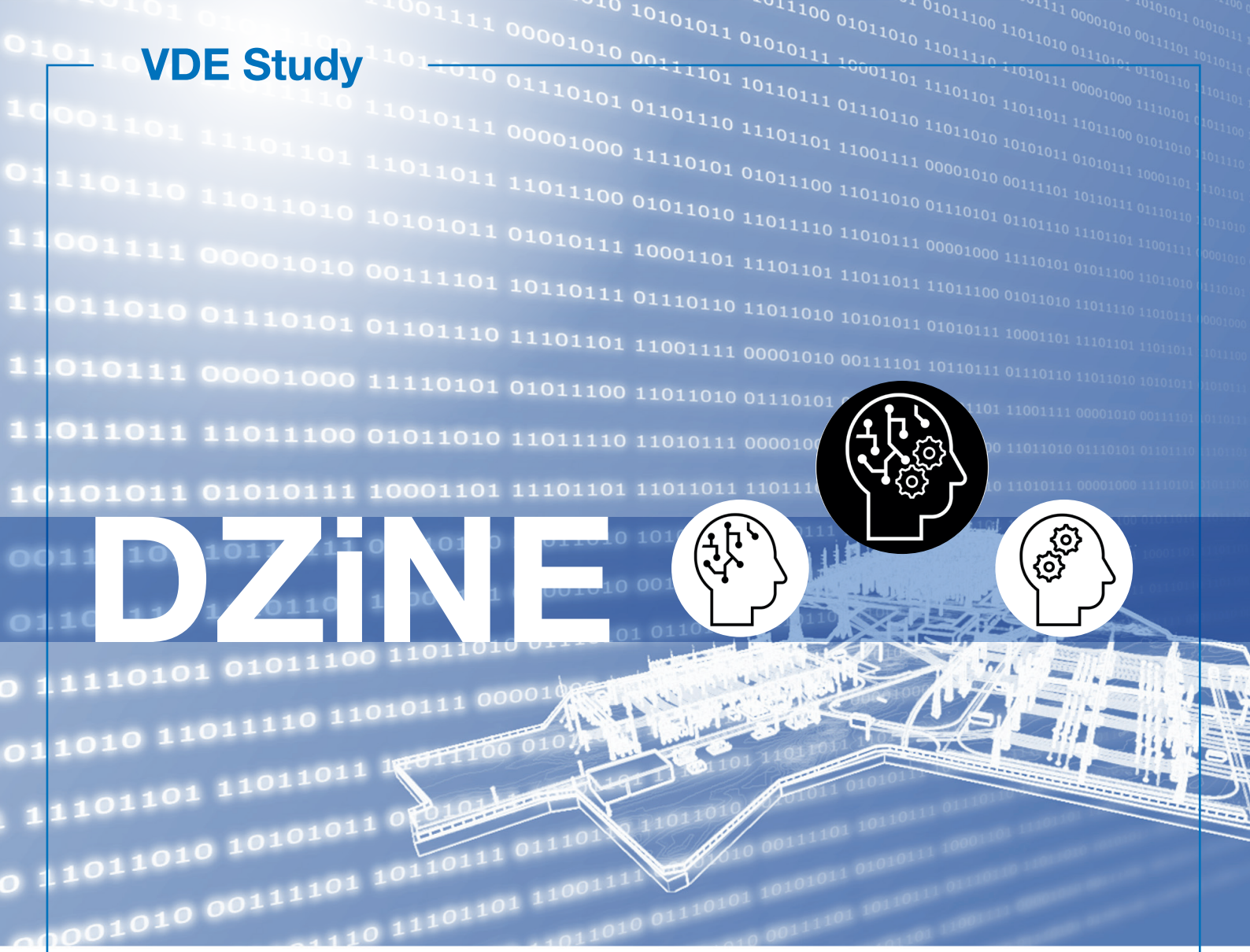
VDE Study



The Digital Twin in the Network and Electricity Industry

by VDE ETG

VDE

Recommended citation
VDE Association for Electrical, Electronic & Information Technologies: The Digital Twin in the Network and Electricity Industry, VDE Study, Offenbach am Main, Germany, May 2023

This VDE study is the result of the work of the VDE ETG Task Force “Digital Twin”.

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Cover picture: © entegra eyrich + appel gmbh

Design: Schaper Kommunikation, Bad Nauheim

May 2023

Content

Management Summary

The network and electricity industry is facing gigantic challenges. A look at the planned investment projects of the grid operators reveals the massive efforts in network reconstruction and expansion to implement the energy transition and thus decarbonization. The ambitious goals of the federal government (6 million heat pumps and 15 million electric cars by 2030) clearly demonstrate how green electricity, especially (according to the Easter Package [1]), with an annual addition of 22 GW of photovoltaic and 10 GW of wind power expansion by 2030, replaces conventional energy sources in sectors such as households, industry, commerce, and transportation, driving further investments in the grids. These increasing investments encounter processes and structures that have grown in isolated silos over decades. Often, there was a lack of awareness that the introduction of digital technology and software, without sufficient coordination by management, leads to redundancies in data models. In overall operations, hidden productivity losses and difficult-to-manage projects are the result. Due to the numerous uncontrolled redundancies of these silos with their own data models, data is continuously manually validated and processed in many manual steps. Thus, there is neither trust in the data nor the ability to accelerate or automate processes to relieve skilled workers or achieve higher efficiency per worker. This is precisely what is necessary because the increased workload coincides with an already severe shortage of skilled professionals at all levels of the process chains. Moreover, it is foreseeable that this will be further exacerbated by the increasing retirement of many experts, competition from modern and digital industries, as well as ever-shortening employment relationships.

Within these framework conditions, our power grid must be completely rebuilt. From the Task Force's perspective, network reconstruction and expansion cannot be achieved solely through more funding and the opportunities arising from the third industrial revolution (introduction of digital technology). The increased and more flexible new requirements for the grids specifically require intelligent and interconnected solutions to uncover and safely utilize the existing reserves in the power grid. Working according to the methods of Industry 4.0 (I4.0), with solutions such as the Digital Twin in the network and electricity industry (DZiNE) presented here, addresses precisely this point. This interconnected simulation model, based on I4.0 methodology, forms the data foundation for continuous, data-driven processes from planning through operation to decommissioning. The implementation of weather-dependent overhead line operation (WAFB) is already a step in this direction, using interconnected simulation models to dynamically utilize the built-in reserves of the power grid. The classical planning methods of the past often included worst-case scenarios, which is why the resulting reserves can now be utilized through the introduction of DZiNE. The promised curative network management further builds on this approach. By means of DZiNE, controlled overloading of power circuits can be enabled through precise bottleneck analysis. Thus, while it cannot replace stalled network reconstruction and expansion, it can be reduced through intelligent and digital solutions.

The foundation of such intelligent and digital solutions lies in data models consisting of valid and interconnected data that can be evaluated by algorithms - so-called Digital Twins. As one of the core results of this task force, a definition of DZiNE is presented, which differentiates it from conventional digital data models based on a series of characteristics. The digital twin...

- is a virtual representation of an existing or to-be-created real object.

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