Driving Operational Excellence™

Asset Performance Management

The Benefits of Next Gen APM 4.0

Manage Risk.
Enhance Compliance.
Boost Profitability.

Operational excellence for the petrochemical, oil & gas, manufacturing, mining and utility industries.

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One of the biggest challenges facing every asset-intensive organization is,

> ***How can I operate more safely and reliably while optimizing performance, reducing risk, and improving quality – and do it all at a lower, sustainable cost?***

To meet that challenge, companies need to change their thinking about assets and how to manage them. The typical refining and chemical company has invested millions in assets, processes, and systems to deliver the results the business demands. They've made that investment while attempting to mitigate safety, financial, production, and environmental risk. All of those assets and systems are capable of producing data that can either produce insight for smarter decision making, or leave organizations vulnerable to operating reactively instead of proactively. Optimizing assets to balance the organization's need for production, performance, and compliance is called Asset Performance Management (APM).

The right approach to APM should have the following goals:

- Collect, analyze, and visualize crucial asset health data
- Prioritize work based on a true picture of criticality
- Provide the accurate status for and a true picture of each asset
- Detect emerging threats
- Prevent equipment failures
- Enhance mechanical, structural, and process integrity of your assets and compliance with regulations
- Prevent process safety events and environmental excursions
- Maximize performance
- Minimize operational risks
- Optimize maintenance and inspection costs

What Asset Performance Management challenges do companies face today?

Companies need a better way to deal with the large volumes of data generated across their fleet each day. This includes both transactional and time-series data; and the means to effectively leverage it to gain deeper insights into overall business performance. Organizations want to predict process abnormalities and equipment failures in the industrial space, but are often unsure how to do so. While process historians are capable of *gathering* large volumes of data, it often is underutilized. Newer technology, including sensors, are capable of *applying* time-series data and leveraging machine-level algorithms to glean new knowledge from underutilized data.

Figure 1 – Systems Online: Listening to Asset Health

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A Dynamic Operations Strategy is Needed

The strategy for operating our production assets needs to follow the business strategy. The requirements in terms of availability, reliability, efficiency, energy, and environmental impact are changing rapidly. This means we need a dynamic model to optimize our asset strategy that takes into account the different drivers but will generate the maximum business value. This integrated view on how to run your business is the basis of **Intelligent Operations**. Intelligent Operations is the most efficient methodology we know of to achieve Operational Excellence.

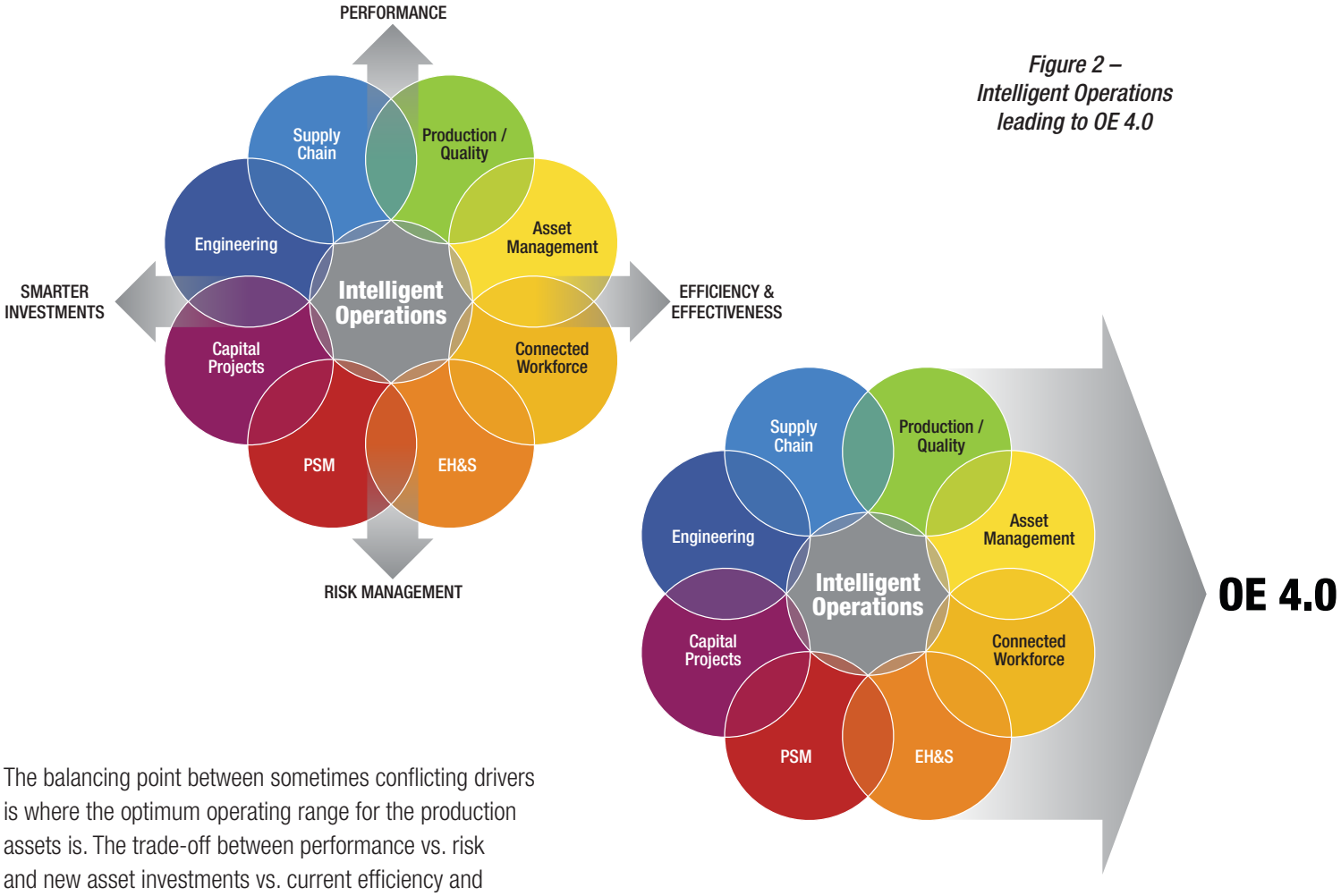

Figure 2 – Intelligent Operations leading to OE 4.0

The balancing point between sometimes conflicting drivers is where the optimum operating range for the production assets is. The trade-off between performance vs. risk and new asset investments vs. current efficiency and effectiveness is what we refer to as **Operational Excellence (OE 4.0)**. This bold new approach to achieving OE requires companies to leverage digital transformation to maximize production, improve human performance, and manage operational risks to follow the best possible scenario to run your assets under the given market conditions and operating restrictions.

The key is creating **interoperable processes** to unlock new business value. This creates a single, relevant source of truth which companies can use to reduce or eliminate redundant processes. It also enables companies to establish a master data governance structure to support the Intelligent Operations platform. The core building blocks include people, materials, and equipment.

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Intelligent Operations

The production assets need to be ready for challenges that companies are facing, so we need to align the asset performance goals with the business demands. Many stakeholders impose different demands on the performance of the assets. Departments must work together...they either do it efficiently or inefficiently.

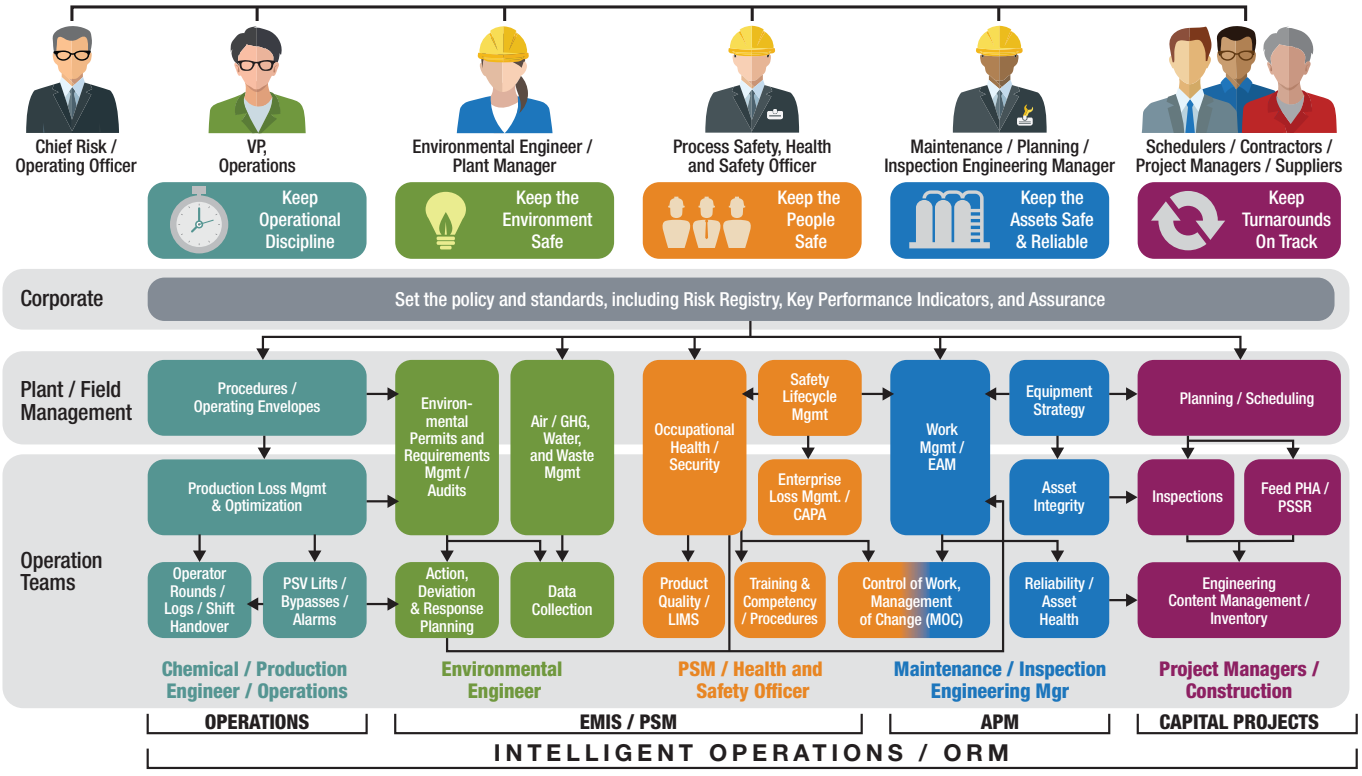

Figure 3 – Stakeholders

If we look at stakeholders in the company, we can identify some of the departmental goals that are top priority for the respective managers:

- The Operations VP focuses on operational discipline to run processes efficiently and minimize risk
- The EH&S or environmental manager looks at the environmental footprint and compliance with new sustainability goals
- The PSM officer focuses on minimizing process risks to people inside and outside the plant
- The Maintenance department focuses on running the assets reliably and safely against lowest maintenance cost
- Project planners focus on smooth execution of projects and minimize downtime due to turnarounds

To achieve these goals, we need to zoom into some of the key work processes that need to be addressed. Our Intelligent Operations solutions are designed to link processes, systems, and information exchange across operational siloes to enable balancing sometimes contradictory business strategies. After all, reliability may say that we can run to failure, but safety doesn't always accept failure as an outcome. OESuite™ delivers efficient organizational insight while managing all the changes and impacts across connected work processes.

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Defining Asset Performance Management

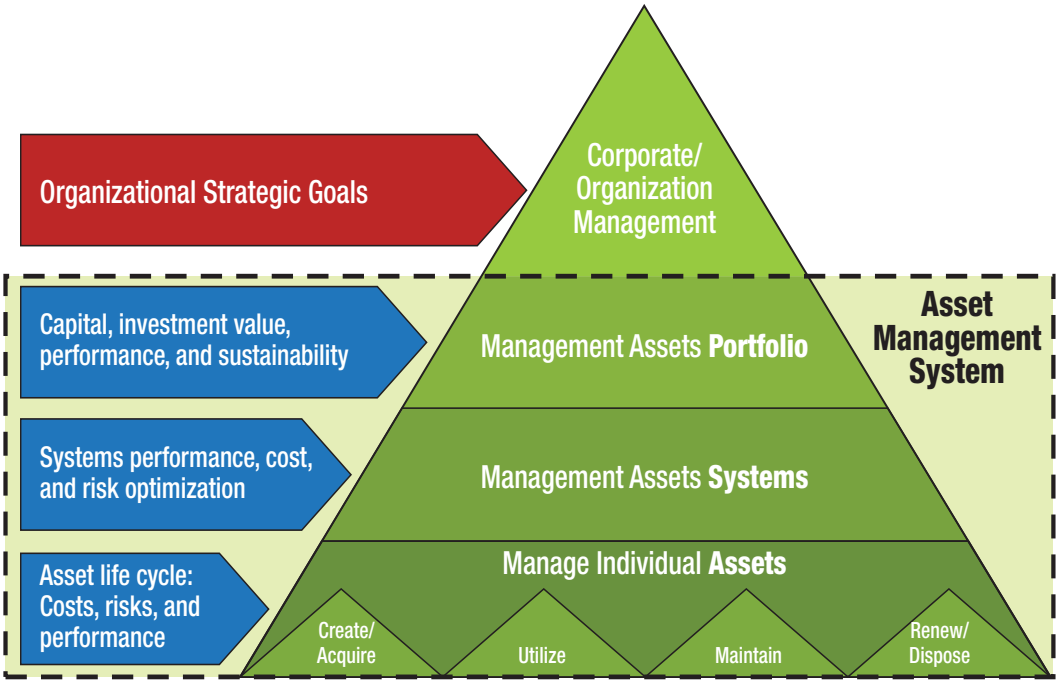
The Operational Sustainability, LLC® (OS) methodologies and processes are designed to call for the right operations and maintenance activities at the right time, thereby reducing costs by eliminating unnecessary or non-productive work, avoiding incidents, and optimizing assets over time. This new approach to APM helps clients enhance compliance activities, reduce business interruptions, increase asset utilization, prevent and minimize unwanted events, and protect their reputation.

Asset Strategy

The **Asset Strategy Module** is a foundational component of the **OS APM 4.0 Framework**. These asset strategies define how you will design, operate, test, inspect, maintain, and replace your assets. The effectiveness of these asset strategies determines the performance over time of your assets in terms of throughput, reliability and availability, integrity, safety, sustainability, and lifecycle costs.

To achieve OE 4.0 in your asset strategy, you must first define your objectives for operating assets. According to the ISO 55000 Standard (Figure 4), the strategy starts at the top level with the organizational strategic goals. These are translated into asset portfolio goals and then cascade down to individual system and asset goals over the lifecycle of the assets.

Figure 4 – ISO 55000 Alignment of Strategies



Developing an Effective Asset Strategy

The process for developing, managing, and executing an asset strategy is shown in Figure 5. This flow can best be described as an integrated process of comprehensive steps. Utilizing an integrated platform such as OESuite™ can simplify and accelerate the overall process. Any system

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chosen should employ an Asset Strategy Library (ASL) that contains the central repository of strategies available to be assigned to each asset depending on its criticality. A lifecycle cost view is used to optimize the asset strategies with the goal of minimizing Total Cost of Ownership (TCO).

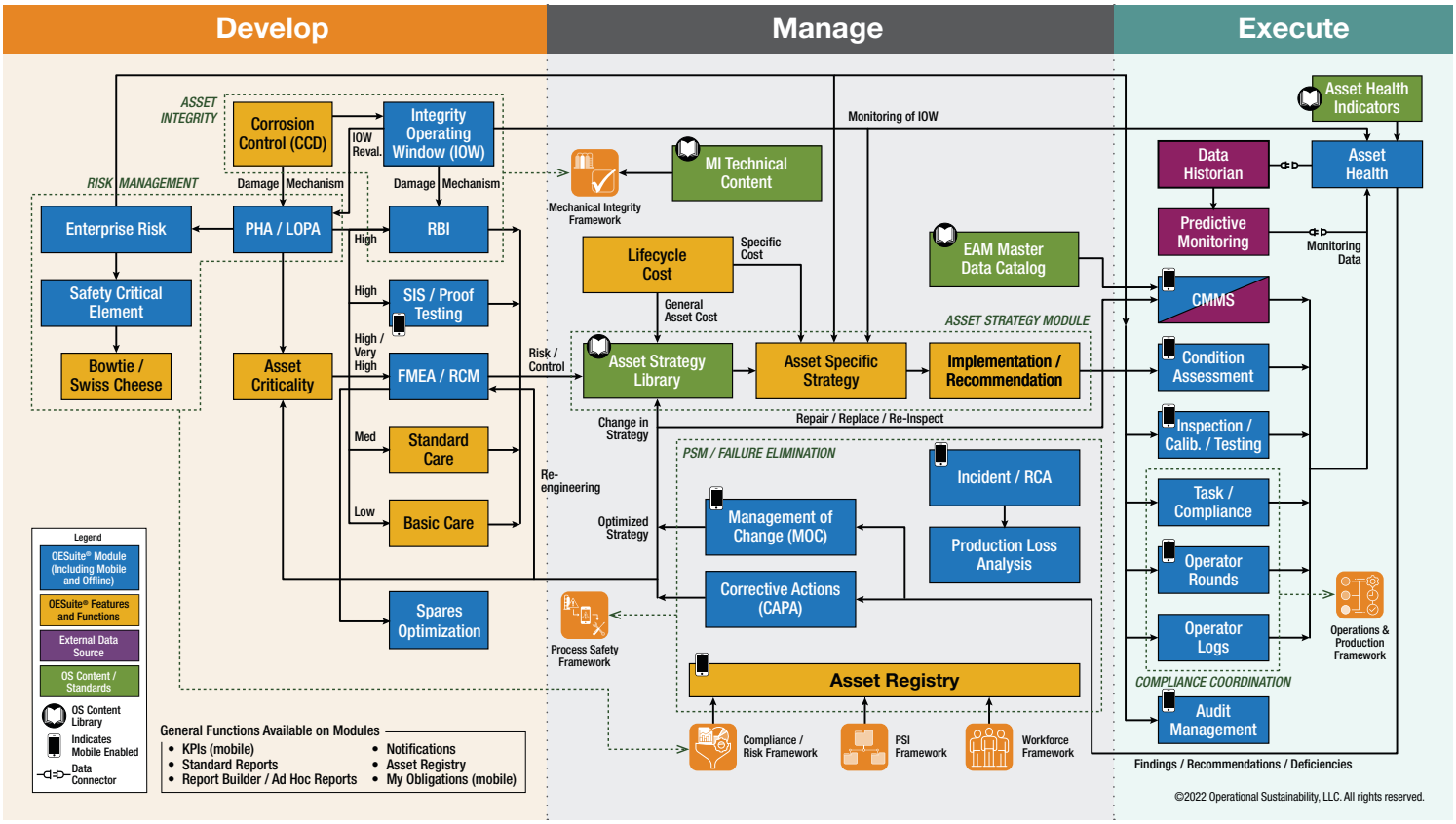

Figure 5 – Asset Strategy Workflow

ASM Implementation

Asset strategy development starts from the asset register with a structured breakdown of all assets from plant to unit, system, and equipment levels. For each asset level, the criticality is determined in an Asset Criticality Analysis using the corporate risk matrix as the basis for assessing asset criticality. The consequence of failures at each asset level is categorized as High, Medium, or Low. The various categorizations of each asset determine the asset strategy tactics (e.g., FMEA / RCM, RBI) that follow.

The optimized asset strategies can then be implemented in execution systems such as an Enterprise Asset Management (EAM) system to generate periodic maintenance, testing, and inspection tasks. That is just the start to effective execution. The results of inspections, operator rounds, maintenance actions, and condition monitoring should then be fed back into the system to improve the effectiveness of the strategies. Having a single pane of glass with "interoperable" modules makes the execution a lot more efficient. Operational Discipline is one expected outcome when using an interoperable set of data and integrated modules such as that available from OS.

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What Does an Integrated Asset Health View Look Like?

Asset health synthesizes asset data sources into asset health information and provides actionable intelligence for asset management via a dashboard – providing a cockpit for reliable operations. Reliability engineers and technical authorities can monitor asset health across the assets from one integrated platform. Decisions such as when to employ a corrective action, perform an extra inspection, initiate Root Cause Analysis (RCA), or a start a Management of Change (MOC) impact analysis to change the overall asset strategy, asset design, or spare strategy can be made with assurance and implemented quickly and easily.

One option that delivers this level of seamless integration is the **OESuite™ Asset Health Module**. It uses real-time data from sensors and process historians and transactional data from work orders, operator rounds or inspection reports to give companies a comprehensive view of asset health. Events can be automatically generated based upon trend analysis and limit exceedances, or other logical combinations of triggers.

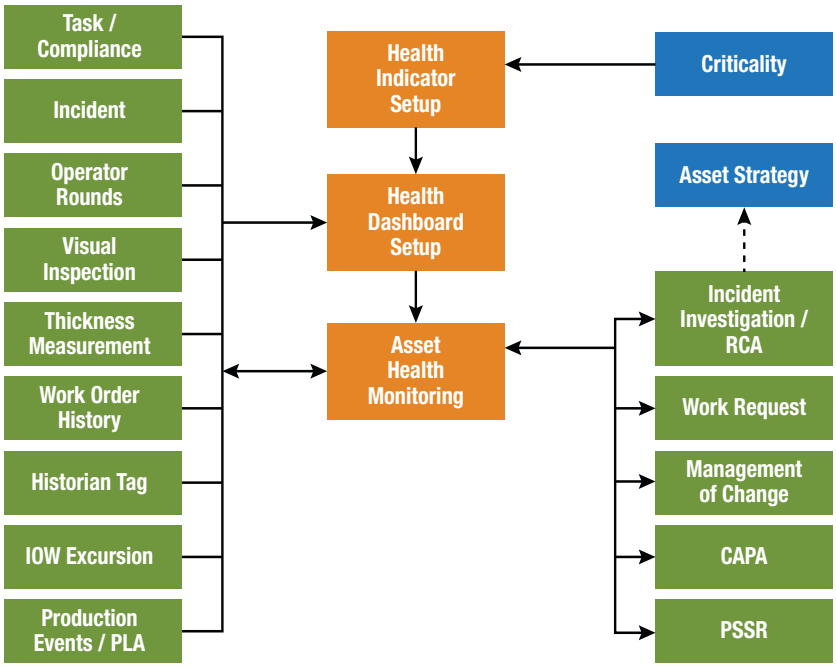

Figure 6 – Asset Health Flow Diagram

Asset Health Monitoring?

The **Asset Health Module** and **Visual Operations Function** can be used to monitor the entire fleet because the **OESuite Asset Health Dashboard** capability can be leveraged to display asset health in location context. Site leadership can quickly assess trending problem areas and mobilize resources to intervene early. A strong asset health program will not only extend asset life, but also help plan maintenance and inspection actions to minimize their impact on operations.

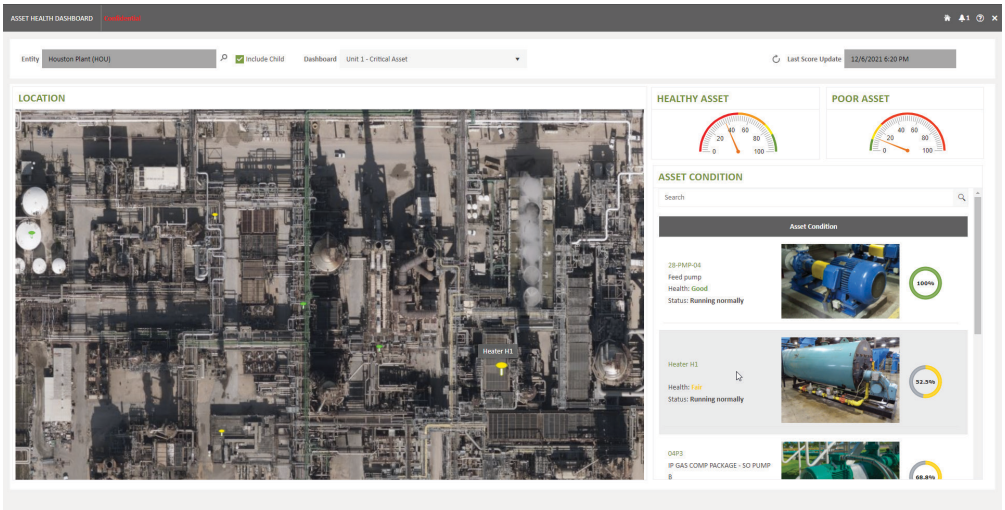

Figure 7 – OESuite Asset Health dashboard

An integrated asset health view provides a real-time feedback of the asset strategy

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effectiveness and efficiency to reach optimum performance. Choose your specific types of assets from the library of asset health indicators to accelerate the journey. Asset health may contribute to refining the asset strategies by measuring actual conditions and identifying early signs of deterioration.

The quality of the asset strategy is only as good as the input data quality. In the development of asset strategies, many assumptions are made on failure mechanisms, failure or corrosion rates, and operating conditions which are in most cases uncertain. Changes in configuration or adapting strategies to improve overall asset performance have a huge impact on the performance of the assets but also on the associated risk exposure.

OS integrates its **Process Safety Management (PSM)** and **Work Management Modules** along with its **Event Tracking and Production Loss Analysis systems** to define correlations and behaviors based on this enhanced data.

The APM methodology and tools are designed to seamlessly work together to help companies efficiently execute the right work, at the right time, by the right people – while capturing and fully utilizing critical institutional data and knowledge. Organizations can define asset strategies based on failure elimination, balanced with risk tolerance, in one mitigated set of activities, such as inspection or operator care. Your engineers can use accurate data to validate strategies and manage change based on real-time learning – making new recommendations when appropriate. As equipment failures occur, the ASL is automatically updated with failure data. OS even offers asset strategy libraries to give you a jump start.

Next Gen APM 4.0 is OS's improved approach to APM that goes beyond the traditional questions of maintenance, cost, safety systems, and condition. Next Gen APM 4.0 moves companies to the next level by embedding operational intelligence, improving worker performance and providing insights far beyond what traditional APM approaches deliver.

Next Gen APM 4.0 is OS's answer to industry's desire to follow best practices and move along the path from earlier generations of thought on asset management to risk-informed intelligent prognostics. It provides the rich industry-centric content needed for prescriptive compliance and proactive asset management throughout the asset lifecycle.

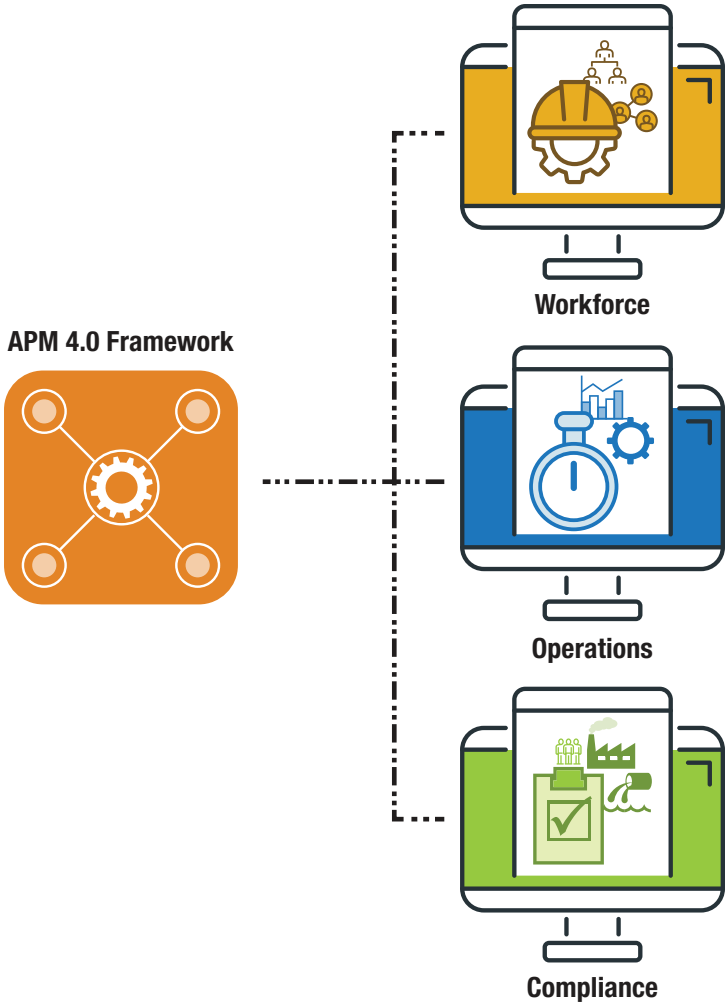

Figure 8 – Why Next Gen APM?

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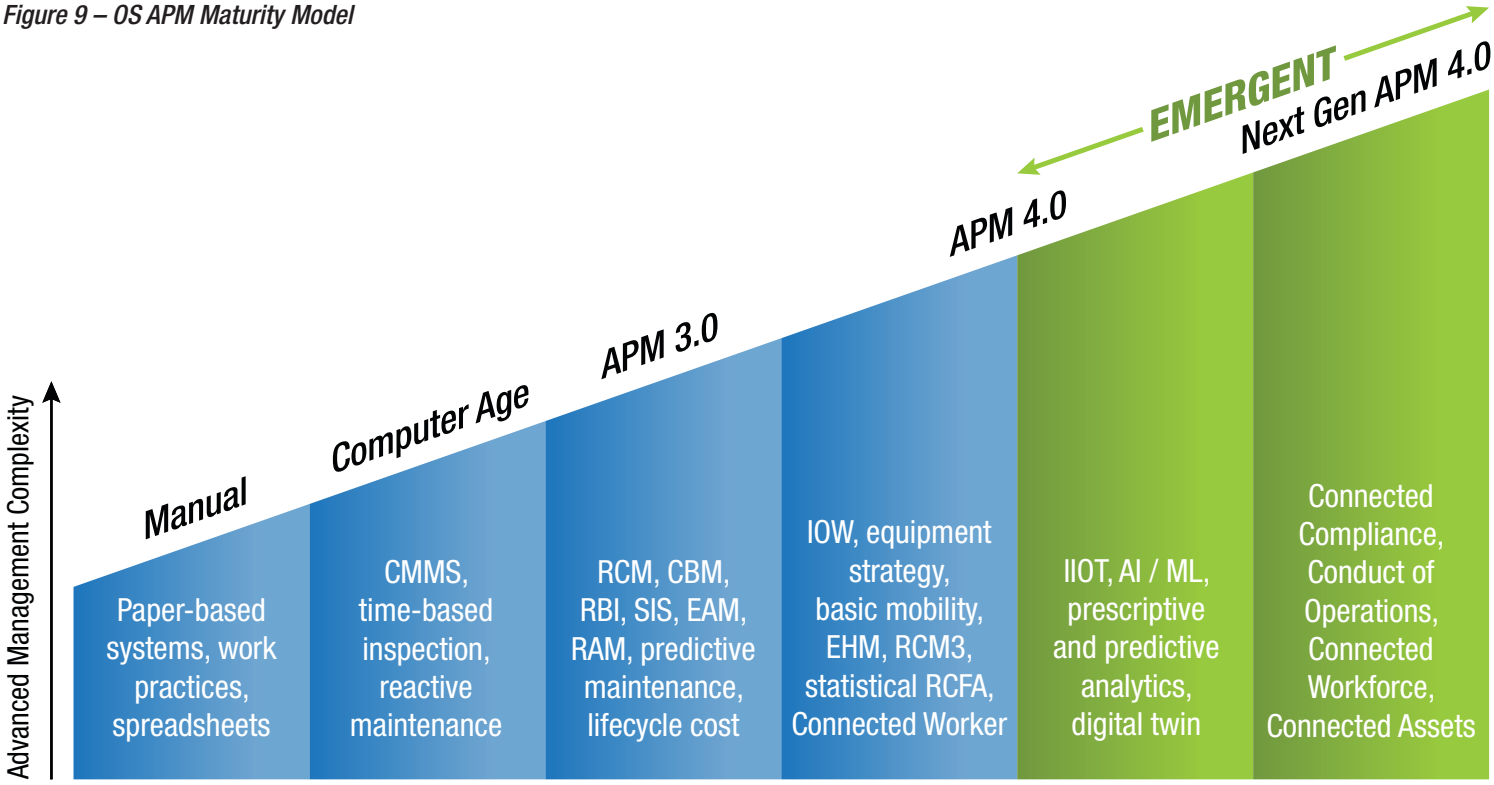
Figure 9 – OS APM Maturity Model



Five key ways Next Gen APM 4.0 differs from Traditional APM / APM 3.0

1. **Traditional APM** solutions rely on manual / human input and updating because system components are often maintained separately. Mis-aligned data is common and hard to spot due to lack of integration and interoperability.
2. Traditional APM has huge gaps in processes, requiring manual intervention and additional cycle time. **In particular, traditional APM lacks perspective on human performance, competency, Operational Risk Management (ORM), and Conduct of Operations (CoO).** Traditional APM takes an "equipment only view" which does not incorporate these other factors.
3. Traditional APM doesn't integrate Condition Assessment, Risk-Based Inspection (RBI), Integrity Operating Windows (IOW), Process Hazard Analysis (PHA), MOC, defect elimination, QA / QC, and other Next Gen APM 4.0 concepts into a single source of truth to drive equipment strategies. Traditional asset strategy solutions are focused on maintenance.
4. Next Gen APM 4.0 leverages existing information to its fullest potential through true system integration and interfacing with the Industrial Internet of Things (IIoT) with Artificial Intelligence (machine learning) to enable APM process convergence, creating opportunities for shared insights and innovation across Connected Assets, Connected Compliance, CoO, and Connected Workforce.
5. Next Gen APM 4.0 integrates people, processes, procedures, data, and technology into operations to give organizations a clearer overall picture, whether viewed from inside or outside of operations – keeping asset strategies up to date and aligned.

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Traditional APM vs. Next Gen APM

Traditional APM	Next Gen APM 4.0 (includes Traditional APM plus the following)
• Asset Criticality Analysis • Inspection Management / Mechanical Integrity • Risk-Based Inspection (RBI) • FMEA / FMECA • Reliability Centered Maintenance (RCM) • Safety Instrumented Systems (SIS) • Calibration Management • Asset Failure Reporting / RCA • Performance Management • Lifecycle Cost Analysis (LCA) • Spares Optimization • Failure Elimination	**Connected Assets** • Work Management / CMMS / EAM / CBM / PdM • Asset Health • Asset Strategy • Digital Twin • Asset Investment Planning (AIP) • Inventory Management (Chemical, Warehouse) • QA / QC (Defect Elimination) • Integrity Operating Windows (IOW) **Connected Workforce** • Organizational / Personnel Change • Competency Management • Procedure Management / Work Instructions • Human Factors Analysis • Training Management / LMS • Connected Culture **Conduct of Operations** • Operator Rounds • Shift Handover • Operator Logs • Work Management / CMMS / EAM / CBM / PdM • Alarm Management • Production Loss Analysis • Condition Assessment • Reliability Centered Maintenance (RCM) • Operational Performance Management **Connected Compliance / Process Safety Managment and EH&S** • Document Management / Redlining • Inspection Management / Mechanical Integrity • Incident / Event Management • Management of Change (MOC) • PSSR / Operational Readiness • Organizational / Personnel Change • Training Management / LMS • PHA / Risk Management • Audit Management • Barrier Management • CAPA / Action Item Management • Relief Device Management • Control of Work / Work Permitting • Operational Risk Management • Safety Critical Elements

Figure 10 – Comparing Traditional and Next Gen APM components

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What happens when companies practice Next Gen APM 4.0?

Next Gen APM 4.0 delivers improved Operational Risk Management (ORM), enhanced compliance assurance, operational discipline, and decision support at the point of work execution. At its core, Next Gen APM 4.0 is an *operational decision support* platform instead of simply a *maintenance / cost decision* platform.

Next Gen 4.0 APM leverages technology to meet new requirements for compliance, workforce, and operational process efficiency. In fact, integrating key areas of information that in many organizations have existed as separate silos of data is a core benefit of the Next Gen APM 4.0 approach.

People, facilities and organizations can make better decisions when they are considering their assets in the light of a single source of truth encompassing:

- Asset Performance Management
- EH&S / Process Safety
- Safety Lifecycle Management
- Operational Risk Management
- Connected Workforce
- Connected Compliance
- Conduct of Operations
- Production Efficiency / Defect Elimination

Next Gen APM 4.0 delivers and utilizes:

- Mobility for driving work processes, data delivery, and updates to the system of record
- Analytics to support CBM, RCM, Predictive Maintenance, Modeling, and Simulation to provide insight to workers while predicting failures coupled with machine learning
- IIoT to integrate real-time data from assets
- Interoperability and simulation modeling for APM business processes
- Enhanced EH&S compliance assurance and reduced safety incidents
- Reduced energy use and emissions
- Increased resource utilization
- Enhanced capital effectiveness and wrench time
- Minimized equipment outages and lost production
- Reduced inspection costs and losses of containment
- Improved planning and reduced emergency repairs
- Reduced inventory carrying costs
- Enhanced equipment uptime
- Improved workforce competency and organizational resilience
- Operator-driven reliability
- Reduced defects on equipment

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Driving Operational Excellence™

EAM / APM Framework

Module — Feature

Lifecycle of Asset / Asset Management

- Asset Analysis: Asset Criticality Analysis; Lifecycle Cost, CCD / IOW Analysis; Failure Elimination / Bad Actors
- Work Management / CMMS + Mobile: CBM / PdM, Work History; Failure Elimination / Bad Actors
- Reliability: FMEA, RCM
- Operator Rounds + Mobile: Scheduler
- Operator Logs: Production Operating Plan; Shift Handover
- Procedure Mgmt / Work Instructions + Mobile
- Relief Device Mgmt
- Inventory Management: Chemical / Warehouse Inventory
- Safety Instrumented Systems + Mobile: SIF, IPL Lifecycle, Proof Testing, SRS Design
- Condition Assessment + Mobile
- Asset Strategy Management
- Asset Health
- Spares Optimization

Asset Integrity

- Inspection Mgmt + Mobile: Scheduler, NDE Data; Visual / Thickness Measurements; Calibration
- Risk-Based Inspection
- Alarm / IOW Management: Safe Operating Limits; Alarm Rational-ization

Compliance

- Process Risk / Risk Assessment: What If, JSA, HAZID, FMECA; HAZOP / LOPA / PHA; Dust Hazard Analysis, PSM Boundary
- CAPA / Action Item Management: Review / Manage Recommend-ations; Deferral & Deviation Management
- Task / Compliance Management: Consequence of Deviation
- Incident / Event Mgmt + Mobile: RCA, Consequence of Deviation; Failure Elimination / Bad Actors; Non-conformances / Product Quality
- Training Management / LMS + Mobile: Skills Matrix / Curriculum; SCORM / AICC
- Audit Mgmt + Mobile
- Management of Change + Mobile

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Operating conditions and production demands change over time, equipment ages or is replaced, upgrades or improvements are implemented, and of course the pressure to reduce cost is always present. **Next Gen APM 4.0** enables dynamic performance management based on a single source of truth across the entire organization so no matter what changes the organization faces, its fleet of fixed or rotating assets will be ready to perform.

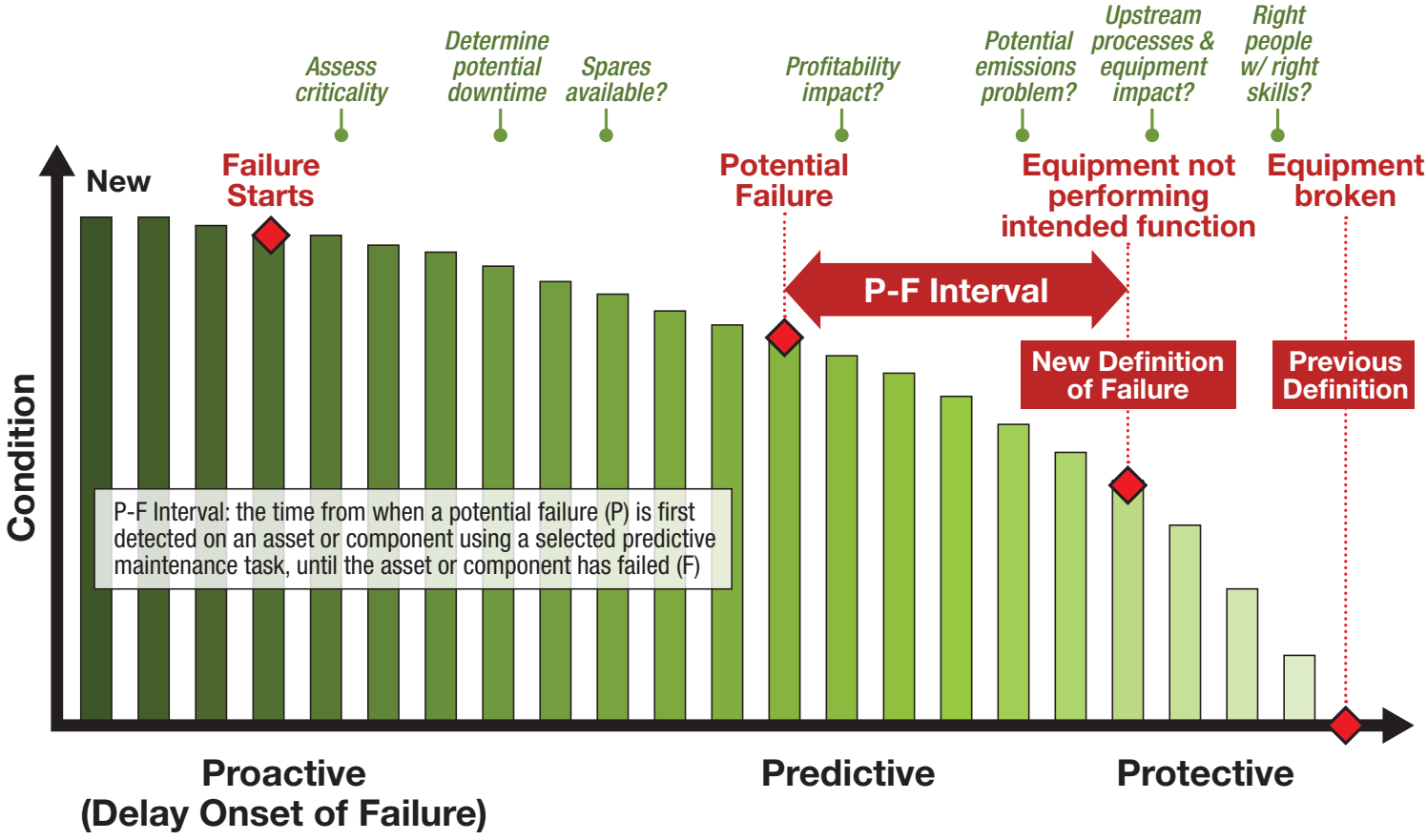

Figure 11 – P-F interval curve

Challenges to implementing Next Gen APM 4.0 occur when:

- Facilities run equipment outside of design limits, or fail to identify process hazards
- Organizations only partially apply APM principles when driven by incidents, without an overall asset strategy
- Companies seek wholesale change without a limited-scale pilot to prove what works
- MOC is not a core function fabric to ensure sustainability of information
- Organizations attempt to justify APM solutions without a tangible measurement of a business case coupled with strategic business objectives

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Asset Strategy Library

For fast deployment, a content library is available with templates and models to support the various strategy development methods. Templates are included to support maintenance tasks and actions; report failure codes; and perform SIS, RBI, and RCM studies with integrated templates based on equipment type (e.g., pumps, compressors, drums, valves, piping, heat exchangers) on one common risk matrix. We use asset health templates to monitor relevant asset parameters and build predictive models for common type of assets with hard or soft sensors. These templates are continuously updated to represent industry best practices and include new technology advancements.

We use the OS library of generic asset templates to quickly populate medium risk assets and a starting point for full analysis for high critical assets. The ASL contains the central repository of strategies that can be assigned to each asset depending on its criticality.

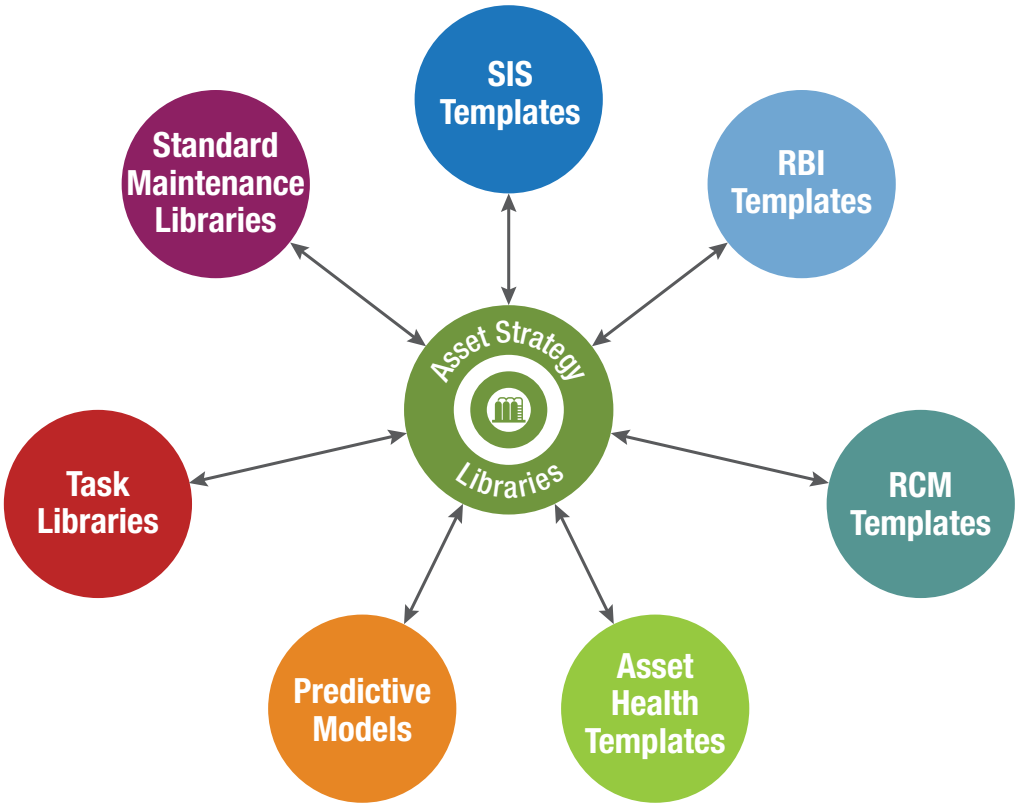

Figure 12 – OS Asset Strategy Library

The templates include:

- Detailed studies templates in order to define the starting point for SIS, RBI, and RCM analyses and apply a set of standard failure modes or damage mechanisms
- Predictive models for standard equipment types to be applied for high critical assets with a predictive monitoring strategy
- Task libraries of templates for equipment types with generic maintenance, testing, and inspection tasks
- Basic care library with standard lubrication cleaning and visual inspection tasks, which may be applied by basic care teams from operations or maintenance
- Asset health templates for real-time monitoring of specific asset types

The majority of our customers today start with an ASL template and utilize a reliability consultant to close out the gaps (e.g., RCM).

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Lifecycle Cost Analysis

A Lifecycle Cost Analysis (LCA) view is maintained to optimize the asset strategies with the goal to minimize overall asset lifecycle cost. The heart of the analysis are the scenarios, where the engineer can compare and contrast the Net Present Value (NPV), TCO, and if revenue is specified, the Internal Rate of Return (IRR) of the scenarios. Scenario examples include do nothing, repair, replace with new, design change, etc. Each scenario contains the expected cash flow by bucket by period and then the NPV, TCO, and IRR are calculated. The engineer can then choose and recommend the most financially valuable strategy.

Integrated APM covers all asset lifecycle related activities: asset creation, care, utilization, improvement and disposal; and it incorporates decision-making processes and actions at the strategic (policy and strategy), tactical (concept and plans) and operational (service providing) levels. Over the lifecycle of the assets, information has to be handed over from one to the next stage. Especially from Engineering (designer) to User (operations) after commissioning all relevant asset information needs to be transferred to ensure operation as intended in the design. A clear process and information flow are required from Engineering to Operation & Maintenance phases.

In the **LCA Feature** of the **Asset Analysis Module**, costs are monitored over the lifetime of the asset. This provides an LCA or TCO view. Different strategies are combined in the **Asset Strategy Module** to find the best balance in strategies with the lowest LCA. Long-term strategies including replacement or investment decisions may be based on the increasing actual cost of the asset compared to its age. All strategies are constantly optimized to reach maximum business value with the TCO as an optimization engine. The outcome is one optimum overall enterprise asset strategy.

To move from traditional APM approaches to Next Gen APM 4.0, companies need to:

- Leverage a risk-based approach to define asset strategies
- Baseline assets determine criticality, identify failure modes, and prioritize work to choose the assets which should receive what resource allocation
- Create effective standards (policies and procedures, field guides)
- Assess skills and codify job roles, assess competency gaps, and provide appropriate training to build a competent workforce
- Create a Mechanical Integrity program and engage the culture to get buy-in
- Leverage an ORM framework to ensure compliance of assets with regulations
- Identify bad actors and remove them from the company culture while improving asset strategies via failure elimination augmented by machine learning
- Enable condition monitoring, operator-driven reliability, and prescriptive maintenance to predict failures, while leveraging real-time information to provide continuous improvement
- Conduct PHAs and audits of facilities
- Prioritize equipment work via IOWs, RBI, and risk-based RCM (i.e., RCM3)
- Gather and analyze performance data that is based on an Operational Performance Management framework
- Enable a Connected Workforce strategy for field data gathering and to provide contact information in real-time improving decision support
- Create a visualization of assets to make changes intuitive to management and field personnel

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New production efficiencies can be achieved by ensuring the right people, with the right skills, are utilized to minimize defects and equipment downtime. Companies can use key **OESuite™ modules** to implement our **Next Gen APM 4.0 Framework**, including our **Asset Strategy** and **Asset Health Modules** to effectively balance risk with the need to continuously improve asset performance.

It's time to take your asset management to the next level.

Our Next Gen APM 4.0 Framework takes your performance to the next level. This holistic approach is the best way to reduce human intensive practices and move organizations along the path to Operational Excellence 4.0. More primitive approaches to APM left out the human performance aspects, and did not adequately account for human error, operational risk, and the connected nature of today's operations. The **OS Next Gen APM 4.0 Framework** enhances availability, reliability, efficiency, profitability, and safety. Our dynamic framework will help you optimize your asset strategy to generate the maximum business value, without upsetting the delicate balance between risk and profitability. If you're ready to take your APM to the next level, we can help.

Call us or email us today at info@DrivingOE.com.

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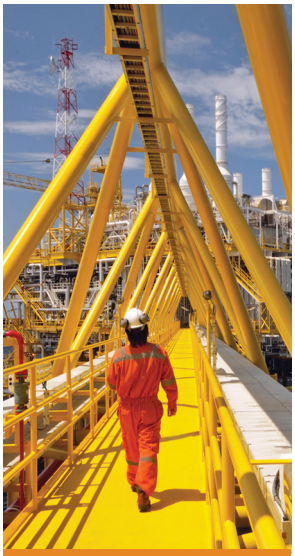
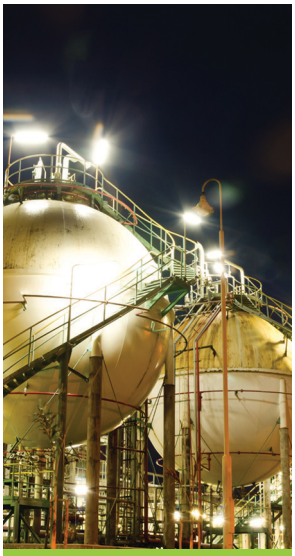
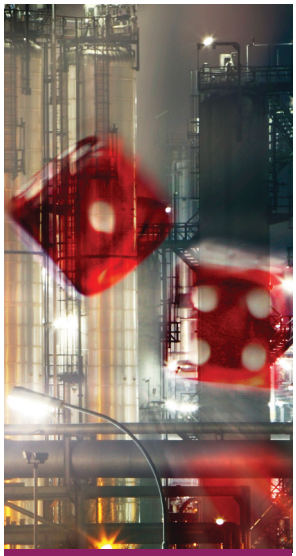

Workforce


Assets

Operations

Compliance


Risk

Operational Sustainability® makes operational excellence simple.

Succeeding in today's complex, highly-regulated industries depends on how well your company manages **operational risk** and enables **operational discipline**. Our world-class advisory services and our industry-leading cloud-based, highly configurable software work together to enable your company to achieve **operational excellence**. To implement OE 4.0 and sustain **operational integrity**, companies must balance production goals with reliability, safety, and human and environmental factors. We identify and help you solve any issues to move to a real-time, mobilized risk-aware culture. With an average of more than 30 years of industry experience each, our advisors can design a solution tailored to your company's culture and needs.

Learn how Operational Sustainability can advise your workforce through our consulting services and support your journey to operational excellence through our OESuite® software platform. See our full slate of free webinars, white papers, detailed module information, and scheduled workshops online at **www.DrivingOE.com**.

Schedule your free consultation and demo today.

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