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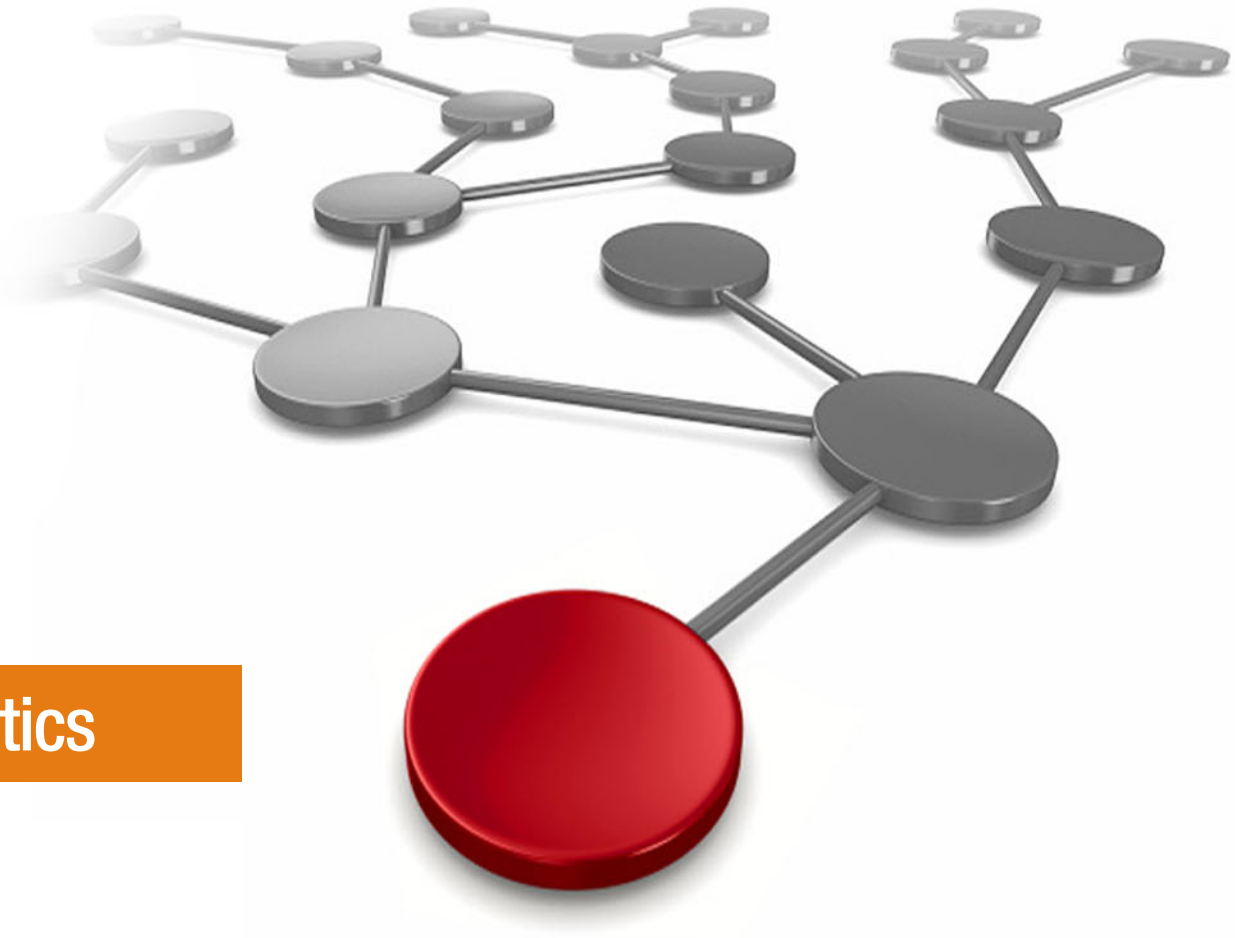
Smarter Asset Management for the Integrated Mill

Akram Bou-Ghannam, PhD



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Smarter Asset Management for the Integrated Mill

Metals industries, such as steel-making, are highly asset-intensive. Efficient and safe use of these assets (ranging from simple equipment, such as pumps and compressors to blast furnaces, casters, and rolling lines to entire facilities) is critical for success.

IBM® Smarter Asset Management for Integrated Mill Operations helps metals companies optimize asset performance and maintenance in the large, unified facilities known as integrated mills. The solution gives metal-making companies direct visibility into asset usage and operational health. It helps executives and managers at all levels make decisions that are based on accurate, up-to-date reports on 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, the solution delivers actionable, data-driven insights to aid in daily operations, shutdown and turnaround management, and regulatory compliance (Figure 1). It helps reduce asset downtime by ensuring maintenance is performed exactly (and only) when needed, and improves overall productivity, which increases operational equipment efficiency (OEE).

The solution described in this IBM Redbooks® Solution Guide combines the IBM Internet of Things (IoT) Foundation to connect real-time data from mill-based sensors to the enterprise systems, IBM Maximo® Asset Management to manage assets, and IBM Maximo Asset Management Scheduler for turnaround management. Typical configurations also include IBM Predictive Maintenance and Quality (PMQ) for predicting asset failures and providing maintenance recommendations, and IBM Maximo Anywhere (or IBM MobileFirst™ on IBM Bluemix®) to enable mobile access to the most critical features.

Figure 1 Primary use cases: IBM Smarter Asset Management for Integrated Mill Operations

Did you know?

IBM can help you implement the Smarter Asset Management for Integrated Mill Operations solution in your enterprise. Our consultants can assess your current asset data integration issues and identify specific products and configurations that can help.

Business value

As any metals industry executive knows, minimizing non-productive time (NPT) and optimizing equipment and plant turnaround operations are near-constant focus points at mills today. With so much at stake, the business value of Smarter Asset Management for Integrated Mill Operations touches upon virtually every aspect of metals production:

- Improve operations

  The solution enables more informed decision-making by helping to identify the best operational choices in the face of environmental and market constraints. And by integrating analytics with asset management, it can improve enterprise-wide intelligence.

  The solution helps operators know when they are ready for critical turnaround activities, such as taking an entire process unit offline for an extended period to repair or replace it. Also, the solution gives operators insight into benchmark performance across assets and projects. They gain new insight into asset interdependencies, which can optimize turnarounds that involve multiple related assets.

- Reduce costs

  Several types of costs can be mitigated by implementing a comprehensive asset management solution with advanced analytics:

  - Operations and maintenance

    When failures can be predicted ahead of time, equipment can be repaired or replaced before it fails, resulting in fewer interruptions in operations and far less NPT. This approach also leads to reduced maintenance costs because good equipment is not replaced unnecessarily. You also can identify the best time to perform the work so it does not result in costly downtime in other parts of the plant.

  - Turnarounds

    Closing or limiting operations at a facility to perform maintenance on multiple assets can be one of the most costly decisions a company makes. But the costs can be minimized with an asset management solution that uses predictive and prescriptive analysis to plan the best times and techniques for the work that must be done.

- Enhance overall equipment effectiveness

  By combining integrated operations, asset management and optimization, and predictive maintenance, Smarter Asset Management for Integrated Mill Operations reduces asset downtime and enhances asset availability, which is a key influencer of overall equipment effectiveness (OEE). OEE is a leading practices metric that identifies the percentage of planned production time that is truly productive. It links three key factors related to plant performance: availability, throughput, and yield (also called recovery).

- Improve asset and process performance

  The solution equips mill operators with powerful analytical tools they can use to identify and resolve the kinds of issues that are common to all asset-intensive industries (and to integrated mills in particular):

  - Asset performance:
    - Lack of visibility into asset health
    - Inability to accurately forecast asset downtime and costs
    - High costs of *unscheduled* maintenance
  - Process performance:
    - Competing maintenance, financial, and operational requirements
    - Organizational silos that inhibit proper tracking of key performance indicators
    - Inability to put analytical insights to use in optimizing processes
- Improve asset management

  The solution enables visibility of enterprise-wide assets and asset performance analysis, tracking and managing all asset-related services activities. It helps you understand asset interdependencies and optimize turnarounds across assets.

Solution overview

Table 1 shows the key functions of the Smarter Asset Management for Integrated Mill Operations solution.

Table 1 Key functions for the solution

Function	Solution features
Traditional asset management	The solution helps to extend the lifecycles of vital machinery. It 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 control	The solution monitors equipment health to predict failures and other actionable events. It identifies the root causes of mill performance bottlenecks, and reduces health, safety, and environment (HSE) risks.
Turnaround management	The solution helps managers determine the best times for plant shutdowns. It proactively manages complex turnaround issues and aides in collaborating with business partners to establish asset-management related triggers and business flows

But how does the solution *work*, exactly?

It starts with the sensors that are used to monitor the various equipment throughout the mill, including the furnaces, castors, hot strip mill, plate mill, cold mill, continuous annealing line, and electric galvanizing line. Smarter Asset Management for Integrated Mill Operations uses the data from these sensors (for example, readings about flow rate, temperature, pressure, air-fuel ratio, oxygen content, vibration, corrosion, and so on) and combines that data with other information, such as recommended and actual maintenance schedules, to create analytical models. The models are then used to predict everything from expected equipment failures to overall mill performance,

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 and 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 creation of the predictive analytic and optimization models that are so vital to the solution's ability to improve mill operations.

To accomplish all of this, the Smarter Asset Management for Integrated Mill Operations solution includes five primary 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.

- Data services

  This layer stores the data for access by advanced analytical processes. It provides a semantic understanding of the data for the applications (such as analytics, visualization, and enterprise asset management), 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 operating a blast oxygen furnace, hot strip mill, cold rolling mill, or whatever else.

- 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 monitoring, logging, and auditing the solution, and various administrative tools.

Solution architecture

Some of the most advanced products and software from IBM enable the Smarter Asset Management for Integrated Mill Operations to deliver all that it does. This section describes the high-level solution architecture (see Figure 2).

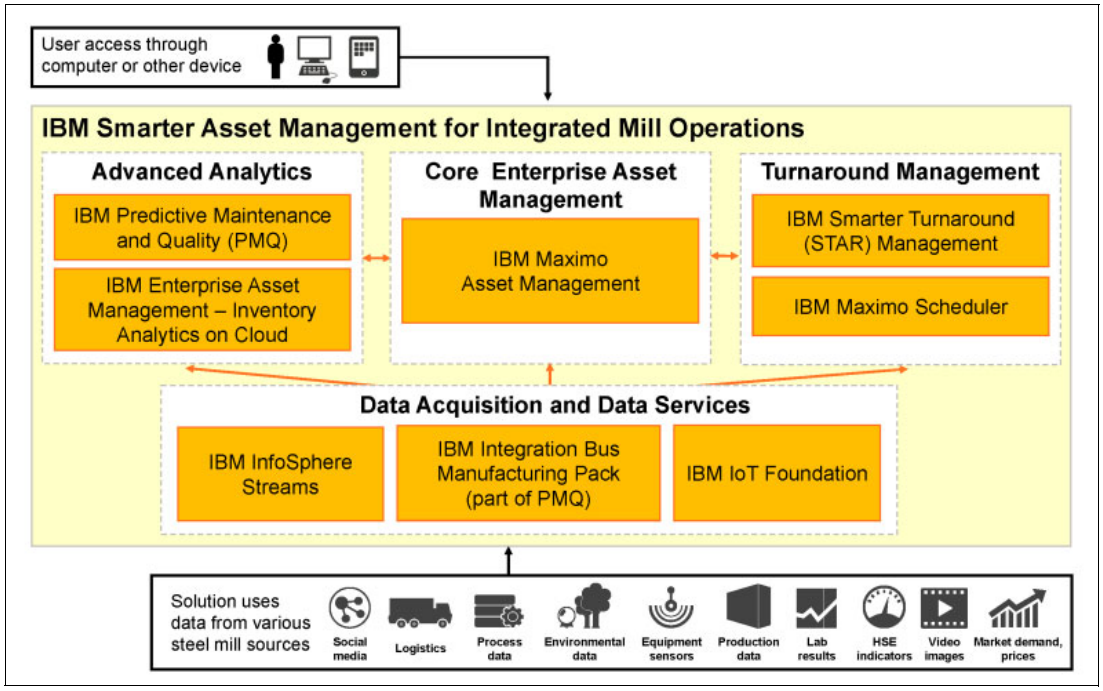

Figure 2 Suggested high-level architecture: Smarter Asset Management for Integrated Mill Operations

IBM Internet of Things Foundation

The IBM Internet of Things Foundation helps make collecting and transmitting data from sensors and devices easier, thanks to its use of the IBM Bluemix cloud development platform. Device events, such as those from mill equipment or other assets, are collected and stored in time-series format in a database.

IBM Streams

IBM Streams (previously known as IBM InfoSphere® Streams) enables real-time, basic analytic processing of data streams from sensors such as those from ladle monitoring thermal imaging cameras, for example. The massive amount of data coming from these types of sensors must be continuously analyzed for optimal decision-making.

IBM Maximo Asset Management

The IBM Maximo Asset Management product provides all of the core asset management functions of the solution. The data that it uses can come from various sources, including the monitored devices just described, a database containing historical maintenance information, or related files.

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

Maximo Asset Management 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® Analytics. Third-party visualization data, such as maps or geospatial data, can be integrated into the dashboards. If access from mobile devices is needed, it can be accomplished through a combination of Maximo Anywhere and MobileFirst on Bluemix, as mentioned previously.

IBM Enterprise Asset Management – Inventory Analytics on Cloud

IBM Enterprise Asset Management – Inventory Analytics on Cloud adds predictive analytics to the Maximo inventory management module. It uses IBM SPSS® software, running in the cloud, to link to the inventory database of an on-premises Maximo system. This way 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 Asset Management Scheduler

IBM Maximo Asset Management 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 ODM Enterprise, which can help synchronize processes (casting and hot-rolling, for example) for reduced energy consumption.

IBM Predictive Maintenance and Quality

IBM Predictive Maintenance and Quality (PMQ) provides advanced analytics and reporting capabilities with seamless, automated, two-way integration with the other systems in the solution, such as Maximo Asset Management. It can analyze large data sets that are collected over time to predict the best maintenance procedures and schedules for metals production-related assets. If an asset is predicted to fail soon, the system can create a work order for repairs and schedule the work for earlier or later dates that are based on PMQ's analysis of potential outcomes.

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

- IBM Integration Bus Manufacturing Pack moves data between production devices and enterprise systems. It builds on the enterprise service bus capabilities of IBM Integration Bus (including protocol conversion, message mediation, and transformation) and supports the integration of popular petroleum industry applications, such as OSIsoft's PI System or AspenTech's Aspen InfoPlus.21.
- 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 Predictive Analytics Enterprise analyzes the events from Maximo or other EAM systems. The analysis is performed based on established rules and results in the recommendation of specific actions to responsible personnel.
- IBM Cognos Analytics 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 required 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 Optimization solution

The IBM Smarter Turnaround (STAR) Optimization solution is a comprehensive offering that covers the full turnaround lifecycle, from the initial planning steps to the ultimate execution and monitoring. The STAR solution features these important capabilities:

- STAR Performance Monitoring gives users visibility across the entire turnaround process, which can help improve preparedness for such operations.
- 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 mills. It identifies dependencies and constraints and suggests schedule improvements. It also uses the IBM Predictive Asset Optimization 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 usage scenarios demonstrate how the Smarter Asset Management for Integrated Mill Operations solution can be used to improve mill-wide processes:

- Core asset management

  Most mill operators repair and replace equipment according to predetermined maintenance schedules. By using the Smarter Asset Management for Integrated Mill Operations solution, these schedules can be integrated into a semantic model, along with device data, previous work orders, asset location information, 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. In addition, it has work flow capabilities to route maintenance requests and updates to proper personnel. Users also can see innovative visualizations of asset information or maintenance reports, either through web browsers or mobile devices.

- Asset management with predictive maintenance

  Metals companies often must do more than visualize their asset data or preventive maintenance information. The Smarter Asset Management for Integrated Mill Operations solution also includes advanced analytics in which data is used as input for predictive models that can help metals 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 metals companies understand the top reasons or predictors of failure for each monitored asset, which can be listed in order of importance. Mill 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 integrated mill 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 mill, even temporarily, can affect operations in other parts of the mill. Advanced analytics can help optimize these plans to minimize the amount of time each piece of equipment (or an entire facility) must be down.

  Turnarounds generally fall into three phases:

  - Scoping: In this initial phase, a list of assets that are expected to need maintenance can be generated from the Maximo Asset Management 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.
  - Action planning: In this phase, each maintenance activity is divided into detailed executable tasks, and considerations are made regarding available resources, needed parts, and competing schedules and priorities. All tasks must be coordinated among the different parts of the mill 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.
  - Execution: This is the final phase in which maintenance staff carries out the work orders that are ultimately issued. Monitoring capabilities are exploited to allow the group that is managing the work to track its progress. Any knowledge that is learned during the turnaround must be captured and shared so that future turnaround plans and schedules can be improved.

Integration

The Smarter Asset Management for Integrated Mill Operations solution can be integrated with other systems in several broadly defined categories. Table 2 lists the potential areas of integration.

Table 2 Typical integration options: Smarter Asset Management for Integrated Mill Operations

Category	Integration options
Enterprise asset management (EAM) systems	As described previously, combing Maximo Asset Management with PMQ provides predictive and prescriptive analytics capabilities that complement traditional EAM systems. But Maximo also can directly integrate with such EAM systems to obtain whatever information they contain about the assets it must manage. Maximo also includes work flow features that can easily integrate into most business systems and automated business processes.
Production management systems	The solution can work with the production management systems that metals companies use to monitor and manage mill processes. For example, when maintenance schedules are being optimized, the solution can consider the production data and schedules that are generated by these other systems as a way to limit any effects on ongoing production. In addition, with the new IBM solution, users can 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.
Enterprise resource planning (ERP) systems	The solution 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 mill shut down, which can save money and improve the planning of future maintenance work.
Enterprise Content Management (ECM) systems	To complement the IBM solution, metals companies can use an 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 Integrated Mill Operations solution with an ECM system, users can find information faster and improve overall operational efficiency.

Supported platforms

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

The solution can be deployed in a cloud-based or on-premises model. Consult an IBM representative for assistance in choosing the deployment model that best fits your needs.

Ordering information

Smarter Asset Management for Integrated Mill Operations consists of separate IBM products and solutions.

To investigate and purchase the solution components piecemeal, follow the hyperlinks for each product that are provided in “Related information” on page 10.

To evaluate the solution as a whole, contact an IBM representative by clicking **Email IBM** on the IBM Passport Advantage® website:

https://ibm.biz/BdHuE3

Related information

For more about the products that comprise the Smarter Asset Management for Integrated Mill Operations solution, see the following resources:

- IBM Internet of Things Foundation:
  - Product page:

    http://www.ibm.com/software/products/en/internet-of-things-foundation
  - Additional documentation:

    https://docs.internetofthings.ibmcloud.com/#/
- IBM Streams:
  - Product page:

    http://www.ibm.com/software/products/en/ibm-streams
  - 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 Asset Management:
  - Product page:

    http://www.ibm.com/software/products/en/maximoassetmanagement
  - IBM Knowledge Center:

    http://www.ibm.com/support/knowledgecenter/SSLKT6/sslkt6_welcome.html
- IBM Predictive Maintenance and Quality:
  - Product page:

    https://www.ibm.com/software/analytics/solutions/operational-analytics/predictive-maintenance/products.html
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- IBM Smarter Turnaround Optimization:
  - White paper: *STAR: IBM’s Smarter Turnaround Optimization:*

    http://www.ibm.com/common/ssi/cgi-bin/ssialias?subtype=WH&infotype=SA&appname=GBSE_GB_BT_USEN&htmlfid=GBW03252USEN&attachment=GBW03252USEN.PDF

- IBM Enterprise Asset Management – Inventory Analytics on Cloud:
  - Product page:

    https://www.ibm.com/marketplace/cloud/inventory-planning-software/us/en-us
- IBM Maximo Asset Management Scheduler
  - Product page

    http://www.ibm.com/software/products/en/maximoscheduler

Author

Akram Bou-Ghannam, PhD, is an Executive IT Architect with IBM Analytics, an IBM Master Inventor, and an accomplished author. He holds a Doctor of Philosophy degree in electrical engineering from the University of Florida. In his role with IBM, Dr. Bou-Ghannam defines cross-industry solutions for enabling operational business intelligence that improves operational decision-making and helps manage and mitigate operational risk. He is an advocate of semantic technology, semantic integration, and contextual computing. In addition, Dr. Bou-Ghannam has deep experience in defining industry solutions for optimizing the operations and maintenance of the high-value engineering assets that are used and deployed in various industries, including industrial products, and aerospace and defense.

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