Asset Management & Industrial Internet of Things

ABSTRACT

Asset management system comprises of a class of hardware and software applications used in process plants for optimum and efficient utilisation of the equipment. With the evolution of the digital control systems, the capabilities have enhanced multi-fold thereby creating opportunities to perform tasks in servers and standalone processing devices. Industry 4.0 has synergised the technologies of big data, Internet and Artificial Intelligence, thereby making asset management tasks easier.

INTRODUCTION

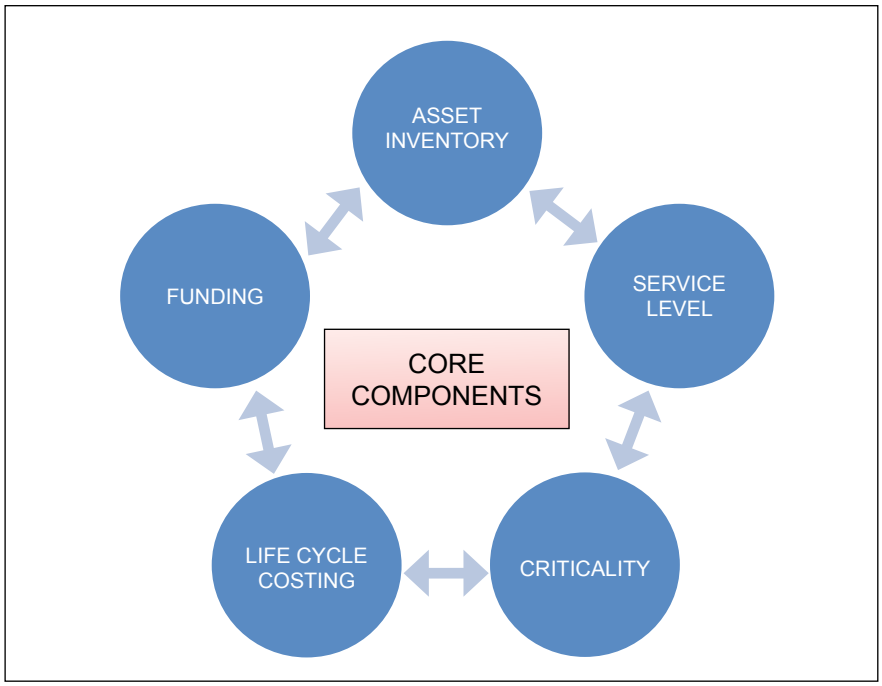
Asset management is a systematic approach in the governance of both the tangible & intangible assets throughout their lifecycle. It is a methodology of developing, operating, maintaining, upgrading and disposing of assets that can manage the risk of failure and consequently can reduce the additional costs or loss of production.

Asset management in the engineering environment refers to the monitoring and maintaining of equipment with the intent of finding the best service to the users to manage them better and utilise them effectively. Through asset management the operating costs and downtime of equipment can be significantly reduced, contributing towards increased reliability, improved plant life and reduced maintenance costs.

Components of asset management system

To evaluate whether implementing an asset management system is worth the exercise, it is necessary to understand the five core components of the asset management system.

- Asset inventory: A clear understanding of the system in terms of assets, the current state of all the existing assets, i.e., remaining life, their value and the replacement costs of the assets.



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- Service Level: An understanding of the system's performance goals, i.e., quality, quantity, reliability etc., for developing and sustaining service requirements.

- Criticality: An understanding of the risk of failure of the assets and its effect on the system. Need to know the probability of failure, consequences of failure & the backup plan to prevent system failure, which might affect the safety of the system and personnel and hence lead to major expenses.

- Lifecycle costing: An understanding of the life expectancy, operations & maintenance (O&M), cost to replace, when to repair and rehabilitate the assets of the system. The system is profitable when low cost assets provide the best level of service.

- Long term funding: An understanding of the funds for O&M, money for asset replacement. An effective asset management system is to take smart financial decisions to meet goals for maintaining revenues while minimising expenses.

Control system asset performance

With reference to the Control system, the assets inventory are physical assets such as field instruments, I/P's, valves, actuators, positioners, VFD's, panel, DCS/PLC system including controllers, HMI, Historians, I/O, wiring, etc. Also there are assets such as soft-

ware, engineering and configuration, which help the hardware to control the process in the plant. Knowledge of the process and the process itself are assets. To put the assets into its best use, an asset management system is required. Asset management is a system-of-record, documenting and managing work orders for each maintenance event across an asset's lifecycle.

An Asset Performance Management (APM) solution is more of a system-of-decisions, providing continuous insights to optimize asset performance and reliability.

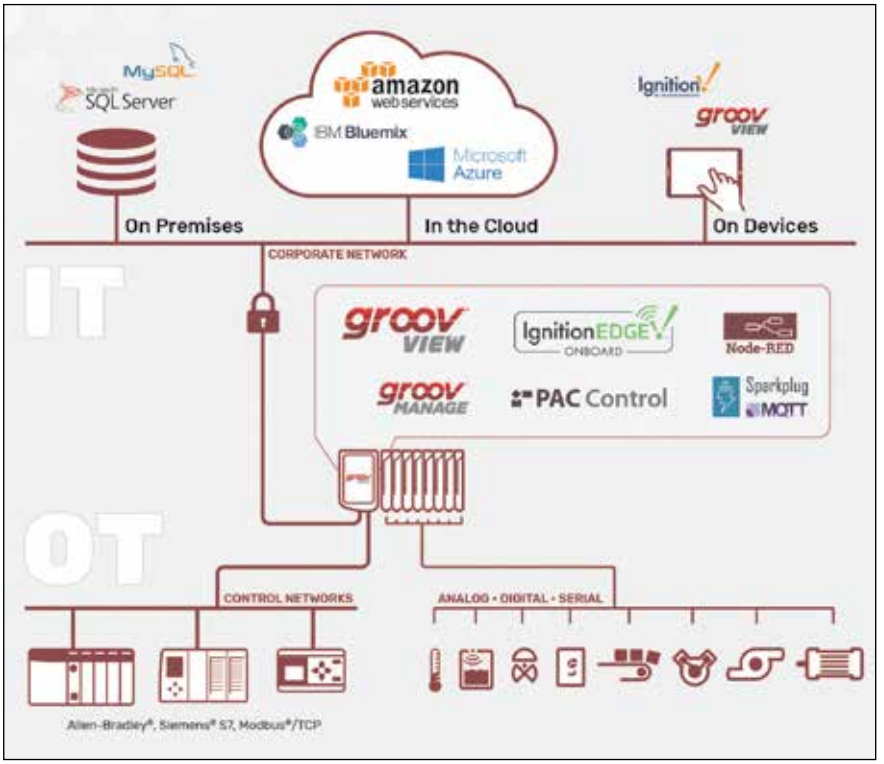
Industrial organisations invest in an APM solution to reduce unplanned downtime, increase availability of assets, minimise the maintenance costs, and reduce the risk of failure for critical and non-critical assets.

Control system Asset performance management should check for the following:

- Whether the control loops are operating in Auto/Manual mode. Operation of the loops in Auto mode will ensure better throughput.
- Condition monitoring of the rotating equipment by providing appropriate sensors. This will reduce the unplanned downtime by preventive maintenance.
- Monitoring of alarms and necessary corrective action to reduce the risk of failure.
- Performance of the process.

Real-time asset performance needs to be improved by analysing each of the above criteria to achieve considerable gains in production, quality, efficiency and cost. Asset criticality is to prioritise the risk of failure of a high cost asset.

Benefits of real time APM vary from one plant to another, depending on the condition of the plant at start.



Though all plants can expect some gain in performance, plants that are in the worst initial condition gain the most. Improvement in performance is measured by:

- Enhancement in production;
- Reduction in operating costs;
- Reliability improvement;
- Quality improvement; and
- Reduced safety/environmental Risk.

The condition of the plant can be predicted based on the long time data logging and analysis of the same. The sequence of tasks performed for predictive maintenance comprises of symptoms picked by the sensor near the equipment in the plant. It continues through the detection phase to identify the problem and its effect on the plant performance.

A prognosis is generated to assist the decision-making process to correct the problem with as minimum resources as possible.

With increase in use of microprocessor-based smart instruments with digital communication protocols such as HART, Foundation Fieldbus, Profibus etc. Asset Management has become increasingly common in all process plants. There is a change in the way sensor information is now gathered by direct digital interface with the control system. The new digital systems use software tracking to manage all the assets. Decision-making models are referred to as Computerized Maintenance Management Systems (CMMS). When using Artificial Intelligence (AI) to determine the algorithm for decision making, it is important to have adequate knowledge of the asset condition, performance risk, cost and their interrelationship, without which there can be errors. Implementation of AI will lead to continuous improvement process with updated and larger data collected. In order to have this data accessible from anywhere and anytime, cloud based solutions are emerging.

AI software acts a Virtual Scientist. This AI software comprises of predictive algorithms & retraining models, which work on structured or semi-structured data in any format. Use of smart sensors has expanded the available data. enabling or increasing the opportunity to derive benefit from predictive maintenance and asset monitoring.

Implementation of Industrial Internet of Things (IIoT) through utilisation of smart sensor data, machine-to-machine communication, machine learning using AI & Big Data, and automation technologies has brought about a digital transformation in the industry.

Asset Management & IIoT

Due to the surge in availability of low cost sensors, economical network connectivity, scalable cloud platforms and storage facilities of large amount of data and machine learning tools, IIoT is becoming one of the common industrial solutions for Asset Management.

Asset Management with IIoT can be implemented in an existing plant or a new plant. It consists of a platform that collects data from different sensors – be it a low volume or high volume data – coming in bursts or in continuous streams, will be stored in one place where analytics & intelligent solutions can be applied to trigger action. The platform consists of a host of services for computing, storage and application development.

All the data from the field/plant/industry is stored in the Cloud where the decision-making takes place after being processed and analysed. Only the critical and essential data required for Asset Management will be uploaded to the Cloud since humungous volume of data will be difficult to handle and process. The remaining data will be processed in the local system.

Hence there was a need felt for innovative decisions in order to reduce the network latency. Edge processing is one such technique wherein major processing can happen in the local system and periodically can be uploaded to the Cloud for analysis on the major parameters for Asset Management. The edge engine will execute processing, filtering and routing within Edge gateways and devices. It will complement the Cloud processing capabilities of the software, thus reducing the traffic. Edge Processing can be implemented to avoid large junks of data getting on to the Cloud.

Edge Computing, as opposed to Cloud Computing, makes use of decentralised server resources that are in close proximity to the devices generating data. This is the so-called edge of the network. This approach has big advantages for certain applications, specifically those in which real-time processing requirements necessitate a low latency.

The essential components of IIoT

Hardware

Attaching a sensor to an asset enhances the ability to capture data and provide remote service monitoring frameworks. The sensors equipped on to the asset helps in enhancing the service and reliability of the assets. The intelligence levels and data granularity of these sensors continues to grow. This is an important aspect of industrial hardware.

Networking

With increasing number of wired/wireless networks, the inter-connected ecosystem offers a very sophisticated way of relaying data from 'Smart' sensors for asset management.

Data Management

For Asset Management system, acquisition of data is too frequent and all the data is not relevant. Unless the data is summarized and conditioned, it will never make sense to what the Asset Management is looking for. Big Data and memory databases can be used to more easily store, share, and act on information quickly, thus improving overall asset management.

Intelligence and Analytics

There are a number of tools available to analyse ever-increasing amounts of unstructured data, enabling manufacturers to generate insights across every aspect of production and to optimise the asset performance. No single tool can address different intelligent and logical requirements. Diverse platforms both proprietary & open source are available. There is a clear desire to increase the use of open source technology. However, the impetus to move the organisation forward through innovation & modernisation is balanced by the desire to improve security measures to protect the business.

Challenges faced

Security

The communication pathway, data capturing & storage need to be safeguarded from being hacked. Compliance & governance policies need to be in place and frequent security testing needs to be planned. The IIoT architecture consists of many heterogeneous networks connecting devices & things via open or proprietary protocols. Security of the network is related to its bandwidth, sensor power supply & processing. Hence data should be encrypted with a unique authentication key.

Interoperability

The IIoT connected networks include a number of hardware devices such as sensors, controllers, gateways, communication protocols, analy-

tical tools and data management platforms, all of which need to be in communication seamlessly. This involves a complex interchange of technologies.

Benefits of Asset Management System in industrial plants

In the traditional method human intervention was required for performing iterations of the data available to analyse and perform actions, which might lead to excessive or reactive results on the asset. The IIoT facilitates automation. All the iterations and mundane tasks could be automated, thereby increasing the accuracy of the actions taken on the assets and consequently leading to process efficiency and reduced cost.

With the increase in automation the requirement of resources is reducing. As a result, skilled personnel can be utilised effectively because routine activities such as analysis, diagnostics, prioritization etc. are performed by the Asset Management software.

Asset performance can give its maximum benefits if it is utilized to its full extent. A typical example is a pump whose flow rate is generally monitored for process control purposes. The shaft vibration levels, bearing temperatures and drive motor currents might be required to understand the condition of the pump and thereby take an action for maintenance. Thus integrating the sensors to measure the same enables to collect the data and connect it to the Internet via Cloud-based IIoT account, which will be useful to take a decision well ahead.

Machine learning and other advanced intelligence help in making real-time decision by providing innovative solutions as against the traditional methods, which posed many challenges over the years.

By predictive maintenance, asset management helps in faster response time for maintenance of the equipment in order to extend its life. Due to the benefits of Asset Management, the unplanned downtime of the equipment is reduced and the expected Return on Investment (ROI) is quicker.

Asset Management analytics help in reducing energy consumption and CO_2 emissions due to the timely operation & maintenance of the plant equipment. This is achieved by diagnostic tools, which will monitor, diagnose and visualize the health of the plant.

As a number of smart sensors are hooked up to the asset, more data, control and hence a better insight of the asset is sought, which helps the company take better decisions. The asset, which was seen as a burden before to the company, can now bring in more revenues to the company.

CONCLUSION

Application of IIoT brought about the digital transformation, making it Industry 4.0 compatible. Thus 'Smart Asset Management' is the concept of the new generation enabling asset owners to manage and maintain their plant, facilities, and equipment in a much more efficient manner.

The biggest challenge is for existing clients who want to implement Asset Management in their plant, but have already invested in conventional sensors, SCADA systems, PLC & other technology and are reluctant to replace the existing infrastructure. In such plants, additional sensors, wherever required, shall be installed to collect the data in addition to the existing data as required for the analytics. All this data can be exported to a single platform for decision-making.

Success in Asset Management is achieved by having an appropriate diagnostic tool & software to identify and diagnose the problem. The Asset Management software, also known as an Asset Management tool, comprises of application software, which can record & track the asset throughout its lifecycle from procurement to disposal. It deals with the predictive maintenance & remaining life assessment by monitoring the plant equipment. This has brought about a revolution in the plant and asset reliability & uptime, thus making it possible to predict the future condition of the assets before they fail.

REFERENCES

1. Control System Asset Performance in Oil Refineries, 2007 George Buckbee, P.E., ExperTune, Inc.
2. http://www.isa.org/FileStore/Intech/WhitePaper/WPAsset-Perf2011.pdf. How to improve performance of process control assets, 2011 George Buckbee, P.E. ExperTune, Inc.
3. https://www.rapidvaluesolutions.com/whitepapers/reimagining-asset-management-with-iot.html.
4. Plant services – *Newsletter* May 2018.
5. Asset management, from Wikipedia, the free encyclopedia.