



WHITE PAPER

Design for reliability: A pathway to optimize project and asset lifecycles





Design for reliability

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Data is everywhere. The increased digitization of industry has introduced new technologies able to generate billions of pieces of data relating to equipment, processes, units and/or entire manufacturing complexes. As the global hydrocarbon processing industry (HPI) evolves through this Fifth Industrial Revolution (Industry 5.0), asset owners have access to huge amounts of data to optimize the entire project value chain from concept/design and construction to operations, maintenance and cybersecurity. From engineering, process, operational and financial data, we seem to be collecting more and more data at increasing speeds. However, only a portion of collected data actually gets used in the decision-making process, leaving decision makers with an information vacuum.

It is well known in the industry that data is of limited use unless it has context, is aggregated with other data to form information and is of use to those needing it. Similarly, data that is siloed within organizational groups, digital systems or in binders on the shelf makes the operational excellence journey much more difficult, time consuming and produces substandard results. Managers and engineers need interoperable systems that can dynamically monitor operations and provide insightful, actionable data that aggregates into decision-making information and can be shared across all disciplines within the facility quickly and easily. Harnessing the ability to capture data and allowing it to flow across the project and operational spectrum can provide tangible benefits in all areas of project, operations and maintenance lifecycles.

The real value of data is converting it into actionable information. Having the ability to capture, analyze, contextualize, visualize and combine data provides managers, engineers, planners and other frontline personnel with actionable information to optimize their respective processes. Octave's tools enable workers to harness these actions and boost productivity and efficiency with a unified, role-based and real-time view across a facility's projects and operations functions, a concept called Smart Digital Reality. This enhanced digital technology is much more than a digital twin, it provides, in near real-time, a comprehensive look into the characteristics, status and performance of projects and assets, including viable pathways to increase efficiency, profitability, performance and safety. In turn, this builds a more intelligent and autonomous "digital projects" and "digital assets" outlook for personnel.

Smart Digital Reality

Design for reliability and the Digital Backbone

The concept of Design for Reliability (DfR) refers to tools, analyses, practices and methods that seek to minimize design weaknesses leading to early asset and process failure and unreliability. It is a systematic, engineering approach where reliability and cost-effectiveness are optimized throughout the planning and development lifecycle. In modern industry, not doing DfR is no longer a viable or smart business decision. Remember, reliability is a business decision.

Why Design for Reliability? Reliability is the measure that an asset system will perform its intended functions for a specified period in its current operating context over its lifecycle. In the HPI, managers and executives struggle with which reliability improvements will result in the optimal return for their company, asset or facility. This challenge exemplifies why decision-making information must be of the highest quality.

Many times, there is a struggle between what the owner/operator wants the asset to do vs. what the asset can do. For example, running equipment harder may increase production in the short-term; however, it degrades the asset faster, leading to a shorter lifecycle, additional failures, diminished production, the consumption of more parts and materials, additional labor needs, higher safety incident risks and greater risks of environmental breaches/releases, more rigging, the need for additional tools and rentals, higher costs, and much more.

DfR is not a concept only when the asset is in operation. Facility owners must think about reliability early in the concept phase of a project and carry it through the entire design and build phases, which will ultimately determine the reliability of equipment and processes later in its operational lifecycle. Designing for maintenance and reliability readiness during capital projects can increase profitability upward of \$500 million in the first five years of operation, as well as save more than \$23 million during construction.¹

As shown in Figure 1, it is far more costly to deal with reliability issues once the asset is in operation vs. upfront in the design process.

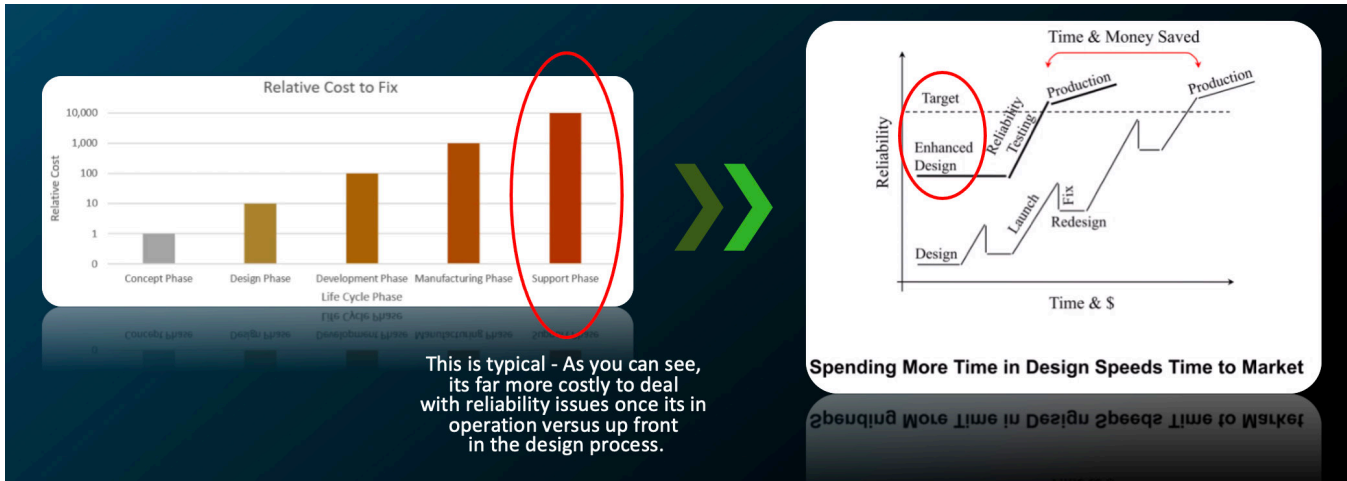


Figure 1. The business case for DfR, and how it can enable assets to reach reliability targets and operational startup quicker and cheaper than the traditional approach.

Many owner operators wait until the operations phase to start thinking about reliability. However, if that money was spent in earlier phases of the project (concept and design phase), operators would be able to avoid the larger chunk in the support/operational phase. This concept is explained in the right image of Figure 1.

Following the bottom line, after design, reliability goes up but inevitably falls due to startup failure. Startup failures can be caused by a host of reasons but are mostly due to human error: poor functional design or quality manufacturing, the wrong assembly or installation and incorrect operation, among others. This cycle repeats itself through the operational launch, with equipment breakdowns, defects and other mechanical mishaps that reduce asset reliability. This approach delays the facility's ability to reach its reliability target. Conversely, an enhanced design built upon DfR principles enables assets to reach reliability targets much quicker. This enhancement is primarily due to reliability assurance through analysis and testing prior to production, which significantly increases the facility's time to startup, saving both time and money for the asset owner.

This is why the Smart Digital Reality spans across the integrated ecosystems: of Design, Build, Operate and Protect (DBOP) (Figure 2). Although these terms have traditionally been seen as separate operations, DfR treats them as one holistic, integrated approach to reliability and efficiency. Data is captured and made available along the Digital Backbone, where operating context is added through application services. This process converts the data into actionable information in all areas of the project and operations ecosystem.



Design



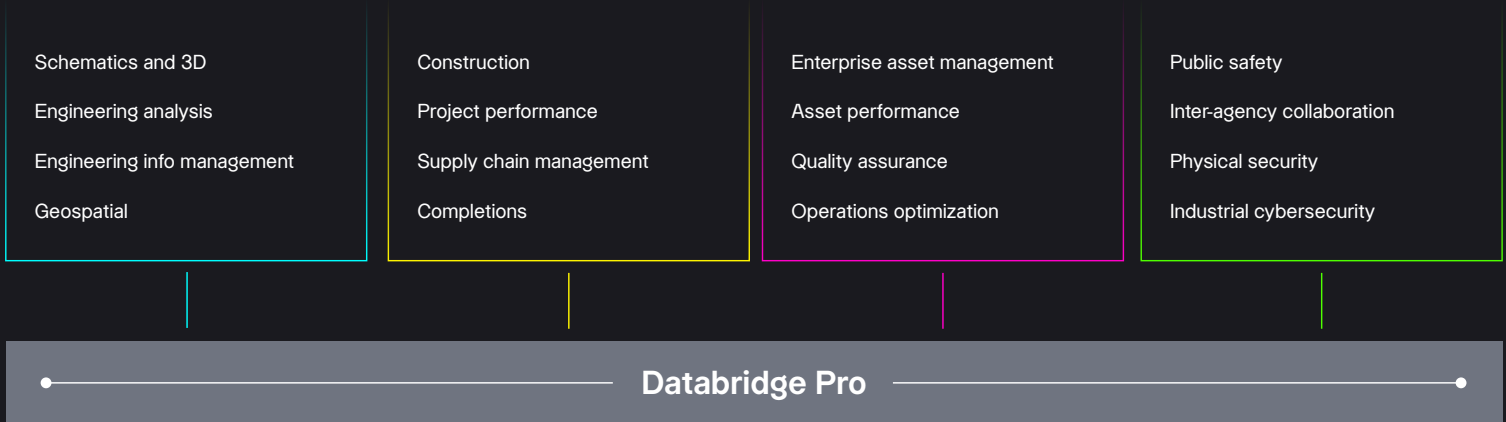
Build



Operate



Protect



Databridge Pro is Octave's common integration platform that seamlessly moves and transforms data across systems, connecting and enabling workflows end-to-end across the Design, Build, Operate and Protect pillars.

Figure 2. DfR is the concept behind Smart Digital Reality. Data is captured and usable across the Digital Backbone that spans across all areas of the project and operations lifecycle.

The Digital Backbone connects all phases of the industrial asset lifecycle (Figure 2): Design, Build, Operate and Protect (DBOP) This system provides autonomy, analytics, artificial intelligence (AI) and other cutting-edge digital technologies to accelerate a facility's digital transformation, enhancing value by optimizing productivity, safety, regulatory compliance and reliability.

So how does this integrated system work? The Smart Digital Reality ecosystem creates feedback loops between Digital Projects and Digital Assets through the Digital Backbone. Any changes made along the various (DBOP) phases are captured in the Digital Backbone and fed to all points along the ecosystem. This ensures that all data/information is up-to-date no matter what stage or operation personnel are engaged in along the asset's lifecycle. This data is readily available on-demand and on any device. In turn, this actionable, up-to-date data provides personnel with the ability to capture additional economic benefits.

For example, organizations utilizing Smart Digital Reality can:

- Reduce cost overruns
- Improve maintenance efficiency
- Improve operational efficiency
- Reduce inventory and documentation efforts

The Digital Backbone provides an effortless way to leverage intelligent technologies to digitalize key work processes and accelerate an organization's path to a more autonomous and sustainable future. It also enables individuals to harness insights and benefits along their respective PDEOMS focus. The following will examine how personnel can leverage Smart Digital Reality to drive business efficiency along the various projects and operational phases of the asset lifecycle.



Digital Projects

DfR begins in the early stages of project development. Utilizing the Smart Digital Reality's Digital Backbone, project planners and constructors can access digital tools to optimize the process, ensuring each phase — plan, design, execute — is completed successfully. In turn, this ensures a smooth transition from the project's lifecycle to operations.

Design

The planning phase is one of the most crucial phases in a project's lifecycle and can set up organizations with success or failure. However, many asset owners lack imperative and/or timely information, hindering their decision-making capabilities. This negative aspect can also affect the engineering, procurement and construction (EPC) contractor's task to fulfill the owner's capital investment initiatives. In essence, poor planning and design can impede project success before it even gets off the ground.

To combat this situation, project developers can harness the power of data to help manage project planning and provide additional insights for more informed decision-making. This is accomplished through an enterprise project performance (EPP) strategy, which integrates processes across the full project lifecycle, improving efficiency, predictability and control to maximize project success.

An EPP strategy is made possible through integration, automation and standardization, which supports data and asset reliability. Integration enables organizations to pull data and third-party information into one unified platform. New data is cycled into the data loop, ensuring all parties are provided the most up-to-date information/data.

The constant updating of the data loop is made possible through automation. As data is transferred from system to system, it decreases the potential for human error since all parties are provided with the latest project information. Automation helps personnel to spend their time on higher-valued operations instead of time-consuming tasks of searching for specific data through various sources.

As data and processes are integrated and automated through the EPP system, it is standardized to ensure the best, most strategic collection of projects are greenlit, and in turn, all projects are planned in a consistent manner according to industry/organizational best practices. Standardizing processes can optimize capital budgeting and planning, portfolio planning and control, resource planning and management, estimating and benchmarking and much more.



An EPP strategy builds a strong foundation that provides the project developer options should unforeseen circumstances arise, enabling the ability to pivot plans quickly in later stages of the project's lifecycle. It provides businesses with the ability to align projects and priorities, allocate resources properly according to priority, proactively help plan for investment needs over the long term and maximize financial returns.

The design phase of a project is full of challenges and obstacles to overcome, such as project costs, safety and regulations, among others. However, traditional design processes were completed with manual, paper-based pathways, which led to inaccuracies and inefficiencies. Utilizing digital tools is a pathway to streamline the design phase in project management, as well as provide quality and efficiency to the project's lifecycle.

The Smart Digital Reality design process is built on conceptual design and detailed engineering. Digital tools such as virtual 3D models and simulations provide designers with dependable data to maximize project cost-benefit. Conceptual design and detailed engineering incorporate these tools to build a clear, concise picture of the overall project layout and intricacies to maximize design accuracy, leading to faster project execution and quicker startup.

It is also imperative to involve operators and maintainers in the design stages of a project. This approach can have a dramatic impact on the project and operations lifecycle. In DfR, several value activities are performed that can maintain and enhance integrity, operability and maintainability:

- Increases knowledge transfer and ensures that future workers are provided with the tools, resources and know-how for efficient operations
- Reinforces a proactive, asset-minded culture
- Past challenges are properly documented, so workers can refer quickly to known solutions when needed
- Design process improvements should focus on design-in (i.e., reusability, wish lists, should-haves, nice-to-haves) and design-out approaches [defects, overproduction, waiting, non-used talent, transport, inventory, motion, extra processing (DOWNTIME)].

Build

After a project is planned and designed on a reliable, data-based process, it is time to execute it. Much like the two earlier phases of project management, the execution phase is wrought with challenges. These primarily include challenges in supply chains, fabrication and construction.

Capital projects are getting more complex, adding concerns in managing project budgets, scope, safety, regulations and more. Poor project execution can quickly lead to disruptions and time overruns, all increasing the project's cost. Utilizing the Smart Digital Reality's Digital Backbone, project managers/ engineers and EPCs can access vital information to optimize supply chains to ensure equipment and supplies are precise and cost-efficient. These tools (Sequence Enterprise, Loop Material Readiness (formerly Jovix), among several others) provide real-time visibility to all stakeholders throughout the supply chain and incorporates digital technologies [i.e., radio frequency identification (RFID) tags to know where equipment is always] and centralized dashboard hubs to monitor all aspects of a project's cost, schedule, risk, productivity and performance.

These tools can also optimize fabrication and construction phases, helping to avoid costly material surpluses and shortages. The Smart Digital Reality can also improve coordination, planning and collaboration across all construction personnel and contractors, enhancing EPC work processes for better project execution.

Digital assets

Planning, designing and executing a capital project are only half of the asset's lifecycle — what you build, you live with for the next 30 years. Smart Digital Reality extends into the operational phases of a facility to ensure reliable and efficient operations to maximize equipment uptime and processes — i.e., the asset integrity lifecycle (Figure 3). The operational phase includes maintaining and securing the asset.

Asset integrity lifecycle - Technical assurance and optimization loop

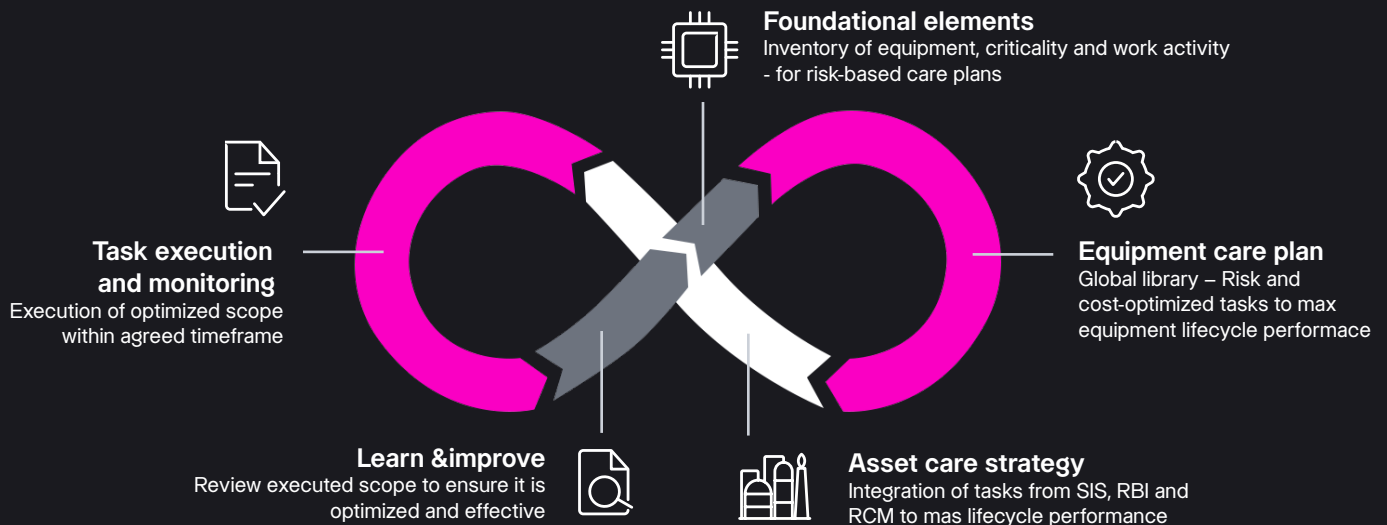


Figure 3. The asset integrity lifecycle. Source: Cenosco.

Operate

Once a project has been completed, it is put into operation. This is when equipment and processes come to life, another area where insightful data can improve operator situational awareness and achieve operational excellence. The operational phase spans across two areas: operations management and environment, health and safety (EHS) risk. Since enhanced digital tools like the Smart Digital Reality's Digital Backbone cycles the latest data across all disciplines, all internal and external stakeholders can access crucial information in a timely fashion. This ultimately breaks down silos and creates more collaboration, leading to increased productivity and operational excellence.

Optimizing operations management provides personnel with the ability to better manage EHS risks and ensure regulatory compliance. All generated data is integrated, accessible and shareable among various operations, maintenance and management teams. This empowers operations personnel to increase reliability/unit uptime and boost safety.

Octave's digital tools can increase operator situational awareness, mitigating abnormal situations and providing actionable data for quick decision-making. These tools include the ability to:

- Improve alarm system management and operator effectiveness Octave Tempo Alarm Management (formerly PAS AlarmManagement)
- Monitor, assess and tune control loops for optimal performance Octave Tempo Control Loop Performance (formerly PAS ControlWizard, TuneWizard)
- Define and analyze performance against operational limits Octave Tempo Boundary Analytics (formerly PAS InBound)
- Mitigate risk and ensure safety by increasing independent protection layer (IPL) visibility Octave Tempo Safety System Performance (formerly PAS IPL Assurance), Octave Tempo Control System Effectiveness (formerly PAS PlantState Integrity)

This data-centric approach optimizes operations by ensuring process safety and production goals are met, expedites an organization's digital transformation from paper-based procedures and work processes to easily accessible and up-to-date digital platforms, prevents operator fatigue and ensures compliance with EHS regulations.

Asset management is imperative for long-term business success. Poorly managed equipment and processes can quickly lead to constant maintenance, shutdowns and even safety or environmental hazards. Equipment and materials break down over time, leading to costlier fixes, maintainability and possible unit downtime. In addition, the lack of knowledge transfer between generations of employees – or even from shift-to-shift – has been a constant challenge within the processing industries. All these challenges can negatively impact processing efficiency.

To remain competitive and ensure optimal operations, facility owners/operators need a proactive approach to asset management that involves effective planning, investment and innovation. Those that adopt digital technologies into their operational approach can gain significant benefits, leading to more efficient and profitability production.

Octave Attune EAM (formerly HxGN EAM) focuses on the various levels of the asset lifecycle: maintenance management, asset integrity and reliability and sustaining engineering. The EAM solution provides facility management, supervisors and frontline engineers with full visibility into asset performance to enable predictive maintenance and optimization of maintenance team resources to keep them informed, productive and safe. The EAM solution enables facilities to switch from a reactive approach to maintenance and operability to a more proactive and predictive pathway, which leads to better decision-making and asset performance and longer asset life. It is fully integrated across the asset lifecycle to improve visibility of historic, current and planned maintenance tasks. The EAM solution harnesses AI, machine learning and advanced analytics to connect critical data sources across multiple platforms and establish leading and lagging industry standard key performance indicators (KPIs) to improve maintenance efficiency, asset reliability and sustainability, production quality and regulatory compliance. Additional benefits of Attune EAM include:

- Cost optimization to enable effective cost control of maintaining mission-critical equipment
- Capital allocation to increase asset service life, reduce capital expenditures and improve spare part inventories
- Automation and intelligence to improve asset energy usage and extend asset life
- Digital operations and asset utilization to harvest organizational knowledge and enable safe operations and increased productivity

Protect

Octave Cyber Integrity (formerly PAS Cyber Integrity) provides actionable insights of potential cyberthreats to enable frontline automation engineers and OT cybersecurity professionals identify, evaluate and prioritize risks efficiently.

The solution evaluates risk from multiple angles for improved mitigation or remediation strategies:

- **Environmental:** This relates to the industrial environment and the connections between assets, which provides visibility into how a particular vulnerability could impact other assets within the same operational environment.
- **Vulnerability:** As cyberattacks evolve, so must an industrial complex's protection. Octave Cyber Integrity can monitor new threats and use automation to determine the vulnerability and strategize the best solution to mitigate or remediate the situation.
- **Temporal context:** Risk is not a one-size-fits-all scenario. Many variables determine the impact a cyberattack can have on an industrial facility. Using variables such as data sensitivity, criticality and safety impact, Octave Cyber Integrity provides the necessary context to effectively assess risk within the OT/ICS environment.

By utilizing Octave Cyber Integrity, facilities can gain a complete asset inventory of OT and IT endpoints, reduce the attack surface and cyber risks by knowing and managing vulnerabilities, improve asset and system performance by employing configuration management, improve incident response with deep forensic analysis of configuration changes and ensure business continuity by having a trusted backup and restore point.

Where to begin

As the HPI evolves through the Fifth Industrial Revolution (Industry 5.0), new digital technologies are enabling asset owners to fully grasp and take charge of the full asset lifecycle. This includes designing, engineering and building capital-intensive production capacity to operate and maintain these assets. Monitoring how units, processes and equipment are functioning in real-time, along with proactive measures to increase asset lifecycles and optimize maintenance duties is also important.

Asset owner operators should partner with a reliable, proven digital provider that can fully optimize their asset's project and operational lifecycle. Octave employs its Smart Digital Reality solution to provide owners with the latest digital asset management system to fully realize a more intelligent and autonomous "digital projects" and "digital assets" outlook for personnel.

This solution is built upon the concept of DfR that seeks to minimize design weaknesses leading to early failure and support systems from early development to end-of-system and asset life. Why design for reliability?

The decisions made in the early stages of a project will ultimately affect how that system operates for the next 30 yr. DfR is more than a concept, it is a pathway to optimize project and asset lifecycles. Because of its importance, reliability is a business decision.

¹ Cahill, J., "Business justification for maintenance and reliability readiness," Emerson, October 14, 2014, online: <https://www.emersonautomationexperts.com/2015/asset-management/business-justification-for-maintenance-and-reliability-readiness/>

About Octave

Octave is a leader in enterprise software, turning data into decisive action and intelligence into your edge. Our software solves for and simplifies complexity, from the design and build to operations and protection of people, property and assets – for any scope, at any scale. For decades, we've partnered with customers to sharpen performance, elevate efficiency and amplify results. From factory floors to entire cities, our solutions are tuned to scale up what's possible from day one onward.

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