What the Future Smart Electricity Grid Can Learn from Other Industries Using Digital Twinning

Surj Patel - Resonet Energy Systems / Patent Garden

Overview

- **Digital Twinning is a new methodology powered by AI and IoT** that allows companies to build utterly transformative products that previously would have been prohibitive or even impossible to undertake without AI and IoT
  - Jet Engines
  - Nuclear Processes
  - Refineries
  - Complex Automation
  - Cars
- The **Smart Grid** is *really* complex in aggregate behaviour. **Ideal Candidate.**

Computer Simulations

- Flight Simulators
- Racing Car Simulators
- Sim City
- Finite Element Modelling

- **The Data is STATIC** – It can only use the data it has at runtime

Understanding Digital Twins

- **Definition: A digital twin is a dynamic virtual model of a physical object or system, updated with real-time data.**
- Current Application Across Industries:
  - **Predictive** maintenance in manufacturing
  - **Personalized** medicine in healthcare
  - **Systems management** in aviation.
- AI is critical
- Resonet Power Transformers
- Patent Garden -ESS Battery Modelling (New Chemistry)

Benefits of Digital Twinning

- **Predictive Maintenance:**
  - Manufacturing uses digital twins for maintenance, suggesting less downtime for grid components and entire subsystems
- **Operational Efficiency:**
  - Logistics for supply chain optimization, hinting at better demand forecasting and resource allocation for the grid. (Amazon makes **16 Billion** routing decisions a DAY)
- **Innovation and Product Development:**
  - Automotive and aerospace industries underline the potential for innovation in grid management and renewable integration.

Current State of Smart Electricity Grids

- Challenges:
  - Demand management, renewable integration, and system reliability.
- Opportunities for Digital Twins
  - Twinning can offer solutions through **real-time monitoring, predictive analytics, and enhanced decision-making**.

Lessons from Other Industries

- **Manufacturing to Grid**
  - Manufacturing's predictive maintenance suggest similar applications for grid components.(Resonet)
  - Mercedes, Dassault PLM, Siemens
- **Logistics to Grid**
  - Apply supply chain optimization techniques for better energy distribution
    - Amazon, FedEx
- **Aviation to Grid**
  - Incorporate rigorous testing and simulation from aviation to improve grid safety and reliability.(Jet Engines, Support Systems)
  - GE Aviation,Dassault, Aerospatiale,

Implementing Digital Twinning in the Smart Grid

- **Integration with IoT**
  - Enhancing grid monitoring and control via IoT and digital twins.
  - CTA, IEEE etc.
- Data Analytics and AI
  - Improving grid management and forecasting.
  - Many Vendors
- Stakeholder Collaboration
  - Collaboration among tech providers, utilities, and regulators
  - DoE / NSF / FERC

Challenges and Considerations

- **Data Privacy and Security**
  - Robust data management and cybersecurity
  - Regulatory Environment
- **Investment and Infrastructure**
  - Requirements for adopting digital twins in the grid.
  - SBIR / DOE / Capstone / PostDoc
  - Investment **motivation for Giant Tech** – Look at the internet

Conclusion and Future Outlook

- **Transformative Potential**
  - Emphasize digital twinning's potential to revolutionize the smart grid.
- **Call to Action**
  - Research, development, and collaboration
    - **Agent Marketplaces and Twinning**

THANK YOU!:: **Surj Patel**

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