborative Supply Chain Risk Management" use case helps companies to exchange information and sensitive data quickly and securely in order to avoid bottlenecks like this. The companies involved work more closely together and increase the transparency of the supply chain in the case of risks.

Moreover, automated risk reports make it possible for the companies to react more effectively and efficiently. This application scenario offers solutions for the automotive industry but is also interesting for other industries.

Compared to classic cloud solutions, Industrial Data Space that serve as a data interface to all participating companies provide a wide range of benefits. IDS creates the technical basis for sovereign data exchange.
Since many of the data that must be exchanged in such risk events are very sensitive, companies have not yet been passing them on automatically to their partners.

With the establishment of the IDS, these companies remain data owners, so that they can retain control over these sensitive data, allowing them to be stored and exchanged decentrally. The participants attach defined terms of use to their information and thus control how the data consumer can use the information.

Phase II

For identifying operative supply chain risks, container-tracking sensors are a beneficial tool. In the use case CSCRM the sensors are used to identify the container location, theft of the container or container content, transport damages and differences between the real container and its digital twin. For these five fields of action the sensor tracks different parameters from the packing at Bosch until the removal of the products from the container at the assembly line at Audi. For the whole tracking process, only shared sensors are used to provide the required data to Bosch, Audi, and the corresponding logistics service provider.

Thus, an added value is generated for all three participants with significantly reduced costs.
Because the sensor tracks internal processes from Bosch and Audi and other sensitive data such as delivery terms, a number of rules are defined for usage control.
The benefit of the Industrial Data Space is that these conditions and rules could be implemented in the IDS connector. This enables the faster introduction of measures to ensure supply security and avoid bottlenecks as well as increased transparency along the supply chain in the event of a risk.

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Fraunhofer IML

Initial situation / problem

Nowadays, the transport infrastructure (including roads, railroads and inland waterways) is working to capacity, while the complexity of transport chains is growing. Therefore, a more efficient way of utilizing infrastructure and modes of transport is needed. Synchromodality has the potential to trigger this increase in efficiency. The overall objective of synchromodality is guaranteeing the mobility of goods. The mobility of goods needs digitization, information exchange and communication as enablers as well as a holistic view of logistics structures and processes.

Approach

In detail, synchromodality is classified by the following characteristics. Synchromodality:
- requires accessing a trimodal infrastructure
- is networked
- optimizes the transport chain holistically
- improves capacity utilisation
- has potential for savings, as every mode of transport is taken into account
- is self-monitoring

To realize such a variety of postulations, on the one hand dedicated optimization methods and on the other hand, a chain-wide exchange of information including all modes are needed.
 In this combination, information can be used in a value adding manner.

Added value of IDS

Synchromodality requires the variety of dynamically paired and changing solutions regarding the way a transport chain is case-specifically designed. Therefore, the Industrial Data Space can support synchromodality with regard to the following aspects:

- **Guaranteeing data sovereignty**

Any data provided is addressed to a specific participant or to a group of participants of a logistic chain – and it can be appropriated to a certain purpose. E.g. schedules or loops of relevant modes of transports are provided depending on the accessibility within a given period of time, the ability to transport certain goods or contractual permits to change the mode.

- **Use of enterprise-owned and open data**

Information about delays, traffic jams, unforeseen events can be provided to partners of the chain if

relevant - without a risk to irritate or overload partners by providing too much critical but irrelevant information.

In the same way, open data from different sources can be utilized in a secure context.

- **Utilisation of assets through efficient application**
  On demand, available assets can be shown and afterwards provided to partners if they have a proven need for these assets, but without opening the view on available assets in general. I.e. IDS supports the ad hoc negotiation of contracts to improve utilization of assets.

- **Prediction of best-fitting way for execution of transports**
  Transport modes or, more precisely, companies operating the respective modes of transport can compete for goods and consignors. In this context, a neutral choice or consolidation of transports are hardly realizable. Therefore, IDS can provide a framework for decision-making and negotiation.

Overall, the IDS is able to facilitate a reasonable use of modes of transport and synchromodality with elementary concepts like data sovereignty, policies or a secure access and identity management.
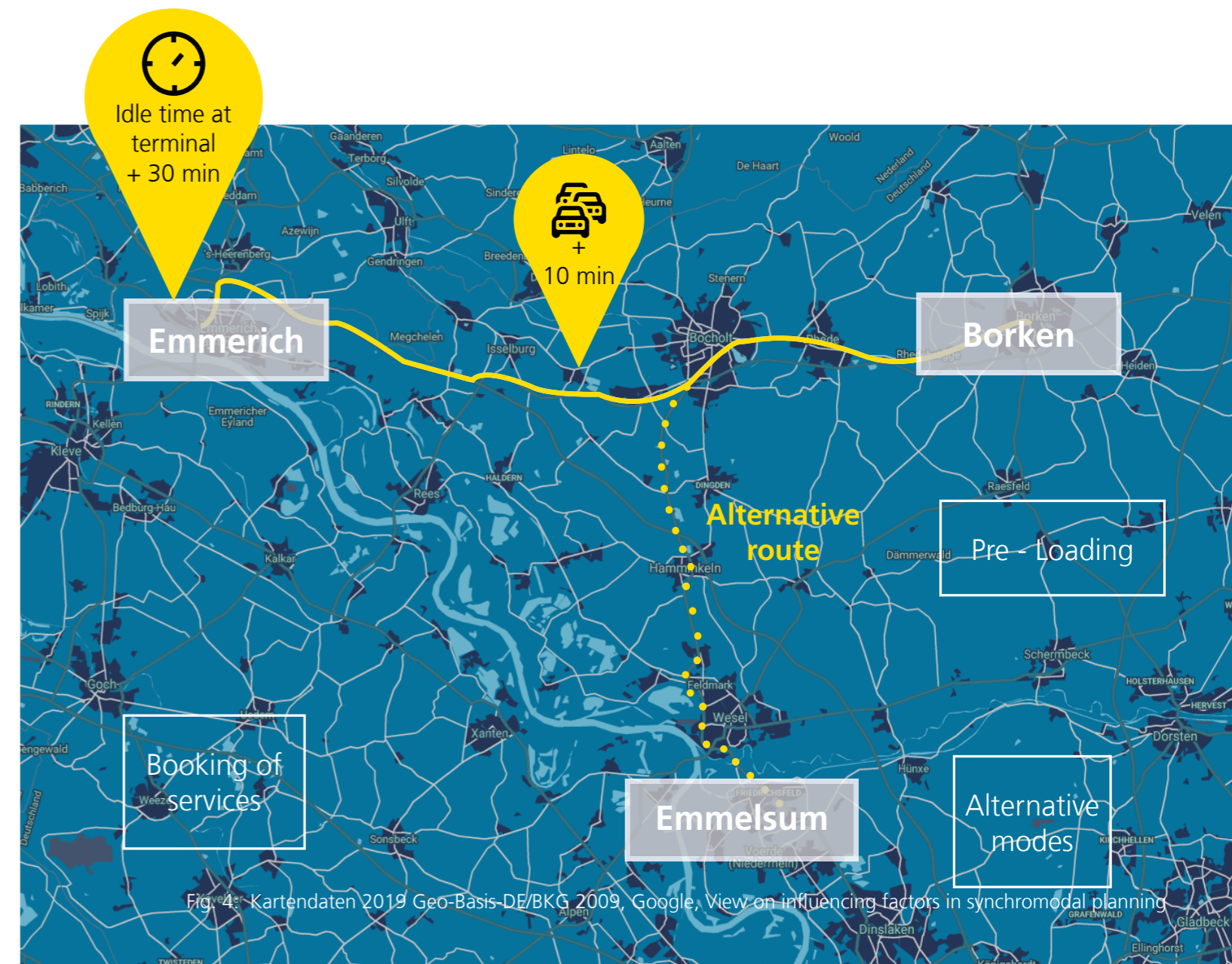

Fig. 4: Kartendaten 2019 Geo-Basis-DE/BKG 2009, Google, View on influencing factors in synchromodal planning

Uses cases and examples of a Logistics Data Space

Ad hoc networking in digital supplier networks

Markus Zajac
Fraunhofer IML

Initial situation

The turbulent market conditions has led to increase in global competition and customer demands. Companies need to respond to increasing changes in market and customer demands and focus their efforts upon achieving greater agility. For this reason, more and more companies are joining together to form business ecosystems, offering hybrid services that add value to customers by tailoring physical products and services to them. A business ecosystem thus forms a dynamic and customer-oriented corporate network.

Approach

Business ecosystems are not static structures, they form and change ad hoc - depending on demand and /or order situation. Ad-hoc networking means, that participants can spontaneously join an ecosystem and communicate with other participants without the need for complex configuration and assumptions. The process of ad-hoc networking of companies and organizations into paperless business ecosystems lead to a digital supply chain. This distinguishes them from traditional value creation networks.

For the demand-driven ad-hoc networking, as well as for the development and provision of joint services, it is essential to exchange data between the companies involved and their customers. This data exchange is of fundamental importance in order to jointly provide data-driven, innovative services and applications. In this use case, based on the ad hoc networking concept, suppliers supply various production companies.

In order to meet demands, all parties are interlinked to form a business ecosystem.

Each supplier decides for himself whether he would like to join the business ecosystem at the time of the request for quotation. As fundamentals for the decision, suppliers can evaluate their production capacities with regard to the request for quotation using a service in the network. Due to constantly new requests for quotations and a potentially large number of suppliers, this business ecosystem is constantly reforming itself.

Uses cases and examples
of a Logistics Data Space

Ad hoc networking in digital
supplier networks

Added value of IDS

A particular challenge in this use case is to protect sensitive business data of the participants. For example, the capacity information of suppliers is one of the data that is particularly worthy of protection, as such information increases competitive pressure in the supplier industry. This circumstance rather leads to a reluctance with regard to data exchange. However, such information is indispensable for the evaluation of the request for quotation through a service in the network.

Nevertheless, it can be assumed that the willingness to share such sensitive data will increase, if corresponding technical and organizational possibilities exist, which allow data usage conditions to be linked to the shared data and to enforce them in the network.

The Industrial Data Space with its scalable and secure architecture offers innovative solutions in this problem area.

Data is only exchanged after request from trustworthy certified partners. In this case, the suppliers decides themselves who may use which data for which purpose. In this way, data sovereignty of all participants can be guaranteed.
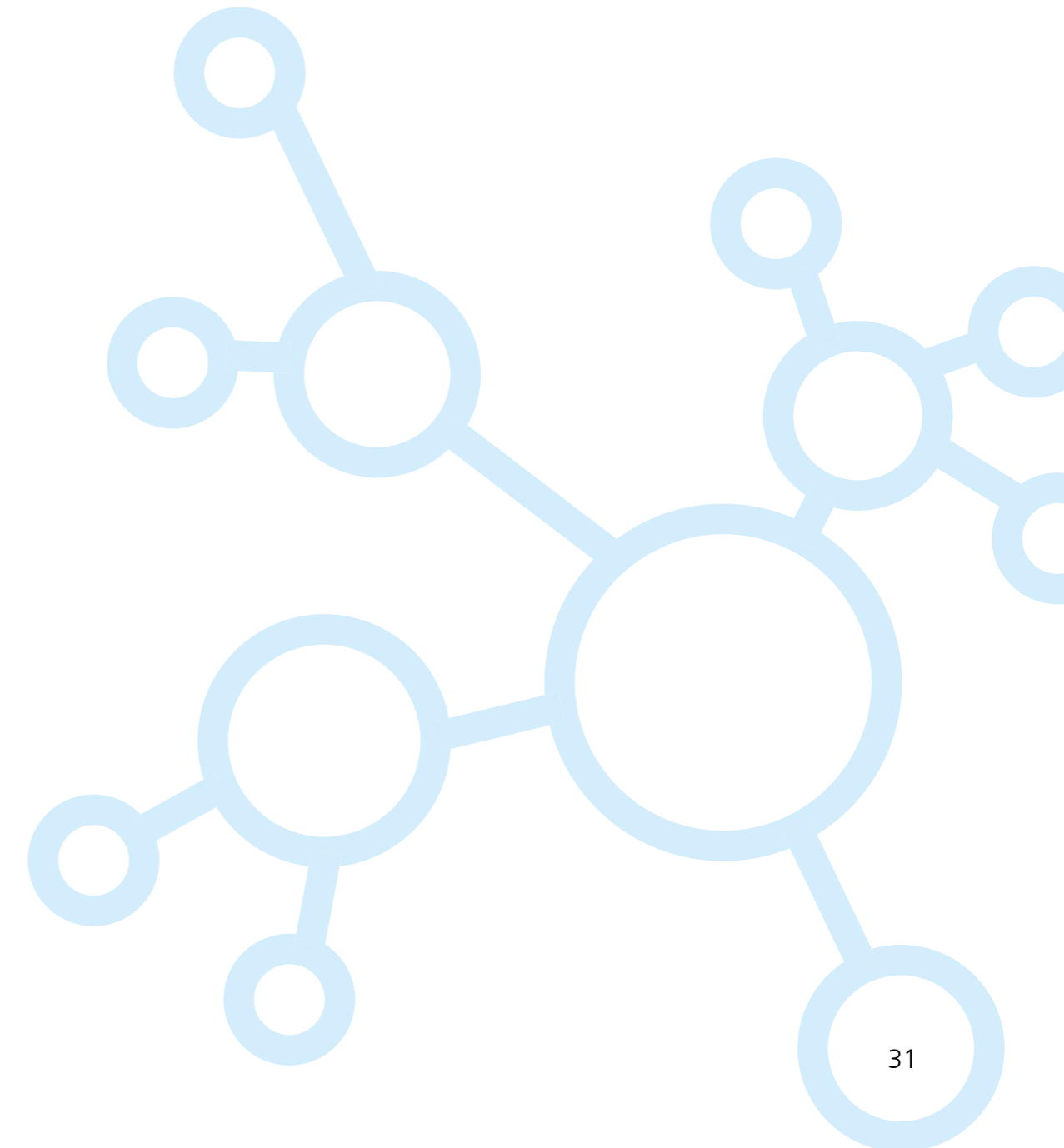
Uses cases and examples of a Logistics Data Space

IDS and blockchain in logistics

Dr. Philipp Sprenger, Sabine Jakob
Fraunhofer IML

Initial situation / problem

Today's companies are faced with an increasing dependency on a timely exchange of data and the verified correctness of the received information. When ordering, shipping or receiving goods, companies rely tremendously on real-time track and trace data or the continuous monitoring of the condition of their goods. Latest data guarantee a more transparent supply chain with higher responsiveness and resilience resulting in a competitive advantage of all involved parties. However, the companies hesitate to share its corporate data even while the demand for seamless data collection along the supply chain is undeniable. Existing concerns regarding to data sovereignty and -integrity are not settled entirely yet and hence harm the facilitation of transparent end-to-end supply chains. New technologies and concepts arising with the advancing digitalization allow to spot, address and transform these concerns into the creation of new data-based added value.

Approach

Among emerging topics in the context of digitalization and industry 4.0 blockchain is a new promising technology for secure and safe data exchange. While it originally derives from financial applications, such as the cryptocurrency Bitcoin, it allows tamper-resistant recording and storing of data.

Since each company, as originators of the recorded data, is able to define and impose irrevocable permission rights regarding to the use of their data, trade partners and possible third parties can develop new business models aiming to create value and generate profit by collecting, analyzing and trading both corporate as well as personal data. For various logistics applications, blockchain technology can present a valuable tool to exchange data, monitor processes and record the adherence to contracts.

Added value of IDS

While blockchain can provide the technical foundation for a secure data transfer and guarantee data authenticity, the technology cannot independently ensure the functionality of a digital data trading ecosystem. A validated framework in which multiple, verified entities can trade and cooperate is also necessary for a growing digital economy. In order to design and set up such a framework, several further steps need to be taken. On the one hand, further research has to be conducted to determine the extent to which digital technologies like blockchain can already provide necessary technical features that enable data trade.

Uses cases and examples of a Logistics Data Space

IDS and blockchain in logistics

Within a corresponding reference architecture, these technologies provide the direction how individual trade solutions can be set up. On the other hand, there is a need for standardization when developing this digital framework. For a successful implementation of data trade, especially across industries, new solutions must meet the actual requirements of the involved corporations, associations and other entities.
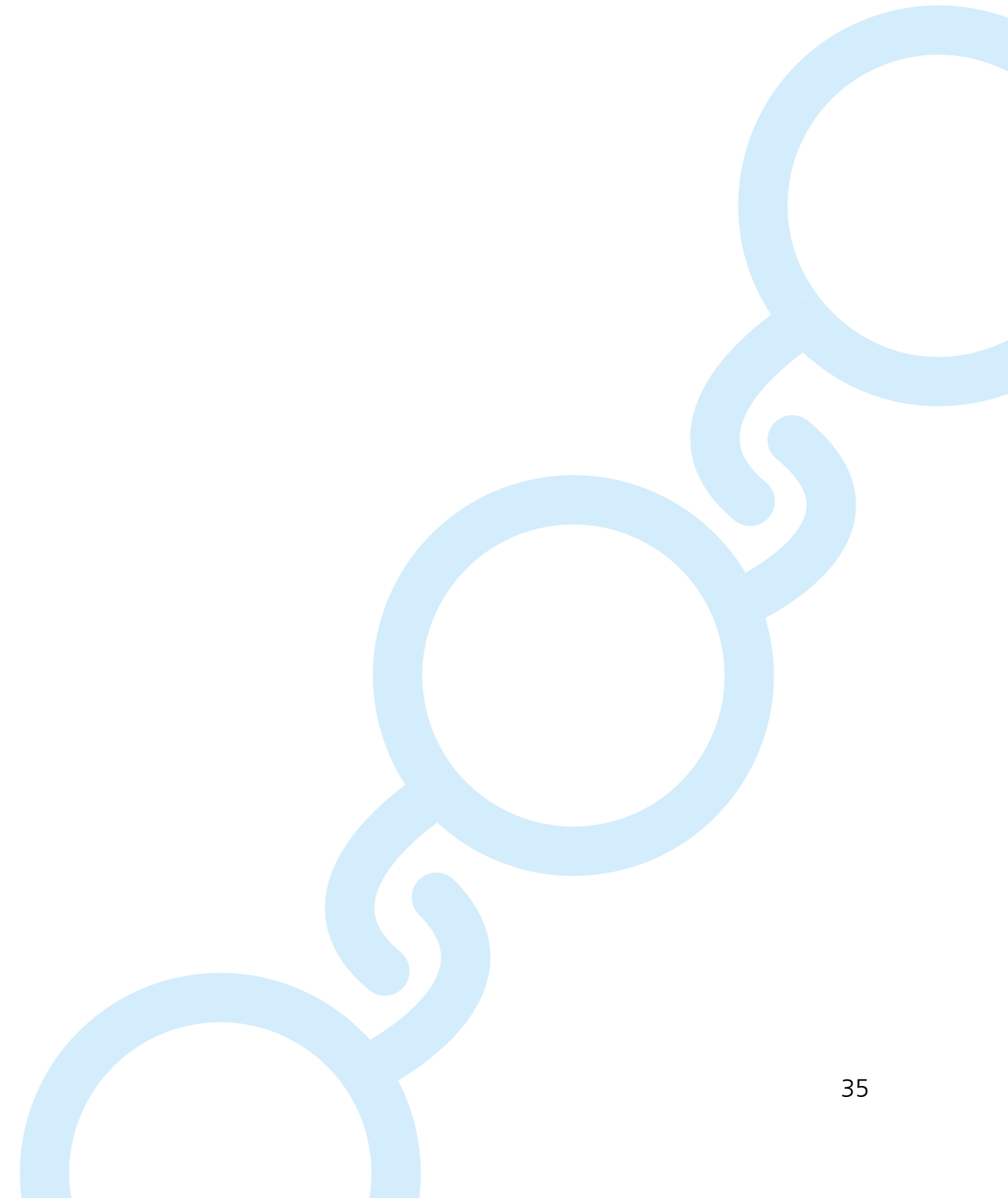
The *Industrial Data Space Initiative* pursues precisely those steps. In cooperation with user associations from the industry, the Fraunhofer society researches and develops a reference architecture model, while the industry partners provide requirements and are responsible for standardization.

The Industrial Data Space (IDS) enables a decentralized data storage, digitally embedded policies for data use and a regulated admittance of trusted partners using certified software solutions, thus providing trust. As a virtual space of endpoints, the IDS facilitates the establishment of a digital business ecosystem.

Within this ecosystem, verified legal entities operate as sovereign data brokers, sellers, buyers and users. Therefore, the IDS initiative promotes data sovereignty in an increasingly digitized economy, by researching and developing a valuable reference architecture for data transactions.

Jens Leveling
Fraunhofer IML

Initial situation / problem

Today, logistics becomes both, more and more complex due to many different business scenarios and the available time is shrinking for covering new or changing customer requirements. Therefore, there is a need for simple and flexible management of logistics processes. Additionally, it is mandatory to fulfil and implement new requirements and guidelines.
These aspects are leading to new requirements and guidelines for logistics systems operators. Unfortunately, more information from logistics systems in production is required but not given. Looking at a typical logistics system, a lot of logic controllers (PLCs) are built

in and processing sensor data. These datasets might be important to address the former addressed situation, but are still not forwarded to support a further usage. One of the most substantial challenges here is that many various sensor devices of a handful of manufactures are in use. The majority is using proprietary protocols and data models, not only changing from system vendor to system vendor, but also from product line to product line of one manufacturer. Besides that, both the system operators and system vendors are aware of security issues by opening up their systems and production lines, e.g. for a cloud integration.

Finally, the data from logistics systems is of use for any kind of digital services offered by system or sensor vendors on top of their physical products.
Those companies would like to offer more and more services, but a concept addressing security aspects on the one hand and integration standards, like

describing data endpoints in uniform manner, on the other hand. At this point, the Industrial Data Space provides a solution to address the mentioned issues.
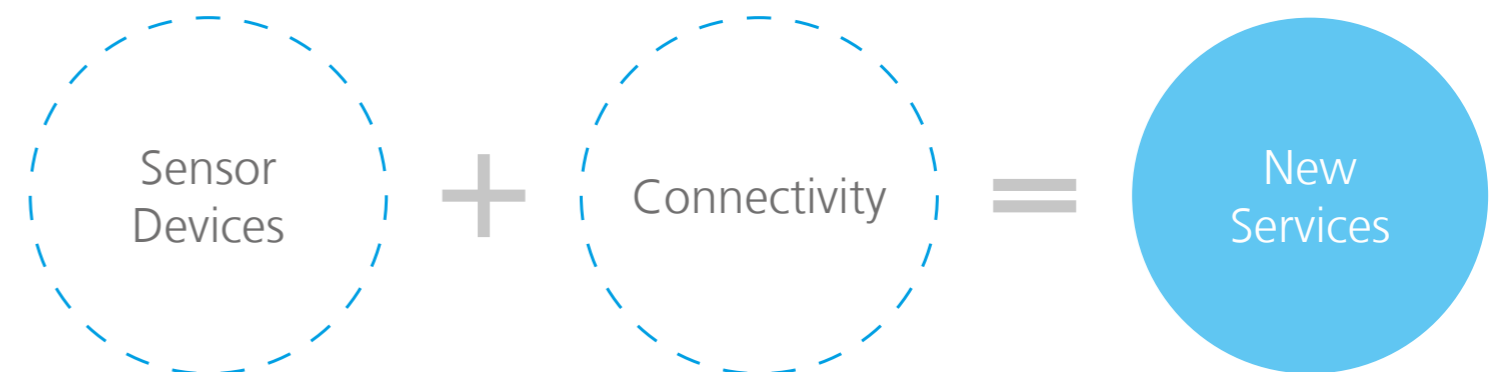

Figure 4: Modern connectivity solutions enable together with powerful device new digital services

Approach

Sensor Data Integration has to tackle four different aspects

1. Different sensor types
2. Proprietary data models of manufactures
3. Proprietary interface technologies and protocols
4. Individualized devices functionality by software

Therefore, the IDS Sensor Connector covers device specifics besides transforming the sensor data into semantic based data models and describing its endpoints based on the IDS Information Model.
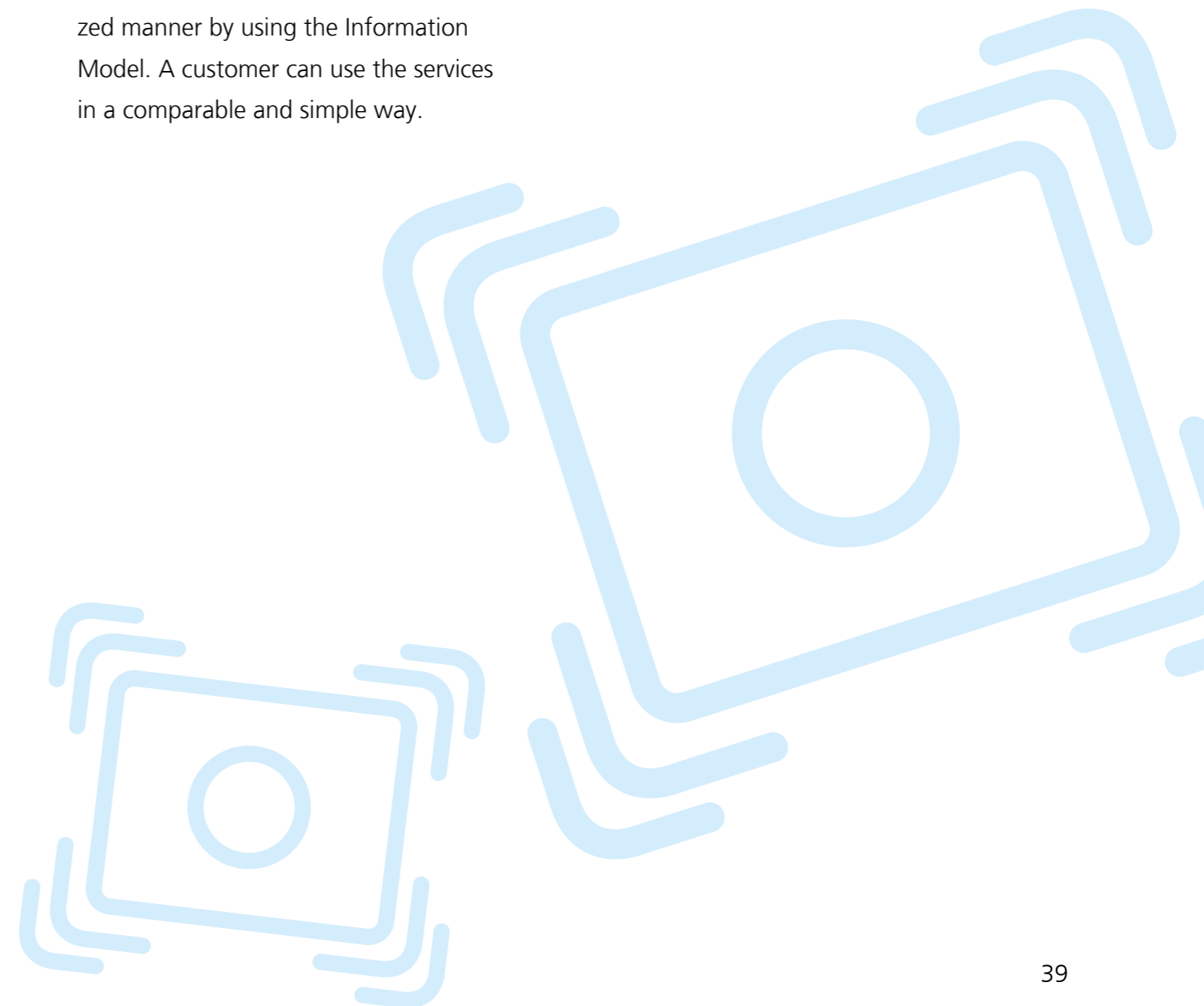
Benefits of IDS

The Industrial Data Space can be seen as a toolset to address the security aspects of a integration of sensor devices on one hand and to address the missing uniform information model for data endpoints on the other hand. The uniform description of data endpoints, which provide access to data sources within the Industrial Data Spaces, is the an important added value of the Industrial Data Space for Logistics services based on sensor data. A system or sensor vendor can describe any datasets or results of a digital service based on the Information Model. Furthermore, the endpoints' description is used not only by one vendor, but can be adapted or applied by other vendors.

In summary, we see a chance in offering digital services in a standardized manner by using the Information Model. A customer can use the services in a comparable and simple way.

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Fraunhofer ISST

Frederik Noll
thyssenkrupp

Challenge

Today, carriers use phone calls to communicate their estimated time of arrival (ETA) towards the shipper by spoken language. This process is error-prone as misunderstandings and typos may occur when manually entering the information into the shipper's transport management system (TMS). Another problem is the limited foresight about emerging delays. The earlier the receiving ramp is informed, the more flexible other incoming trucks can be rescheduled. The result of missing real-time ETA information is an inefficient use of ramps and long queues of trucks, some of them even hindering traffic.

The optimization of ramp usage and manual efforts in the information process was the motivation for implementing an IDS use case in the logistics system at thyssenkrupp Steel Europe. Data creation and data networking can solve this challenge. However, data sovereignty must be guaranteed, i.e. giving control to the data owner who can see which data is used at what time.

Solution

Inspired by the thyssenkrupp use case, an Industrial-Data-Space-based approach of dynamic time slot management has been implemented at the IDS Lab to highlight the benefits of an improved data exchange in the logistics domain. In this lab environment, the carrier uses a smartphone app to transmit his GPS coordinates automatically, together with a manually entered estimated time of arrival. This app comprises an Industrial Data Space connector, which transmits the data (pickup request and status notification with GPS coordinates taken from the smartphone). The method of dynamic time slot management based on the Industrial Data Space is depicted in Figure 1.

Both, the shipper and his customers have IDS connectors integrated into their backend systems (TMS and ERP). Hereby, they automatically communicate GS1 XML [11] EDI messages between their systems. In practice, the pick-up request is sent to the ERP system(s) of the customer(s), which is confirmed back to the TMS system of the corresponding shipper.

Android App with connection to an IDS Connector

IDS Connector with integrated Backend-System

GS1 EDI XML message via IDS

2. Pick-up/Drop-off Request

Shipper
uses
Transport management system (TMS)
Table with serveral supplies for different receivers and carrier. Transmit new estimated time of arrival to the customer. Can enter a new estimated time of arrival as well.

1. Pick-up/Drop-off Request + Status Notification

3. Pick-up/ Drop-off Confirmation

uses
Smartphone App
Transmission of GPS coordinates and manually initiated estimated time of arrival

uses
ERP System
Contains serveral supplies from different shippers. Confirms new estimated time of arrival.

Carrier

Customer

Figure 5: Carrier app and backend systems of shippers and customers communicate via IDS

Added Value by using IDS

Using the Industrial Data Space in the scenario enables a standardized, secure, trustworthy and sovereign data exchange through terms of use and a potential monetarization of data and services. The standardization and security features of IDS enable a universal networkability with partners and as a consequence an improved accessibility of data. The data sovereignty features of the Industrial Data Space, including terms of use and their enforcement, are helpful for an improved monetarization of data. Above all, they increase the willingness of the data producer to make the data available. These features can be can be considered in future use cases. The advantage for the data provider is that he can output data in a controlled way via the industry data room as standard and does not have to be afraid that his data will be used for other purposes. Ideally, the adoption of standardized connectivity based on IDS usage and the adoption of a common data format in the logistics domain can also help customers, shippers and carriers to reduce their efforts to manage multiple interfaces, e.g. between TMS and ERP systems. In the sketched scenario, high quality data is available to the data receiver enabling him to better control his ramp assignment. Key to further adoption of the system is to provide sufficient motivation to the data providers to participate and share data. As part of the DEMAND [12] project , the motivation of shipping companies to provide real-time

Uses cases and examples
of a Logistics Data Space

Dynamic Time Slot Management with
Digital Sovereignty

ETA information to the customers and
the best integration scenario is analyzed
in detail by thyssenkrupp.
The vision is that using the Industrial
Data Space is an affordable and easy to
use entry to an open, distributed data
market place, especially for SME part-
ners. The showcased scenario provides
the basis for more business use cases
to follow. One key insight from the first
implementations is that the integration
can be achieved with very little effort on
the systems in use (e.g. the TMS or ERP
systems), since IDS supports the usage
of standard EDI formats.
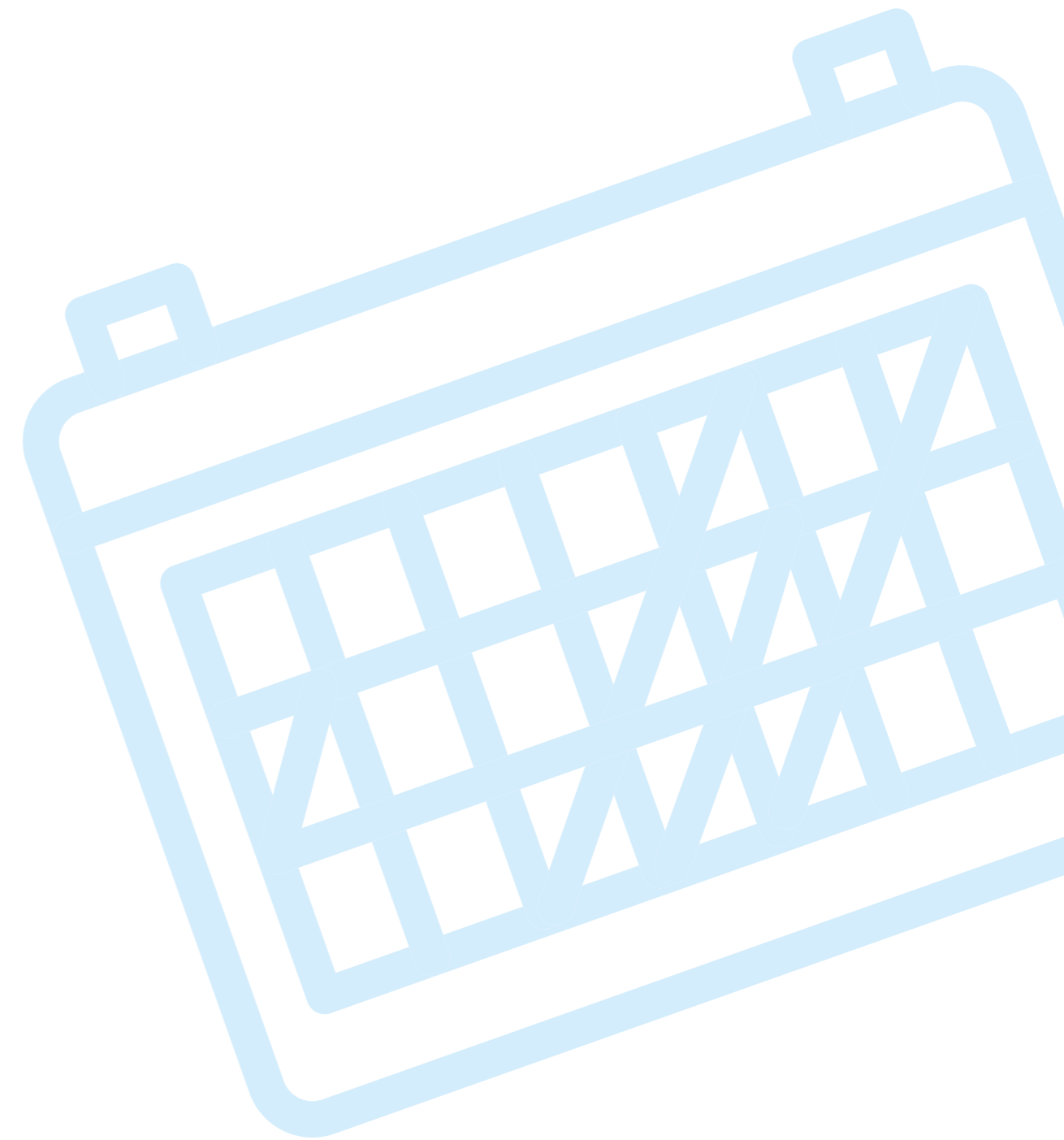
Gong Wang, Thomas Hilpert
SICK AG

Initial situation / problem

Growing digitalization and globalized collaboration allow partners to build up the next generation of supply chains that deals easily with the growing complexity of interacting partners. Every movement of goods generates data, which is necessary for the fulfillment of further processes and will be interchanged between different partners. For efficiency reasons, supply chain partners should seek easy data exchange, maximum real time transparency and seamless interoperability of their individual digital eco systems.
The *horizontal supply chain collaboration solution* contributes to ensure the transparent, reliable and secure transfer of data in collaboration between supply chain participants by means of the IDS Trusted Connector.

Approach

At the start of supply chain collaboration (as shown in figure 6), the producer collects various types of data (e.g. tracking ID, address data, expected delivery dates and various master data like dimensions, weight, etc.) for each packing unit. With the IDS Trusted Connector, the relevant data can be transferred to the logistics service provider. As soon as the packages are handed over to these couriers, they read the same data of the package.

Matching the data received from the producer and the detected data, the packages can be checked for e.g. possible damage or delay and a decision can be made immediately to determine whether the package should be accepted and sorted or returned and re-planned. The same approach can be utilised for every handover in the supply chain e.g. to incoming goods at the final destinations of end customers and allows a digital proof of delivery. The collected data, online reports, status tracking lists or a track history of the parcels are generated in real time and can even support ERP processes by offering appropriate data formats. A trusted third partner records und monitors data use in the process and provides trusted transaction documents using IDS technology. The essential components of the solution include:

- The SICK track and trace solutions (laser, camera, RFID or other tracking technology) are used to identify the package. Additional sensors and systems can be integrated if additional data about the package is desired for inspection.

- The SICK SIM2000 (Sensor Integration Machine), a programmable control and evaluation unit,

aggregates the data from the various sensors in the track and trace system, transmits the detected data to other trusted partners via the internet.

- The IDS Trusted Connector, a software component developed by SICK, packs, encrypts and sends the data through the internet. It can be installed on a wide variety of hardware platforms, for example on the SIM2000.

Added value of IDS
Horizontal supply chain collaboration makes individual packages or items trackable along the entire supply chain

and accelerates the handover and receiving process which can be build out to a fully automatic 24/7 process amongst partners. IDS creates the technical foundation for implementing future horizontal supply chain collaboration solution while taking into account high levels of data security requirements. The solution offers the following major advantages:

- Standardized IDS technology gives all users a clear and uniform definition for dealing with data security and sovereignty in the horizontal supply chain collaboration solution.

- Direct data interchange using IDS Trusted Connector eliminates the necessity of central data storage and

protects against unauthorized access to sensitive data.

- The secure data pool, encrypted data transfer and the defined access rights according to IDS technology ensure maximum data security.

- The uniform database from independent and certificated providers for confirmation and transac-

tion protocols allows for a reliable clearing process for relevant parties.

- IDS Trusted Connector as a software component is completely flexible and can be extended to include new partners in the process.

- Standardized IDS technology interfaces simplify system integration and maintenance.
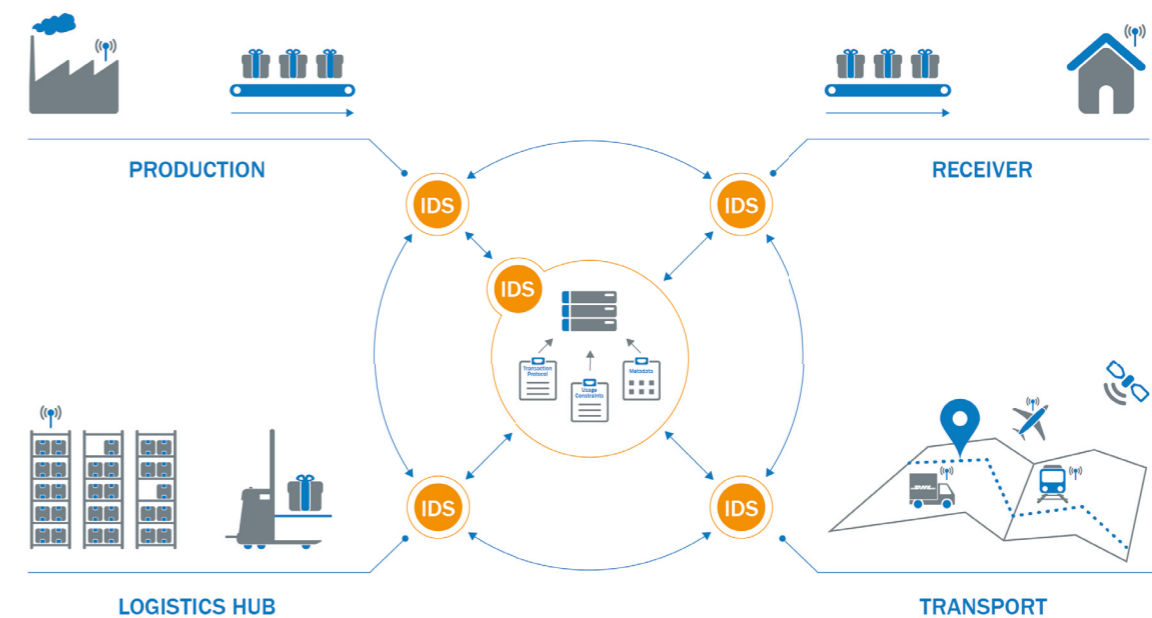

Figure 6: Overview of horizontal supply chain collaboration with IDS Trusted Connector

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References

[1] Data exchange as a first step towards data economy – PwC

[2] White paper Industrial Data Space - Fraunhofer Gesellschaft

[3] Trends und Strategien in Logistik und Supply Chain Management

[4] Plattformökonomie und Crowdworking: eine Analyse der Strategien und Positionen zentraler Akteure - BMAS

[5] Weißbuch Digitale Plattformen – BMWi

[6] Next Generation ERP Systems: Scalable and Decentralized Paradigms (Paul M. Griffin, Christina R. Scherrer)

[7] Conceptualizing the knowledge to manage and utilize data assets in the context of digitization - Fraunhofer IML

[8] Briefing: Robotic process automation
URL: http://usblogs.pwc.com/emerging-technology/briefing-rpa/ , abgerufen am 13.11.2018

[9] Industrie 4.0 Maturity Index – acatech STUDY

[10] Innovationen in der Logistik (Michael ten Hompel, Michael Henke)

[11] https://www.gs1.org/standards/edi/gs1-xml , abgerufen am 30.01.19

[12] https://www.demand-projekt.de , 2019