



Operations +

Maintenance +

Services +

GE Power Conversion's Digital Suite

Intuitive **digital tools** and **expert services** to enable operational and business outcomes that matter

DIGITAL

gepowerconversion.com





POWER CONVERSION'S DIGITAL SUITE

The right information, into the right hands, at the right time. Putting software and analytics into action.



Software and analytics are changing the way we do business

Every year industries spend billions of dollars on equipment – not just capital costs but also maintenance, downtime and even inefficiencies. That’s a lot of money. And because industrial machines are often critical to infrastructure and economies, we all still pay it every year. Of course, it’s good to invest to keep assets healthy. But what if we could get more out of that investment – more predictability, better and simpler situational awareness, improved performance?

Software and analytics are changing the way we all do business. They can provide us with a wealth of information, but it needs to be accessible, useful.

At GE’s Power Conversion business, we put to play software and analytics, connecting the physical world with data, to enable operational and business outcomes that matter. We create usable tools and valuable insights to help you optimize asset integrity and operational performance. This helps better adaptation of operations to different priorities and changing environments. It means that decision-making can be driven by data, information and insights.

In addition to GE’s expertise in digital solutions, our deep domain experience means we understand applications across the marine, energy, process industry and infrastructure sectors. We have more than 100 years of electrification expertise and one of the largest installed bases of electrical and control assets. They work to high performance and availability requirements, and in rugged and remote operating conditions.

Our engineering and software know-how unite to enable intelligent asset strategies. We build solutions that work for your business model, helping to improve investment return on your valuable business assets.

GE Power Conversion's Digital Suite

Making data work harder, enhancing performance

If you're looking for ways to reduce downtime and enhance the performance of operations and assets, GE Power Conversion's simple suite of clever software applications can help. Its flexibility includes 'on-prem' and cloud-based options which help to optimize operations and energy, and enable predictive maintenance and cyber-secure service solutions.

GE Power Conversion's digital suite is based on a straightforward, modular range of digital app's, tools and services, connecting data with the right people. Already, more than 500 sites are benefiting from Power Conversion's digital solutions.

Each of our three easy-to-navigate modules focuses on a key area of improvement:

Operations+, Maintenance+ and Services+ tools and apps provide solutions for organizations of all sizes, regardless of their current level of digital transformation. Simple to install and user-friendly, Power Conversion's digital suite is about connecting people with their machines and equipment through useful, actionable intel and real results.



Operations+

Unlock greater efficiency in ops performance and energy efficiency

Operations+ solutions include **Performance, Process** and **Energy Optimization**. Operational efficiency, repeatability and safety are enhanced with the help of real-time feedback on operational Key Performance Indicators (KPIs), with advisories for timely and targeted intervention.



Maintenance+

Improve reliability and availability, right-timing maintenance and planning downtime

Maintenance+ is your **Asset Performance Management** range of tools, protecting your investment in valuable equipment by helping to improve its availability. It provides a view on the health of your critical assets with early warnings of developing issues to help you take timely, corrective actions. This can unlock a shift from unplanned to planned downtime, or even avoid downtime altogether.



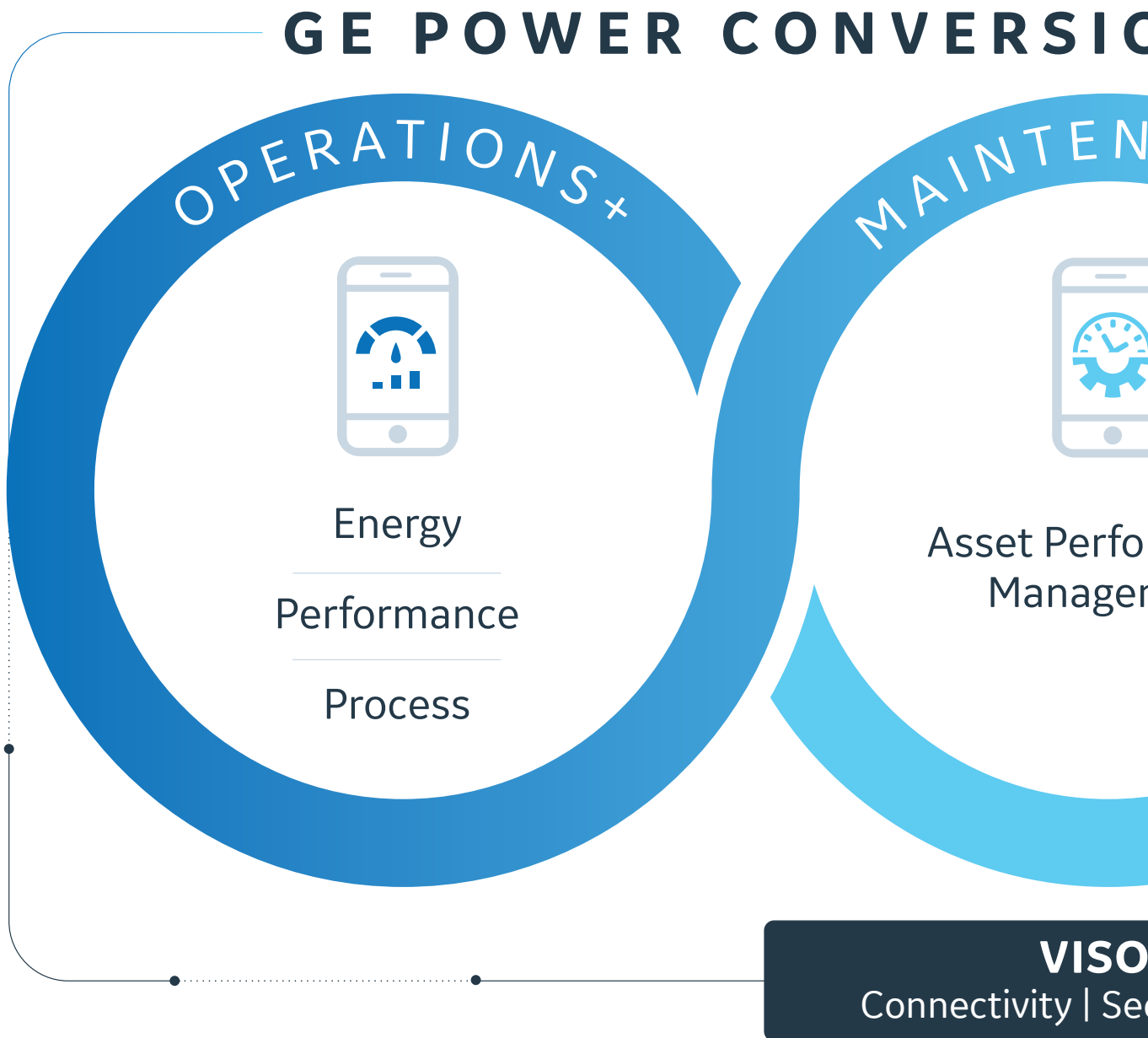
Services+

Access remote services and experts for on-tap asset health support

Services+ helps to extend your organization's capability and resource with a 'lean' mindset. It's about tapping into GE expertise at the point you need it, and includes our **remote engineering** solution for remote monitoring, diagnostics and support.

Understanding performance

Critical assets may not always perform at their peak. Understanding when and why they perform below peak levels unlocks the opportunity to improve performance. Even the smallest unplanned downtime and loss of efficiency can hit the bottom line.

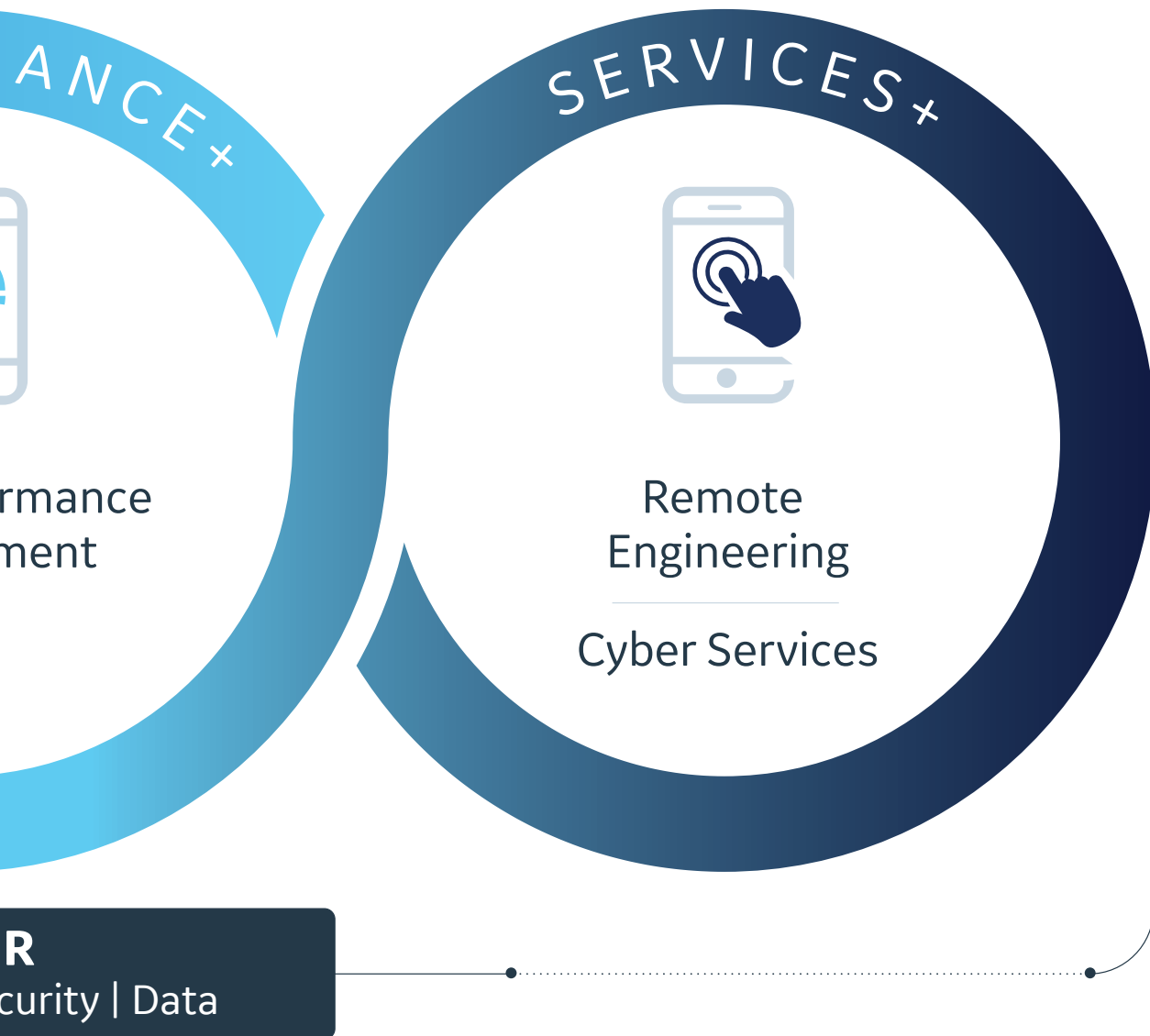




Analyzing past and present performance in detail, and using that information to improve efficiency can leverage more from your investment in critical equipment and operations.

This is where GE's Power Conversion business can help.

ON'S DIGITAL SUITE



Operations+

GE's Operations+ solution provides real-time insights into system efficiency and effectiveness. To help optimize your operations, its range of tools compares how well your system functions and how performance varies over time.

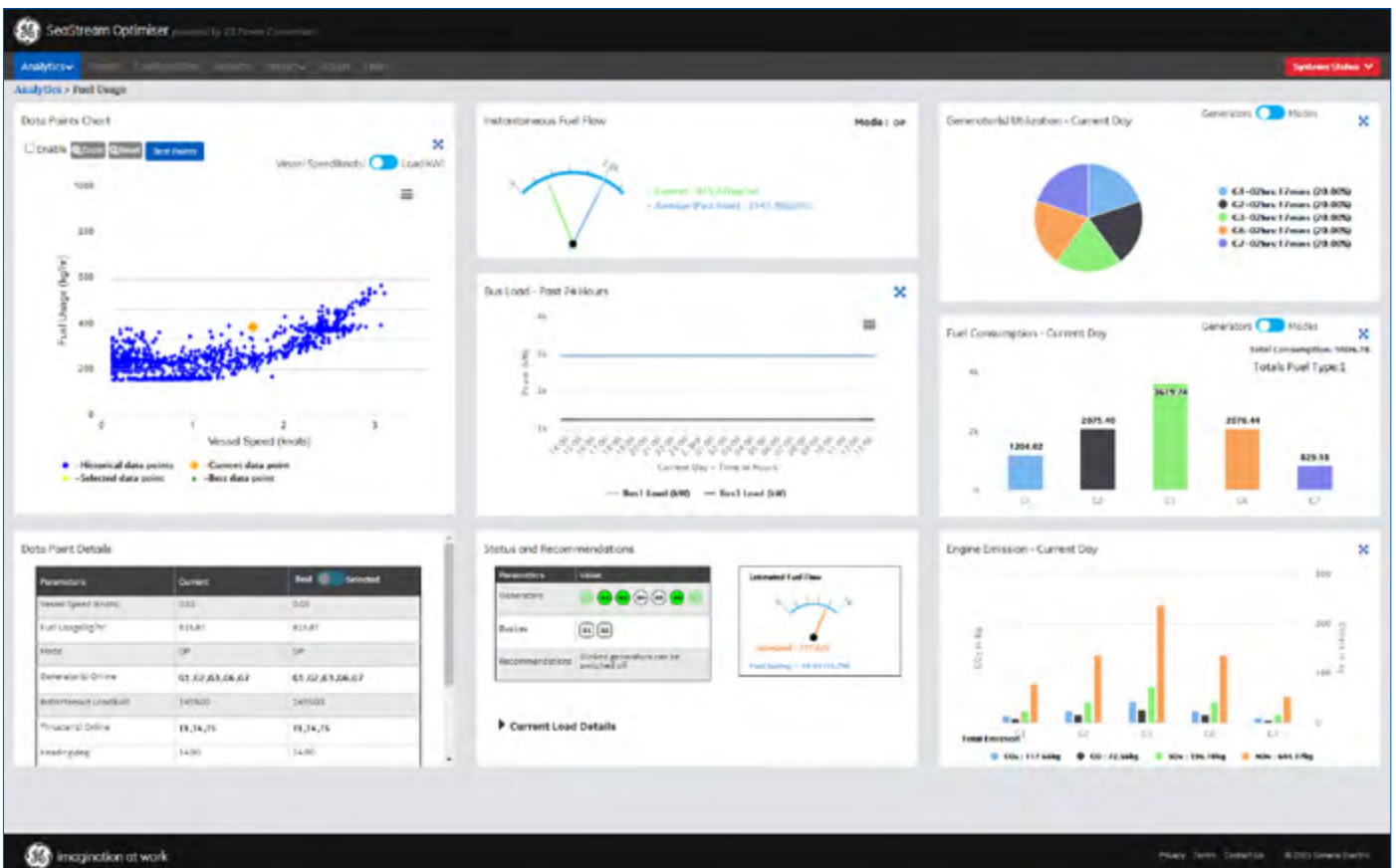
Energy

Focused on boosting energy efficiency to enable reduced fuel consumption, emissions and fuel costs

The **Operations+ Energy Optimization** tool is suitable for a range of industrial applications, but particularly those with high fuel and energy usage looking for effective ways to help achieve cleaner operations and manage operational expenditure.

USE CASE: In the marine industry, **GE Power Conversion's Energy Optimization** app has been used to simplify operator compliance with IMO energy reporting requirements, helping to reduce operator workload. Operations+ Energy Optimization compares your vessel's current and historic operating states, profiling similar speed, system load and weather conditions. It then analyzes the factors resulting in any difference in fuel consumption and associated emissions. It provides the operator real-time, simple information on how the power system is running, **recommending an enhanced configuration** that helps improve fuel efficiency and reduce emissions – all from an intuitive, on-prem dashboard.

The clear, easy-to-understand data dashboards facilitate the crew to make informed, real-time decisions on how best to operate the power system. Our Energy Optimization app is designed to work seamlessly on vessels with GE's SeaStream Vessel Control and Dynamic Positioning Systems, or any other vessel control and automation system.



Customer Success Story

Deployed on an offshore vessel, GE's Operations+ Energy Optimization app used six months of operational data to demonstrate potential of **upto 30% fuel savings during specific operating conditions**, without sacrificing transit speed or system integrity (and while maintaining sufficient spinning electrical power reserve).



OUTCOMES

GE's Operations+ Energy Optimization app has helped our customers:

- Realize that their vessels may not be operating as efficiently as intended
- Identify systems running under sub-optimal conditions, with particularly easy opportunities to reduce energy consumption during non-mission-critical activities (such as transit)
- Uncover simple, immediate configuration options to impact energy use (such as the number of generators online, bus-tie status, and load-dependent start/stop thresholds)
- Demonstrate lower carbon fleet credentials to their customers and stakeholders
- Achieve reduction of fuel by about 30% in some scenarios



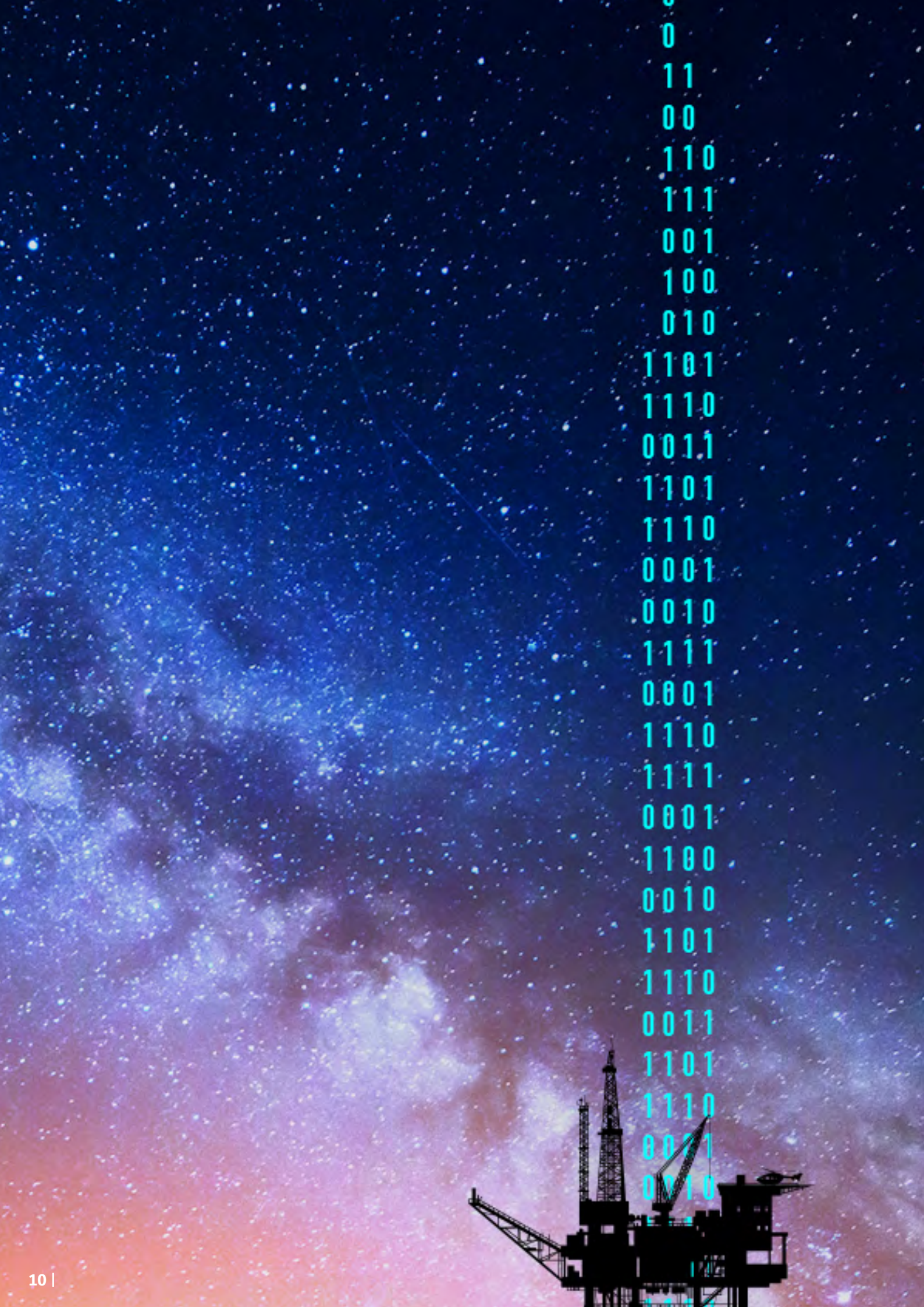
Performance

GE's Operations+ Performance Optimization tool provides a simple interface to analyze true system capability by comparing actual functional performance with previous performance under the same conditions.

In comparison with GE Power Conversion's Maintenance+ APM solutions that monitor equipment health, this Operations+ Performance Optimization tool delivers enhanced insights into your asset's functionality. We could guide you to adjust settings, tolerances and manage operator trainings by working with you on dashboards for equipment KPIs, thereby enabling operational improvements.

USE CASE: Our **Operations+ Performance Optimization app** can show the real-time performance of your dynamic positioning (DP) system. Capturing performance of a vessel over its lifecycle helps you enhance performance and lower your risk during DP operations. With our Performance app, you'll be able to see your vessel's true capability via real-time information, and view failures that take place during DP operations.

Our **Operations+ Performance Optimization tools** deliver smart system learning capabilities to help experienced users and support new operator and refresher training, even helping share best practices for energy efficiency between sites or across fleets.



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Process

GE Power Conversion's Operations+ Process Optimization tool brings real-time operational intelligence to help optimize your operations, based on data-driven decisions

By analyzing repeatable equipment movements in your operations, our Operations+ Process Optimization tool helps streamline benchmarked processes for improved performance. This is done by using gathered data to create Process Autodetect Models to help determine both operational inconsistency and time variances.

A key benefit of the **Operations+ Process Optimization tool** is a shared source of information – that delivers the ability to communicate timely, significant information between teams to provide immediate feedback for improvement or troubleshooting.

Any industry process that deploys equipment for repetitive tasks can benefit from the analysis performed by our Operations+ Process Optimization tool. A breakdown of the discrete steps required for each task is presented on your dashboard, and the tool evaluates variations and identifies opportunities to speed up specific process steps. A prime example occurs on an automotive production line, where our Process Optimization can be put to use analyzing distinct operators to improve efficiency through specific training. With your dashboard, you can see the impact of improvements, and dig into variations.

USE CASE: GE's Operations+ Process Optimization tool has been helping enhance drilling productivity by evaluating activities that are carried out on the rig main and auxiliary floors, then mapping the process at the activity level. One such activity is 'tripping in', where a section of drill pipe is moved to the well center, connected, then lowered down the well to the seabed. Data from each part of the process can be tracked, timed and viewed on an operator dashboard. Through equipment analysis, you may identify areas for process efficiency improvements, enabling an accessible shift from Drilling-as-an-Art to Drilling-as-a-Science.

Customer Success Story

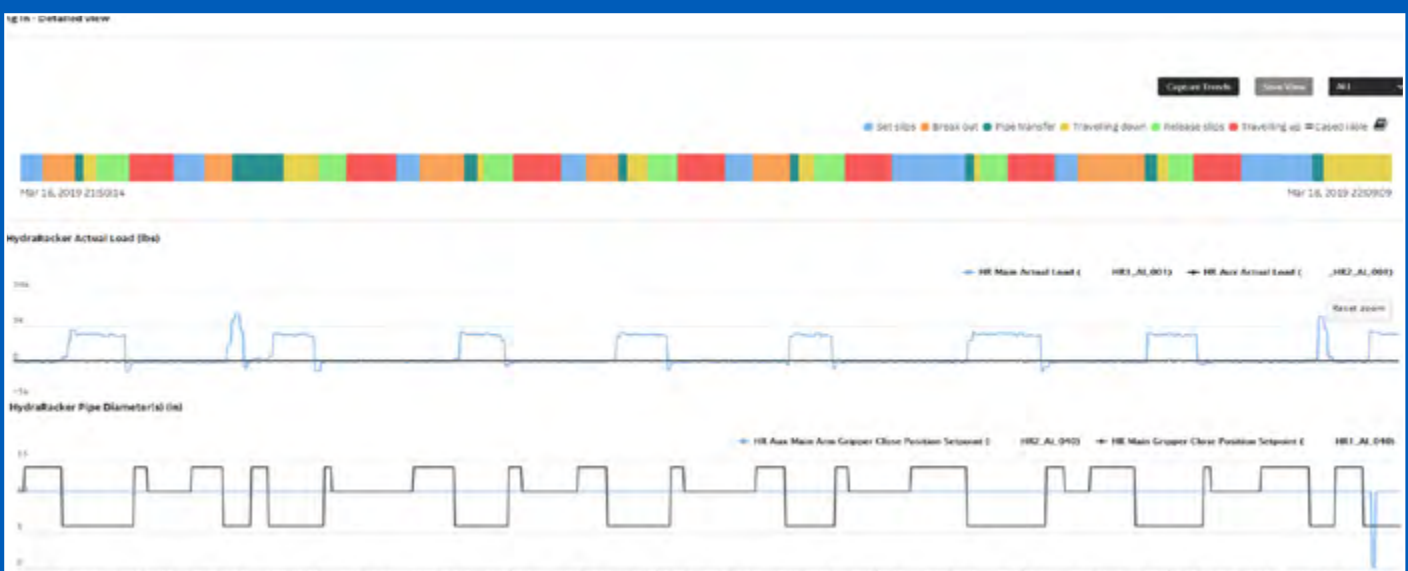
Our customer observed inconsistent pipe transfer durations when the pipe racker moved it from the well center to the finger board.

On two occasions the pipe racker's attempt to pick up the stand failed, resulting in decreased efficiency and slower tripping times. That's when GE's Operations+ Process Optimization tool was called on to help.

OUTCOMES

Our GE Power Conversion's Operations+ Process Optimization tool helped our customer:

- Detect potential fatigue failure of equipment components
- Recognize drill team training opportunities
- Identify inconsistent durations for the same process that led to slower tripping speeds



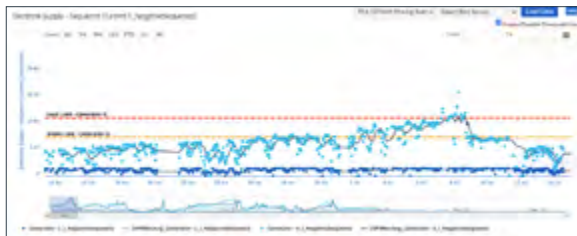
Maintenance+



Asset Performance Management (APM)

Transforms equipment maintenance with unique analytical techniques and support

GE's Maintenance+ APM tools evaluate asset health by analyzing data from key systems, like rotating electrical machines and power electronics, using KPI analysis and Electrical Signature Analysis (ESA). Our tools assess asset health and monitor for performance degradation, providing an early warning system and helping operators to reduce unplanned downtime.

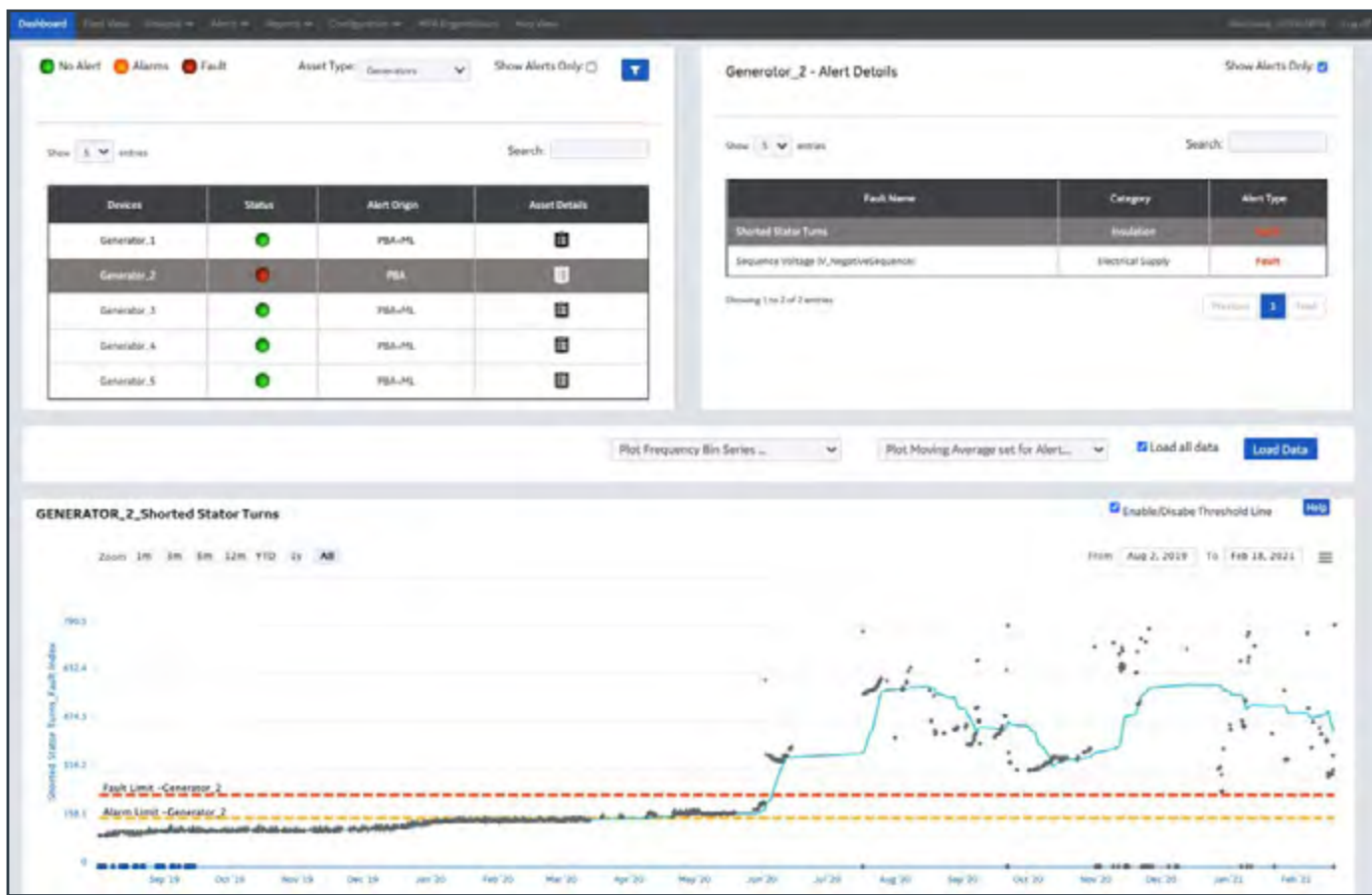


USE CASE: Many organizations already benefit from our **APM for Rotating Machines and Drives** solutions, which collect in-depth data when applied to drives and rotating machines manufactured by GE. This can also be suited for rotating machines of non-GE make.

With extensive expertise in variable frequency drives and more than 100 years of experience engineering motors, generators and control equipment, our specialists put their software, data and domain expertise to work for you. We can provide early warning information of potential failures—with input from high-frequency sampling, Electrical Signature Analysis (ESA) and Machine Learning (ML)—to help you shift from unplanned to planned maintenance, thereby enabling reduced downtime.

Our solutions can be applied to any industry segment that uses electrical rotating machines or drives, such as the Wind, Metals, Marine and Energy sectors, to name a few.

The GE difference is in translating analytics to user-friendly information and actionable insights for faster and more-informed operational decisions. Not only do we help operators to identify future issues, we also enable through insights, the avoidance or resolution of those issues and also facilitate planning for spares requirements.



Customer Success Story

When our wind energy customer needed a solution to provide early warning of potential generator and gearbox issues to avoid unplanned downtime, they turned to GE for our Rotating Machines APM solution.

An indication of increased negative sequence current was observed in one of the generators, months in advance of the actual failure. When compared to an adjacent wind turbine’s healthy generator, the degrading condition was observed. The cause was connected to broken slip ring brushes on the generator and the early warning helped customer to minimize the unplanned maintenance cost and loss of production from downtime.

OUTCOME:

Our Rotating Machines APM solution helped our customer:

- Enhance predictivity for better early warning capability
- Minimize unplanned maintenance costs
- Reduce production loss from downtime





Services+



Remote Engineering

Delivers on-tap expertise to remotely manage, update and check on the health of your assets

As the world adapts and even benefits from increased digital remote operations, GE's Services+ Engineering solution is the secure interface between your operations and our Ops Centers. It provides peace of mind to have your teams and equipment connected quickly and directly with an engineering specialist and our diagnostic tools. Reducing the time and travel costs associated with experts visiting your site, this cost-effective remote solution can help keep your teams lean.

How does it work? Connectivity for the Services+ Engineering solution's remote monitoring and diagnostics (RM&D) of drives and automation systems is enabled by GE's Visor Service Portal. The Visor data platform, which sits at the heart of GE Power Conversion's digital suite of solutions, provides a single, encrypted tunnel meeting security compliance standards to your site or vessel. Read more about GE's cyber security and the Visor platform and the Visor platform in the *Implementing Your Solution* section below.

The Services+ Engineering tool enables remote, secure software updates, too.



Cyber Services

We offer cyber security services to complement your Cyber Security Management System (CSMS), specifically aimed at supporting IEC62443 certified automation and control solutions. Our services include:

- Automation inventory creation and regular update surveys
- Advice on recommended product and system updates
- Risk assessments and threat modeling prior to updates/changes
- Patch monitoring to help enable quick mitigation of new exploits
- IEC62443 training



Implementing your solution

Conceived for operators

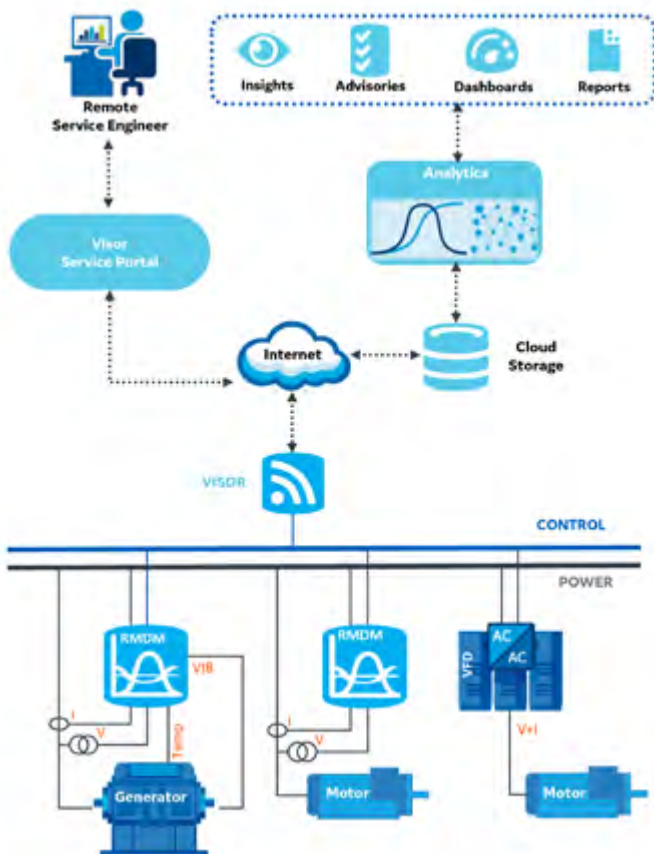
The suite is built on GE's industry wide expertise in IT, OT (operating technology) and IIoT (the industrial internet of things). Above all we believe it should be intuitive, visual and customized for your operational needs. Featuring simple, clear interfaces it provides organizations of all sizes with access to GE's powerful data analytics, made accessible and usable by providing better intel and situational awareness. Genuine performance improvements are within reach, to help your organization work with increased efficiency and profitability.

Selecting your solution

Choose a single app or a custom suite of tools from our three modules—Operations+, Maintenance+, and Services+. We are here to help you learn more about Power Conversion's digital suite value package, including the most cost-effective way to access solutions through integration with your Long-Term Service Agreement with GE.

Whether you have a single site, complex vessel, full fleet or a multiple-site operation, we can answer your questions and help align your selection with your organization's KPIs and operational priorities.

Common Architecture – Flexible and Scalable



Cloud Analytics + Dashboards

- Advanced algorithms and Machine Learning
- Single or multi-site asset views
- Cloud data storage
- Auto-reporting

Site Data Storage and Secure Transport

- Communications interface to site equipment
- Storage of collected data and files
- Deadband and reporting options for streaming
- Automatic file push to cloud (buffered)

Data Collection

- Direct from GE or customer owned non-GE equipment/systems
- Indirect using existing equipment
- Variable capture frequency to suit specific applications



COMPUTER

SECURITY

ONLINE SHOPPING

E-MAIL

SOCIAL

GLOBAL

LOCATION

NETWORK

SMART PHONE

WORKSTATION

SYMBOL

Installing the suite

Peace of mind with GE Power Conversion's Visor platform

One powerful data platform brings GE Power Conversion's digital solutions together—seamlessly and securely

Backed by more than 15 years of proven product experience, GE's Visor platform's common architecture — scalable to multiple sites — delivers the remote monitoring you need, while meeting the much needed security standards. The **Visor Service Portal** and **Visor Connect Box** enable data storage and remote connectivity, and provide a unified cloud dashboard for displaying analytics and insights.

The **Visor Connect Box** provides **remote access securely** through a simple, compact hardware installation that is connected to your system control network. It collects data and stores it in compliance with security standards. It also acts as a gateway, sending data to be discussed to GE Power Conversion's cloud storage and allowing our experts access to the system – under your control – to provide Services+ Engineering support. As an important data and network interface it incorporates our security management suite in alignment with the IEC62443-4-2 protocols. Firewalls isolate Visor from administration and control networks.

Cyber Security

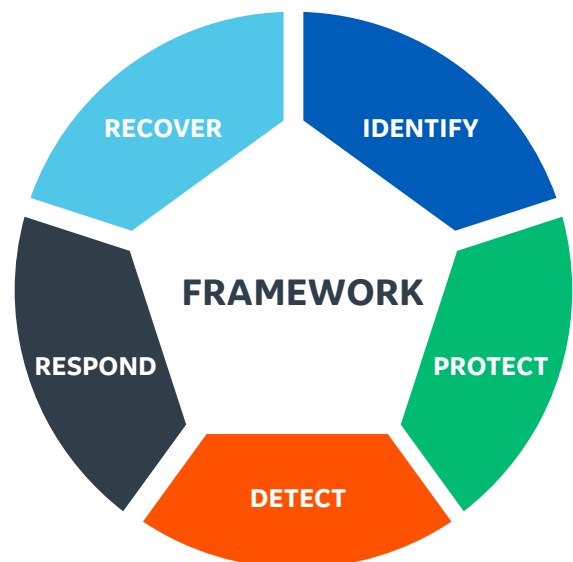
Reducing exposure to vulnerabilities associated with software and connected systems

Industrial applications benefit from enhanced operational performance enabled by electrification, connectivity and advanced controls, with increased use of software and analytics. Even in long-cycle industries, there is now a need to update systems more frequently than in the past – as people expect to do with personal tech – to reduce exposure to vulnerabilities associated with software and connected systems.

The latest standards specific to industrial applications reflect how important cyber security is for critical infrastructures. They also help to demystify and formalize security for both system providers and operators in a series of risk management outcomes.

Power Conversion's digital suite and our control and automation platforms are aligned with the NIST framework, IEC standards 62443 and 61508 for cyber security and integrity, and with specific industry sector requirements such

as IMO security guidelines. The platforms also are verified by Exida and Achilles certification. At a practical level our Visor data platform provides centralized user access management and system audit logging.





With you into the future

The next step on the road to enhancing performance will require fully autonomous systems. Many of our tools already incorporate smart automation and decision support, and we are working with you—our customers— to explore priorities for functionality without needing definite human intervention. Watch this space.



Services

With a comprehensive global network of service engineers and technicians, GE is uniquely positioned to provide the knowledge, experience and skills to help you protect your assets, maintain critical processes, lower risk and increase productivity.

We deliver original equipment spare parts around the world and we repair, refurbish and upgrade your systems with our latest technology. GE offers risk protection through contractual services based on system experience and sophisticated application calculations.

About GE's Power Conversion Business

GE's Power Conversion business applies the science and systems of power conversion to help drive the electric transformation of the world's energy infrastructure. It does so by making and delivering advanced motor, drive and control technologies that evolve today's industrial processes for a cleaner, more productive future. Serving specialized sectors such as energy, marine, renewables and industry through customized solutions and advanced technologies, GE's Power Conversion business works with customers to increase efficiency.

Conceived for Operators

GE Power Conversion's Digital Suite is built on GE's industry wide expertise in IT, OT (operating technology) and IIoT (the industrial internet of things). Above all we believe it should be intuitive, visual and customized for your operational needs. Featuring simple, clear interfaces it provides organizations of all sizes with access to GE's powerful data analytics, made accessible and usable by providing better intel and situational awareness. Genuine performance improvements are within reach, to help your organizations work with increased efficiency and profitability.

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