BIG DATA ANALYTICS FOSTERING ELECTRICAL POWER GRID TO ADD VALUES IN SMART CITY

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Abstract— *In today's world software development has been changed from traditional development to web based application, where web is the integral part of the software instead of just a communication channel. We are in era of "Internet of things" where data are in the fight we have to store and process these continuously coming data (data streaming) immediately else data will be wasted. Traditional database failed at certain point, its reaching its thrash hold value we required a technology to handle lots of data, that is nothing but big data. It's time to shifting the technology. In smart city, big data and analytics play the vital roles in most of area such smart grid, smart vehicle, health care, smart transportation etc. In this paper will emphasize, how bid data and analytics fostering electrical grid to make grid smarter (smart grid) and how the citizen of cities can extract the value from it , as of now lots of worked has been done , in this paper relevant work has been reviewed. In this paper will discuss how smart grid data (grid operation, smart metering and asset & workforce management) has been emerged with big data analytics and discussion extended up to benefits of smart grid from users and society view points.*

Keywords—*Big Data and analytics; smart grid; smart meter; Grid operation; Asset and workforce management*

I. INTRODUCTION

Unlike the traditional electrical power grid, Smart grid is two way communication system where electricity supply will be done from smart grid to consumer and usage details of consumer will send to the electricity provider in continuous fashion, in the smart grid consumer has more control over his electric usage, consumer may see real time electric usage through his smart grid online account. Smart grid is more reliable and sustainable, it's have the auto rerouting mechanism when any faults occurs anywhere in electric supply. After discussion about smart grid, types of big data analytics has been discussed, when smart grid is throwing the continuous data, data will be captured in big data format where variety of data will come in volume with different velocity and will be handled by the framework, once big data is available, data will be ready to use for big data analytics. Big data analytics will be applied and used to do prediction, prescription, diagnosis and description on the smart grid data (Grid operation, Smart Metering, Asset and Workforce management) to make the smart grid more efficient, reliable, sustainable and secured. Finally benefits of smart grid from customer and society viewpoints has been discussed which will give light on how smart grid will contribute to develop smart city.

II. BACKGROUND

WHAT IS SMART GRID

The definition defined by IEEE 802.15-09-0658-00 "an automated, widely distributed energy delivery network characterized by a two-way flow of electricity and information, capable of monitoring and responding to changes in everything from power plants to customer preferences to individual appliances [2]."

Electricity takes as for granted and imagination of life is not possible without it to keep it going we need more efficient way to manage the electricity, that is smart grid. Over one hundred years coal and other fossil fuels have been used for power plant to produce the electricity which we use every day. The grid used power lines and substation to carry electricity from power plant to homes and businesses.

Today grid has problems its needs updating, when power lines breaks or power plant can't produce enough power, black holes can occurs and that's the problem at the same time today's grids often relies on the single power source and does not provide details information on usage which makes electricity difficult to manage. To address these problems in past we simply build new power plants but now we can work on sustainability and reduce on dependability on fossil fuels by using a **smarter grid** [4].

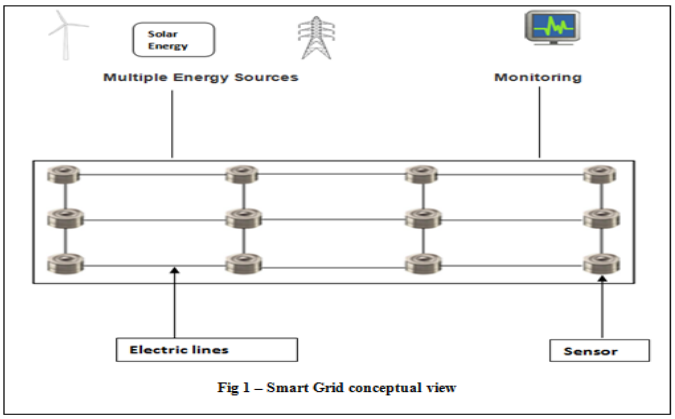

Fig 1 – Smart Grid conceptual view

Smart grids adding sensors and the software to the existing grids that will gives new and details information which will be monitor through the information based system and helps to understand and changes quickly.

With Smart Grid sensors and software detect the faults immediately and reroute the power around the problem [4].

A. TYPES OF BIG DATA ANALYTICS

There are four types of big data analytics [3].

i. **Prescriptive** – This type of analysis reveals what actions should be taken. This is the most valuable kind of analysis and usually results in rules and recommendations for next steps.

ii. **Predictive** – An analysis of likely scenarios of what might happen. The deliverables are usually a predictive forecast.

iii. **Diagnostic** – A look at past performance to determine what happened and why. The result of the analysis is often an analytic dashboard.

iv. **Descriptive** – What is happening now based on incoming data. To mine the analytics, you typically use a real-time dashboard and/or email reports.

III. EMERGENCE OF BIG DATA AND ANALYTICS IN SMART GRID

Big data and & analytics have emerged the followings in smart grid [5]:

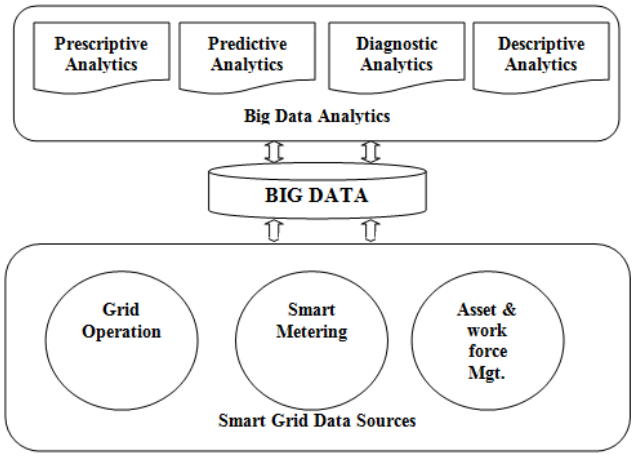

Fig 3: Conceptual view

A. GRID OPERATION

i. Predictive model will run by analyzing continuous data stream in real time.
ii. In response to demand, do the enhancement in the energy generation.
iii. Grid Status and performance will be monitored.

iv. Detailed analysis of grid loads and energy demand, affects of distributed generation resources.
v. Cleanse and validate data from multiple customer or outage management systems prior to loading in the warehouse.
vi. Strong real time, streaming data performance across distributed grid data.

B. SMART METERING

Big data and analytics capabilities drive real business value from smart metering data [5]:

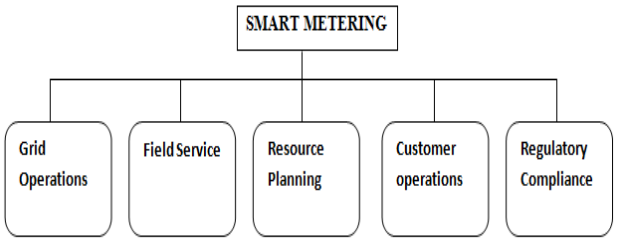

Fig 2 – Smart Metering

Grid Operations: outage & downtime should be reduced; Energy Loss and Theft / Fraud can be detected.
Field Service: Optimization of repair and maintenance.
Resource Planning: load can be forecasted and demand accuracy can be increased.
Customer operation/Services: Prefixed acceptance rates can be improved.
Regulatory Compliance: Regulatory Compliance will become more eefficient [5].

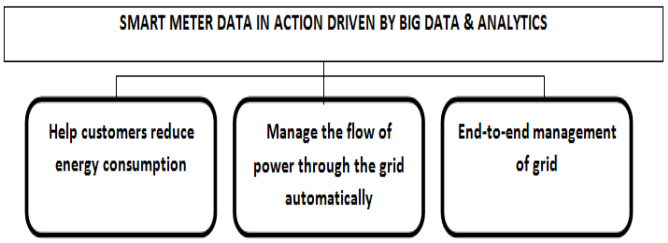

Fig.4 – Smart metering data in action

To simplify the Fig 4, few frequently asked question has been placed as follows:

FAQ 1: How a customers can get more control over their energy use?

Ans.: Help customers reduce energy consumption: use smart meter data for a customer web portal, where customer can access their personalized information and learn how much electricity he/she requires.

FAQ 2: How can I manage the load capacity of the grid without relying on manual calculation?

Ans.: Manage the flow of power through the grid

automatically: Data will be acquired and analyzed from smart grid to represent diverse weather & demographics

FAQ 3: How can I use smart meter data to reduce energy consumption?

Ans.: End-to-end management of grid: Implement smart meter infrastructure that provides real-time, integrated view of the grid [5].

C. ASSET AND WORKFORCE MANAGEMENT

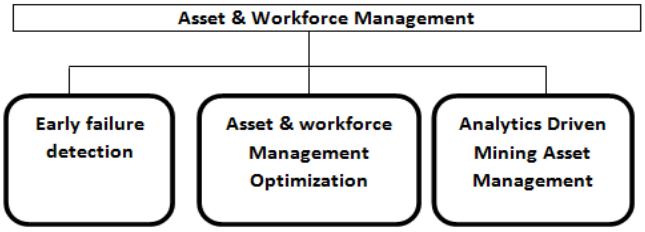

Fig 5 – Asset & Workforce Management

To simplify the Fig 5, few frequently asked question has been placed as follows:

FAQ 1: How do I reduce unscheduled maintenance cost?

Ans.: Do early failure detection: used text mining methods for extracting insights from unstructured sources e.g. identify 11 months early warning of production and supplier issue**.**

FAQ 2: How do I measure the risk of failure and optimize repair / replacement work?

Ans.: Apply Asset & workforce management optimization: use advanced analytics to identify potential problems based on location, time, and weather and maintenance history e.g. 20-40% savings on selected inspection and preventive maintenance [5].

FAQ 3: How can I minimize down time related to asset maintenance?

Ans.: Do Analytics driven mining asset management: Apply analytics on data from mining devices, weather; operational routine and price to evaluate asset health e.g. reduce 20 days failure probability to less than 2 % [5].

IV BENEFITS OF SMART GRID

A. SMART GRID BENEFITS FROM USERS VIEWPOINT:

Users can have the benefits by enabling smart meter tools such as 1.track energy use by day, by the hour. 2. Energy alerts; get notified by email, text messages or phone when your electric use moving towards a higher cost tier. 3. More choices in pricing plans learn about your rate options that could help you control your energy use and expenses [6].

B. SMART GRID BENEFITS FROM SOCIETY VIEWPOINT [7]:

Improve Reliability: Decrease in cost finally help keeping the prices of goods and services lesser than they would be otherwise.

- Virtual removal of blackouts.
- Improved infrastructure can increases economic development.

Economical viewpoint:

- A more strong transmission grid will put up larger rises in wind and solar generation i.e. green energy.
- Downward burden on prices — through improved operating and market efficiencies
- Creation of new electricity markets — enabling society to offer its electricity resources to the market and creating the opportunity to earn a revenue stream on such investments as demand response, distributed generation, and storage.

Efficiency viewpoint:

- Delay of capital investments as future highest loads are reduced and more precisely forecasted through the combined efforts of consumers and delivery companies
- Reduced consumption of KWh's through conservation, demand response, and reduced communication and supply (T&D) losses

Environmental viewpoint:

- Reduced Carbon di oxide emissions
- Enhanced public health

V. CONCLUSION

Information and Communication Technology has been reshaped most of the engineering discipline, smart grid is one of the them, in this area, there are lot of scope for the big data analytics engineers, researchers to do the enhancement specially in the smart grid quality attributes (Non Functional Requirement) such as the performance, reliability, efficiency, and security. Smart grid is very young area to work as of now in most of the countries including India are using traditional electrical power grid

which need to upgrade with smart grid technology to make each city of the world, smarter. Consumer can get more control over the electricity usage; which will be more reliable and cost effective.

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