Asset Management

Machine learning & Digital Twin!

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According to ISO 55000 (International Standard), an **asset** is defined as an item thing or entity that has potential or actual value to an organization, and **asset management** is defined as a coordinated activity of an organization to realize value from assets.

The asset management & maintenance activities receive significant importance due to the high potential consequences involved in terms of cost, risk and safety of personnel, environment, and reputation.

Significant time and effort are invested in improving asset operations by optimizing the reliability and availability, reducing the operation and maintenance costs and by adopting digitalization to improve decision-making.

The Institute of Asset Management (IAM)'s conceptual model on asset management states there are six subject groups, namely strategy and planning, asset management decision-making, life cycle delivery, asset information, organization and people and risk and review. The assets are classified into physical, financial, human, information and intangible assets, Examples of physical assets include equipment, systems, components and plants in the process, mining, chemical and oil and gas industries.

Asset management, it cannot be done without Reliability Engineering.

Reliability Engineering. Reliability is defined as the probability that an asset, equipment or a component will not fail over a specified time interval. The equipment failures over time may be best represented by different probability distribution functions and various statistical inference techniques such as maximum likelihood estimation. Statistical methods are used to identify the best-fit probability distribution function from the historical failure data.

Reliability, Availability and Maintainability (RAM) studies, Operational availability may be defined as the fraction of total time that the equipment is functioning, and the maintainability is defined as the probability that a component or a piece of equipment is being maintained over a specified time interval (Ease of Maintenance). The key performance metrics of RAM studies are mean time to failure and mean time to repair which are derived from the probability distribution functions of failure history and repair time of the equipment.

A Reliability Block Diagram (RBD) may be first modelled & simulated over the life cycle to quantity determine the system availability.

Reliability-Centered Maintenance (RCM) technique helps to determine the maintenance strategies of the equipment by considering their functions, functional failures within their operating context, followed by the selection of tasks (according to an algorithm) to prevent or mitigate the consequences. A criticality analysis of each failure mode may also be performed, as a part of the RCM studies.

Improving Asset reliability is the core subject of interest for reliability engineers and maintenance professionals.

Seven factors if existed, an asset reliability can be improved at the design, Operation, and maintenance phases.

1. Improve data and quality.
2. Rank assets according to criticality.
3. Improve the effectiveness of maintenance work.
4. Develop metrics that track reliability.
5. Increase equipment redundancy.
6. Improve skills & on job training of Asset operator.
7. Improve Reliability culture.

Machine Learning is widely used in asset maintenance and management owing to the Fourth Industrial Revolution Maintenance 4.0 and availability of big data that are interconnected. It is a very efficient tool in processing huge amounts of data and identifying patterns and classifying them to understand the asset better and to facilitate proper management of assets.

The dataset is used as an input to the computer as a prior experience and the computer is trained to learn the patterns of the dataset to give a 'trained model'. This will aid in predicting the likely pattern of a new dataset when presented to the trained model.

This can uncover the hidden patterns of the new dataset, which would improve the decision-making and optimize the asset operations and availability.

Digital Twin is an application of the machine learning in asset management include the development and predictive analytics for fault diagnostics and anomaly detection to monitor the health of the equipment.

There are several Methods model fault detection and reliability prediction systems considering all type of data for industrial equipment such as pumps, bearing, gearbox, air compressors, steam turbines, gas turbines etc.

The concept of digital twin first proposed was by NASA in the aerospace industry in 1969, with the term 'digital twin' coined by Michael Grieves in 2002. The technology has gained popularity over the recent years in the energy sector for asset management and is being mentioned as a promising technique in Industry 4.0, complete with different operating contexts, and may be simulated over numerous scenarios to arrive at a decision on asset management.

The data from the physical asset are linked to the digital twin platform to continuously update the digital twin models to complement the physical entities. The digital twin models may be a combination of statistically derived models and artificial intelligence techniques.

The main advantages of using a digital twin includes improving the decision processes for operation and maintenance of the assets, predicting the asset behavior and equipment failures over the life cycle of assets, and simulating over any phase of the life cycle of the asset to determine the total cost of ownership and to optimize the reliability, availability, and maintainability of the assets.