Industrie 4.0

ARTIFICIAL INTELLIGENCE AS THE DRIVER OF THE SECOND WAVE OF DIGITALIZATION

© Jim Rakete

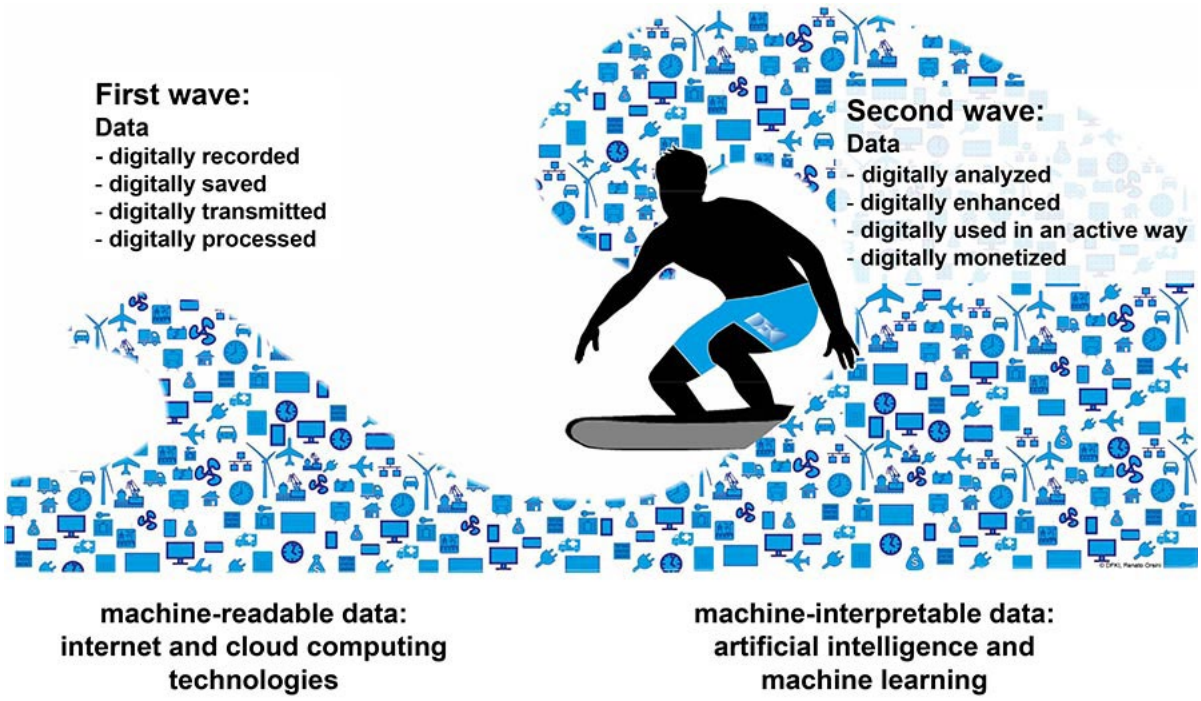
Professor Wolfgang Wahlster.

Internet technologies and the related cloud solutions have been driving the first wave of digitalization for over 20 years. Nowadays, analog data storage and transmission systems are hard to come by in important German economic sectors. The second wave of digitalization, however, will make all the difference, as it focuses on the analysis of digitally available data. A secondary publication.

By Prof. Dr. Dr. h.c. mult. Wolfgang Wahlster

Original Source: “Künstliche Intelligenz als Treiber der zweiten Digitalisierungswelle”. In: IM+io Das Magazin für Innovation, Organisation und Management, issue 2, June 2017, p. 10-13

Most IT experts would simply shake their heads in disapproval if they were to hear sweeping statements about innovation through digitalization - and quite rightly so. After all, data is already being digitally recorded, digitally stored and digitally transmitted everywhere. In important sectors of the German economy, analog data storage and transmission systems have become as elusive as the proverbial needle in the haystack. In the first wave of digitalization, companies, organizations and private households ensured that all important data is machine-readable and can therefore also be digitally processed (Figure 1).



© IM+io

Figure 1: Two waves of digitalization: from machine-readable to machine-interpretable data.

Internet technologies and the related cloud solutions have been the driving force behind this first wave of digitalization for over 20 years - and only very few companies and organizations have failed to keep up with the times. Nowadays, management is at serious fault with regard to safeguarding the future of their company if they fail to ensure that important process data is available in a digital and machine-readable form.

Automatic analysis of digital data

The second wave of digitalization, which is engulfing the whole economy and society like a giant wave, is shaped by the analysis of digitally available data. While it is based on the achievements of the first wave, it boasts much greater innovative strength as it paves the way for disruptive business models in a platform economy of self-learning smart services (Figure 1). A text is no longer viewed as a sequence of ASCII characters and an image is no longer processed as a pixel array. Instead, the contents of texts and images are described using terms from predefined conceptual networks. This allows unstructured documents to be transformed into structured descriptions, which can then be actively used for mechanical decision-making, consultation and optimization processes.

Since approximately 95 percent of mass data on the Internet is available in the form of unstructured, multimedia-based documents with a high degree of natural language, the key innovation of the second wave of digitalization is the automatic transformation of this data into content that can be analyzed by machines. Artificial intelligence (AI) technologies, such as machine learning and the algorithmic extraction of information from unstructured mass data, are thus becoming the driving force behind the second wave of digitalization.

The German Research Center for Artificial Intelligence (DFKI) has been developing AI technologies for text and image analysis, for deep learning, and for drawing conclusions on extracted relations between identified entities and processes. These technologies will make it possible to transform the 44 zettabytes of mass data, which is anticipated to be digitally available in the form of big data by 2020, into smart data. Only data that is not redundant, corrupted and outdated is taken into account in this process and transformed such that it can be used as a basis for optimization and value-added processes. This data is then enhanced using metadata to ensure that it can be used in an active and targeted manner.

Thanks to the semantic data enhancement using AI methods, smart data can be monetized in new business models.

If you are catching the second wave of digitalization at the right time, machine-readable user data will unlock a lot more far-reaching innovation potential in all company departments and for society in general than was the case with the first wave of digitalization (Figure 1).

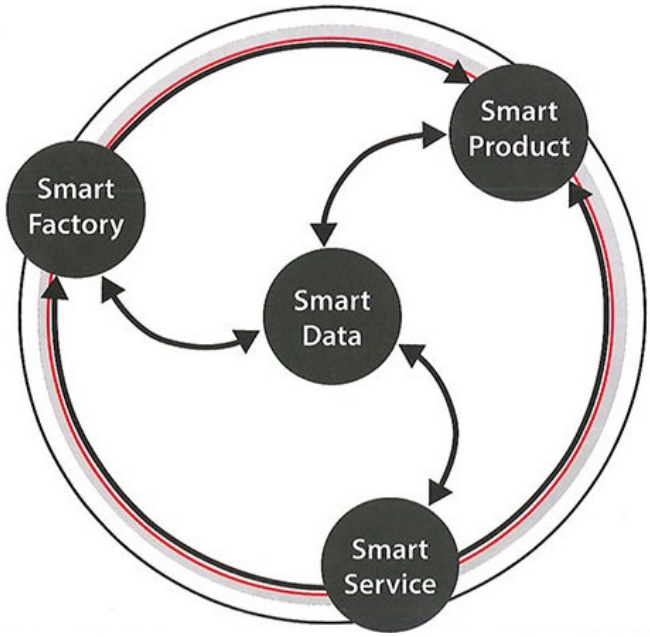


Figure 2: Smart data as the turbo engine behind Industrie 4.0 and the smart service world.

Smart data in self-learning smart service architectures

Smart data can already be obtained during production via the paradigm of Industrie 4.0 in the smart factory defined by us[1]. However, it is also collected when customers use smart products, enabling smart services for digitally enhanced products. Since valuable user data is generated during the provision of services, a turbo cycle driven by smart data is created that increasingly accelerates and enhances process innovations in the smart factory, product innovations in smart products and service innovations in smart services (Figure 2).

Creation of a turbo cycle driven by smart data

In the smart service world, artificial intelligence methods and tools play a decisive role at all layers of a new generation of self-learning smart service architectures[2]. In early multi-sensor fusion in the factory, the digital product or customer service, and in the necessary data processing, ambiguous, vague and unverified

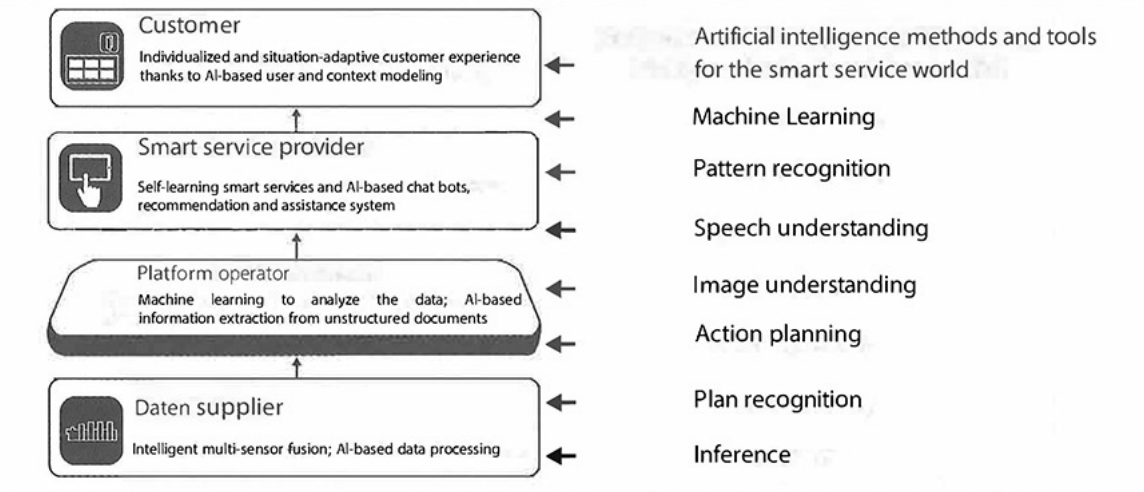


Figure 3: Artificial intelligence for the smart service world.

individual data can only be transformed into aggregated user data with added value when using advanced AI technologies (Figure 3).

Platform operators play a key role in effective competition, because the quality and speed of the machine learning methods used to analyze the data and the precision of AI-based information extraction from unstructured documents become the decisive factors for success (Figure 3).

Thanks to AI-based chat bots, recommendation and assistance systems, smart service providers can not only dramatically improve their service quality, but also considerably reduce the cost of services through automation. Since machine learning methods can also be used on these service platforms, the result is self-learning smart services that can autonomously adapt and customize services[3]. Based on automated and dynamic customization, knowledge-based user and context modeling finally paves the way for a new customer experience that, in contrast to the static customer interfaces of conventional digital services, contributes to the development of disruptive business models.

Two specific examples for AI-based smart services

The role of AI as the driver of the second wave of digitalization can be illustrated using two examples.

For production-synchronized logistics within the framework of Industrie 4.0, it is important to learn of events that can lead to significant supply chain disruptions as early as possible. Relevant examples include spontaneously arranged demonstrations and strikes, which can seriously disrupt the supply flow if logistics processes cannot be rescheduled early enough. In the SD4M project (Smart Data for Mobility) funded by the Federal Ministry for Economic Affairs and Energy (BMWi), the DFKI collaborated with syndicate partners to develop a cross-sector service platform in the research area of language technology that semantically integrates both data from conventional mobility service providers and data from social media[4].

The AI system simultaneously analyzes all texts from relevant websites, subscribed news feeds in the form of RSS feeds and twitter notifications in real time. As a result, any intention to demonstrate or strike can be identified at an early stage before the disruption and its formal announcement are made. The time and location of the various disruptions are visualized in a large interactive map display, and the parallel news feeds used to make the predictions are displayed on three small screens positioned above the map. Arranged in the form of a funnel, this visualization illustrates how freely accessible cloud news are transformed into smart data using AI systems to ensure smart logistics services.

In the Smart Farming World project funded by the BMWi, the DFKI's Smart Service Engineering research department has developed a smart farming service using a digitally instrumented potato. This real-time service is used to inform the operators of agricultural machinery and the farmers at which point and to what extent potatoes are damaged by the impacts and rotations of a potato harvester during harvesting.

Using deep learning methods, the system is able to determine the field's profit and losses and to display this information directly to the farmer. This means that as early as during the harvest itself, farmers are able to

see how the settings on their harvesting machine affect the yields. Using learning algorithms, the prediction improves over time by minimizing forecast errors. Based on historical market data, the potato variety and other economic factors, predicted losses caused by suboptimal system settings and operating modes can be visualized on the control panel of the harvesting system so that an alternative harvest strategy can be implemented immediately.

Conclusion

Artificial intelligence has recently triggered a second wave of digitalization that unlocks great opportunities for innovative smart services. In today's world, it is no longer sufficient to merely provide machine-readable data in digital form. In order to generate the desired benefits for smart services, software platforms must be capable of interpreting the content of digital data using AI technologies. ■

References

[1] Kagermann, H., Lukas, W.-D., Wahlster, W. (2011): "Industrie 4.0: Mit dem Internet der Dinge auf dem Weg zur vierten industriellen Revolution", VDI nachrichten, 01. April 2011, Nr.13, p. 2
[2] Kagermann, H., Riemensperger, F., Leukert, B., Wahlster, W. (eds.) (2017): "Wegweiser Smart Service Welt: Smart Services im digitalen Wertschöpfungsnetz". acatech, Deutsche Akademie der Technikwissenschaften, April 2017.
[3] Wahlster, W. (2014): "Semantic Technologies for Mass Customization". In: Wahlster, W. et al (eds.): "Towards the Internet of Services". Berlin, Heidelberg, New York: Springer, p. 3-14.
[4] Hennig, L., Thomas P., Ai, R.,Kirschnick, J., Wang, H.,Pannier, J., Zimmermann, N., Schmeier, S., Xu, F., Ostwald, J., Uszkoreit, H.(2016): "Real-Time Discovery and Geospatial Visualization of Mobility and Industry Events from Large-Scale, Heterogeneous Data Streams". Proceedings of the 54th Annual Meeting of the Association for Computational Linguistics (ACL-16), August 7-12, Berlin, p. 37-42.

Prof. Dr. Dr. h.c. mult. Wolfgang Wahlster

Wolfgang Wahlster is the Director and CEO of the DFKI GmbH, which was founded in 1988 and is currently the world's largest AI research facility with more than 700 scientists. In Federal Government advisory bodies, he has contributed to launching forward-looking projects such as "Industrie 4.0", "Smart Service World" and "Autonomous Systems". He is a member of the Nobel Prize Academy in Stockholm and the German National Academy of Sciences Leopoldina. He has been awarded the Federal President's "Deutscher Zukunftspreis" and holds honorary doctorates from various universities. With more than 70 start-ups, he heads one of the research centers that is most involved in the establishment of new businesses.

Further Information

VDMAimpulse | Primary publication: "Künstliche Intelligenz als Treiber der zweiten Digitalisierungswelle", In: IM + io, Das Magazin für Innovation, Organisation und Management, Ausgabe 02, p. 10-13, 06/2017 | IM + io Das Magazin für Innovation, Organisation und Management | DFKI | Professor Wahlster

Contact

DFKI, E-Mail: uk-sb@dfki.de

About VDMAimpulse

Read the magazine online: www.vdmaimpulse.org

VDMAimpulse is an international online magazine addressing the mechanical engineering and machine manufacturing industry. VDMAimpulse will be published every other month on or around the last Wednesday in January, March, May, July, September and November. If you want to receive an e-mail every time the new issue of the magazine is published, please contact the editorial office:
VDMAimpulse@vdma.org