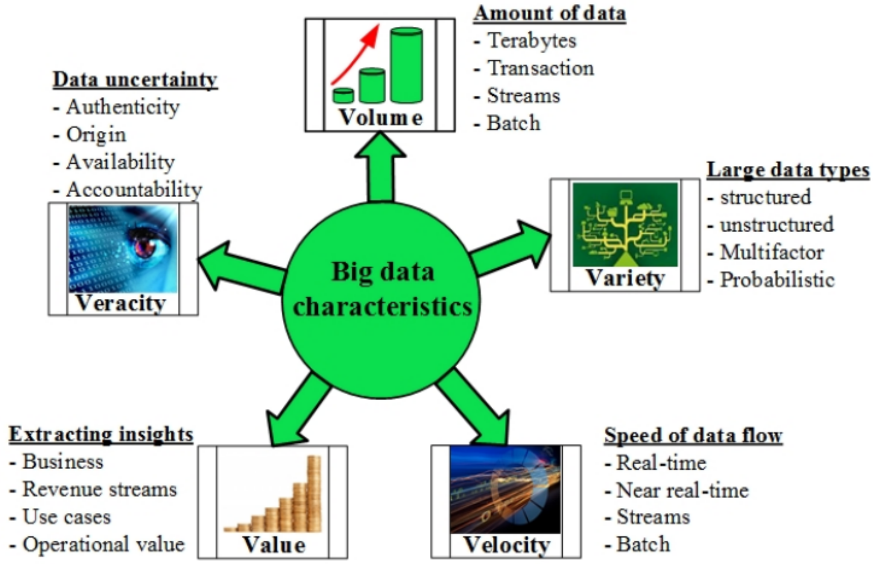
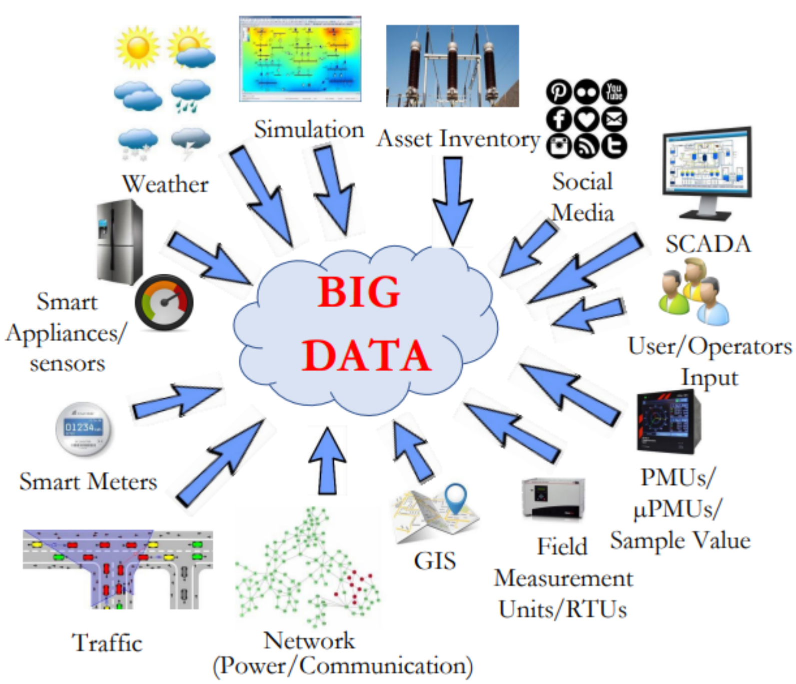
Smart Grid Data Analytics Opportunities



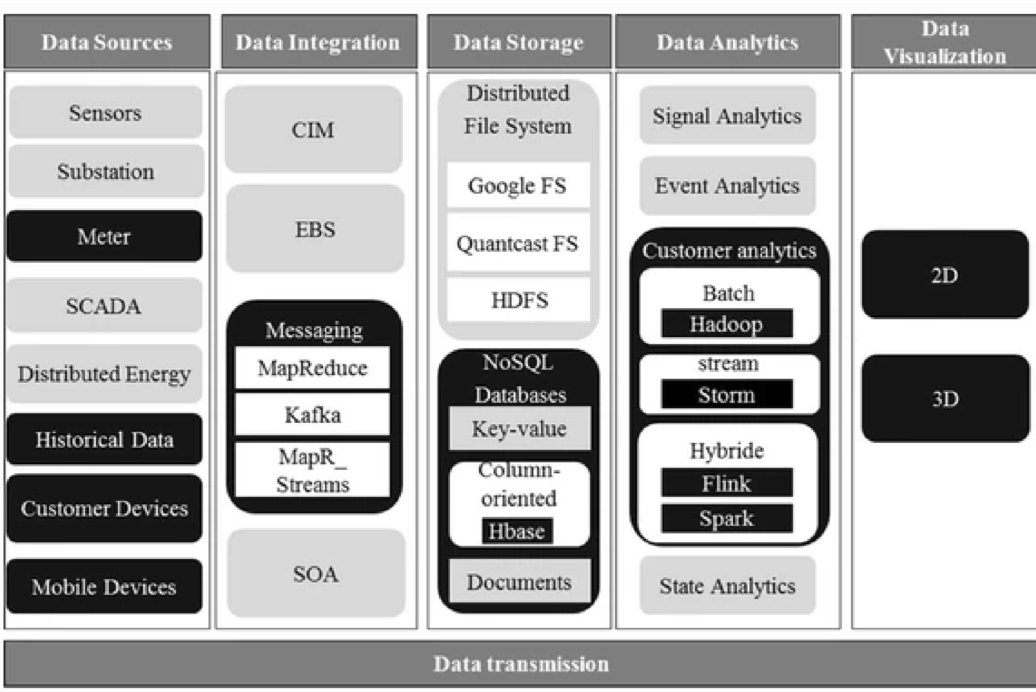
Conventional electric grids have limited measurement and control capabilities. A smart grid optimizes the generation, distribution, and consumption of electricity though shared information and communication technologies. Smart grid big data is characterized by high volume, wide varieties of structured and unstructured data, varying velocity from real-time upward, veracity inconsistencies such as redundancies and missing data, and varying values. It is necessary to process large volume and varieties of real-time and historical data to make meaningful data-driven decisions. Smart grid data analytics provide opportunities for efficient operation, controlling grid assets, distributed energy resources, end user energy consumption in real time, planning processes, and new business models.



There are various sources of smart grid data. Applications of that data include energy management, improved grid reliability and stability, real-time monitoring, planning, optimizing asset use, accuracy of crisis management decision-making (relying on real-time, large datasets), faster and more accurate information sharing.

A report from the Electric Advisory Committee of the US Department of Energy indicates, “The legacy EMS, ADMS, market management systems, asset management systems, and back-office systems are not designed with big data analytics requirements in mind. The cost recovery approach for updating such systems to accommodate big data and related analytics needs to rapidly evolve (e.g., capital vs. operations and maintenance expenses)." Challenges, issues, and potential solutions to applying big data analytics to smart grids:

Challenges	Issues	Potential Solution
Data volume	Need for increased storage & computing resources, flexibility scalability	Dimensionality reduction, parallel computing, edge computing, cloud computing, pay-per-use, distributed file system, NoSQl databases
Data availability	Need immediate and accurate access to data, distributed storage capacity	Redundancy & resilience in networks, servers, physical storage and storage systems parameters (storage nodes), batch, real-time, and hybrid processing tools
Data quality	Lack of complete information, misleading decision	Probabilistic and stochastic analysis, data cleaning
Security	Vulnerable to attack, compromise consumer privacy/integrity	Data anonymity, aggregation, encryption, compliance with platform requirements
Performance (latency)	Impact operational decision, errors in interpretation of data	Single transaction, synchronize devices
Indexing	Computational complexity and long processing time	Deploy new indexing techniques
Value proposition	Non-acceptance by stakeholder, delayed deployment of big data	Quantifying technical and economic values to key stakeholders (consumer, systems operator, utility)
Standards & regulations	Interface challenges among computing, storage, processing platforms, delayed deployment	Regulatory guidelines and standards for data sharing/exchange



"However, big data analytics is more than just data management; it is rather an operational integration of big data analytics into power system decision-making frameworks. Therefore, the key challenge of big data analytics is to turn a large volume of raw data into actionable information by effectively integrating into power system operational decision frameworks."
From IET, Big data analytics in smart grids: state-of-the-art, challenges, opportunities, and future directions.