

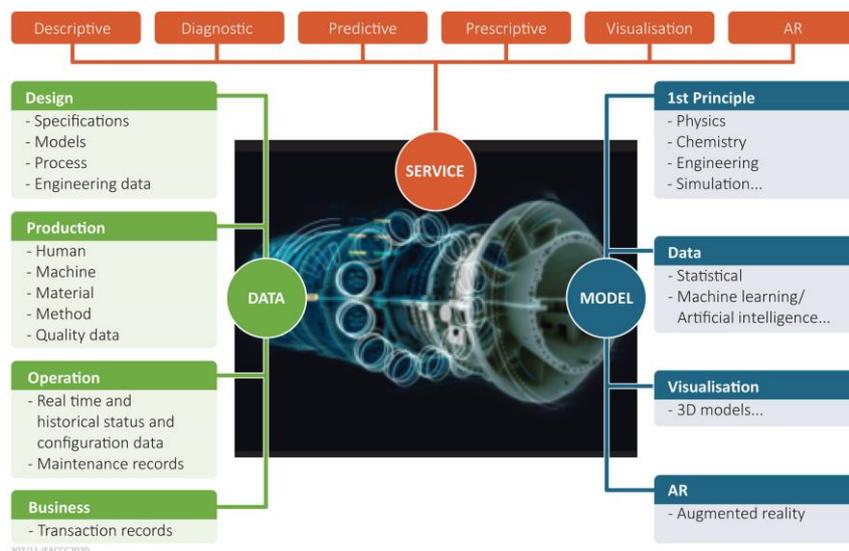


DIGITAL TRANSFORMATION OF THE COAL SECTOR

The global power industry is undergoing the fundamental changes of decarbonisation, decentralisation and digitalisation. These pose significant challenges to energy systems and the coal sector, especially coal-fired power generation. The power sector has begun a digitalisation process that is transforming the way electricity is generated, transmitted and distributed, and will help it meet the challenges.

KEY DIGITAL TECHNOLOGIES FOR POWER GENERATION APPLICATIONS

Digital transformation of power generation will be based on five key functions: connection, monitoring, analysis, prediction and optimisation. Today, the ever faster and ubiquitous connectivity provides the foundation for a digital power plant by enabling the connection of sensors, devices, assets and people.



Constituents of a digital twin (Malakuti and others, 2020)

A suite of digital technologies such as the Industrial Internet of Things (IIoT), Big data, Analytics and Artificial Intelligence (AI), Digital Twins, the Cloud, and Mobility have been developed and are being applied in power plants. The IIoT provides the building blocks of a digital power plant, allowing for collection, transmission, analysis and management of operations, processes and assets data. Software, such as artificial neural networks (ANN) and simulation models, provides tools to identify or predict any issues and determines the appropriate actions with real-time responses to prevent or resolve the problems, and to maximise the potential performance and profitability of assets, power plants and fleets to achieve the best possible outcomes. By using software that understands a machine's physical capabilities relative to its theoretical potential, today's advanced analytics and control can detect any deviations from setpoints and adjust operating parameters in real time to optimise operational and environmental performance and minimise production costs. Digital Twins provide a platform to simulate and visualise individual equipment, processes and an entire plant's operation, and to keep track of performance, operation and maintenance (O&M) needs. The Cloud provides power producers with computing service

over the internet with faster innovation, flexible resources and economies of scale. Data are the main driver in the digitalisation of power plants. AI and machine learning, combined with Big data, enables power plants to shift from current preventive maintenance systems to predictive or condition-based maintenance. Digital tools can detect any anomalies or operational issues, assess the likelihood of asset failures, identify their respective root causes and when they might occur, and recommend quick actions for their resolution. Consequently, forced outages are minimised, uptime is increased, and the lifetime of assets and power plants are extended leading to reduced O&M costs and improved economic value of the plants. Big data and advanced analytics and AI can provide power producers with insights on the state and performance of assets, processes and operations within a plant and system-wide, help them to make better, faster decisions and to maximise the plant's operational efficiency while responding optimally to changing conditions on the grid and in the overall power market.

Using data from remote sensors, power producers can pinpoint where to send a crew for a repair, and based on an assessment of the damage, ensure the team arrives with the right tools for the job and receive the support they need. Robotics can be used to perform inspections, maintenance and repair activities at risky or difficult-to-reach areas or sites, improving health and safety standards, reducing repair time and O&M costs.

As digitalisation advances, power plant operation becomes increasingly dependent on ICT, which increases the risk of cyber attacks. Hardware and software have been developed and implemented to protect energy infrastructure from such attacks. Digital solutions adopting AI and machine learning, and/or blockchains for enhanced cyber security are under development.

DIGITAL TRANSFORMATION OF THE COAL SECTOR

The future intelligent power generation enterprise will be a data-driven, Cloud-enabled enterprise in which decisions in all areas of the business are informed by live streams of data and connected by a single digital platform at plant or fleet level. The digital platform will be connected to almost everything from energy production and transport, power generation, transmission and distribution (T&D), sales and services, and beyond. The digital platform can run complex power generation operations efficiently, leading to optimal operational and environmental performance, improved flexibility, reliability, security and profitability. Digital technologies can also be applied to coal mining, helping to automate and optimise coal production, improve operational efficiency, environmental performance, workers' safety and production workflow at reduced costs.

BENEFITS OF DIGITALISING POWER GENERATION

Digital plants can operate at optimal efficiencies leading to a substantial reduction in CO₂ emissions from coal power generation. The cost of electricity is also lowered due to reduced fuel consumption, optimised O&M, improved reliability, availability and flexibility resulted from digitalisation. The digital transformation towards a sustainable and more efficient power generation that provides cleaner and cheaper electricity with minimal environmental impacts is compatible with the UN Sustainable Development Goals of good health and wellbeing for all, affordable and clean energy for all, and actions to combat climate change and its impacts, as well as responsible consumption and production. In short, digitalising coal power plants with innovative technologies will increase their efficiency, affordability, reliability, and sustainability.

The IEA Clean Coal Centre is a technology collaboration programme of the International Energy Agency (IEA). The objective of the IEA Clean Coal Centre is to provide definitive and impartial information on how coal can continue to be part of a sustainable energy mix worldwide.

Each executive summary is based on a detailed study which is available separately from www.iea-coal.org. This is a summary of the report: Digital transformation of the coal sector by Dr Qian Zhu, CCC/307, ISBN 978-92-9029-630-0, 80 pp, September 2020