discoverLOGISTICS

Magazine of the Fraunhofer Institute for Material Flow and Logistics IML Dortmund #20

Coverstory

SILICON ECONOMY

ABOUT US

The Fraunhofer Institute for Material Flow and Logistics IML is the partner of choice for integrated logistics research. It works in all fields of internal and external logistics. In keeping with the concepts of the Fraunhofer-Gesellschaft, solutions to problems for immediate use in business are developed on the one hand, but initial research is also conducted on the other hand. Currently 315 scientists as well as 250 doctoral candidates and students work at the institute founded in 1981.

Teams assembled according to project and customer requirements create cross-industry and customer-specific solutions, among other things in the field of materials handling, business process modelling, transportation systems and resource logistics. Artificial intelligence, smart finance and the Internet of Things are also among the current research focal points.

For interdisciplinary projects, the institute has access to a total of 26,600 employees in 72 facilities of the entire Fraunhofer-Gesellschaft.

Locations aside from Dortmund include Frankfurt/Main, Hamburg, Prien am Chiemsee and Beijing.

www.iml.fraunhofer.de

DEAR FRIENDS OF LOGISTICS,

Sometimes decisions are easy. For example, if it's about the competitiveness of companies in a changing market environment, there are basically two options: to be there or not. Whether we go ahead or bury our head in the sand becomes an existential question. The worst idea is certainly to want to discuss the change away instead of finding innovative solutions and new business models. There is still a lot of waiting, especially in Germany, to discuss whether Industry 4.0 technologies and artificial intelligence (AI) are needed to such an extent. The security concerns about such solutions are also immense. But the paradigm shift towards the widespread use of AI will come – whether we like it or not.

While discussions are taking place in Germany, Chinese and American companies have long been working on corresponding business models. In the B2C competition, we will no longer catch up with the Amazons, Alibabas and Ubers of this world. With the right platforms and algorithms, however, German and European companies can still be at the forefront in B2B business. It is not just about deciding the race for yourself, but above all, about designing the decisive platforms to determine the algorithms behind the AI oneself. Surprisingly, it is precisely the virtues that sometimes make us discuss too long in Germany, which can ultimately give us decisive advantage – for example, our strong idea about security.

In the Silicon Economy, International Data Spaces will provide open and federal digital platforms that connect companies without giving away their business models or data. This is where solutions made in Germany have great credibility and our strict data protection guidelines make them internationally trustworthy.

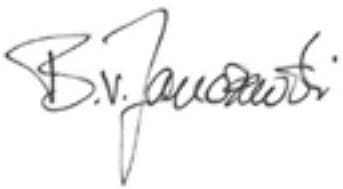
We have also had the necessary technologies for the Silicon Economy in our hands for a long time. In this issue we will present some of them to you – and show you how they will turn the world of tomorrow upside down in an AI-driven platform economy. A particularly impressive example is the LoadRunner, a highly dynamic vehicle that combines all components of the Silicon Economy (see p. 12).

If artificial intelligence permeates everything, it is also important to examine all associated opportunities and challenges – especially for science. It starts with machine learning (see p. 14), inevitably leads to the legal framework of a system in which machines make decisions independently (see p. 18) and extends to the social acceptance of such technologies (see p. 19).

Direct exchange with the Federal Chancellor and her ministers shows that the Silicon Economy has long been on the political agenda (see p. 26).

So, let's tackle it together and design the Silicon Economy according to our social ideas.

With this in mind, we hope you enjoy reading.



Bettina von Janczewski
Team leader press and media / press spokeswoman
Fraunhofer Institute for Material Flow and Logistics IML

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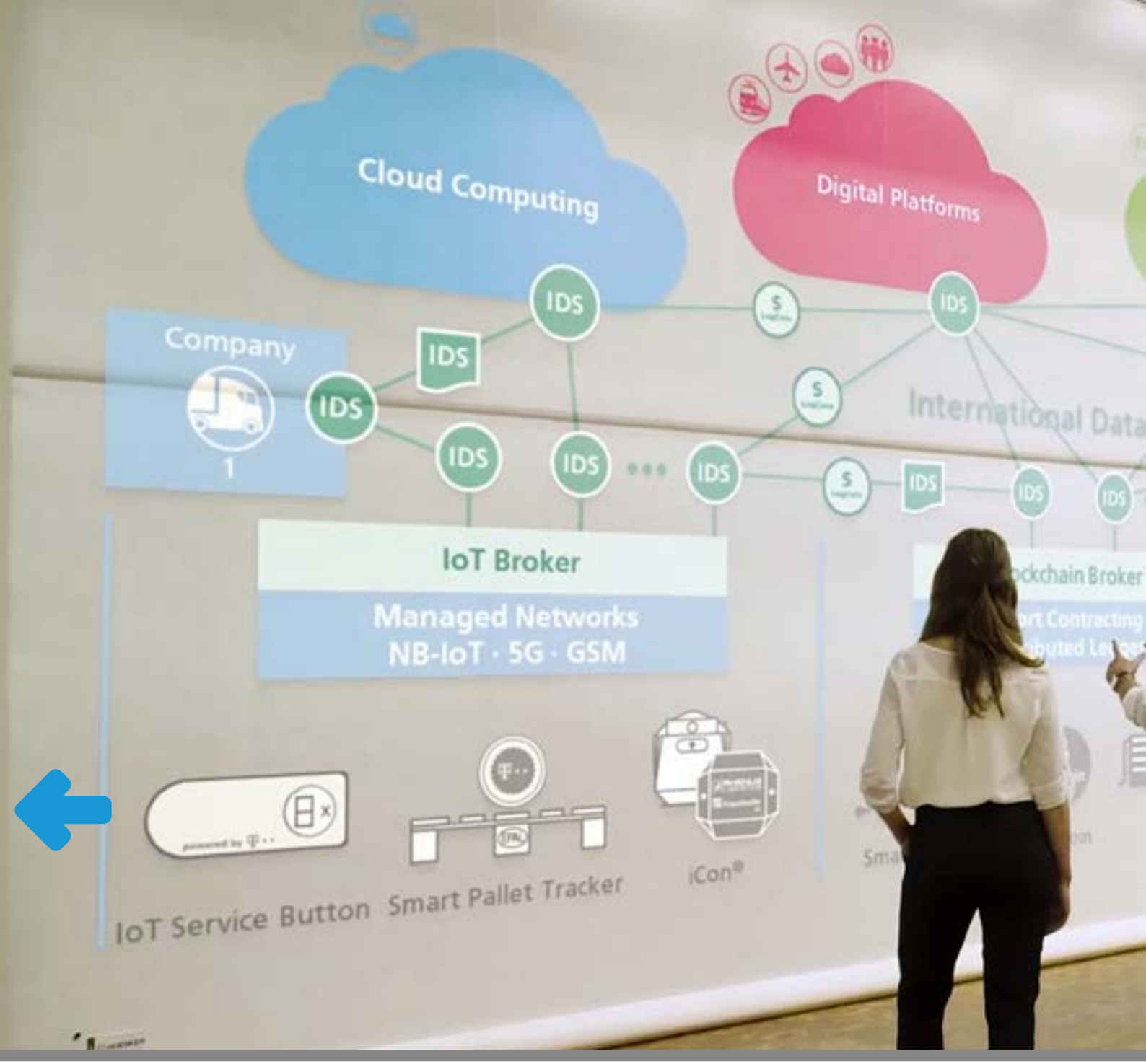


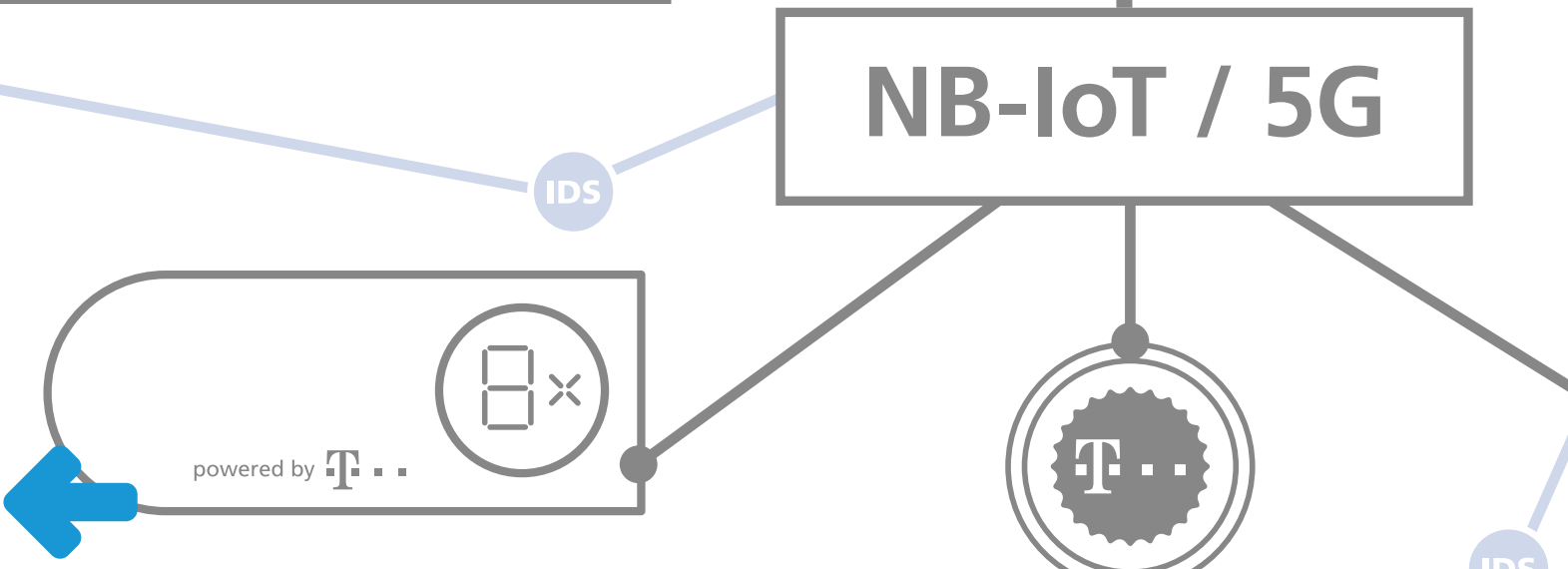
SILICON ECONOMY

Digitization and artificial intelligence will lead the world into a platform economy. This creates new business models that are based on data and use key technologies such as IoT or Blockchain to interlink goods, information and financial transactions worldwide. A look at the Silicon Economy.

Logistics is undergoing a paradigm shift: access-controlled systems are being replaced by open, federal structures in which international data spaces ensure data sovereignty. This is the basic idea of the Silicon Economy, in which distributed artificial intelligences act as an essential driver. They negotiate, schedule, optimize stocks, simulate flows of goods or analyze goods by camera. Billions of autonomous devices will soon share information with each other, while smart contracts based on Blockchain technology will be negotiated and concluded using software according to defined rules – and will automatically trigger payment processes based on fulfilled if-then statements.

When everything becomes intelligent and everything communicates with everything, huge amounts of data are created – a real paradise for new, data-based business models. This creates digital platforms for the B2B area, which have long been part of our everyday life in the private customer area with Amazon, Uber or Alibaba. Companies can become brokers in the Silicon Economy: IoT brokers that connect intelligent containers or pallets with each other and offer the data obtained from them; Blockchain brokers through which smart contracts can be concluded and offer payment using cryptocurrency; or logistics brokers that offer logistics services and organize logistics processes.

The gigantic computing power and storage capacity that we now have, as well as the real-time connectivity via 5G enable us to help the Silicon Economy to have a breakthrough now. It is about converting existing technologies into end-to-end solutions. We will show you on the following pages that we have long since been holding the necessary technologies in our hands – with developments from Fraunhofer IML that piece by piece put together the puzzle of the Silicon Economy.



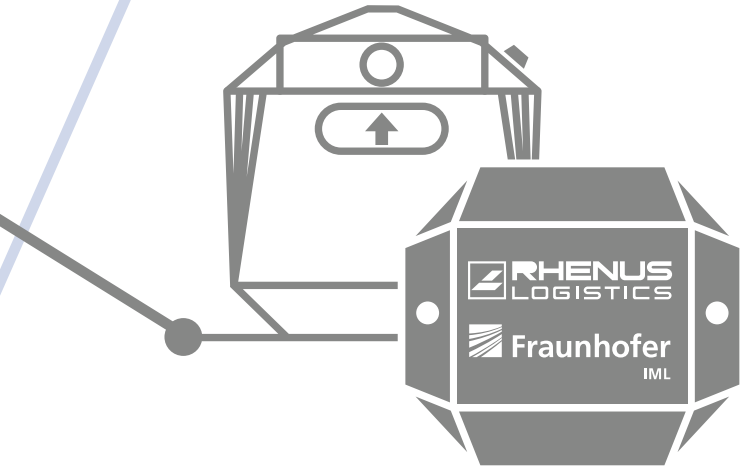
IoT Service Button

Whether in the laboratory, on the construction site or in the car workshop: With the "IoT Service Button", which Fraunhofer IML developed in cooperation with Deutsche Telekom, ordering processes can be triggered automatically with a simple push of a button. The button sends the information via "Narrowband IoT". This new 5G-compatible radio technology offers numerous advantages that make any object a part of the Internet of Things in no time at all: The low power consumption enables extremely long battery life for many thousands of clicks. In addition, the deep building penetration of the network ensures reliable data transmission – even from remote factory halls or cellars.

http://s.fhg.de/siliconeconomy-en

Low-Cost-Tracker

The low-cost tracker makes the Internet of Things suitable for logistics: In collaboration with Deutsche Telekom, Fraunhofer IML launched it in a first test in late 2018 together with EPAL – and thus made ordinary pallets intelligent. In addition to determining the position, the low-cost trackers can also call up movement, the effects of shock and the temperature changes. A waterproof sensor registers shocks, position, tilt angle, accelerations and temperature of the pallet. In the event of deviations such as vibrations or temperature fluctuations, the pallet reports itself and sends its current data to its own platform. Thanks to their robust and compact design, the trackers can be installed in practically any load carrier. The built-in battery lasts for years; as with the "IoT Service Button", data is transferred via the Narrowband IoT network.



Level Meter

Together with Rhenus, Fraunhofer IML has developed a 5G-compatible sensor for the Internet of Things (see also p. 20). Thanks to "iCon", levels and movements of containers can be transmitted – reliably, cheaply and maintenance-free. The data transmission is completely independent of existing network infrastructures. A wide variety of container management applications are conceivable for the wireless, battery-operated sensor: the developers first tested the sensor on containers for document shredding; however, use of glass and wastepaper containers for municipal disposal is also conceivable in the future. Series production and sales are scheduled for 2020. Then Rhenus wants to bring the first 100,000 smart data containers onto the market.

> In essence, it is about bringing existing technologies together in end-to-end solutions. The introduction of an intelligent container or a blockchain solution alone only makes sense in very few cases. The complete business model from the sensor to the platform is crucial.

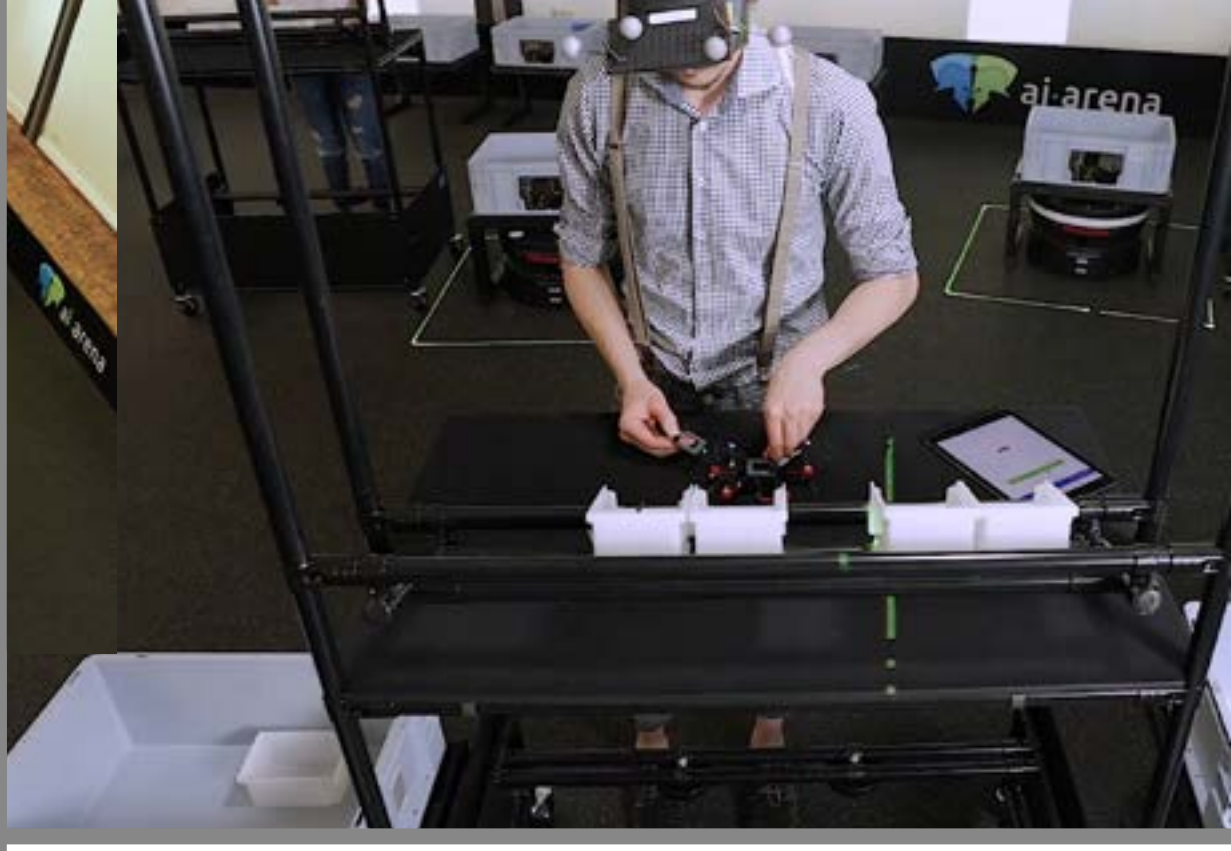
Prof. Michael ten Hompel, executive director of Fraunhofer IML

Smart Contracting
Distributed Ledger

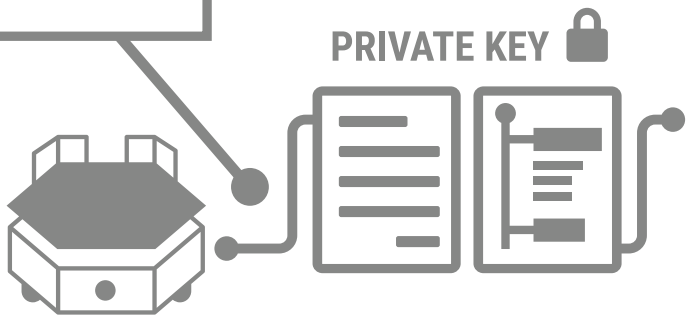
LogCoin

The "LogCoin" cryptocurrency, which is based on Blockchain technology, is intended to enable smart contracts to be concluded in logistics (see also p. 22). The researchers involved are currently setting up a token network for this. In this network, LogCoin is the accountable currency with which micro payments can be processed. Via Blockchain, the network enables seamless monitoring of transactions in real time. Thanks to smart contract technology, billing and processing are easy. Freight forwarders, banks and providers can also trigger follow-up processes automatically. The technology works across companies and for the entire supply chain network.

> The winners will be digital platforms and AI algorithms that penetrate the entire logistics and thus essential parts of the economy.
>
> Prof. Michael ten Hompel

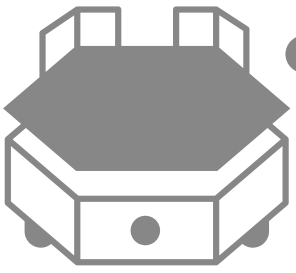


Supply Chain Management



Cyber-physical production systems (CPPS)

If artificial intelligence, the Internet of Things and Blockchain technology work together, production processes can run more flexibly and efficiently: In the so-called "cyber-physical production system" (CPPS), for example, groups within the system negotiate with each other about which resources are needed for a new order. They also communicate which units – for example robots, load carriers or employees – are available and which ones are best suited for the job. This communication is hardly noticeable to people and happens very quickly. If material stocks have to be replenished, an artificial intelligence informs the system. Thanks to this decentralized organization, the CPPS can also react flexibly to individual orders or short-term plan changes – the rigid structures in production are dissolved and a self-optimizing system is created.

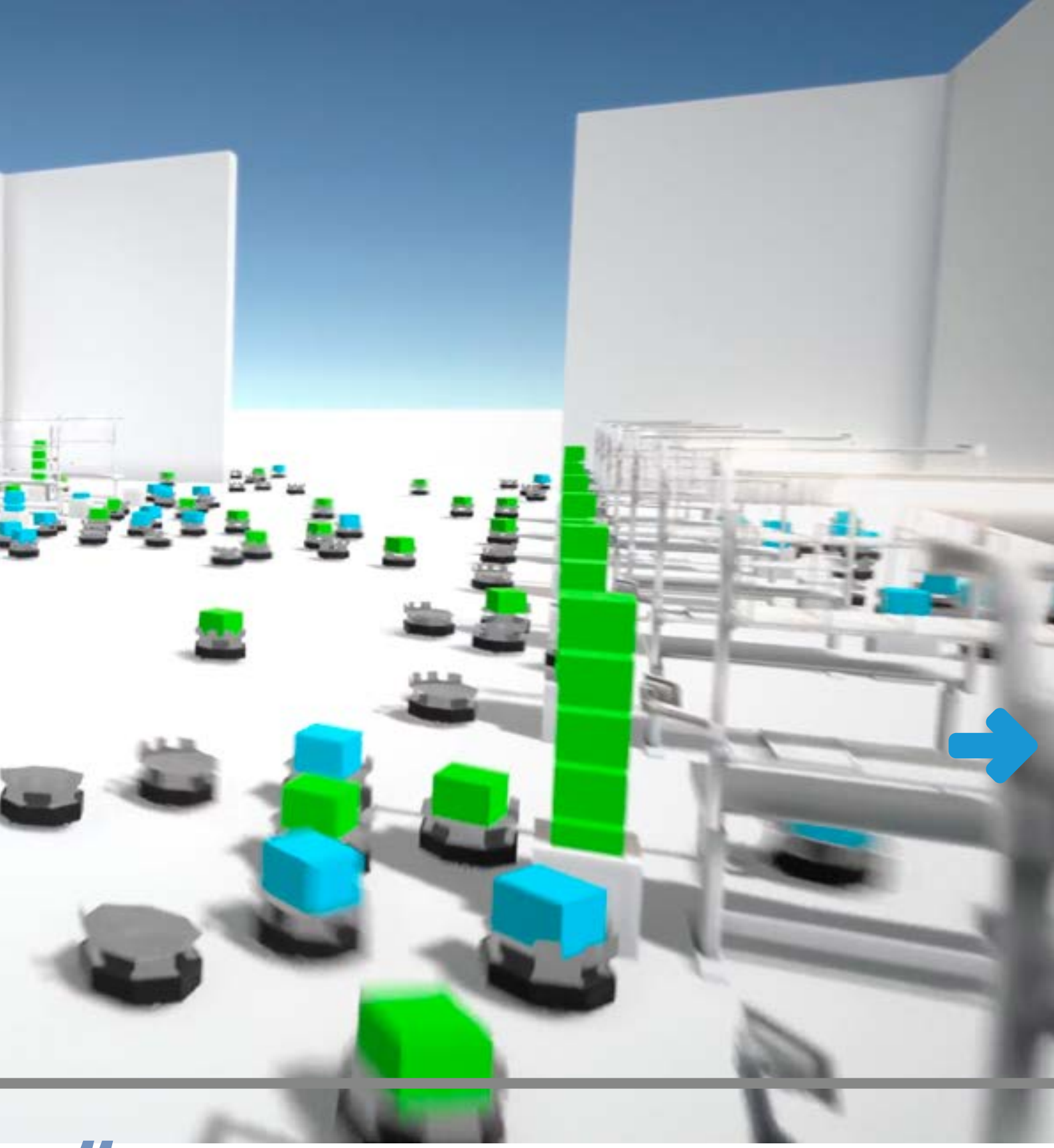


LoadRunner

With the "LoadRunner", Fraunhofer IML has developed an autonomous transport vehicle that is predestined for use in the Silicon Economy. The vehicles have a special form of load pick-up and drop-off, can organize themselves dynamically and autonomously in the swarm and, if necessary, can even couple together for transport orders. Thanks to highly distributed artificial intelligence, they will be able to independently accept and negotiate orders in the future. In the Silicon Economy, swarms of vehicles will organize themselves and connect with people, other swarms and platforms. This requires an open digital infrastructure in which the vehicles can communicate securely via 5G and independently conclude pay-per-use contracts using Blockchain. The LoadRunner has the prerequisites for this. It embodies the great idea of the Silicon Economy in a small vehicle: interlinking goods flows, information and financial transactions – in an open, federal ecosystem. The potential of the technology has not gone unnoticed by politicians either: The German Federal Ministry of Transport and Digital Infrastructure is funding the development of the LoadRunner with 1.6 million euros.

Funded by:

Federal Ministry of Transport and Digital Infrastructure

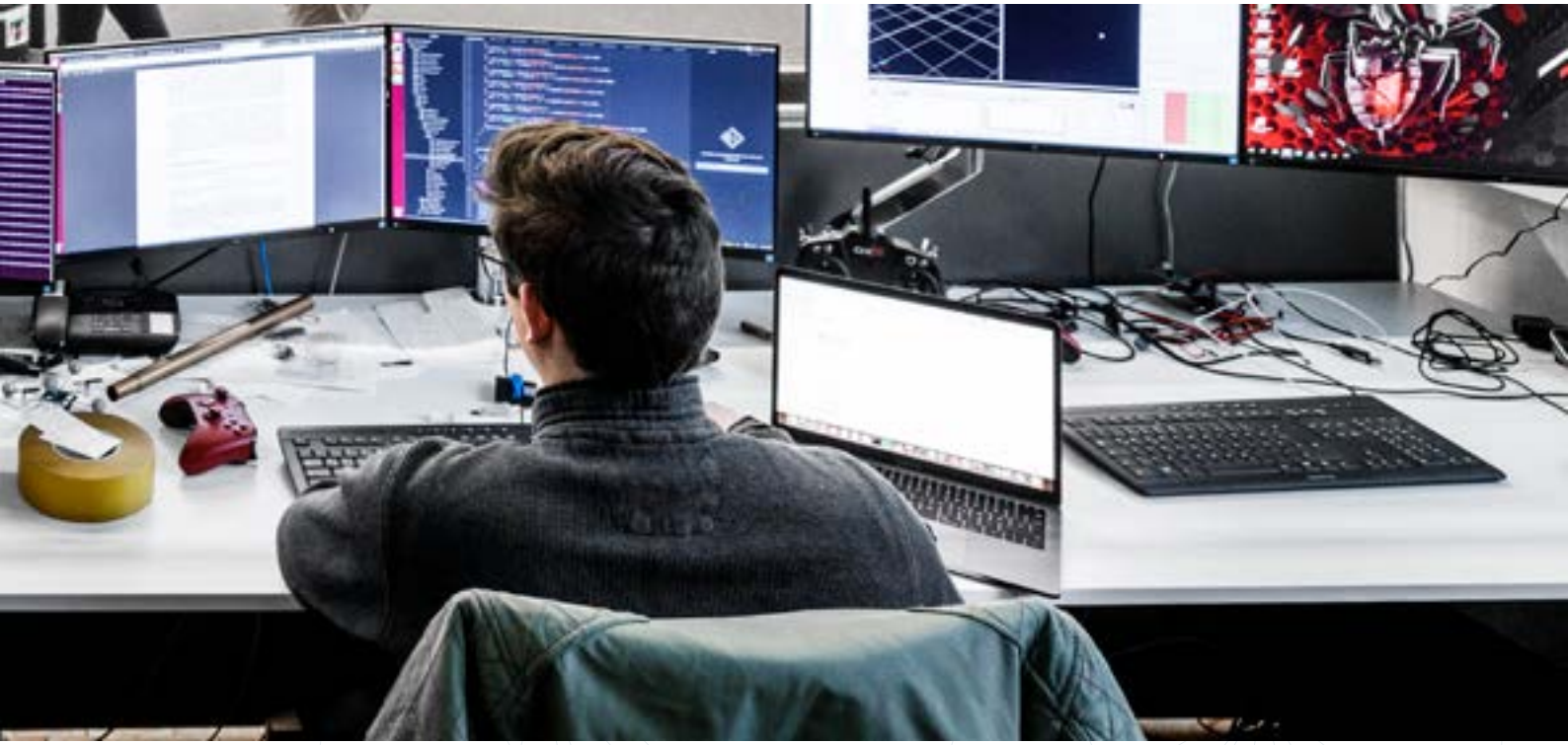


> Logistics will be the first branch in which AI processes will prevail on a massive scale. For this very reason, much more needs to be invested in ideas and new business models based on the use of artificial intelligence in logistics country Germany. Because whoever controls the world's logistics chains also controls the world's economy.
>
> Prof. Michael ten Hompel

SCIENCE FICTION? NOT AT ALL!

Machine learning at Fraunhofer IML

Just a myth or doable? On the research map of the Fraunhofer IML scientists, more than 20 individual projects related to machine learning (ML) are marked, which the researchers are currently dealing with. Progress has been made which points to the real added value of this methodology. Nevertheless there are still a few obstacles to overcome in the implementation.



Anike Murrenhoff has an overview of the multitude of activities. She heads the research clan "Machine Learning" founded by the Center for Logistics and IT in early 2019, a group of leading research companies, including Fraunhofer IML. According to her, ML means empowering machines to do things without having to explicitly program them. Instead of following specific instructions, the machines should "find the best action themselves". This is achieved by deriving a statistical model based on training data, on the basis of which they then make their decisions.

However, machine learning is not a synonym for a specific learning process, instead there are several methods. What applies to the database and the algorithms used also applies to the possible uses of ML methods. "There are different areas of application for machine learning", emphasizes Murrenhoff. The projects at the Dortmund site are, for example, assigned to intra, corporate and transport logistics or, in some cases, to the health care sector.

A question of data

Part of the kaleidoscope of ML activities at Fraunhofer IML are the varying forecast models that Martin Friedrich deals with. There are a few things to predict in logistics: volume developments, the electricity demand for e-trucks, driving time and Estimated Time of Arrival (ETA). For the forecasts, the project staff combine internal and external data, including calendar information or weather information.

As soon as a large number of variables influence the desired result, the use of ML is worthwhile, according to the researchers. The relationships are then often too complex, so that people cannot grasp them analytically in a simple straight-line equation. On the other hand, on the basis of the models calculated using ML, it would be possible to map them consistently. However, the often inadequate data availability is a hindrance. Because, if algorithms are to deliver reliable results, a lot of information is required.

These are not always accessible, partly for data protection reasons, partly missing or their quality is insufficient. For example, it is difficult to find sufficiently qualitatively assured data specifically for forecasting demand in logistics. Friedrich also knows the problem that the information available is not machine-readable per se. However, he is confident. Most companies have become aware of the importance of adequately recorded data for ML and related developments. Research was now able to pick up speed.

Bonus program for drones

In the Fraunhofer IML project, in which Anike Murrenhoff is involved, this connection is already on the safe side. In order to transfer natural swarm behavior to drones, her team generates the data both in simulations and in a real system itself. For the necessary "motion capturing", a camera tracks the movements of the small flying objects while they are floating around in the research hall. When training the swarm,

the scientists rely on "reinforcement". With this method, the arbitrary behavior of a drone is first assessed using a point system. Over time, it then reacts in such a way that as many points as possible are gained. However, there is no panacea for how the scientists assess which behavior. In some runs, for example, they would have been "punished" with point deduction if a drone took a long time to reach its destination. "With some rewards, the drones learn faster than with others," says the clan boss. "It also happens that a drone does something completely different than we would have expected." Sometimes the cause then lies in programming errors, for example, a wrong plus/minus sign. Apart from that, the action of AI-based machines would not necessarily reflect what the scientists themselves had decided. This fact often creates skepticism in the industry.

People-oriented development

The German Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung BMBF) believes that the widespread use of AI technologies requires social acceptance. One approach is that people can understand the behavior and decisions of an ML system in principle. For this reason, the traceability, explainability and transparency are of great importance for the BMBF in research projects. The "Competence Center Machine Learning Rhine-Ruhr" (ML2R), which started in January 2019, is therefore orienting its research towards people. In addition to the Technical University of Dortmund and the University of Bonn, the Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS and Fraunhofer IML are also involved.

What it means to make the learning process understandable for people is specified by Dr. Oliver Urbann, who works at the competence center via Fraunhofer IML: An artificial neural network learns to recognize certain objects using thousands of sample images. It should be transparent to humans which image features exactly the artificial intelligence (AI) uses for their decision. This is sometimes misleading. The scientist describes a past case in which an AI system supposedly identified a ship in photos simply because water was depicted on them.

Focus on minimizing resources

The research focus, which Fraunhofer IML also sets within the framework of ML2R, is resource-restricted machine learning, which is also possible on small devices – such as smartphones or sensors. Oliver Urbann demonstrates this using a robot soccer player. Its built-in processor is too weak for completely independent image processing, especially if it has to calculate its own running and shooting at the same time. In practice, sending the material to a central computer is unthinkable: "The network would be overloaded very quickly."

Instead, the project team first used a powerful supercomputer to train a model for image recognition. Decisive numerical values can be used from the finished design in order to then write their own programming code. The robot soccer player can do this much faster because, unlike the original neural network, it is executed independently of subroutines and auxiliary modules, so-called libraries.

There is a weakness in the application

The declared goal of ML2R coincides with the Federal Government's claim that Germany and Europe should assume leading positions in the development and application of AI technologies. The AI strategy adopted in November 2018 is worth three billion euros to the federal government. Nevertheless: "Global competition is extremely strong," says Prof. Dr. Reimund Neugebauer, president of the Fraunhofer-Gesellschaft. The cooperation between individual institutions of the Fraunhofer Alliance Big Data & Artificial Intelligence had therefore carried out an analysis of the competence in the field of machine learning. Accordingly, the United States and China are among the strongest competitors. Whether Germany simply needs to keep pace or first gain a head start over these nations is

a matter of perspective. Because Germany is already well positioned in research. However, there is a need to catch up in the application, because the findings of science are not yet being consistently implemented to create value. Between 2006 and 2016, almost three quarters of the patents in the ML area came from the USA, China and South Korea. It is therefore urgently advisable that Germany and Europe get more involved in concrete product and service innovations. Neugebauer comments: "In this way, we indirectly use an AI based on our legal and value system."

At the front of application-related research

Against this background, the Frauhofer IML-team's research map paints a positive picture. The majority of the projects covered, fall into the category of applied research. This includes an infrastructural indoor location of vehicles or an "intelligent" goods receipt.

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AI AT FRAUNHOFER IML

- Clustering of loading units based on optical features; machine detection of damage and dangerous goods symbols
- Intelligent goods receipt
- Generated suggestions to avoid bottlenecks in scheduling; fully automated scheduling; dynamic route planning for a parcel service
- Automatic planning in supply chains
- Prediction models, for example for volume developments, to identify fluctuations early and to plan capacities
- Detection of charge carriers; individual rod tracking in rolling mills; vehicle tracking in intralogistics
- Analysis of the ergonomics of manual movements using "Motion-Mining"
- Personalized break recommendations on your own smart device
- Restricted learning; testing an artificial neural network for a robot soccer player
- Drone swarm with learned natural swarm behavior
- Simulation and digital twin as data provider for machine learning
- Research on a web for distributed intelligent factories ("Smart Factory Web") in cooperation with Fraunhofer IOSB

WHO SIGNS THE SMART CONTRACT?

It is already a reality that machines can independently order replenishments for production and conclude smart contracts. Most legal questions on this topic are still open. A cooperation between Fraunhofer Institutes IML and ISST with the Saarland University and the Ruhr University Bochum will address this issue over the next four years.

If a shipment does not arrive on time or a part of the goods is missing, this is annoying. If you then want to make those responsible accountable, there is a risk in Industry 4.0 that this is simply not possible – especially when machines have concluded the supply contract. According to the current understanding of the law, a machine or software program is not a holder of rights and obligations, so that it cannot be held liable.

In order to shed more light on legal issues in Industry 4.0, the "Industry 4.0 Legal Testbed" project was initiated in June 2019. Emanuel Skubowius summarizes the mission of this project, which is funded by the German Federal Ministry for Economic Affairs and Energy and headed by Fraunhofer IML: "Identify actually relevant legal problems, provide technical and legal solutions, and remove legal security-related investment barriers for companies."

"Sandbox" as an experimental field

In order to be able to derive legal behavior for machines, Industry 4.0 use cases are examined and legal conflicts identified. Then lawyers assess the situation based on the current legal situation. The interdisciplinarity of lawyers with IT security experts, IT specialists, engineers and logisticians is a key potential of the consortium.

Such a legal testbed for smart machines is new. Lara Waltermann from Fraunhofer IML describes the project: "Like in a large sandbox, companies can try out the software that their machines will use to carry out transactions in the future." Software and negotiation agents represent the machines and place orders, create offers, negotiate and book. How these negotiations take place and which legal clauses help to ensure legal conformity becomes understandable. For example, IT security gaps or deficits in the general terms and conditions could be identified. The testbed should be used in particular by small and medium-sized enterprises (SME), for whom a test environment is usually too expensive.

The results are model clauses and contracts. The project thus tries to develop a head start from which the companies participating in the test bed will benefit. Framework conditions, prerequisites, necessary legal knowledge, software modules – in short, everything that an SME in Industry 4.0 needs in order to be legally well positioned, should be provided by the testbed and thus become permanent beyond 2022.

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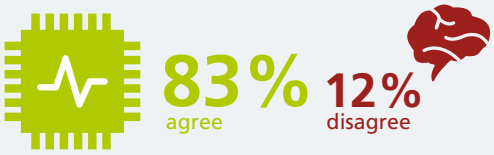
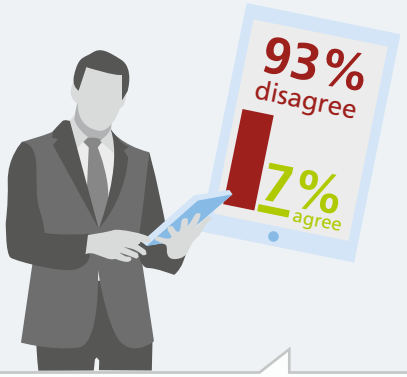
How will we work in the future?

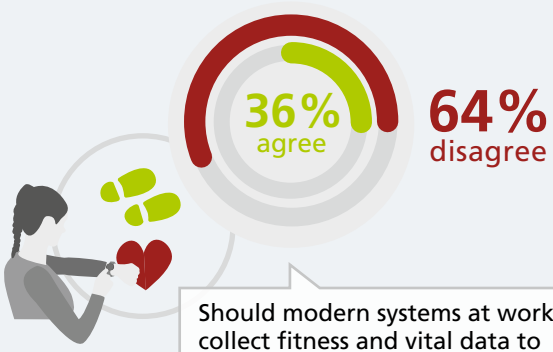
During an interactive debate on the topic of "Digitization in the world of work" the Leibniz Research Centre for Working Environment and Human Factors and Fraunhofer IML asked the participants, among other things, the following questions. The approximately 50 employees from different industries, students and researchers discussed how they imagine the working world of the future. These are the results in detail.

Should we try to create even smarter AI?

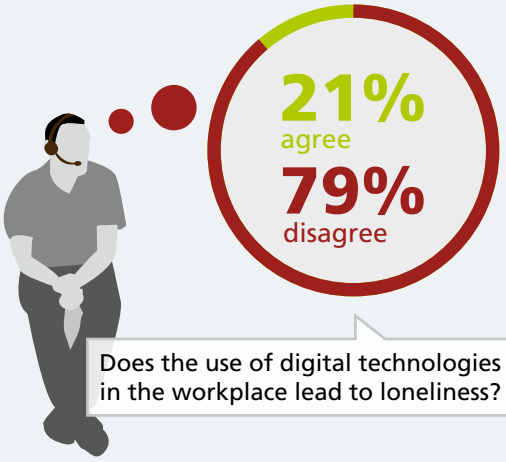




Should the AI tell us what to do at work because it's smarter than us?

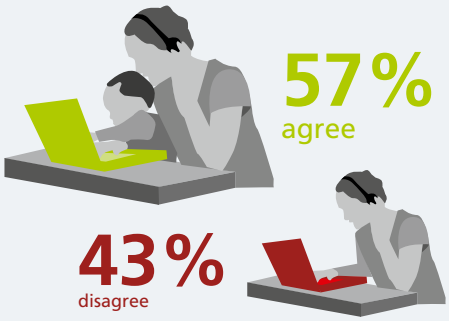


Should modern systems at work collect fitness and vital data to protect us individually from stress?

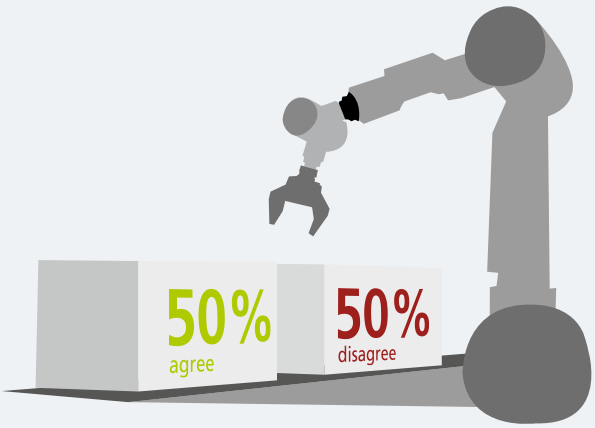


Does the use of digital technologies in the workplace lead to loneliness?

Should programming become a compulsory subject at school?



Work from home or on the go at any time: Does digitalization increase the compatibility of family and work?



Should machines replace people in all monotonous and exhausting work?

INTELLIGENT
WASTE MANAGEMENT

Watch our video
http://s.fhg.de/bML

The EU General Data Protection Regulation introduced in 2018 obliges companies to dispose of customer-related data in accordance with data protection. But how does John Doe behave correctly when the file trash container is full, but the date for emptying is a few days away? Simply putting the documents with highly sensitive data in the trash container and then waiting and drinking tea is definitely not the solution. Logistics service provider Rhenus and Fraunhofer IML have jointly developed a level sensor for the “smart data container”. The intelligent container recognizes its level and coordinates its own emptying.

The level sensor from Rhenus leaves the dispatcher with the philosophical question of whether the container is half full or half empty. Tested objectively and reliably in a field test, it records the tank fill level and transfers the relevant data to a cloud on schedule. Regardless of whether it is half full or half empty, below a critical fill level, the service provider responsible can still wait for the container to be picked up, thereby avoiding unnecessary journeys. Likewise, customers do not have to be annoyed about containers which were already full some time ago whose collection is overdue. A timely alarm prevents this.

Efficient disposal of sensitive data

With the sensor developed by Rhenus SE & Co. KG and Fraunhofer IML in the joint Enterprise Lab, pickups can be planned more efficiently. The two partners think even further: In consultation with the customer, it should be possible in future to empty the containers without being asked to do so. Prof. Michael ten Hompel, Managing Director of Fraunhofer IML, shares this idea: "This is another important step on the way to fully digitized process chains in the sense of the Internet of Things."

This step is almost done. After the cooperation partners started prototyping at the end of 2017, which was followed by an extensive field test a year later, the production of a pre-series has started since the beginning of this year. "We expect series production and sales to start at the turn of the year 2019/2020," reports Leon Siebel-Achenbach from Fraunhofer IML, who has been in charge of the project from the very beginning.

The next level of waste disposal

The sensor is integrated in a "smart data container", of which 100,000 are to be launched in 2020. The developers first tested the intelligent container during professional document shredding, which Rhenus Data Office GmbH, a subsidiary of Rhenus SE & Co. KG, does for companies. According to Siebel-Achenbach, the file trash container was ideally suited as the first use case, since the containers are handled with care in the protected office area and the conditions are perfect for testing the technology as such. The "next level", he says, is then coarser environmental influences such as dirt, sun, frost and moisture. Siebel-Achenbach thinks of glass and wastepaper containers for municipal disposal. He sees the future of collaboration in the Enterprise Lab in these two exemplary applications. The project should by no means end after the pre-series. Siebel-Achenbach says that great interest has already been expressed on all sides to further develop sensor technology and to advance the Internet of Things.

T-Systems International GmbH is also involved in the smart data container. It operates the "Cloud of Things" IoT platform, in which the current fill level of data can be called up. Wireless data transmission takes place with the help of the "Narrowband IoT" (NB-IoT) radio technology. A key advantage of this 5G-compatible radio network is the low power consumption. This enables very long battery lifetimes.

Sensor performance exceeds expectations

At the start of the project, Rhenus had expected a much higher energy requirement and thus an annual battery change. By using the NB-IoT network, a ten-year battery life is realistic, says Michael Wiegmann, Managing Director of Rhenus Data Office GmbH. This corresponds approximately to the average lifespan of a container. With NB-IoT, the sensor is also up to the challenge of sending data from factory halls or basements, because the building penetration of the radio network is high. Conventional network technologies such as WLAN, GSM or Bluetooth would not be practical here.

In addition to longevity, the developers also aimed for a low-cost solution. The sensor costs 30 euros, and one euro per month for the connectivity including cloud service, says Siebel-Achenbach about the estimated costs. The customer does not have to buy any other software. The sensor can be connected to existing systems via standard interface. This means that the sensor is not just software-independent, it is equally detached from any additional infrastructure.

"Together we were able to find an economical and reliable solution for our requirement profile", Michael Wiegmann sums up the cooperation with Fraunhofer IML. A patent has already been filed for the system that emerged from the Enterprise Lab. But its full effectiveness, he believes, can only be achieved on a larger scale – with several dozen to a hundred containers. Rhenus is not far from that. Michael Wiegmann is positive about the previous test. For him as an optimist, the container would still be half empty. In container management, this would probably be the better condition than a half or almost full container.

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Multilateral data exchange – A matter of security!

Blockchain has long ceased to be a niche topic. Because, with its entry into supply chain management, the value chain becomes a value network within the Silicon Economy. In order to exploit the associated opportunities – also with regard to new business models – the European Blockchain Institute is being formed at Fraunhofer IML. This is part of the digital strategy of the state of North Rhine-Westphalia and has already achieved initial results with "LogCoin".

A look into the future: Industry 4.0 will not only be smart, but will also be shaped by complex international goods and financial flows. The Internet of Things, i. e. networked objects that connect themselves independently via the World Wide Web and do their jobs, creates space for new applications. Network participants will also include smart objects such as "speaking" containers and cyber-physical systems that deliver measured values in real time. In connection with intelligent assistance systems, new potential for process improvements and optimized management can be leveraged.

Data immediately available – everywhere

To be able to use the large amounts of data in real time, however, new structures are required. The common method of bundling all the information that comes up first in a central location, for example using a server and then forwarding it to individual recipients takes time and resources. It is therefore of immense importance to set up a decentralized network that connects all those involved and thus enables fast and secure transfer. This is exactly what the application of distributed ledger technology, which also stands behind cryptocurrencies like Bitcoin, enables. In contrast to public cryptocurrencies, a private Blockchain can only be opened for selected participants.

Tamper-proof and fast

The Blockchain is a decentralized data store that stores information in blocks and links them. Thanks to the resulting chain, each participant can track all transactions. Access control also protects the decentralized data from unauthorized persons. Manipulation security is further supported by the fact that each partner involved has a copy of the entire Blockchain. "Unlike a 'normal' network, it is not enough to modify a single entry – you would have to make the same change at every single Blockchain location," explains Philipp Sprenger, Blockchain expert at Fraunhofer IML. "With the large number of members in an internationally networked supply chain, this is an impossible task." It is precisely these security factors that make distributed ledger technology interesting for broad applications. It can make the food supply chain transparent, protect works of art and luxury items from counterfeiting and generate smart insurance.

Systematic innovation work

The Blockchain Institute at Fraunhofer IML is working on further opportunities. So far, only isolated applications have been implemented through advances from companies or associations. However, these cannot be used to create a holistic platform for everyone. Rather, "island solutions" are created. That is why a coordinated, intra-European approach is so important. The European Blockchain Institute is being created at

INTERVIEW

with Prof. Michael Henke, director of Fraunhofer IML

What do you say to critics who consider Blockchain technology to be energy-intensive?

With public Blockchains, such as are used for Bitcoin, that's true. Here, in particular, the computing-intensive mining process with its proof-of-work process ensures a high energy requirement in the entire network. In the corporate environment, however, private Blockchains are more promising due to the lower degree of decentralization – such private Blockchains are far less energy-intensive and can also be administered much better.

NRW Economics Minister Andreas Pinkwart sees NRW as a pioneer with the newly founded European Blockchain Institute at Fraunhofer IML. Can we also take on the USA in the Internet of Values?

At Fraunhofer IML, a project is underway to set up a European Blockchain institute, in which the Blockchain broker is also to be developed. The connection with IoT and logistics brokers creates a completely new infrastructure in the B2B area for AI applications, the Silicon Economy. A new "Internet of Values" is emerging in this federal and open ecosystem, which is unique in the world not least due to the simultaneous integration of the International Data Spaces in combination of AI, IoT and Blockchain for the application domains of logistics and supply chain management. It is therefore fair to say that the Internet of Values comes from Europe.

Why is Blockchain technology an important enabler for the Silicon Economy?

Blockchain technology makes it possible to address the many micro transactions in the IoT broker with micro payments. In addition, smart contracts are based on Blockchain technology, so that the transactions cannot only be booked and settled in a revision-proof manner, but also that the associated contracts can be automated and legally securely negotiated, closed and fulfilled in the future. The Blockchain broker thus provides both business and legal logic for the silicon economy.

Fraunhofer IML 2019. As an independent organization, the Dortmund institute can develop adequate standards. This creates the technical prerequisites for an open source solution that gives everyone involved in the supply chain access to Blockchain: AI start-ups as well as manufacturers of warehouse hardware, ERP providers, production companies or logistics service providers. As a result, AI services, new business models in logistics and also supply chain management can build on them.

The research infrastructure around the topics of Blockchain and logistics at Fraunhofer IML is particularly helpful here. North Rhine-Westphalia in particular, with the largest number of logistics companies in Germany, can benefit particularly. The project is intended to answer pressing questions so that Blockchain technology can be used effectively across Europe. The aim is also to increase trust in online business relationships and to make detours via large Internet companies superfluous. The result would be a "democratization of the Internet and the digital economy".

Courageous companies wanted

The Blockchain institute has already initiated a first innovation: "LogCoin". The start-up will build a token network. In this, LogCoin is the accountable currency with which micro payments can also be processed. Via Blockchain, the network enables seamless monitoring of transactions in real time. Thanks to smart contracts, billing and processing is also easy. Freight forwarders, banks and providers can also trigger follow-up processes automatically. The technology works across companies and for the entire supply chain network. There is also the option of integrating LogCoin into other services, such as the Industrial Data Space.

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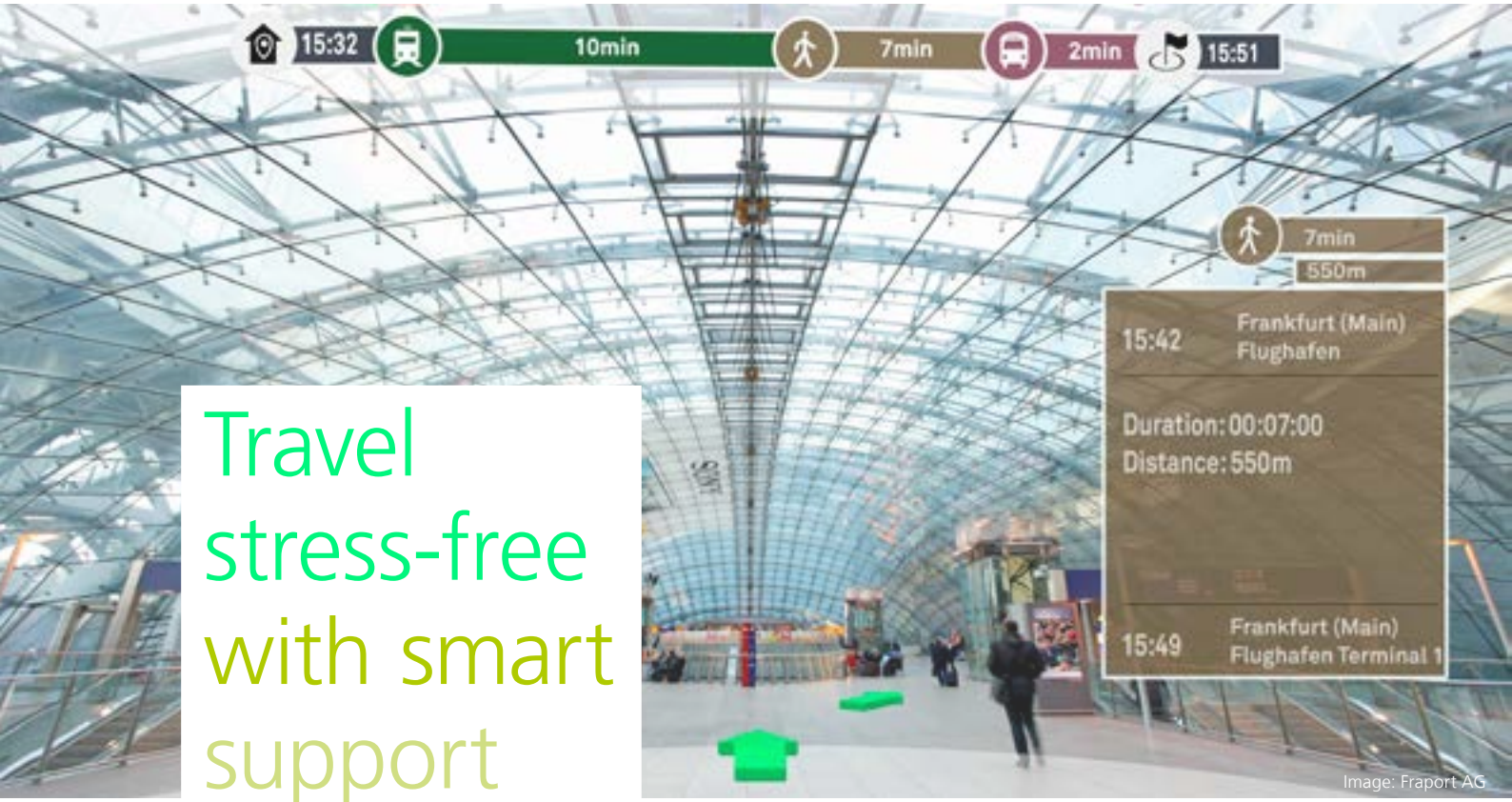

Image: Fraport AG

Travel stress-free with smart support

It's loud, the platform is full of people and the train leaves for the airport in five minutes. But where does it leave from? Situations like this are encountered by travelers every day. The "RadAR+" assistance system can help. Through augmented reality technology it shows the best connection and the right routes – even when changes occur.

Door-to-door navigation with a smartphone has long been the norm for going on vacation by car. But what if the route to your destination is covered by different modes of transport? Navigating from the local train station to the next airport by train and S-Bahn is not yet easy. At the latest when changing trains in the station or looking for the right terminal, previous navigation tools do not know what to do. "Especially when travelers have no local knowledge, stress quickly arises," says team leader Nicole Wagner from Fraunhofer IML, who helped design the system and examined the requirements of users and operators in a field study.

Navigation via smartphone and data glasses

With RadAR+, travelers can reach their destination stress-free: the "travel assistance system for dynamic environments based on augmented reality", funded by the Federal Ministry of Education and Research (BMBF), uses smartphones and smart glasses. Thanks to radio transmitters, so-called beacons, the device also recognizes its location in buildings, and the continuous location of the user is ensured. A good 150 beacons have been hanging in the long-distance train station and in Terminal 1 in Frankfurt since the beginning of 2019. They are usually no further than two meters apart.

This allows the system to localize itself correctly and show the best way to the right track or terminal on the glasses. Via the sound output of the glasses, the system provides additional tips, such as an exit reminder.

If a bus, train or flight is delayed, RadAR+ will inform the travelers immediately. The wizard integrates real-time data into the planning and suggests changes if necessary. The user can choose between the various options by gesture or voice control or request more information. The display on the nose and a voice interaction module enable largely hands-free operation of RadAR+. Logistics is already using similar systems today: AR glasses help, for example, when doing order picking or showing the way through the warehouse.

Avoid waiting times or use them well

Whether accessibility, special haste or bulky luggage: the system is constantly learning. With frequent use, RadAR+ recognizes the average walking speed. So, it can adapt the planning to individual travelers and, for example, suggest an alternative route with fewer changes. If necessary, the user can also request the connection to be rescheduled if, e. g., an elevator is not working and has not yet been recorded by the

INTERVIEW

with Prof. Uwe Clausen, director of Fraunhofer IML

How much will intelligent algorithms support us in our individual mobility in the future?
Thanks to advances in driver assistance systems, many intelligent algorithms are already in use, for example in lane guidance, traffic sign recognition or distance assistants in road traffic. In combination with traffic-dependent navigation and Car-to-X communication, new qualities are achieved e.g. before reaching a traffic jam or a junction, the vehicle speed is adjusted and the traffic safety is increased. We still see a lot of possible applications in both passenger and freight transport, especially if we think across various modes of transport and organize mobility in a new and better networked way. There is often a willingness to use public transport, but availability and flexibility, comfort and travel time can be further optimized by investing in infrastructure, vehicles and better control. In planning and control in particular, there are a whole range of current approaches to achieve better results with new algorithms.

The Silicon Economy will permeate the entire economy. Which technologies driven by artificial intelligence will conquer traffic logistics?
With machine learning processes, we have successfully implemented first applications to better forecast demand for a general cargo network. In the area of personal mobility, we create prerequisites for digitalization projects for operators of local public transport, in order to be able to develop good solutions with AI methods based on real-time information. One goal – currently in the European "EIT Urban Mobility Project AITraWell", for example, is to identify faults faster and offer alternatives, in particular, to increase comfort and flexibility in the interests of passengers.

How can the technologies of the Silicon Economy help to make transport, mobility and logistics chains more sustainable?
The underlying technologies are initially very universal and do not automatically have anything to do with sustainability. However, we can use them in this respect. On the one hand, we have been researching the field of greenhouse gas emissions for some time and are also active in international bodies and European project consortia such as LEARN or the ISO; on the other hand we are opening up new potentials, e. g. through AI technologies. I see the task above all in capturing and forecasting the core of logistics or mobility needs even better and then achieving better solutions in terms of sustainability in a customer and efficiency-oriented manner.

system. If there are any waiting times, the assistant can also help to bridge them well: It learns about culinary and cultural preferences and can recommend nearby cafes or restaurants for the waiting time. For this individual travel planning, it collects usage data and saves it securely on the smartphone. Here they are evaluated locally by an algorithm. This suggests optimal routes based on previous trips, current events and individual preferences. Because the data does not leave your smartphone, your protection is guaranteed.

A solution not only for Frankfurt

During the practical test of the assistant, Fraunhofer IML's main focus was on acceptance among travelers.

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This was very good for the test subjects: "Although they were fully aware that they attract attention with the glasses, the ‚feel-good factor' was high." Many of the test subjects could imagine using the travel assistant in everyday life. They would use the assistant especially in unknown transfer situations or when choosing the best mode of transport – above all because they can react better to short-term changes and avoid stress. Other passengers also found this exciting: "Our test subjects were approached with curiosity when they were waiting at the track: What is that? How does it work?" describes Wagner.

Thanks to the rapid development of the market for AR glasses, the use of assistants like RadAR+ is realistic in the not too distant future. That is why Fraunhofer IML and the project partners want to improve the position detection and the integration of real-time data in possible follow-up projects. They also want to test RadAR+ on additional hardware and expand it to more locations.

Prof. Michael ten Hompel gives Chancellor Merkel an insight into the Silicon Economy

On October 29, 2019, the digital summit coordinated by the German Federal Ministry for Economic Affairs and Energy (BMWi) led the big politics to Dortmund: On a tour of selected exhibits in the Dortmund Westfalenhallen, Prof. Michael ten Hompel, executive director of Fraunhofer IML, gave Chancellor Dr. Angela Merkel an insight into the digital platform economy of the future: the Silicon Economy.

Using various innovations from Fraunhofer IML, ten Hompel illustrated how Germany can maintain its market leadership in logistics using digital platforms and artificial intelligence. He presented an intelligent pallet developed in cooperation with Deutsche Telekom and EPAL, an intelligent recycling material container developed in collaboration with Rhenus, and a high-speed transport vehicle (LoadRunner), which can negotiate with an intelligent pallet and take over transports. In addition to Chancellor Merkel, several ministers from Merkel's cabinet also visited the exhibit, including Federal Minister of Education and Research Anja Karliczek, Federal Minister of Labor and Social Affairs Hubertus Heil and Federal Minister of Transport and Digital Infrastructure Andreas Scheuer.

Federal funding for the Silicon Economy

In the context of the digital summit 2019 German Federal Minister of Transport and Digital Infrastructure Andreas Scheuer also presented ten Hompel with a funding notice for the development of the LoadRunner. The ministry supports the development of "Digital infrastructure for autonomous vehicle swarms" with 1.6 million euros to help the Silicon Economy achieve a breakthrough.

Prof. ten Hompel presents Silicon Economy at the BMVI

Prof. Michael ten Hompel also presented the Silicon Economy at the German Federal Ministry of Transport and Digital Infrastructure (BMVI). The occasion was the presentation of the "Logistics 2030 Innovation Program" in the Federal Ministry of Transport and Digital Infrastructure in September 2019. The innovation program includes various measures designed to make logistics sustainable. Prof. ten Hompel was also appointed to the Innovation Commission of the 2030 Program.

Research minister visited AI projects

Anja Karliczek, German Federal Minister of Education and Research, informed herself about the latest advances at the Competence Center Machine Learning Rhine-Ruhr (ML2R), which is funded by her ministry. The scientists demonstrated, among other things, a drone swarm consisting of 20 drones that can handle complex logistical tasks.

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