



SKF Asset Management Services

Your trusted resource for life cycle support
and sustainability of physical assets



People, processes and technology to optimize asset efficiency and effectiveness



In virtually every industry, in every part of the world, industrial facilities are turning to outside experts to help them optimize their processes and plant assets to remain competitive in a global economy. SKF Asset Management Services brings a unique combination of expertise, services and tools to benefit your organization.

With 100 years of manufacturing experience and knowledge of rotating machine reliability; decades of consultancy expertise in process industries; and leadership in condition monitoring, SKF provides a complete array of strategic and tactical asset management services worldwide.

We begin with a proven process to identify plant improvement opportunities and help develop solutions. Our consultants work to understand your business goals, application challenges and plant culture to create a road map for improving reliability. Together with you, we develop strategies and programmes to achieve bottom-line results.

Our industry experts have multiple ways of looking at every machine, system and process – all to optimize asset efficiency in your unique organization.

SKF Asset Management Services offers:

- **Experience and expertise**
- **Proven methods**
- **Technology enablers**
- **Measurement systems**
- **Ongoing support**

You believe that an effective asset management strategy can benefit your organization, but where do you begin?

The answer is *wherever you are*.

SKF Asset Management Services has the people, processes and technology to assist with:

- | | |
|---------------------------------|--------------------------------|
| Strategic planning | Work logistics |
| Assessments and benchmarking | Application engineering |
| Achieving business goals | Maintenance engineering |
| Risk analysis | Reliability engineering |
| Maintenance strategy review | Maintenance management systems |
| Spares and inventory management | Life cycle costing |
| Asset performance | |



SKF Asset Management Services focuses on Strategy, Identification, Control, Execution, and Optimization. Improvement can begin anywhere along the continuum and proceed indefinitely – a living process for asset optimization.



Assessments and benchmarking

By obtaining a comprehensive understanding of your plant's unique requirements, our consultants can identify improvements that help you achieve optimum results. Our assessment tools provide a snapshot of current maintenance efficiency. We help you not only measure performance against benchmarks and best practices within your company or industry – we develop continuous improvement options.

Key Performance Indicators and Balanced Scorecard

Because success depends not just on one department or function, it's important to link major operational perspectives with your business objectives. One way to accomplish this is with the establishment and measurement of Key Performance Indicators. SKF can help to assess performance based on business objectives, define critical indicators and recommend actions to reach a targeted goal. Using the Balanced Scorecard approach, our experts help to establish individual and group goals, and map and measure results desired.

Defining and measuring success

Strategize

Maintenance strategy development and review

Choosing the right technologies and processes to maximize asset efficiency requires knowledge and experience to identify and pursue the highest value strategies for your unique situation. SKF has the people, processes and technologies to help you choose the most appropriate path.

Criticality analysis

Our unique Point-Based Criticality (PBC) is a qualitative method to establish and rank equipment criticality at system and tag level without considering individual machine failures. The points-based system uses severity and frequency of failures in safety, environment and production, and delivers a relative criticality ranking.

Reliability-Centered Maintenance (RCM)

A core tool in the development of a maintenance strategy, RCM is often recommended for detecting and preventing failures where criticality is high and confidence in existing maintenance is low. The process determines what is required for an asset to keep fulfilling its intended function in its present operating context. RCM is effective in delivering a roadmap of appropriate tasks, frequencies, man-hours and skills mix.

Failure Modes and Effects Analysis (FMEA)

FMEA, an integral part of the reliability-centered maintenance process, identifies equipment failures and consequences by examining ways a component or machine can fail; causes for each failure mode; and effects of each failure. Especially useful during the design or operational phases, results are used as input to design trade-offs, safety engineering, maintenance engineering, maintainability, logistics service support analysis, test equipment design and planning, and more.

SKF SRCM process

SKF SRCM is an RCM process that uses substantially less time and resources, yet achieves results by focusing on the dominant failure modes of equipment and the significant effects of those failures. Critical areas include plant safety, environmental and regulatory violations, reduced production or shutdowns. RCM and SRCM change the maintenance culture by helping plant personnel develop an appreciation for a reliability-based maintenance strategy.

Risk-Based Maintenance (RBM)

A quantitative, financially-based analysis technique, RBM establishes the relative worth of various maintenance tasks and serves as a continuous improvement tool. RBM defines opportunities for incremental improvement by eliminating low-value tasks and introducing tasks that address high commercial risk areas. Risk-based maintenance evaluates the current commercial risk and analyzes the costs and benefits of steps to mitigate failures.

Risk Based Inspection (RBI)

SKF expertise extends to defining inspection levels based on Risk Based Inspection analysis. To provide a high quality outcome, the analysis examines risks of regulatory categories; failure consequences; remaining life prediction and equipment deployment. The analysis includes corrosion management and inspection intervals optimization to conform to industry specifications and legislation.

Regulatory Integrity Level Analysis – Safety, Environment, and Commercial (SIL, EIL, CIL)

SKF performs regulatory inspections for SIL, EIL, and CIL to determine risk in equipment designed to protect people and assets, and recommends appropriate risk reduction measures. This approach considers the consequence of failure, exposure probability, possibility of avoiding the hazard and demand rate. Based on the level of risk and acceptability, function test frequency can be calculated based on the probability of failures and taking credit for levels of redundancy in safety systems to ensure maximum availability of protective equipment. SKF experts are trained in meeting OSHA, EPA and individual regulatory agency requirements to gain or remain in compliance.

Fleet Maintenance Recommendation Analysis (FMRA)

In an FMRA, SKF and client experts work together to organize common assets across the fleet by reviewing existing strategies and maintenance tasks for common assets, and developing a fleet-wide plan to improve equipment reliability.

Spares and inventory management

Managing inventories means balancing supply and demand to achieve minimum asset ownership with minimum risk to reduce the total cost of inventory. SKF has a Spare Parts Alignment, Rationalization and Optimization programme to identify and address problems or audit an existing programme. The process takes into consideration downtime costs; delivery lead-times; safety and environmental consequences; capital cost; warehouse charges and write-off costs. Analysis is applied to critical, slow moving, expensive spare parts with an actionable report showing recommendations for spare parts purchase based on cost versus risk.



Identifying asset performance

Identify



SKF asset performance services use proven processes and enabling technologies to determine the condition of equipment and predict when maintenance will be required. The process begins by collecting condition monitoring data from process instrumentation installed on the machine for continuous monitoring or portable diagnostic equipment used for periodic inspections. Recorded data such as machine vibration, thermography, lubricant condition, motor current analysis, process parameters and more can be stored, analyzed and trended using SKF asset performance management software. Our experience with prognostics and decision support systems facilitates knowledge retention, increased confidence and consistent analysis and action.

Predictive Maintenance (PdM)

Predictive Maintenance is a process aimed at detecting a machine condition that will eventually lead to failure and then estimating the amount of time before failure occurs. While most PdM programmes stop at detecting a problem and making a residual life prediction, SKF uses this information as the basis to diagnose the problem with the objective to determine which proactive tasks are necessary to achieve an extension of machine life.

Proactive Reliability Maintenance (PRM)

Through a defined process including best practice predictive maintenance activities, the root causes of failures are systematically diagnosed and proactive steps are taken to help eliminate their recurrence. This process incorporates setting and using performance indicators and regular operational reviews to monitor improvements toward benchmarks for your industry.

Operator Driven Reliability (ODR)

SKF was a pioneer in the Operator Driven Reliability process empowering operators to be a proactive resource to contribute to a company-wide maintenance strategy. Enabled by automated technologies, operators perform tasks that include process parameter inspections, minor adjustments, and general observations of machine performance. An SKF ODR programme enables operators to accurately and consistently record, trend, store, communicate and act upon process and inspection data to generate improvements in process availability.



Controlling work logistics with effective planning and scheduling

Control

Planned Maintenance Routines (PMR)

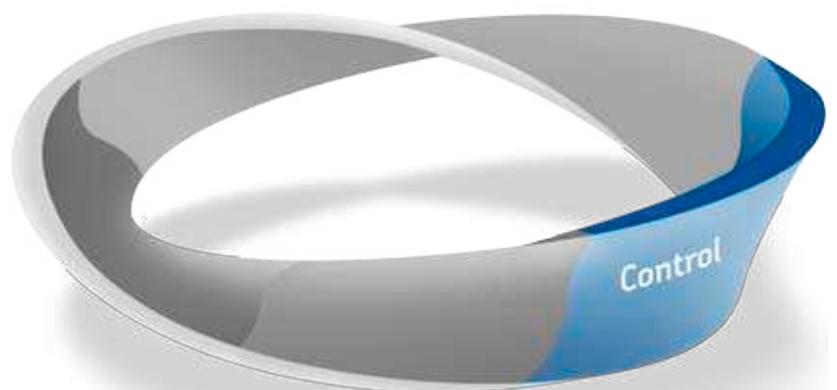
SKF can help to coordinate maintenance activities with production schedules and machine availability to improve production efficiency and promote cross-functional communication. By aligning maintenance tasks to business goals based on asset criticality, safety, environmental and financial impact, measurable improvements can be made. Some benefits include increased maintenance productivity, greater reliability of existing capacity, improvement in uptime, and enhanced personnel satisfaction by meeting production targets and business goals. Effective planning and scheduling results in efficient Planned Maintenance Routines that can be incorporated into new or existing Computerized Maintenance Management Systems (CMMS) or Enterprise Asset Management Systems (EAM).

Resource Leveling/ Work Packaging

To simplify the scheduling process without requiring an expensive planning software package, SKF developed Resource Leveling/Work Packaging – a simplified, cost-effective approach of assigning Planned Maintenance Routines to a long-term schedule based on the average monthly man-hours for each PMR frequency. This approach can prove very effective when maintenance regimes contain many relatively short-duration PMRs, and will produce a smooth manning profile throughout the scheduling period.

Turnaround management

While downtime that “just happens” can be disastrous, a carefully planned shutdown can provide your maintenance department with a rare opportunity to identify and address issues in order to improve plant safety and efficiency. SKF can assist you in prioritizing needs and identifying what can be accomplished within time and budget restraints. Our project managers can prioritize and schedule the order of activities; plan for new or additional work during a shutdown; report and document preparation and execution, and identify future needs.



Expert execution – enabling asset improvements

Execute



Precision maintenance

Based on 100 years of expertise in bearings, SKF provides comprehensive service programmes for rotating machinery maintenance including precision alignment and balancing to correct faults and optimize machine running time. We conduct bearing failure analysis and root cause analysis to determine why the failure occurred and take corrective action to help eliminate repetitive failures.

Post-maintenance testing

Our comprehensive approach can include bearing installation, technology advice, lubrication management, machine upgrades, rebuilding, redesign and refurbishment of bearings and assemblies. Our experts can conduct post-maintenance testing as a quality control to verify the effectiveness of equipment maintenance.

Applications engineering

SKF offers a unique combination of competencies from different fields of engineering, including virtual testing using dynamic simulations of rotating machinery; lubrication and surface engineering, and material analysis and evaluation. SKF consultants can support you from the first ideas to the realization of the products, and continue with you on the aftermarket with evaluation of field tests, lubrication management or finding the root cause to rotating machinery problems.



A living process for continuous improvement

Optimize



Reliability, Availability and Maintainability (RAM)

Another comprehensive method is the Reliability, Availability and Maintainability analysis, in other words, system modeling. SKF uses proven RAM methodology to provide an integrated analysis of expected system performance based on system design, operations and maintenance. RAM models are used to evaluate reliability issues around specific equipment and/or systems focusing on the cost implications through cost/benefit analysis of proposed changes.

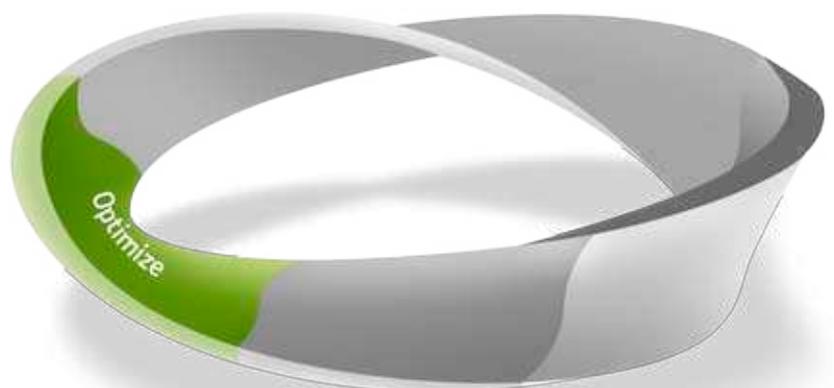
Reliability, Availability and Function Test Interval (RAFTI) Calculator

This tool makes it easy and convenient to automatically determine equipment availability, reliability and function test intervals to increase reliability of the overall system. The calculator allows the user to evaluate the resulting Function Test Interval (FTI) given a desired reliability and Mean Time Between Failure (MTBF) or calculate availability given a desired FTI and MTBF.

Reliability engineering

Reliability engineering collects and analyzes data to either predict future reliability or to determine the causes of past unreliability to help prevent their recurrence. SKF uses proven reliability engineering approaches to identify and coordinate critical elements to help improve key asset reliability. These include an effective maintenance and implementation strategy; quality data capture and retention; the ability to determine key plant or equipment failures; a structured repeatable method of failure analysis and a method of capturing and implementing analysis recommendations.

The reliability engineering approach also provides a closed-loop framework for organizational learning – all of the information gathered and developed during the model's implementation is fed back to the starting point to refine the strategy. SKF consultants deploy industry-standard statistical analysis techniques such as reliability growth, probability distribution and the cost of unreliability.



A living process for continuous improvement, *cont'd*



Building and implementing a Maintenance Management System

SKF Asset Management Services can help to build, implement and support an Enterprise Asset Management (EAM) system to integrate configuration management, work execution, planning and scheduling, preventive maintenance, spare part management, inventory and purchasing. Our experienced consultants create a custom solution by thoroughly defining system requirements, selecting a system, developing interfaces, converting data, creating reports, and managing data warehousing. Continued support is available to optimize logistics, provide training and perform application support on Computerized Maintenance Management Systems (CMMS) and other plant-wide information management systems.

Optimize

Root Cause Analysis (RCA)

Root Cause Analysis seeks to identify the sequence of events leading to failures and creates a plan to help prevent future failures. The SKF service is based on the theory that every failure stems from three causes: physical or technical causes; human causes such as errors of omission or commission; latent or organizational causes that stem from the organization's systems, operating procedures and decision-making processes. After investigating each category, SKF delivers a set of causes and effects plus a comprehensive plan of corrective actions to prevent recurrence.

Life Cycle Costing (LCC)

The Life Cycle Cost of any asset is the cost of acquisition plus the total cost of ownership, including operation and maintenance costs. An SKF Life Cycle Cost analysis determines the future value of maintenance engineering decisions made while developing a maintenance management system. The LCC is associated with the total cost of ownership because by the time the maintenance system is under development, the design is complete and the asset is usually in the construction phase with 60-70 % of its maintenance costs already built in. However, significant cost savings can still be achieved by optimizing the maintenance required to meet the asset's defined business goals, reliability targets, and production profile. An SKF LCC analysis compares a variety of scenarios for the asset to determine the best return for a given investment profile.



Real world success stories

Oil refineries

Bulgaria's LUKoil Neftochim refinery at Bourgas is a subsidiary of LUKoil, the leading oil and gas company in Russia and the biggest refinery in the Balkans. When the refinery was transformed from a government-owned operation to a privatized company, a goal was to raise performance to world standards – or better. The overall objectives were to increase the reliability of the refinery while lowering maintenance and repair costs and reducing risks to safety, health and environment.

LUKoil chose SKF to perform an SKF SRCM analysis to develop an optimized reliability-based maintenance strategy, and a Risk-Based Inspection (RBI) study to focus on mechanical integrity. SKF SRCM concentrated on the reliability factor to make sure that the equipment



most critical to continuing operation of the plant received the highest level of maintenance work. RBI evaluated the risk element to make sure that inspection and maintenance were prioritized for equipment where the probability of failure was highest and consequences of failure most grave.

After three months, the maintenance strategy was put into operation and LUKoil was satisfied with the results and asked SKF to complete an additional programme for three more units. The client expressed that in addition to technical changes, there was the added benefit of creating positive cultural changes in medium-level engineers.



Power plants

After several years of cost-cutting measures, a large utility was experiencing reliability and performance problems. There was a clear need to improve performance by decreasing equipment failure while ensuring properly focused maintenance resources.

SKF developed a Proactive Maintenance Programme applied to all key systems, encompassing 27 coal and gas-fired operating units at 15 power plants. SKF studied the systems over a 30-month period. Implementation included:

- **Developed documentation for the maintenance programme**
- **Focused planned maintenance on critical equipment and dominant failure mechanisms**
- **Emphasized condition-based tasks**
- **Eliminated unnecessary routine and outage tasks**
- **Reduced maintenance costs**
- **Improved availability and reliability**

The customer reported:

- 30 % reduction in equivalent forced outage rate (EFOR)
- 7 % increase in peak period reliability
- 30-40 % reduction in high priority corrective work



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