Gain New Insights and Optimize Your Assets with Real-Time Engineering Analysis
Real-time engineering insight into your asset

During the design process of industrial assets and structures, the structural analysis of stresses and strains is crucial. Potential load cases and safety factors are analyzed to optimize the design of the construction and these are relied upon for the life of the asset or structure.

The load cases that are used during the design stage of an asset are often based on assumptions that don’t necessarily represent the final working environment of that asset.

Nevertheless, the asset is built based on those assumptions and put to work. As a result, conservative recommendations on inspection and maintenance intervals as well and operational limitations are often made. Rationalizing those limitations represents an opportunity for savings in operations and maintenance.

With the help of the Internet of Things (IoT) and the advanced engineering analysis of the SAP® Predictive Engineering Insights solution you can assess the actual performance of the asset in operation. This enables a transition from manual inspection to continuous digital inspections, the move from interval based maintenance to predictive maintenance, and possibly an uprating of the asset operational limit parameters.
Advanced engineering expertise meets the Internet of Things

SAP Predictive Engineering Insights combines advanced physics-based engineering simulation with big data based IoT technologies in a new way. A digital twin of the asset is created, which includes a representation of its design, physical properties, and control systems, to create an accurate finite element model.

Feeds from sensors are then fed into the digital twin to create an exact picture of the loads and vibrations acting on the asset as well as its response to these stimuli. The stresses and strains acting on the asset can be calculated in great detail and hot spots identified.

Monitoring change in frequency patterns gives further insights about the real behavior and structural integrity. This enables the solution to give you valuable feedback about the fatigue usage, remaining lifetime of the asset and emerging maintenance requirements. If there’s a need for manual inspection, maintenance personnel will know where to focus their efforts. Changes in behavior patterns are also recognized to warn of imminent potential failures or changed external conditions.

Assets are digitalized using simulation models to produce a virtual state of the asset that is as close as possible to real conditions and behaviors.

Advanced engineering expertise meets the Internet of Things

A versatile tool for monitoring structures and machines

A machine has a fingerprint - see it with vibration analysis

Teaching machine learning algorithms

Insight includes foresight and hindsight

Creating value through integration
A versatile tool for monitoring structures and machines

The engineering analysis framework used in SAP Predictive Engineering Insights is called Finite Element Dynamics in Elastic Mechanisms (FEDEM). It’s versatile and quick and can be used to model, and so monitor, static and flexible structures and moving machinery, including:

- Wind turbines (onshore/offshore, foundations, tower sections, nacelle, drivetrain)
- Infrastructure (bridges, towers, and suspended structures)
- Utilities (pipelines, power generators)
- O&G (wellheads, pumpjacks)
- Heavy machinery (cranes)
- Robotics

Access to this sort of monitoring means that owners and asset operators can analyze operational engineering trends to minimize unplanned downtime. By better understanding defect and failure patterns, you can manage risk and maintenance operations.

Service providers can expand offerings and deliver standard and add-on services more quickly and efficiently. Asset manufacturers can identify design issues, lower warranty costs, predict recalls, and create innovative aftermarket business models.

Effective monitoring of assets can **lower costs, increase efficiency and improve management.**

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SAP Predictive Engineering Insights includes vibration analysis capabilities that you can use to identify the unique vibration signature of your asset: its fingerprint. Under similar conditions, that vibration pattern of the asset should remain the same.

If you notice a short-term or long-term change in the vibration pattern it’s usually a sign of changed behavior such as:

- Wear and tear
- Cracks or yielding
- Lubrication failures
- Changed boundary conditions such as erosion or water saturation of the ground
- External events
- Overloading

These changes can serve as indicators and early warnings of failure. Armed with this information, the asset operator can proactively schedule maintenance at the optimal time.

Vibration sensors placed at strategic locations on the asset will continuously monitor its behavior and create a fingerprint for that asset.
Teaching machine learning algorithms

Machine learning algorithms use large volumes of time series sensor data to establish a baseline and determine what is normal and abnormal behavior for the asset. Very often the algorithms will recognize patterns which might not be noticed by human operators and can warn about imminent failures or events.

The strength of big data analysis is, at the same time, one of the shortcomings of machine learning. The need for large historical data streams means that it takes time before it is operational with sufficient accuracy. In cases where a particular event is fairly rare, this may take years.

By using the model-based analysis provided by SAP Predictive Engineering Insights, you can simulate and generate time series data in advance, which can in turn be consumed by machine learning algorithms even before the asset is installed. The most prominent failure modes can also be simulated in order to supply the machine learning model with a sufficient amount of data for it to be operational from a very early stage. The solution is, in effect, pre-training the machine learning algorithms.

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SAP Predictive Engineering Insights can teach and improve your machine learning algorithms.
Insight includes foresight and hindsight

The continuous condition monitoring of SAP Predictive Engineering Insights gives you a complete load history of an asset. If an undesired event occurs, you can replay the event and see the exact consequences using the same kind of calculations used during the design of that asset. This can help you to assess if the event was within the design envelope or if you need to take corrective measures.

The effect of these corrective measures or other control inputs can be analyzed and optimized with SAP Predictive Engineering Insights before you initiate them. Using feeds from other data sources, such as weather or market information, the trade-off between wear and tear and profit can be optimized and shown with a high-performance 3D visualization.

With these insights at hand you can plan maintenance operations according to when they would have the lowest impact on your operational efficiency.

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Creating value through integration

To optimize maintenance and service processes, SAP Predictive Engineering Insights integrates with SAP Predictive Maintenance and Service and SAP Asset Intelligence Network, supporting end-to-end IoT based asset management scenarios, from insights to action.

The out-of-the-box integration with SAP Enterprise Asset Management (for example, plant maintenance) means you can fully integrate operational data with your business information systems. Once a critical situation arises you can trigger service notifications.

Authorized business partners can access critical alerts, engineering insights and sensor data through SAP Asset Intelligence Network to provide maintenance services on behalf of asset manufacturers or operators. In any business model for maintenance and service, integrating business and operational data can improve asset performance and shrink maintenance, service, and warranty costs.

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SAP Predictive Engineering Insights integrates seamlessly with other SAP solutions to create even greater value.
Real-time analysis in action

SAP Predictive Engineering Insights provides historic usage which you can use to predict asset health and remaining lifetime. This gives insight into parts of a machine or structure which are usually hidden or inaccessible. Expensive production stops for inspections can be avoided and the operational envelope of the asset can be expanded.

Design assumptions can be verified and the effect of potential modifications or changed operational parameters can be assessed early.

With integrated end-to-end processes, you can pass requests to core business applications for creating maintenance notifications.

A closed-loop engineering process enables equipment manufacturers to optimize and fine-tune designs according the real-world performance of assets and constructions. By integrating quality management deeply into R&D and production, manufacturers can minimize recalls, repairs, and establish processes for continuous product and service improvement.

SAP Predictive Engineering Insights helps you **monitor assets and inspect them digitally** instead of manually, reducing cost, and increasing safety.
Summary
SAP Predictive Engineering Insights digitalizes industrial assets, using engineering simulation models, to produce a virtual state that is as close as possible to the real, physical environment and behavior of the asset. From there it can see and predict problems before they arise.

Objectives
With the help of IoT technology and SAP’s advanced engineering analysis you can assess the actual performance and behavior of the complete asset in its real life operating condition. This helps a transition from manual inspection to continuous digital inspections, the move from interval based to predictive maintenance and possibly an uprating of the asset operational limit parameters.

Solution
• Using advanced structural analysis and sensor data in real time
• Full hindsight - a documented history of the asset
• Full insight - a full overview of the current condition
• Full foresight - an evaluation of the effect of changed operational parameters

Benefits
Manufacturers can:
• Enhance product quality
• Encourage collaboration
• Implement transformational business models

Operators can:
• Increase equipment reliability
• Decrease operational costs
• Boost both quality and safety

Learn more
To find out more, call your SAP representative today or visit us online at www.sap.com/pei