Lernende Systeme

GERMANY'S PLATFORM FOR ARTIFICIAL INTELLIGENCE

Shaping sustainable change with AI

On the strategic link between Artificial Intelligence and sustainability goals

Executive Summary

- Digitalization and sustainability are among the most important challenges of this decade: Our society is confronted with the effects of climate change and changes in ecosystems on the one hand, and with the economic and social consequences of political measures to mitigate the effects of climate change on the other. This requires a transformation towards sustainable development.
- The digitalization of society and the economy is itself a transformation process that affects all areas of our everyday and professional lives. Used in a targeted manner, digital technologies can help us shape sustainable change.
- To preserve our livelihood, both transformation processes – sustainable development and the digital transformation – must be linked in business, science, and society. For sustainable change, economic, ecological, and social dimensions must be considered.
- Innovation-relevant key technologies such as Artificial Intelligence (AI) have many potentials to effectively support business, science, and society in acting in an ecologically compatible, socially just and economically successful manner. For example, AI can help improve environmental protection and nature conservation or minimize energy and resource consumption. At the same time, AI can also be used to optimize the distribution of scarce goods (e.g. raw materials) or to control the circular economy. As a multifunctional tool, AI allows the intelligent linking of various socio-political, economic, and ecological objectives and can also support their implementation.

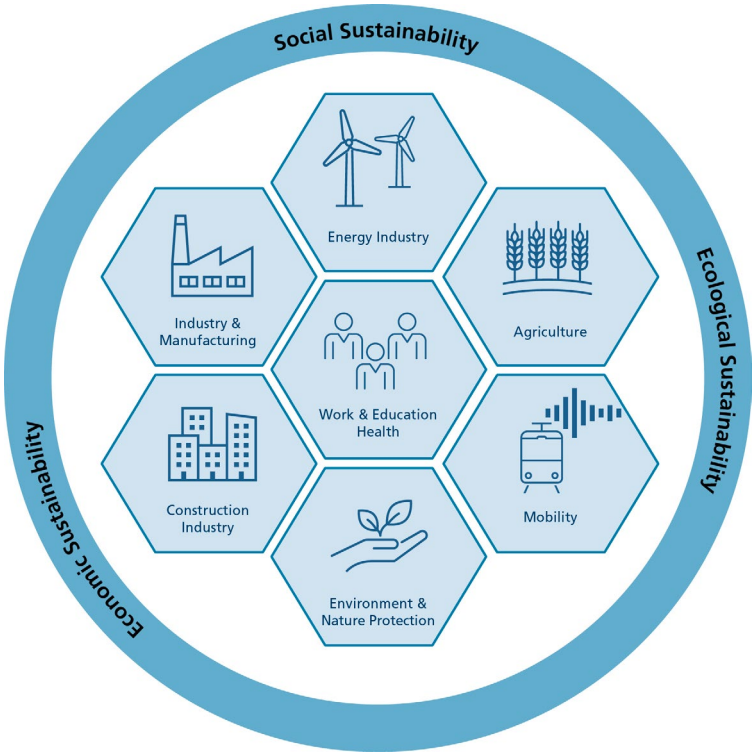
- More sustainable businesses and digital technologies can simultaneously increase the resilience of society and the economy by balancing dependencies and price fluctuations of globally traded commodities or vulnerabilities (e.g. in supply chain management).

- **Key opportunities:** Through or with the environmentally aware use of AI, efficiency gains can be released (e.g., energy, emissions, and resources) and competitive advantages created (e.g., material savings, quality improvements material savings, quality improvement, higher resilience).

- **Challenges:** Key prerequisites for linking sustainability goals with key digital technologies such as AI are a sufficient data basis or data infrastructure, legal regulation, political measures, and broad social digital competence. In addition, the high energy and resource consumption of digital technology, the lack of clarity about possible applications and the long-term investment as well as the different data basis/infrastructure in companies and in public authorities of industry, science and politics must be addressed. Rebound effects, which reduce or even overcompensate for possible efficiency gains if appropriate precautions are not taken, can also impair the sustainable use of AI.

AI and sustainability – On the strategic linkage of two fields of action

Digitalization and its AI component are heralding one of the greatest economic and social transformations since the beginning of industrialization. Used correctly, AI can help us



shape sustainable change: Against the backdrop of economic, social, and ecological objectives, there are many opportunities to transform processes and business models sustainably through new technologies including AI to transform processes and business models in a sustainable way.

Digital societies and the use of AI enable us to derive insights and recommendations for action from collected data. This can lead to important conclusions and progress for environmental protection, in the energy sector, in industry, or in healthcare or agriculture. A solid data infrastructure is important for this. Companies can also strengthen their resilience using key digital technologies; for example, AI can help to design more resilient supply chains and logistics networks by better managing machine failures, risks of supplier and logistics route failures, or alternative solutions. Nevertheless, side effects of the increasing use of digital technologies must also be considered: This concerns the high consumption of resources and energy, the lack of transparency in decision-making and optimization processes, the market power of companies with Big Data, or the reproduction of social inequalities. Therefore, the far-reaching consequences of the development and application of AI models on labor markets, consumption patterns and competition must be considered.

The operational linking of digital technologies and sustainability goals in business, science, and society with a focus on the potential of AI enables a strategic combination of two fields of action to better achieve sustainability goals. The core issue is that AI can enable more sustainability, as well as that the use of AI itself becomes more sustainable by means of innovative technological and business solutions. On the one hand, AI can be used to support the implementation of sustainability goals; on the other hand, the use of AI in companies must also be carefully coordinated against the background of sustainability goals.

The potential of AI for sustainable change

Resource conservation, efficiency gains, emissions reduction – AI technologies can significantly support science, business and society in acting in an ecologically compatible, socially just and economically successful manner. The central impact potentials of AI for sustainable change include:

- **AI-based monitoring:** AI systems map past and current processes (e.g. traffic usage patterns, customer behavior, biodiversity).
- **AI-based predictions:** AI systems forecast/model future developments/processes (e.g., weather, market demand, traffic usage).
- **AI-based recommendations:** AI systems make recommendations based on monitoring/forecasting data (e.g., machine usage, customer offerings, public infrastructure offerings).
- **AI-assisted decision and control processes:** AI systems provide automated assistance in decisions (e.g. logistics, price development, plant maintenance, production, intelligent traffic systems, power grid).

Further, exemplary AI applications and potentials in science, economy and society can be assigned to different sustainability dimensions.

AI deployment opportunities and potentials by sustainability dimensions

Ecological Sustainability
– Precision agriculture
– Energy and resource efficiency (CO_2 savings)
– Distributed energy networks
– Circular economy: circular economy, recycling, sustainable product life cycle
– Environmental monitoring and enforcement; precision ecosystem monitoring
– Habitat prediction, migration patterns and habitat loss monitoring (Flora/Fauna)
– Pollutant dispersion prediction and tracking (air/water)
– Monitoring ocean currents and ecosystems
– Forecasting of severe weather, drought
– Real-time monitoring and management of water supply
– Modeling of extreme weather events and forecasting
Economic Sustainability
– Decision support, material savings and quality improvement
– Use of smart production processes and evaluation of production data
– Improved information processing and time savings
– Adaptation of product designs, process and production workflows
– Innovative sharing and cooperation models
– Data-based business and service models
– Predictive maintenance and servicing of equipment
Social Sustainability
– Social participation and inclusion (e.g. medical care)
– Prevention, diagnosis and research of diseases, therapies and active ingredients
– Improved working conditions and sustainable supply chains
– Monitoring of supply chains and tracing of origin
– Early warning systems and real-time coordination of disaster relief and development cooperation/ humanitarian Aid (e.g., natural disasters, floods, disease outbreaks)

Source: Own representation (cf. BMWK, 2020; Boll & Schnell et al., 2022; World Economic Forum, 2018).

AI potentials for ecological, economic and social sustainability

AI and environmental sustainability

The aim of ecological sustainability is to preserve the basis of human life, which is defined by planetary boundaries: From an ecological perspective, this specifically means not using more resources than a system is capable of reproducing and ensuring that future generations have equal opportunities and a good livelihood. While the use of resource-intensive AI technologies can put a strain on ecosystem stability, when used correctly, AI technologies can also help us to build a kind of early warning system for the protection of biodiversity and our natural environment, as well as transform our energy supply and mobility behavior. AI can also help to accelerate development and production processes, make them more efficient, and conserve energy and resources. It thus makes an important contribution to greater sustainability and climate protection.

AI and economic sustainability

For businesses, AI enables processes to be designed more efficiently, resource consumption to be optimized and emissions to be reduced as a result. Many ecological optimization measures therefore also pay off concretely in terms of potential economic benefits,

for example in rationalization gains or recycling processes. The use of AI in companies therefore often creates synergy effects between economic and ecological potentials. At the same time, it is important to bear in mind that economic benefits (e.g. cost savings) from the use of AI can also potentially lead to increased demand for goods or services, which could counteract resource-saving sustainability effects. In terms of sustainable change, economic and ecological sustainability are in harmony if the additional consumption opportunities for consumers created using AI are greater than the costs incurred for this, considering the ecological standards demanded by society.

By using digital technologies and AI, industrial companies can increase productivity and flexibility at lower cost and higher quality, reduce scrap rates in the production process, and at the same time meet customer demands for more environmental efficiency and climate friendliness of production and products. By collecting product and production-related data within the entire value creation system, the conditions for a sustainable circular economy are improved at the same time. AI can thus help build and improve the infrastructure for „reverse logistics" to close the loop for products and materials by optimizing the processes for sorting and disassembling products, reprocessing components, and recycling materials.

AI and social sustainability

The increasing use of AI also requires ethical discussion about the responsible use of technologies to support the implementation of the Sustainable Development Goals. Socially sustainable development aims at a sustainable, globally just and livable society for all social groups and includes the fulfillment of basic human needs (e.g. food, housing), good living conditions (e.g. education) as well as equal opportunities for realization and social participation. AI technologies also offer many opportunities in this context if they are used in a targeted manner for this purpose (e.g. poverty reduction, education, good working conditions). AI can also be used in the field of development cooperation and humanitarian aid, for example, to predict natural disasters and disease outbreaks, to detect human rights violations, or as a machine translation tool to over-come language barriers.

AI technologies can also support us on the path to social sustainability, for example, through technological innovations and advances in medical care, such as faster and more efficient research processes, early detection of diseases (e.g., in cancer diagnostics), or support in care. AI can also help us to further promote social inclusion and support equal participation in the world of work and in social life for people with impairments, people with low language skills or with limited mobility.

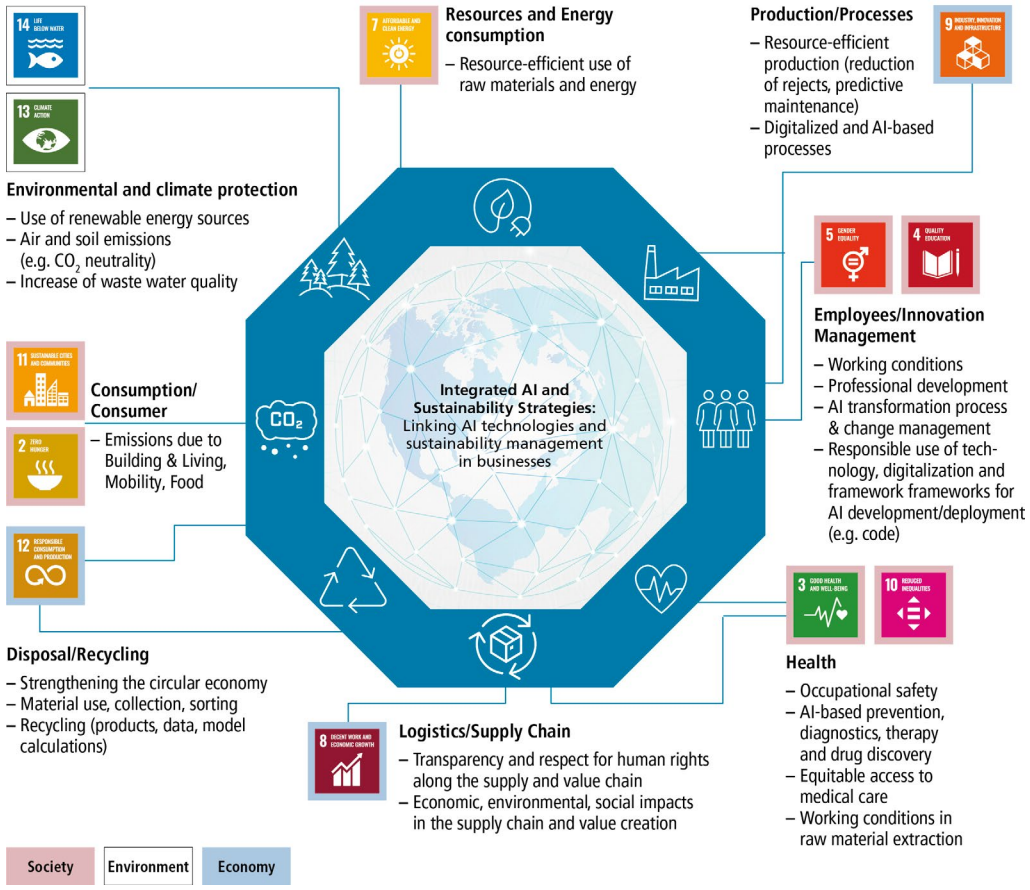
Integrated AI and sustainability strategies in businesses

To achieve sustainable change, we must meet the needs of the present without risking that future generations will not be able to meet their own needs. Against this backdrop, the global community committed to 17 global goals (UN Sustainable Development Goals, SDGs) for sustainable development in 2015 under the umbrella of the United Nations with the 2030 Agenda. These goals are specified by various targets and indicators that relate

to the environment, economy and society and cover different areas, such as improving health, eradicating poverty, gender equality and combating climate change.

How can companies effectively contribute to the realization of sustainability goals with and through AI? The following compass for the sustainable use of AI in businesses provides an overview of the diverse opportunities for sustainable development in various corporate dimensions.

Compass for the sustainable use of AI in companies



Source: Own representation (cf. Vinuesa et al., 2020, p. 8; Robert Bosch GmbH, 2022).

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