ZVEI: Die Elektroindustrie

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Application of Artificial Intelligence in an Industrial Context

Artificial intelligence (AI) in the industrial environment is a key driver for securing the future of Germany as an industrial location. As enabler industry at the interface between IT and production, the electrical industry has a special role to play in this context. The ZVEI Factsheet seeks to clarify key differences between industrial AI applications and consumer-related applications and to highlight the potential of AI technologies for innovative, data-driven business models.[1]

1 Use of industrial AI along the ZVEI lead markets

1.1 AI is not new to the electrical industry

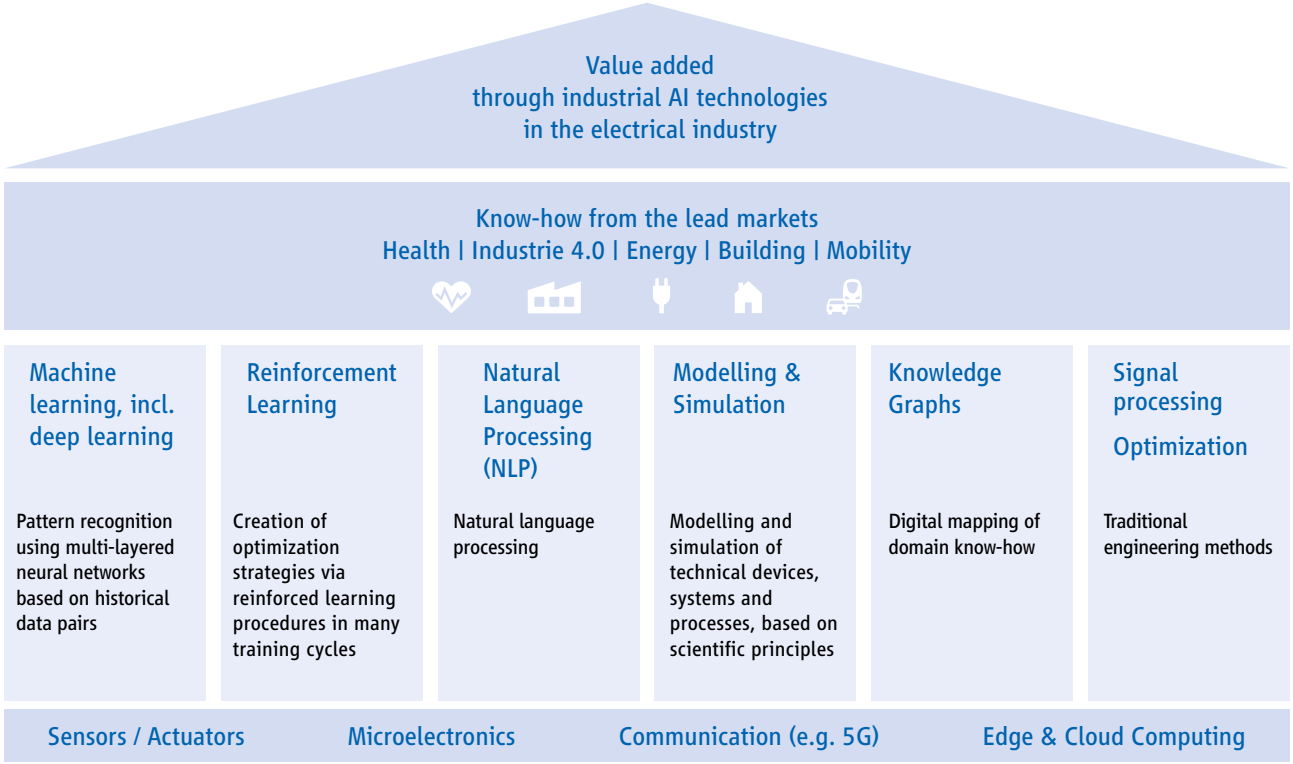
For more than three decades the electrical industry has been using data analysis methods (signal processing, optimization, etc.) in the production, operation and service of assets. The use of AI technologies is yet another tool in the data analytics toolbox and is now being applied to other fields as well such as design and engineering.

1.2 User & Provider at the same time

Companies in the electrical industry are not only users of AI technologies in their own production, but also providers of AI solutions for many important sectors of the economy.

The areas of application are diverse, and technical, regulatory or legal requirements can differ greatly between the various sectors. The following examples illustrate typical industrial applications in five lead markets of the electrical industry (table 1, page 2).

Figure 1: Selection of core AI technologies and necessary infrastructure



[1] Further information: https://www.zvei.org/themen/digitalisierung/kuenstliche-intelligenz

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Table 1: Examples of industrial AI solutions in the lead markets of the electrical industry

	Industrie 4.0	Mobility	Health	Building	Energy
Solution	Digital intelligent assistant for plant operators in the process industry	Predictive remote maintenance of trains and their components	Personalized, precise radio-frequence -ablation therapy for cancer.	Decision support in emergency situations in buildings	Optimization of the energy consumption of industrial sites
Data	Control system, Condition monitoring systems, production planning	Vehicle data, usage data, infrastructure data, weather and traffic data	Individual as well as anonymized patient data, tissue data	Data from building sensors and camera systems	Data from PV systems, battery storage states, electricity price consumption data
AI Technology	Natural Language Processing (NLP), Machine Learning, Multivariate Analysis	Machine learning	Modelling and simulation, De-identification algorithms	Machine Learning, Deep Learning	Optimization algorithms, machine learning
+ Application	Detection and interpretation of anomalies, recommendation of Options for action	Predictive maintenance	Evaluation of different treatment approaches, anonymization and pseudonymization	Detection and interpretation of anomalia, control of escape doors, fire protection, etc.	Prediction of power generation & power consumption, optimization of feed-in & feed-out direction
Domain Knowledge	Topology of the process plant, process engineering knowledge	Train technology expertise, experience in working with railroad engineers	Oncological knowledge, medical-technical knowledge	Building services engineering, building automation	Knowledge of industrial electricity consumers, local distribution network, electricity pricing
Added Value	Operator support for a safe operation of the plant (product quality improvement)	Increased availability and reliability of trains, savings in train operation, e.g. through reduction of downtimes	Individualized therapy approach (treatment depending on localization, duration and intensity of treatment)	Networking and analysis of data for the detection of emergency situations, adaptation of building control systems	Lower production costs, increased grid stability, sustainability in the local use of renewable energies

2 Differences between industrial AI and consumer AI

Artificial intelligence provides assistance and relief for humans - not only in private everyday life, but also in industrial applications. The use of AI can, for example, optimize production processes and raise them to a new level of efficiency. It thus also makes a significant contribution to resource efficiency and sustainability. In this context, solving industrial challenges represents a separate class of challenges in AI, which often differs greatly from common use cases in the consumer context:[2]

2.1 Use of different types of data[3] - Focus on machine data

- AI applications in the electrical industry operate in many cases without using personal data or a direct consumer interface. According to a ZVEI-survey from June 2021 non-personal data are used in 84% of cases in industrial AI usage.[4]

- In the B2B context, machine data is generated locally at the shop-floor. This means that the data primarily relates to machines and systems and only becomes personal when correlated with other data.

- In some applications, AI technologies support humans in their work, e.g., as operators of machines or as interpreters of medical data (AI as digital assistant or human augmentation). Here, there is an indirect or direct reference to the person.

2.2 Heterogeneity and Contextuality of Industrial Data

- The analyzability of industrial data strongly depends on the real application environment and the physical environment.[5] Depending on the area of application, data is generated from various sources along the industrial value network.

- In the B2C context, data is usually much more homogeneous since it is usually generated by humans and is therefore more context-independent (Fig. 2).

2.3 Importance of low-data AI

- Compared to the AI application in software-based products such as Internet search engines or voice assistants, industrial data often contain relatively little information.

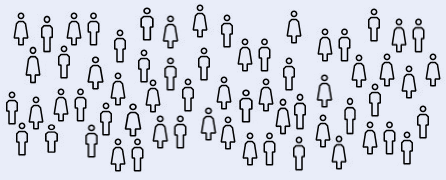
- Digitized production machines often provide very similar or identical data over long periods of time. Machine data show changes (= relevant information) only at the beginning and with advanced service life - until corresponding components are repaired or replaced. Since only data with comparable characteristics and in the same application context can be correlated with each other, low-data AI applications play a greater role in industry than in the consumer sector.

2.4 Domain Knowledge

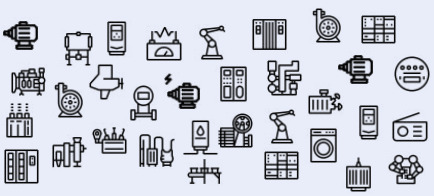
- Next to expertise in data and algorithms, the success of AI deployment in an industrial context requires expertise in the real production environment and in the physical context. The inclusion of employees with domain knowledge is therefore central to the development of AI solutions and the evaluation of AI results.

- Therefore, in B2B, the challenge is to incorporate knowledge about the machines into the development of data-driven algorithms.[6]

Consumer AI (B2C): Comparable individuals



Industrial AI (B2B): Many different sources



Source: ABB AG

Fig. 2: Different data sources in the B2C and B2B sectors

[2] ZVEI Position Paper (2018): Human-Centered Artificial Intelligence in Industry: Ten Recommendations for Action for Germany and Europe.
[3] The ZVEI and its member companies are committed to the responsible handling of data and have drawn up corresponding guidelines for this purpose: ZVEI(2020): Guidelines of the German Electrical and Electronic Industry for the Responsible Use of Data and Platforms, Version2.0
[4] ZVEI Survey on Digitisation of the Electrical Industry (06/2021)
[5,6] Lehmann-Brauns & Hoffmann (2020): Business Model Potential of Industrial AI. Atp Magazine 09/2020.

3. Facts & Figures

Global market for industrial AI applications

- 72.5 billion US-Dollar global market volume for industrial AI applications in 2025[7]
- 31% annual growth of the market for industrial AI until 2025[8]

AI in Germany and Europe in international comparison

- In international comparison, Germany leads the field in the share of AI start-ups in the manufacturing sector relative to the total number of AI start-ups (13 out of 174). In the overall view, Germany is in 7th place (174) with a clear margin behind the USA (2332), the UK (408) and China (341).[9]
- With 5416 AI publications between 2015-2019, Germany ranks 5th among the top 20 countries with most AI publications, behind the USA (21596), China (19760), India (10317) and the UK (6994). The EU (excluding the UK) has 19604 publications and is thus on a par with the USA and China. [10]

AI in the electrical industry

- 14% of all spending by German industry on the development, introduction and maintenance of AI processes is accounted for by companies in the electrical and mechanical engineering sector (€680 million). This corresponds to a third place after the ICT sector and the automotive industry.[11]
- 66% of companies in the electrical industry attach high or very high importance to AI regarding their business model. Even though different assessments of the importance of AI between larger and smaller companies remain visible, already 28% of smaller companies (turnover < 50 Mio €) attach a high or very high importance to the usage of AI.[12]
- In the electrical industry, missing or unusable data (52%), regulatory or bureaucratic hurdles (51%) as well as the lack of AI experts (47%) are generally mentioned as biggest obstacles when using AI. For smaller companies (turnover > 50 Mio €) unclear economic value (40%) constitutes an additional obstacle regarding the usage of AI.[13]
- When deploying AI technologies in the electrical industry, non-personal data is used in around 84% of cases. The share of companies deploying AI, that are using non-personal data for their AI solutions, is the highest share in the electrical and mechanical engineering industry compared to all other economic sectors.[15]

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[7,8] IoT Analytics (2019): Industrial AI Market Report 2020-2025 https://iot-analytics.com/product/industrial-ai-market-report-2020-2025/#%3A~%3Atext%3DIndustrial%20AI%20is%20emerging%20as%2C%2472.5B%20market%20by%202025
[9] Acatech Horizonte (2020): Artificial Intelligence in Industry, p.52.
[10] Acatech Horizonte (2020): Artificial Intelligence in Industry, p.58.
[11] BMWi (2020): Einsatz von Künstlicher Intelligenz in der Deutschen Wirtschaft – Stand der KI-Nutzung im Jahr 2019, ZEW-Gutachten und Forschungsberichte, S.6.
[12, 13, 14] ZVEI Survey on Digitisation of the Electrical Industry (06/2021)
[15] BMWi (2020)