Digital Transformation in Energy Industry

inavitas

Asset Performance Management

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Evolution of Digital Processes

1980s: The Beginning of Automation

First use of SCADA (Supervisory Control and Data Acquisition) systems in power plants.

1990s: Rise of the Information Age

Development of remote monitoring and control systems.

2000s: Smart Grid and Advanced Analytics

Integration of renewable energy sources.

Introduction of advanced data analytics methods and machine learning in the energy sector.

2010s: Big Data and Artificial Intelligence

Integration of big data management and analytics solutions into the energy sector.

Revolutionizing energy economics and operational efficiency with artificial intelligence and machine learning.

Evolution of Digital Processes

2020s and Beyond: Digitalization and Sustainability

Real-time monitoring of each energy asset with the widespread use of **IoT (Internet of Things)** devices.

Digital twins and simulation technologies for sustainable and flexible energy systems.

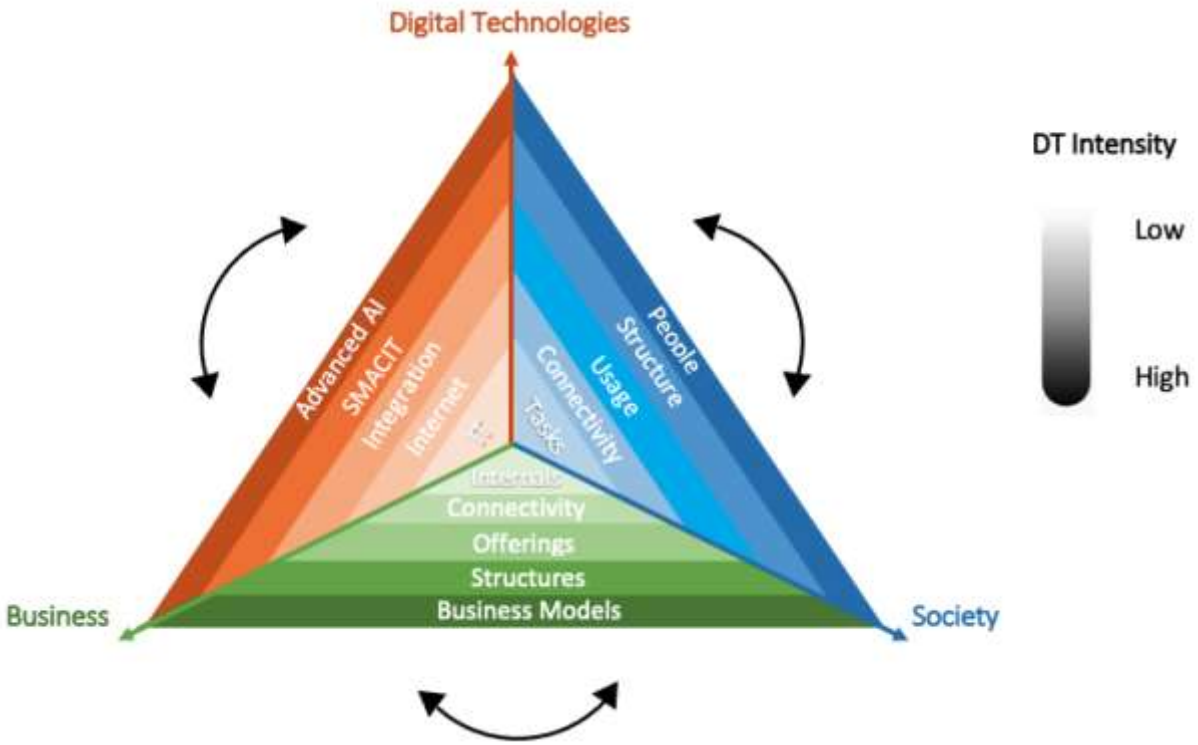
The prominence of **artificial intelligence**-supported solutions in preventive maintenance, data analytics and asset management.

Integrating various renewable resources (solar, wind, hydroelectric, etc.) and supporting them with **energy storage solutions**.

Development of charging infrastructure and inclusion of **electric vehicles** in grid operations, vehicle-to-grid (V2G) technologies.

Blockchain technology for tracking renewable energy certificates and carbon credit trading.

Digital Transformation Process



Nazari, Z. and Musilek, P., Impact of Digital Transformation on the Energy Sector: A Review, *Algorithms* 2023, *16*(4), 211

Digital Monitoring

Real Time Data Acquisition: Instantaneous energy production data, performance indicators and environmental conditions.

Forecasting Systems: Machine learning algorithms on weather and power generation forecasts.

Condition Monitoring: Analyzing data from sensors for equipment health and performance.

Warning and Alarm Systems: Automatic notifications for early detection of abnormal conditions or faults.

Asset Management

Digital Twins: Creating virtual models of physical assets for performance analysis through simulations.

Remote Monitoring and Management: Remote surveillance of assets and adjustment of operational parameters.

Data Management and Analytics: Continuous monitoring and improvement of asset performance through data analysis.

Energy Management Systems: Advanced software tools for managing energy consumption and production data.

Condition-Based Maintenance: Predictive maintenance scheduling based on data analytics of asset condition.

Maintenance

Predictive Maintenance

Data-Driven Insights: Utilizes data to predict equipment failures.

Condition Monitoring: Regularly assesses the equipment's health to forecast potential breakdowns.

Maintenance Scheduling: Aligns maintenance activities with predicted downtime.

Prescriptive Maintenance

Actionable Recommendations: Goes beyond predicting failures by providing specific.

Operational Efficiency: Integrates with operational systems to automate responses and improve overall equipment effectiveness.

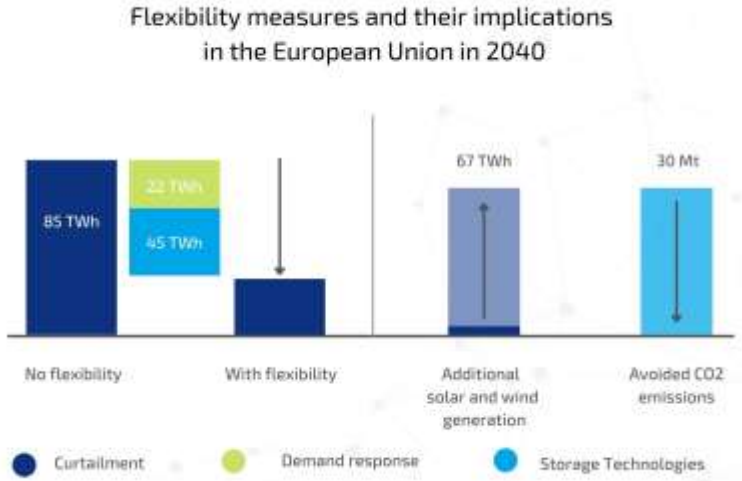
Continuous Improvement: Enables a feedback loop from the outcomes of prescribed actions.

Flexibility

Digitalization can help integrate variable renewables by enabling grids to better match energy demand

In the European Union

Increased **storage** and digitally-enabled **demand response** could reduce **curtailment** of solar photovoltaics (PV) and wind power from **7% to 1.6%** in 2040, avoiding 30 million tonnes of carbon dioxide emissions in 2040.



International Energy Agency (IEA). 2017. *Digitalization and Energy*

Generative AI

Preventive maintenance, data analytics, and asset management in renewable energy encompass a **comprehensive strategy** that employs regular maintenance schedules, interprets machine-generated data, and oversees asset performance to optimize energy production and extend equipment lifespan.

It covers the **entire scope** of asset performance in renewable energy operations, from the **proactive steps** taken to avoid equipment failures to the **intelligent use of data** to drive decisions and the holistic oversight of all asset-related activities.

Thanks!

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