Conference :-
Heat Rate Efficiency Summit 2023

Topic :
Digital Intelligence To Improve Performance of TPPs

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3RD HEAT RATE EFFICIENCY SUMMIT 2023

Digital Intelligence To Improve Performance of TPPs

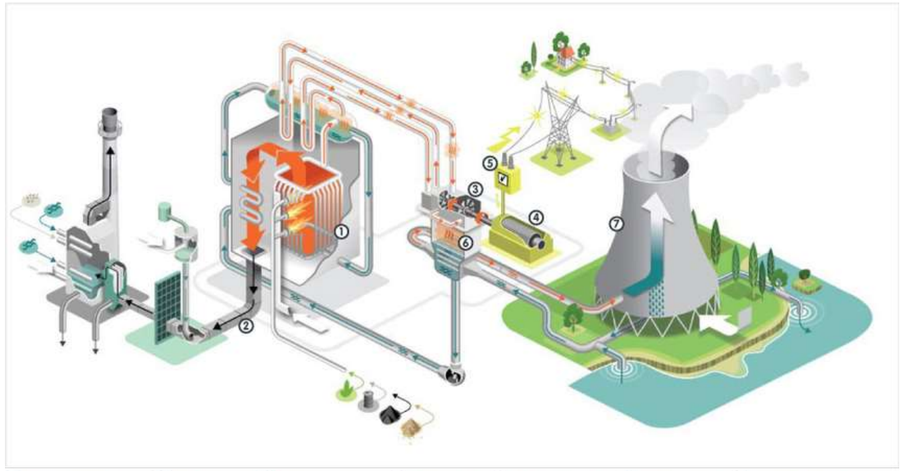
- Digitalization Of Thermal Power Plants

Digitalization, globalization, urbanization, demographics, and climate are the forces that are shaping our world – both currently and in the future.

Focus Points

- Need of Digitalization of TPPs
- Objectives , Benefits and Value
- Strategies of Adoption
- Challenges in adoption
- Conclusion

TPPs in Work Today …

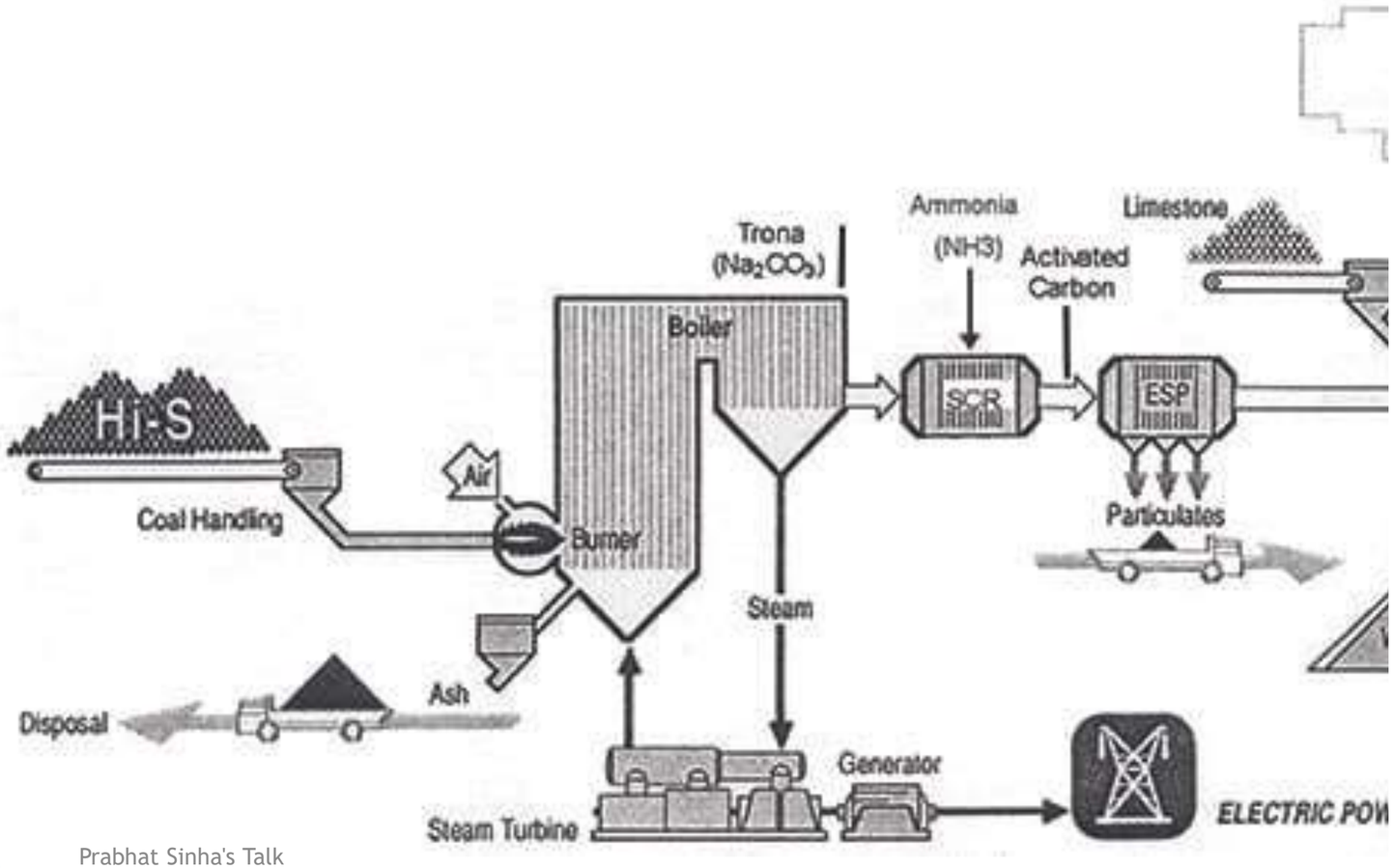


- Thermal power plants consist of large and complex equipment with Multiple Layer Of Decision Making

- Even with advanced control systems in place, monitoring, optimizing performance, and periodic maintenance of these equipment becomes challenging due to :
  - *Complex plant dynamics , Interconnected equipment with interacting operations*,
  - Variability in coal quality due to diverse sources and inadequate blending
  - *Flexibility to accommodate transient and sharp variations in power demand*
  - Gradual degradation and faults of equipment over time
  - *Tightening and evolving emission standards and safety regulations*

- There is considerable dependence on operator expertise for running the plants.
- Operators take decisions based on heuristics that often result in sub-optimal operation, leading to higher cost of operation and emissions.

TPPs In work Today …



Some Key Control Systems In Place :

- Distributed Control System
- BMS/FSSS
- ATRS

They have key functions to –

- Control
- Protect
- Interact
- Communicate

  In a close or Open loop within the given loops like Boiler , Turbine , CHP, Off Site etc

They have Limitations to interact and provide key information to operator in Totality , so manual dependences

Digitalization of TPPs – Need Of the Hour

TPPs and Power Sector is facing a Rapid transformation in its approach of business deliveries .

Drivers of change in the sector :

- rapid urbanization and industrialization
- addition of renewables,
- consumers becoming generator,
- climate Impacts
- flexible operation

Objective of Transformations are to deliver :

- Reliability,
- Affordability and
- Sustainability.
- pull down costs,
- improve efficiencies, and
- lower carbon output of a power plant

A paradigm shift for the industry is needed to embrace digital transformation of energy management and automation - enabling the emergence of a new landscape of energy,

Transformation Benefits

	From a traditional power plant . . .	. . . to a digital power plant
1. Operations	Focus on safe and reliable operation with major effort on manual work for reporting, issue resolution, and control walks	Real-time performance optimization during safe and stable operation—supported by automated reporting, guided issue resolution, and digitized control walks
2. Maintenance	World-class reliability based on engineering experience, OEM maintenance intervals, and diligent execution	World-class reliability and reduced planned-outage time and maintenance cost—using data analytics and digital process support
3. Energy efficiency	Heat-rate losses regularly analyzed by performance engineers based on manually created	Heat-rate losses and root causes visualized in real time, triggering immediate

Transformation For Performance Improvement

Sl No	Impact Area	Reasons	Improvement Potential	Digital
1	Station Heat rate reduction due to fluctuation in Coal GCV	Loss in Storage , Handling , Poor Blending	Coal Value Chain optimisation , Stock Pile Blending	AI, IoT based planning and real time corrections
2	Low vacuum in Summer and more than desired vacuum in winter (severe winter in this part of the country)	Problem in Condenser , High Steam flow, Low CW Flow , Tube Fouling ,	Integrated & continuous monitoring and evaluation of the weak areas in the value chain	-- DO-
3	100% auto loops	Existing System defunct?? Or bad design	Existing System Improvement	Automation, I Upgradation

Transformation For Performance Improvement

Sl No	Impact Area	Reasons	Improvement Potential	Digital
4	Mill Reliability improvement	Coal Quality , Maintenance approach	Predictive mtce , Performance Data collation	Automation, AI , Up-gradation
5	Reduction of TAT of Wagons by improving Belt utilization factor.	Manual Control , Reliabilty of value chain	Automated control , Upgradation of Controls , Realtime monitoring	-- DO -
6	Emission , Zero liquid discharge	System Integration missing , Poor Monitoring	Performance Data Collation , Automated Control	-- DO --

Drivers Of Digitalization in TPPs

Some Area of Opportunity	KPI
Operations will have no unplanned outage	• % Generation • % PLF
Auxiliary Power Consumption optimization for all assets	• % APC reduction
Boiler Tube leakages prevention	• %Availability
Water, Air and other critical resources monitoring, management & deviation handling for no surprises to power plant	• % Avalabilty
All power plant asset's reliability including electrical assets, grid fluctuation/monitoring, switchyard and other BOP assets with equipment's indexing and performance check.	• %Availability •
Root Cause Analysis methodology to be integrated with equipment's breakdown analysis and its effectiveness	• %Availability

Drivers Of Digitalization

Other Performance KPIs

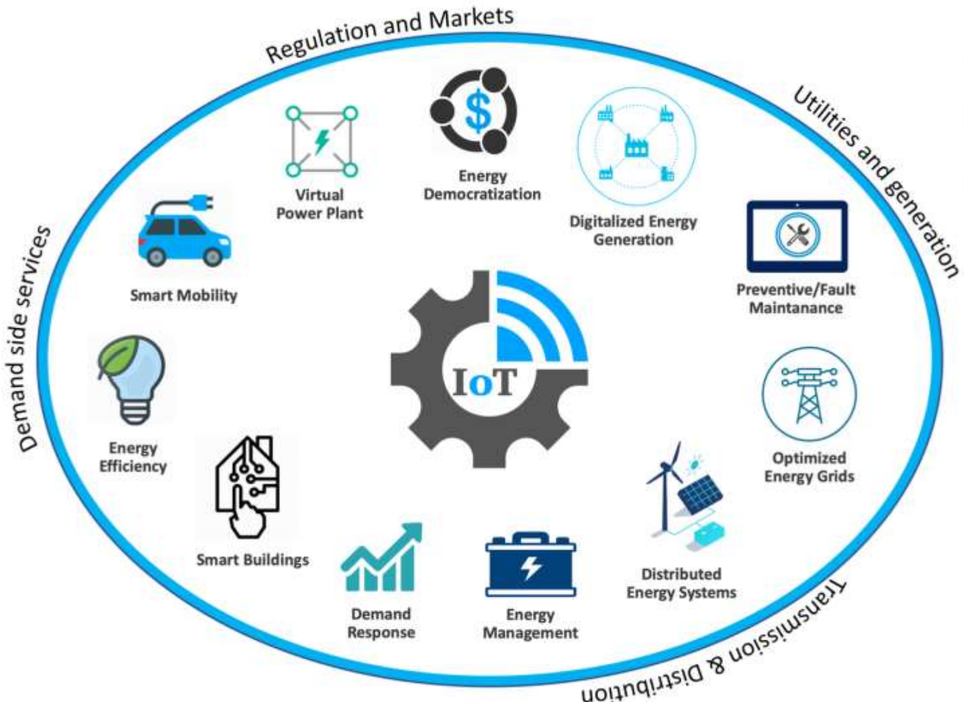
- Power Balancing & Forecast
- Water/ Compressed Air Consumption & balancing
- Auxiliary Power Consumption Opt.
- Coal Mill Efficiency
- ID Fan/ FD Fan Compressor Efficiency
- Boiler efficiency
- Condenser & Pumps efficiency

- Inventory Management
- Coal Quality
- NOx & SOx Opt.
- FMEA & RCA
- Shutdown Management
- Coal Yard Management
- Safety-Digital Interventions
- Predictive Maintenance / Asset optimization KPIs
- Ash generation & utilization /AHP

Digitalization Approach

Digitization in power plants fundamentally means combining technology such as -

- IoT (Internet of Things),
- AI (Artificial Intelligence)
- Machine Learning
- Big Data with advanced hardware
- Digital twins



- ***Internet of Things (IoT)*** describes the network of physical objects—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. These devices range from ordinary household objects to sophisticated industrial tools.
- The main purpose of IoT is to connect any device and object to the internet, allowing them to collect and share information, and to be remotely monitored and controlled.

Digitalization Approach

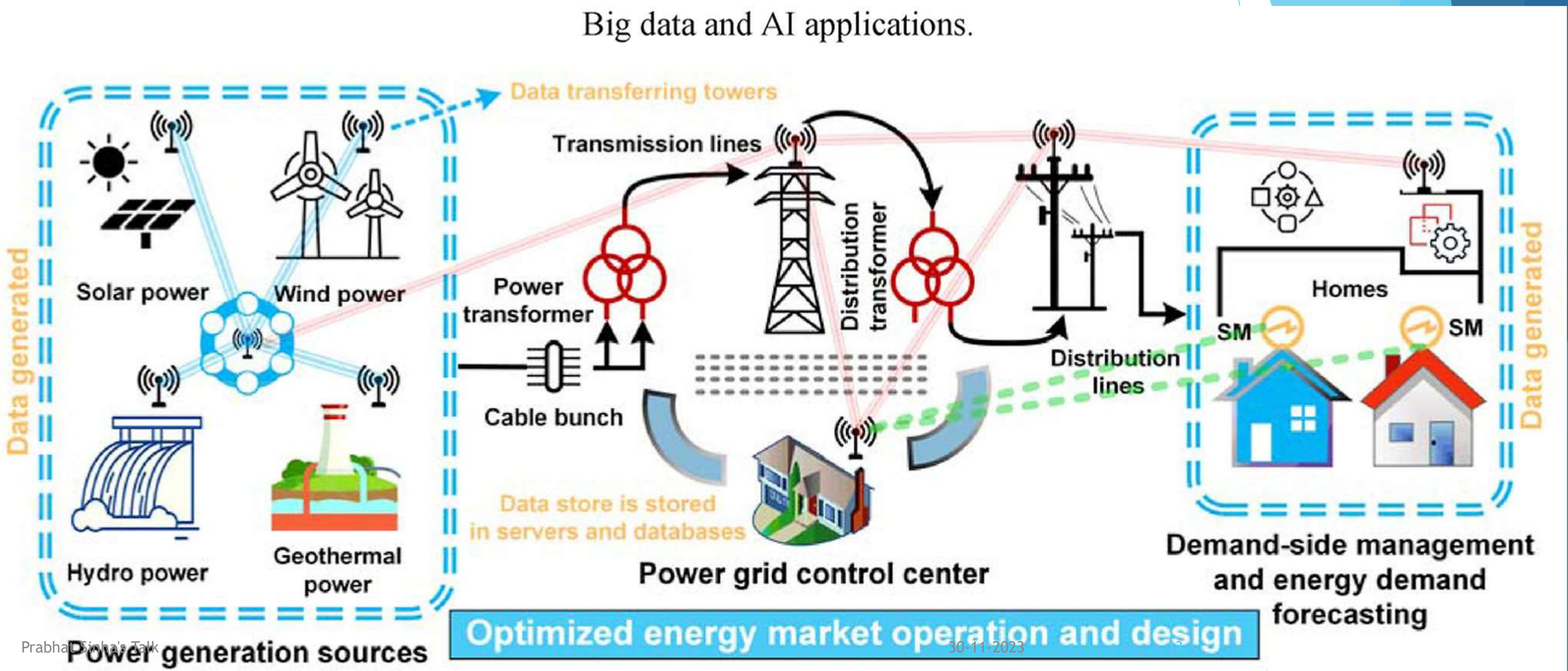
Internet of Things and Artificial Intelligence are two distinct concepts that complement each other.

- IoT devices provide the data for AI systems to analyze, learn from, and automate.
- While IoT focuses on connectivity and automation, AI focuses on analysis, interpretation, and decision-making.

Digital twins incorporates Big Data , Artificial Intelligence (AI), Machine Learning(ML) and Internet of Thing(IOT) which are also the main key and are predominantly used in the industry of IoT these days.

A ***Digital twin*** powered by thermodynamic analysis and machine learning allows power plant operators to diagnose performance gaps for every asset in the cycle in real-time and provides recommendations for improving performance

An Ideal Scenario with Digital Transformation ..



Application Of Digital twins

- In a coal inventory management, digital solutions can help reduce losses and spillage, along with determining the optimal blending ratio for the operator.
- Real-time monitoring of coal stocks can aid in forecasting probable shortages and offer suggestions for averting this scenario.
- In terms of power cycle chemistry monitoring and analysis, digitalisation can lead to a reduction in boiler tube and pressure part failures, lower maintenance costs due to unplanned shutdown, and optimised chemical dosing for variable operating conditions.

- A digital twin of the boiler can utilise the power of internet of things (IoT), AI and digital technologies to detect changes in the coal.
- Digital twins of boilers can reduce SO2 and NOx emissions and significantly cut coal consumption.
- A digital twin of a flue gas desulphurisation system can identify the optimal operating conditions required to maintain consistent SOx removal efficiency.
- The predictive maintenance module of the twin can prevent catastrophic failures through early fault detection and dynamic root cause analysis.

Digitalization Stand Alone Solutions

Digital solutions for ***condensers facilitate*** real-time monitoring of condenser key performance indicators (KPIs),

- Anomaly detection based on historical Behaviour
- Recognition of deviated parameters and identification of root causes.
- Early warning alerts,
- Prediction of condenser performance under different load conditions,
- Insights into factors influencing condenser performance, thus helping in planning any maintenance actions.

Digital solutions For ***Boiler modelling*** and performance optimization to address variable generation domain .

- To this end, provide insights into boiler operating conditions,
- predict boiler performance when using different qualities of coal,
- guide operators towards optimising boiler operation,
- Enable the evaluation and prediction of temperature profiles and heat absorption across each of the heating sections of the boiler.
- Evaluation and prediction of boiler performance under varying load conditions.

Challenges In Digitalization and Plans To Succeed

Strategic Approach to Succeed :

- Strong Alignment to Strategic Goals and Objectives
- Well defined Digital Transformation Strategies
- Deeper Understanding of Existing Landscape
- Proven Industry Value Engineering For Predictable Outcome
- Agile Solution Engineering Excellence Model
- Strong approach for Change Management Implementation

Conclusion

- TPPs area asset heavy entity with multiple layers of decision making happening in the entire value chain based on Manual , automated processes data input . Therefore, their best performance can be achieved when a holistic approach of the value chain processes are co ordinated

- Adoption Of Digitalisation will prove a major positive impact on Operational excellence , Productivity , Reliability , Safety , EBIDTA

  - However Digitalization also poses threat of Cyber Security which should be analyzed and protected

  - Adoption of Any Digital Solution Should be backed by Strategic approach

Thanks !!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