



Project closure Embodied Intelligence

Embodied Intelligence: Engine of the Digital Transformation 2.0

The results of a broad-based study conducted by fortiss, Siemens AG, the German Dialogue Institute and the Center for Digital Technology and Management have been released under the title “Embodied Intelligence: Engine of the Digital Transformation 2.0”. The goal was to identify the societal, economic and technical developments and challenges of embodied intelligence (EI) and recommend actions for government, business, education and science. The study focused on the question of how we can ensure our standard of living by actively addressing the challenges of the digital transformation, while at the same time actively managing it.

The Digital Transformation 2.0 is a highly-dynamic process that is leading to a completely new economic architecture dimension. As a result, the use of digital ecosystems is turning into an imperative success factor for companies given that day-to-day products and goods are becoming digital building blocks for the realization of a significant part of the value chain. Embodied intelligence will be one of the future players in these digital ecosystems. And in order to successfully address this paradigm change, the development of the production landscape in Germany must be even more strongly characterized by overriding issues such as adaptability, real-time systems, autonomous control and sustainability.

Progress in autonomous machines illustrates how AI and robotics are converging in more and more areas. The emergence of embodied intelligence is closely related to this development. Things that contain embodied intelligence are systems that can regulate themselves and increasingly react to changes in their environments in an adaptive fashion. They can also react with little or no human intervention and in the future be able to represent parts of our infrastructures. While initial approaches are already being employed today, it won't be until the future that much more mature forms will appear.

Embodied intelligence as a future driver of growth

In the study, a team of fortiss scientists led by project manager Markus Duchon explains that over the mid-term, machines with embodied intelligence will form the central basis of innovation for the next cycle of growth. This applies especially to the platform economy. For this reason, the use of EI can be formulated as a long-term societal, economic and technology goal. Furthermore, developments in these areas will yield great human benefits in key fields of application such as information and communications technology and the integrated sensor systems, intelligent materials and production, plus energy supply and transport.

In their presentation, Markus Duchon and his colleagues explain that previous physical marketplaces and value chain systems are increasingly evolving into virtual infrastructures. This trend is clearly visible not only with online retailers and social media, but also in the allocation of government and public administration tasks. At the same time it has become readily apparent that in terms of decentralized energy production, the development of satellite-based communication infrastructures or the use of self-driving vehicles, although humans will initially be responsible for operating the existing infrastructures, in the future these tasks will be assumed by EI systems.

Addressing current and future challenges with the help of embodied intelligence

In summary, the study identifies key areas of action up to the year 2035 that could be actively shaped through the use of embodied intelligence and in the context of the platform economy. With this information as a basis, the authors of the study derive concrete recommendations for action for government, business, education and science.

Development in the individual areas will be strongly driven by accelerated urbanization, migration, demographic change, the pursuit of independence from energy - and to some extent water and food provisioning – in addition to climate change and government dysfunction. For this reason, fast action and implementation of the recommendations is urgently required in order to actively help shape the digital transformation in a targeted fashion.

Recommended steps			
	Government	Business	Education & Science
Create an atmosphere of change	Launch campaigns for spurring the transformation into a new technology era	Embark on company-specific transformation strategies	Develop a combined education, business and research strategy
Use change for own purposes	Digitalize administration	Stronger user focus calls for an end-user-centric approach and completely new target systems	Establish innovation tanks, reformation and integration into association structures
Drive change at the societal level	Use large European grant projects as a blueprint for a European platform economy	New infrastructures as third-wave of the transformation of the economy offer new business opportunities	Introduce systematic transfers between research and science and between science and business

The graphic encompasses all relevant areas of action and the corresponding recommendations for the use of EI.

Employing embodied intelligence to deal with climate change

The degree to which the study is important and thematic is illustrated by the reference to the necessary transformation of the global energy sector from fossil fuels to a CO₂-neutral energy. By the second half of this century this process will also accelerate the development of a new form of machines with embodied intelligence. In particular, combining embodied intelligence with renewable energy and using the platform economy to increase energy efficiency, is seen as a key lever to achieve the required reduction in CO₂ emissions.

The Research Institute of the Free State of Bavaria for Software-intensive Systems will now apply these findings to a new project referred to as Affordable Industrial Mobility Energy Ecosystem (AIMEE), which will involve the accelerated transformation of industrial e-mobility through energy-as-a-service (EaaS) models. The goal is to establish a product-service system for energy storage and storage capacity. Within the framework of this platform-based system, the idea is to transform energy storage from a product into a service as a way of offering sustainable and cost-effective storage capacity.

How the study was conducted

Apart from fortiss, other participants in the study included the German Dialogue Institute, the Center for Digital Technology and Management and the Department of Corporate Technology (CT) at Siemens AG, which served as coordinator of the alliance. The study was carried out on the basis of interviews and workshops conducted by experts from business, research and society, as well as government representatives. An online survey also took place.

Prior to the interviews and surveys, the mechanisms and developments related to the digital transformation were identified and analyzed. Using the survey results as a foundation, the project team first documented the current situation in German industry, including the production environment, and assessed the future direction of developments on a national and international basis. The areas of action required for safeguarding and strengthening the German business landscape were then identified in order to derive steps for the next stage of the digital transformation.

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