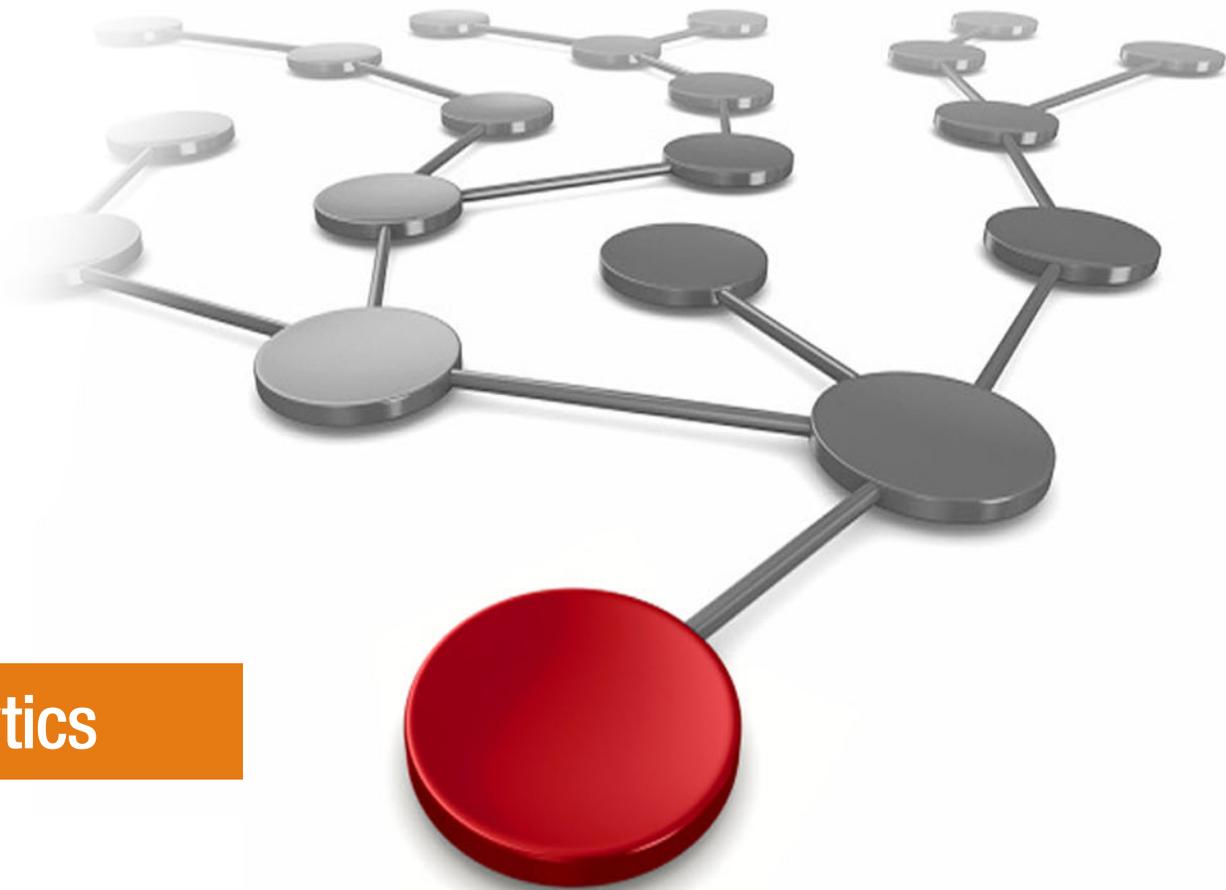


# Reducing Refinery Downtime with IBM Smarter Asset Management for Oil and Gas

Jenny Li

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 Analytics



## Reducing Refinery Downtime with IBM Smarter Asset Management for Oil and Gas

IBM® Smarter Asset Management for Oil and Gas gives oil and gas companies direct visibility into asset usage and operational health. It helps executives and managers make decisions that are based on accurate, up-to-date reports of the running conditions and performance of their most critical assets. It also includes predictive analytics features that can help companies get ahead of the curve in terms of plant maintenance and turnarounds.

By combining sensor-based condition monitoring with advanced analytics, Smarter Asset Management for Oil and Gas delivers data-driven insights to aid in daily operations, shutdown and turnaround management, and regulatory compliance. It helps reduce asset downtime by ensuring maintenance is performed exactly (and only) when needed, and increases overall productivity, which increases operational equipment efficiency (OEE).

The solution (see Figure 1) delivers the following vital functions:

- ▶ Traditional asset management: Extends the lifecycles of vital machinery; optimizes maintenance and repair cycles (including work order management), and integrates with enterprise systems for procurement, enterprise resource planning (ERP), and more.
- ▶ Predictive maintenance and quality (PMQ) control: Monitors equipment health to predict failures and other actionable events; identifies the root causes of downstream performance bottlenecks, and reduces health, safety, and environment (HSE) risks.
- ▶ Turnaround management: Identifies the best times for plant shutdowns; proactively manages complex turnaround issues, and collaborates with key Business Partners to establish asset-management related triggers and business flows.

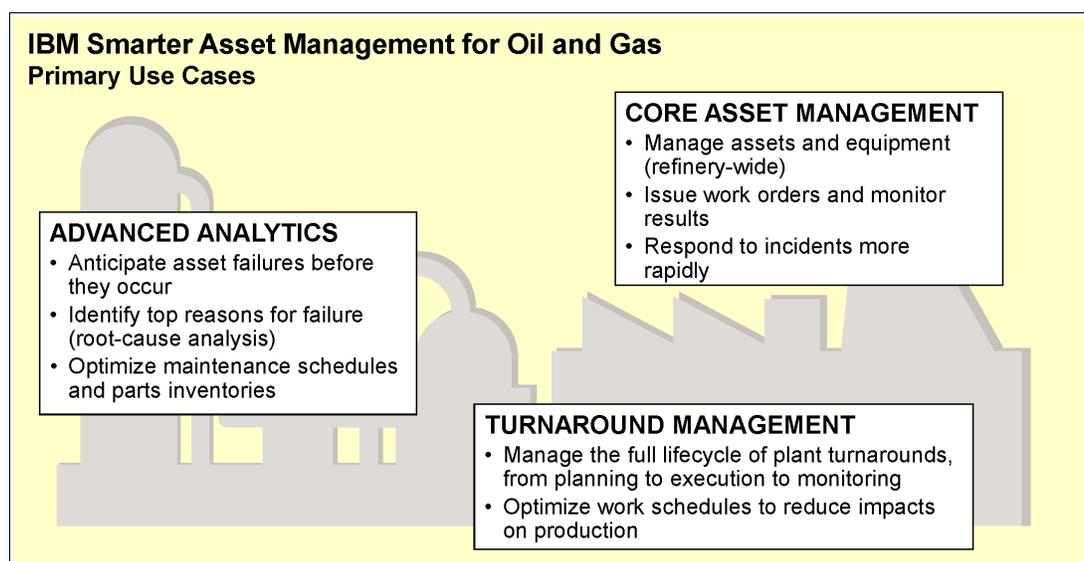


Figure 1 Primary use cases of IBM Smarter Asset Management for Oil and Gas

## Did you know?

IBM can help you implement Smarter Asset Management for Oil and Gas in your enterprise. Our consultants can assess your current asset data integration issues and identify specific products and configurations that can help.

Smarter Asset Management for Oil and Gas combines the IBM Internet of Things (IoT) Foundation to connect real-time data from field-based sensors to the enterprise systems, IBM Maximo® Oil and Gas for asset management, and IBM Maximo Scheduler for turnaround management. Typical configurations also include IBM PMQ for predicting asset failures and providing maintenance recommendations, and Maximo Anywhere (or IBM MobileFirst™ on IBM Bluemix®) to enable mobile access to many features.

## Business value

In addition to keeping production costs low, the biggest priority for oil and gas companies is to keep the plant safely up and running so that production is uninterrupted. If an asset is not performing to specifications, it can become a liability to the company and negatively affect production.

Benefits of Smarter Asset Management for Oil and Gas fall into the following broad categories:

- ▶ Reduce operational cost

Several cost categories can be mitigated by implementing a comprehensive asset management solution with advanced analytics:

- Maintenance: An asset management solution can identify the best time to perform maintenance rather than doing it based on a specific schedule or recommendation. You can also optimize your spare parts inventory to trim costs because of overstocking.
- Turnarounds: An asset management solution that uses predictive and optimized maintenance techniques can help you better plan for plant turnarounds and reduce associated costs. Because turnarounds typically involve shutting down all or part of the plant, optimizing any part of the process almost always saves money.
- Field operations: When failures can be predicted in advance, equipment can be repaired or replaced before it fails. This predictive feature leads to fewer interruptions in field operations and reduces wasteful non-production time.

- ▶ Increase production and efficiency

If an asset management solution can reduce maintenance durations, the natural benefit is increased production. Less time is needed for maintenance and turnaround efforts; therefore, the refinery can keep producing with far less interruption.

- ▶ Improve facilities maintenance

Common goals that are related to facilities maintenance include optimizing logistics and equipment scheduling and improving equipment capacity, availability, and utilization. A comprehensive asset management solution helps to achieve these goals, which, in turn, promotes the reliability of the equipment (including rotating equipment) and other assets.

- ▶ Forecasting and allocations

Because the solution allows for greater visualization and analysis of operations data (current and projected), it can help oil and gas companies better understand and forecast future production output. In addition to better forecasting, insight into the reliability of the available equipment allows companies to better allocate assets to reach production goals.

## Solution overview

Sensors are used to monitor equipment throughout a refinery, including crude oil distillation units, vacuum distillation units, catalytic reformer units, distillate hydrotreater units, fluid catalytic crackers, and more. Smarter Asset Management for Oil and Gas uses this sensor data (flow rate, temperature, pressure, air-fuel ratio, oxygen content, vibration, corrosion, and other readings) with other information, such as recommended and actual maintenance schedules, to create analytical models that can predict everything from fractional distillation performance to expected equipment failures.

The solution is designed to collect the sensor data in time series format and store it in a database (for example, OSIsoft's PI System) or stream it directly to the involved solution components by using a publish/subscribe model. The sensor readings can be augmented with process data, such as maintenance logs, production reports, geospatial coordinates, and video and still images. Together, this data fuels the creation of predictive analytic and optimization models that are designed to support better decision making.

Smarter Asset Management for Oil and Gas includes the following main logical components or layers:

- ▶ Data Acquisition

This layer uses adapters to connect to the sensors, databases, and other data sources to be analyzed. It is responsible for integrating or referencing pertinent data into the solution, where the Data Services component facilitated its use by the remaining components.

- ▶ Data Services

This layer stores the data for access by advanced analytical processes. It provides a semantic understanding of the data for the involved applications (analytics, visualization, enterprise asset management, and so on), and ensures that it is consistent with the master data from any enterprise systems of record that are in place.

- ▶ Advanced Analytics

This layer uses predictive models to identify potential asset failures, which allows maintenance work orders to be issued. In this way, maintenance is performed only when needed. This layer can also be used to optimize work schedules for turnaround management.

- ▶ Role-based Visualization

This layer provides users with the relevant visualizations they need to perform their roles (such as Plant Supervisor, Plant Operator, and Maintenance Specialist).

- ▶ Solution Management

This layer manages the overall solution. Among other things, it provides services for the installation and configuration of the solution's software components, services for the monitoring, logging, and auditing the solution, and various administrative tools.

# Solution architecture

Some of the most advanced products and software from IBM enable Smarter Asset Management for Oil and Gas to maximize its performance. This section describes the solution architecture (see Figure 2).

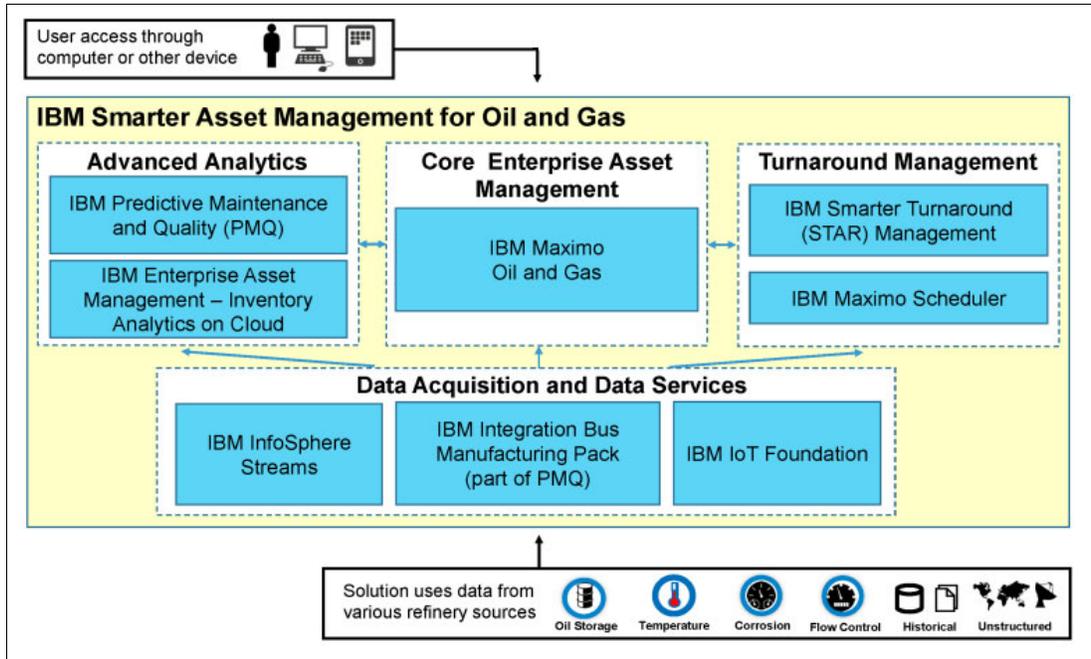


Figure 2 Suggested architectural configuration of IBM Smarter Asset Management for Oil and Gas

The IBM IoT Foundation makes it easy to collect and transmit data from sensors and devices thanks to its use of the IBM Bluemix cloud development platform. Device events, such as those from refinery equipment or other assets, are collected and stored in time-series format in a database.

## IBM InfoSphere Streams

IBM InfoSphere® Streams enables real-time basic analytic processing of data streams, such as those from production fields. These fields generate massive volumes of moving data (such as flow rates, temperatures, and tank levels) that must be continuously analyzed to improve business insight and decision making.

## IBM Maximo Oil and Gas

IBM Maximo Oil and Gas is a product bundle that includes all of the core asset management functions of IBM Maximo Asset Management along with incident management and other capabilities from IBM Maximo Health Safety and Environment Manager. The data that it uses can come from various sources, including monitored devices, databases, or files.

Maximo Oil and Gas integrates data from external systems (such as enterprise asset management systems and ERP systems) in batch mode and supports HTTP, JMS, and web services protocols. After the external systems are configured, automated tasks and schedules can be set to collect the wanted sensor or device data.

Maximo Oil and Gas provides an asset information model that can link related information. It also features reporting and dashboard capabilities that are provided through the integration of IBM Cognos® Business Intelligence. Third-party visualization data, such as maps or geospatial data, can be integrated into the dashboards. If remote access is wanted, Maximo Oil and Gas includes Maximo Anywhere to enable connecting to the system from mobile devices.

### **IBM Enterprise Asset Management - Inventory Analytics on Cloud**

IBM Enterprise Asset Management - Inventory Analytics on Cloud adds predictive analytics to Maximo's inventory module. It uses IBM SPSS®, which is running in the cloud, to link to the inventory database of an on-premises Maximo system and enables users to profile inventory (including tracking and reporting movements of inventory items and the amount of each item on hand), predict out-of-stock conditions, and reduce overstocking.

### **IBM Maximo Scheduler**

IBM Maximo Scheduler provides extended resource scheduling capability. Based on the forecast of upcoming asset maintenance work orders, Maximo Scheduler can assign resources to work orders and optimize the work schedule to reduce effects on production. It also embeds IBM iLOG ODME for optimization.

### **IBM PMQ**

The IBM PMQ provides advanced analytics and reporting capabilities. PMQ can analyze large data sets that are collected over time to predict the best maintenance procedures and schedules, including those procedures and schedules for oil and gas production assets. PMQ provides seamless, automated, two-way integration with systems, such as Maximo Oil and Gas. If an asset is predicted to fail soon, the predictive analytics component of PMQ triggers that creation of a work order and it can schedule the work for earlier or later dates that are based on its analysis of potential outcomes.

Because PMQ is a pre-configured software bundle of its own, it also provides the following data processing and analytics components that are critical to asset management:

- ▶ IBM Integration Bus Manufacturing Pack moves data between production devices and enterprise systems. It builds on Integration Bus technology, which provides enterprise service bus capabilities (including protocol conversion, message mediation, and transformation) and support for integrating more applications that are commonly used in the petroleum industry, such as OSI PI or AspenTech IP21.
- ▶ IBM SPSS Modeler provides many of the solution's predictive analytics capabilities. It uses sophisticated analytical models to predict when asset maintenance is needed before major and costly failures occur. It also has the ability to perform root cause analysis and discover the top reasons for failure of each asset.
- ▶ IBM SPSS Decision Management analyzes the events from Maximo (or other EAM systems, such as SAP Plant Maintenance) that are based on established rules and creates recommended actions for the responsible personnel.
- ▶ IBM Cognos Business Intelligence provides the solution's critical visualization capabilities. It can display analytic data in various standard or custom dashboards and reports (predictions of asset health and needed maintenance, analysis of top reasons for failure, and so on). It helps users visualize site overviews, asset status, product quality, material usage, and other information.

## IBM Smarter Turnaround Management Solution

The IBM Smarter Turnaround (STAR) Management Solution is a comprehensive offering that covers the full turnaround lifecycle, from planning to execution and monitoring. The STAR solution features the following main capabilities:

- ▶ STAR Performance Monitoring gives visibility across the turnaround process and can improve preparedness.
- ▶ STAR Analyzer identifies key performance drivers and conducts large-scale “what-if” analysis for different turnaround scenarios.
- ▶ STAR Optimizer synchronizes turnaround plans for individual assets or entire fields or plants. It identifies dependencies and constraints and suggests schedule improvements. It also uses the IBM Predictive Asset Optimization (PAO) solution, which helps to reduce unexpected asset failure, minimize planned maintenance to only what is necessary, and improve operational efficiency for individual assets.

## Usage scenarios

The following specific usage scenarios demonstrate how asset management can be used to improve oil and gas refinery processes:

- ▶ Core asset management

Most oil and gas companies perform reactive maintenance or preventive maintenance according to predetermined maintenance schedules. By using Smarter Asset Management for Oil and Gas, these schedules can be integrated into a semantic model, along with device data, previous work orders and location information of the assets, and so on. A semantic model links data that has different formats or comes from different sources, so users can access all relevant data and see a holistic view of the assets.

The solution can commission new assets, manage registered assets, create and assign work orders, assess the risks of each work order, request work permits, check regulatory compliance, manage the inventory that is associated with each work order, handle change requests, and so on. It also contains work flow capabilities to route maintenance requests and updates to proper personnel. Users can see innovative visualizations of asset information or maintenance reports, whether through their browsers or mobile device.

- ▶ Asset management with predictive maintenance

Oil and gas companies often must do more than visualize their asset data or preventive maintenance information. Smarter Asset Management for Oil and Gas also includes advanced analytics in which data is used as input for predictive models that can help oil and gas companies to identify what is likely to occur in the future, such as predicting a specific asset’s health and making related maintenance recommendations.

Advanced analytics helps oil and gas companies understand the top reasons or predictors of failure for each monitored asset, which is listed in order of importance. Refinery operators can receive early warnings about accelerated failure rates that might be discovered during the inspection of production batches, or be alerted to rapid wear rates in certain parts that are under warranty.

- ▶ Turnaround Management

A typical refinery turnaround involves planning and coordination among managers, supervisors, financial staff, maintenance team leaders from different parts of the plant, and others. Shutting down one part of a plant, even temporarily, can affect operations in other parts of the plant. Advanced analytics can help optimize these plans to minimize the amount of time each piece of equipment (or an entire facility) must be down.

The first phase of a turnaround is typically for *scoping*. A list of assets that are expected to need maintenance can be generated from the Maximo Oil and Gas component (which uses the analytics features of PMQ). The turnaround planning team reviews the list to understand the effect of repairing (or choosing not to repair) each asset, a study that involves evaluating dependencies, potential production losses, and ensuring continued regulatory compliance, among other things. The result is a list of critical assets that are affected by the planned turnaround.

The *action planning* phase is next in which each maintenance activity is broken down into detailed executable tasks and information about available resources, needed parts, and competing schedules is considered. All tasks must be coordinated among the different parts of the plant so the work schedule can be optimized. The planning team might use an optimization engine to adjust the schedule, or run simulations to review the effect of proposed changes to the plan to create the ultimate project plan for the work.

The final phase is *execution*, where the maintenance staff carries out the work orders that are ultimately issued. The group that is managing the work requires monitoring capabilities to track progress. Any knowledge that is learned during the turnaround must be captured and shared to future turnaround plans and schedules can be improved.

## Integration

IBM Smarter Asset Management for Oil and Gas can be integrated with other systems in several broadly defined categories. Table 1 on page 7 lists these potential areas of integration.

Table 1 Integration options for IBM Asset Management

Category	Potential integration
Enterprise asset management (EAM) systems	Combining Maximo Oil and Gas with PMQ provides predictive and prescriptive analytics capabilities that complement traditional EAM systems. But Maximo Oil and Gas can also directly integrate with such EAM systems to obtain whatever information they contain about the assets it must manage (for tasks, such as work order management, inventory control, preventive maintenance, and critical asset rankings). Maximo Oil and Gas also includes work flow management features that can easily integrate into most business systems and automated business processes.
Production management systems	The Smarter Asset Management for Oil and Gas solution can also work with the production management systems that oil and gas companies use to monitor and manage refinery processes. For example, when it optimizes maintenance schedules, the solution can consider the production data and schedules that are generated by such systems as a way to limit any effect on ongoing production. In addition, with the IBM solution, users define key performance indicators for each asset, watch real-time production data for anomalies, and send automatic alerts to key personnel to prevent breakdowns or other problems.

Category	Potential integration
ERP systems	The solution also can be integrated with ERP systems, such as SAP ERP. In this way, maintenance operational costs, including planned or unplanned downtime, loss of production, and parts inventory expenses, can be automatically reported to the ERP system for overall production planning. Integrating these systems enables maintenance and financial managers to track the true costs that are related to each maintenance work order or refinery shut down, which can save money and improve the planning of future maintenance work.
Enterprise content management (ECM) systems	To complement the IBM solution, oil and gas companies can use an Enterprise Content Management (ECM) system, such as IBM FileNet® Content Manager for version control, audit trails, and more. This kind of integration allows you to search content, such as schematics, work logs (historical and current), maintenance instructions, worker permits, and regulatory compliance information. By integrating the Smarter Asset Management for Oil and Gas solution with an ECM system, users can find information faster and improve overall operational efficiency.

## Supported platforms

The separate components of Smarter Asset Management for Oil and Gas, such as PMQ, Maximo Oil and Gas, and Maximo Scheduler, are supported on 64-bit Red Hat Enterprise Linux (RHEL). The supporting hardware can be IBM Power servers (such as POWER7, POWER7+ or Power8), or x86-based systems with quad core processors.

Smarter Asset Management for Oil and Gas can be deployed in a cloud-based or on-premises model. Consult your IBM representative for assistance in choosing the deployment model that best fits your needs.

## Ordering information

Smarter Asset Management for Oil and Gas consists of separate IBM products and solutions. To purchase the solution components piecemeal, see “Related information”.

To evaluate the solution as a whole, contact an IBM representative by clicking the email IBM link on the Maximo Oil and Gas page within IBM Passport Advantage at this website:

<https://ibm.biz/BdHuE3>

## Related information

For more about the products that comprise IBM Smarter Asset Management for Oil and Gas, see the following resources:

- ▶ IBM IoT Foundation:
  - Product page:  
<http://www.ibm.com/software/products/en/internet-of-things-foundation>
  - Extra documentation:  
<https://docs.internetofthings.ibmcloud.com/#/>
- ▶ IBM InfoSphere Streams:
  - Product page:  
<http://www.ibm.com/software/products/en/infosphere-streams>
  - IBM Knowledge Center:  
[http://www.ibm.com/support/knowledgecenter/SSCRJU/SSCRJU\\_welcome.html](http://www.ibm.com/support/knowledgecenter/SSCRJU/SSCRJU_welcome.html)
  - IBM white paper *Real Time Analytic Processing with IBM InfoSphere Streams v2.0*:  
<http://download.boulder.ibm.com/ibmdl/pub/software/data/sw-library/ii/whitepaper/InfoSphereStreamsOverview031809.pdf>
- ▶ IBM Maximo for Oil and Gas:
  - Product page:  
<http://www.ibm.com/software/products/en/maximo-for-oil-and-gas>
  - IBM Knowledge Center:  
[http://www.ibm.com/support/knowledgecenter/SLL9G\\_7.5.1/com.ibm.oil.doc/welcome.html](http://www.ibm.com/support/knowledgecenter/SLL9G_7.5.1/com.ibm.oil.doc/welcome.html)
- ▶ IBM Enterprise Asset Management - Inventory Analytics on Cloud (formerly Maximo Inventory Insights) product page:  
<https://www.ibm.com/marketplace/cloud/inventory-planning-software/us/en-us>
- ▶ IBM Maximo Scheduler product page:  
<http://www.ibm.com/software/products/en/maximoscheduler>
- ▶ IBM PMQ:
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<http://www.ibm.com/software/analytics/solutions/operational-analytics/predictive-maintenance/>
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- ▶ IBM Smarter Turnaround (STAR) Management Solution:
  - Product page (see the “Asset management and optimization” section):  
<http://www.ibm.com/industries/chemicalspetroleum/solutions.html>
  - White paper:  
[http://www.ibm.com/common/ssi/cgi-bin/ssialias?subtype=WH&infotype=SA&appname=GBSE\\_GB\\_BT\\_USEN&htmlfid=GBW03252USEN&attachment=GBW03252USEN.PDF](http://www.ibm.com/common/ssi/cgi-bin/ssialias?subtype=WH&infotype=SA&appname=GBSE_GB_BT_USEN&htmlfid=GBW03252USEN&attachment=GBW03252USEN.PDF)

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