HEXAGON

Lighting the Way: The Digital Future of Reliable Power Transmission and Distribution

Hexagon's solutions can help your power transmission and distribution (T&D) operations prepare for tomorrow, today!

Introduction

Benjamin Franklin, one of the early discoverers of electricity who helped light the way for innovations that would impact the world centuries later, once said:

> ❝ **Change is the only constant in life. One's ability to adapt to those changes will determine your success in life.**"

Fast forward to present day. Anyone can attest that our world, our environment, our businesses and our lives have undergone fundamental changes as we continue to adapt and evolve into the "next normal."

Therefore, let us consider what the "next normal" will look like in relation to power transmission and distribution (T&D) and the roadmap for the journey to get there. According to Energy Innovation (2020),[1] falling costs coupled with falling emissions are the "new normal," as major utilities announce ambitious clean energy goals with customer affordability in mind, and due to economics and policy supporting these goals, wind and solar will become the national grid's new backbone. We have seen this trend arise daily in our news cycles — countries, states, cities and companies across the globe are committing to 100% clean electricity.[2] However, the existing fleet[3] of power plants is aging and faces expensive upgrades to meet federal environmental rules.

To meet these ambitious clean energy goals and keep customers satisfied, reliability is a critical factor in power T&D operations. When electric grid operators underestimate demand, this can lead to catastrophic power outages. The supply problems in Texas during February 2021[4] that were caused by a winter storm is an example of this, leaving many to be both anxious and curious as to what the "next normal" will hold for energy reliability — especially in extreme cases such as this winter storm that knocked out power for days with rolling blackouts in single-digit temperatures affecting nearly 4.5 million people.

Furthermore, with the forecasted steady increase in global population, so comes the need for reliable and stable power T&D to homes and businesses around the world. The United Nations (2019)[5] reported that the world's population reached 7.7 billion in the middle of 2019 and is expected to reach 8.5 billion in 2030, 9.7 billion in 2050 and 10.9 billion in 2100. As a result, according to McKinsey & Company (2021):[6]

> ❝ **Over the next 20 years, emerging countries will need to expand their power networks rapidly to serve growing populations. Meanwhile, developed economies will need to upgrade aging infrastructure, implement smart grids and respond to mounting regulatory, customer and technological pressures. To meet demand, the world's transmission and distribution lines will need to increase by more than a third to an estimated 94 million kilometers by 2035, with an estimated cost of more than $310 billion per year.**"

To meet these challenges, *T&D World* (2019)[7] recommended that power T&D operators need to embrace the Digitalization of Everything (DOE) movement. This is facilitated by the availability of intelligent electronic devices, the growth of advanced analytics, machine learning and other forms of artificial intelligence (AI) that utilize the mountains of data now captured across the power grid (which positively impacts efficiency, costs and customer interaction). *T&D World* also argued that developing a broad array of digital technology-related assets and business capabilities has a multiplier effect on a power T&D business' functional potential. With the same sentiment as Benjamin Franklin's quote above, *T&D World* succinctly summarized the benefits of becoming a digital enterprise to power T&D operators:

> ❝ **Digital maturity is an evolving capacity to reap the benefits of continuous change.**"

[1] Energy Innovation, "Power Sector Transformation"
[2] NRDC, "Race to 100% Clean"
[3] Wood Mackenzie, "Three Regulatory Models That Could Help Utilities Embrace the Future"
[4] USA Today, "'Massive failure': Why are millions of people in Texas still without power?"
[5] United Nations, Department of Economic and Social Affairs, "World Population Prospects 2019, Highlights"
[6] McKinsey & Company, "Transmission & Distribution"
[7] T&D World, "The Digitalization of Everything"

As a result, power T&D companies are looking to fast-track their digital transformation journey to manage new project ventures, remain competitive, lower operational risk, reduce downtime, increase worker productivity and facilitate compliance with important regulatory requirements. This is where Hexagon can help your organization prepare for the "new normal" and the "next normal." Whether you need to digitalize and transform operational systems and processes, accelerate your continuous improvement initiatives, improve decision making, maximize leadership time in the field, drive compliance to processes, optimize alarm management, protect your investment with state-of-the-art cybersecurity or build out a comprehensive digital twin, we are here to support your digital transformation journey and prepare for tomorrow, today.

In today's digital age where technology is being embraced at an exponential rate, personnel at many power T&D companies are still using hard-copy documents, siloed spreadsheets, scattered databases and other inadequate data collection and management tools for crucial day-to-day procedures such as shift handover. This can lead to miscommunication, mistakes, inefficiencies and major operational and safety risks — all of which can be avoided. Some of the common challenges faced by power T&D operators include:

- Deficient mobile technology and/or applications

- Detached real-time and process data from data historians, the CMMS, the DCS, EAM, PLC and SCADA systems

- Double handling of data

- Inadequate schedule compliance or compliance plan performance

- Insufficient leverage of the information collected in business value decision making

- Limited, singular add-on tools or point solutions that are costly and often incompatible with each other

- Missed opportunities to collect, store and structure more situational, qualitative and quantitative information

- Multiple data-entry systems for operations and HSE personnel

- Siloed information that's inaccessible to employees across the operation

- Slow and expensive methods for making changes that impede operational continuous improvement efforts

- Sluggish uptake of multiple systems for new employees

Based on our own internal expertise and listening to our customers share their experiences, we have identified three principal business reasons why an organization should power up its digital transformation journey (employee safety and fatality prevention, workforce productivity and asset productivity).

Photo: SRP Control Center

Customer Spotlight

Salt River Project (SRP), founded in 1903, has been shaping the concept of a public power utility in the United States of America for 119 years. It has gone on to become the United States of America's third largest public power utility and one of Arizona's largest water suppliers. The company uses renewable energy sources as part of its portfolio for power production, including hydro, geothermal, solar and wind energy sources.

Customer Challenges

SRP used an old generic notes application for the standard logging of events at their power T&D operations. The limited functionality of its previous software made monitoring maintenance issues burdensome, manual processes unnecessarily difficult and restricted situational awareness when managing and recording events. Consequently, the company decided that its outdated processes did not fit in with its modern environment, and change was needed to ensure greater efficiency and visibility of operations management activities.

Hexagon Solution

After defining requirements from its business units and conducting a formal RFP process, SRP implemented a range of **j5 Operations Management Solutions** that are easily adaptable, customizable and extendable. The recording and managing of manual and automated events across shifts are now clearer and more efficient. Operators and supervisors can review relevant data and alarms at shift turnover thoroughly. j5 Operations Management Solutions significantly improved the flow of communication

and information, which has ultimately raised the company's productivity levels. Digitalizing its manual processes has helped the company achieve time savings and increase accuracy. Overall, SRP is achieving the following benefits across its power T&D operations:

- SRP has now implemented a leading-edge digital solution that can be extended easily and is fully supported

- The improved flow of communication and information has resulted in better productivity

- Using the proven j5 Operations Management Solutions platform connected to IBM Maximo® and the OSIsoft PI System rather than multiple disconnected and in-house-developed applications allows SRP's internal resources to be utilized elsewhere

- Manual processes have now been digitalized and reduced

- The auto feed of specific alarms is saving time at the end of shifts and improving accuracy

- Importantly SRP have end-user buy-in as operations personnel have adapted to j5 Operations Management Solutions easily

> **Without j5 Operations Management Solutions there would be more manual processes and as a result less accuracy and situational awareness of recorded events and important alarms. Our business users like the solution and it has helped them achieve greater productivity."**
>
> **- Maureen Kempton, Manager of Business Systems Applications, SRP**

Accelerate Your Digital Transformation Journey to Operational Excellence with Hexagon

Investing in a comprehensive, interoperable and enterprise-scalable digital transformation strategy will accelerate your continuous improvement efforts in this ever-changing economic landscape. It will also promote the long-term resilience of your company's safety performance, workforce and asset productivity and provides your business with the competitive edge it needs to perform at its best. As your trusted digital transformation partner, Hexagon's operations and maintenance solutions can help you create intelligent information from disparate sources including **unstructured** disconnected data, documentation, and **structured** digital data sources and existing databases. Hexagon's solution also help you find and resolve duplicate data and **consolidate** information to reduce operational risk, increase efficiency, decrease downtime, remove value leaks and meet internal and external compliance. Here is how we can work with you to implement your operational excellence digital transformation roadmap, step-by-step.

Step 1 — Digitalize Operational Processes, Procedures and Permits

The creation of a solid operations management data ecosystem by digitalizing your operational processes, procedures and permits is a strong first step on the road to digital transformation. Critical asset, situational, qualitative and quantitative information should be captured, structured and stored digitally and more importantly, organized and made available to support safety-critical operational processes. **j5 Operations Management Solutions** can take your shift, operator round, personnel, safety, maintenance and process information and make it visible and viable to users across the entire organization. This on-premise, or SaaS, solution is designed to foster greater communication, coordination, transparency and knowledge transfer between teams that in turn leads to improved safety and productivity, reduced operational risk and a more empowered and engaged workforce. j5 Operations Management Solutions offers a unique, straightforward digitalization approach with its patented spreadsheet-like configuration environment. This distinctive yet familiar low-code/no-code approach enables personnel to quickly manage changes without requiring expensive and slow vendor and IT services, accelerating operational continuous improvement so your information collection and sharing is always up to date and reflective of your operations. This distinction allows j5 Operations Management Solutions to be a quick-time-to-value investment, with high flexibility and a lower total cost of ownership.

Reinforcing this first step with an industry-leading knowledge management suite aimed at making human performance better through digital tools and connection to the modern process industry solutions used today is critical.

AcceleratorKMS is an industry-leading solution that expedites the digital transformation of paper-based, high-risk operational procedures and work processes. However, it also enables organizations to easily manage, govern, and distribute the up-to-date critical operational content field workers require to keep operations running optimally and learn faster. AcceleratorKMS is a purpose-built and industry-leading Knowledge Management System for critical operational content. The digital system includes Procedure Life-cycle Management (PLCM), a Connected Worker Platform (CWP), a Learner Experience Platform (LXP), and a Component Content Management System (CCMS). The combined capability facilitates solutions to many critical problems experienced in workplaces across America and around the World. The system provides an integrated digital content ecosystem in an easy-to-use and intuitive package focused on making the complex simple.

Proven Business Outcomes

These are quantitative benefits that were reported by surveyed j5 Operations Management Solutions customers in 2020:

- Enhanced situational awareness (**30%-50%**)
- More accurate shift handovers (**30%-50%**)
- Increased asset availability (**20%-50%**)
- Better workforce productivity (**20%-50%**)
- Improved regulatory compliance (**20%-50%**)
- Reduced maintenance costs (**10%-50%**)

> **The implementation of j5 Operations Management Solutions across the water control function has given greater visibility of ongoing issues and given us a consistent and accountable shift handover tool."**
>
> **- Ant Tyler, Systems Operations Compliance Manager, Thames Water, UK**

> "To me it's completely game-changing to have all this information readily available on one screen. This is the first time an end user can go to one place and get all the operations, maintenance, engineering and process data they need to do their duties. By having all this information readily available in a digital twin, I believe this is an industry first for the oil and gas industry, where it has been difficult to monitor remote assets and equipment in dangerous areas."

- Michael Fry, President and CEO, Deepwater Subsea, USA
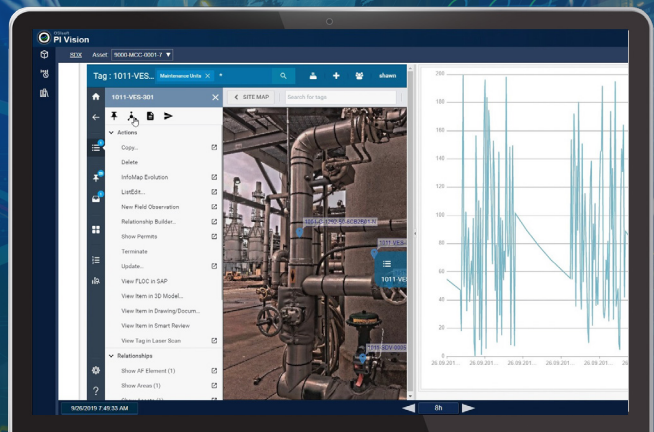
Next, organizations must bridge the islands of crucial information and records in numerous formats on separate systems and digitally connect them to operational processes, procedures, permits and data to help reduce operational risk, increase efficiency, decrease downtime, remove value leaks and meet internal and external compliance. With PAS AlarmManagement™ you can easily implement industry-wide best practices to streamline and improve your alarm systems and operator effectiveness. PAS ControlWizard™ and PAS TuneWizard™ work together to monitor, assess and tune your control loops to ensure optimal performance, robust control, and improve overall safety and reliability. PAS InBound® helps you create a master database of operational limits. With it, you can ensure alignment across all your sources of record and analyze your performance against those limits. PAS IPL Assurance® provides visibility into your Independent Protection Layers (IPL), making it easier to assure your operations are safe to run. And the PAS Solution portfolio are interoperable with j5 Operations Management Solutions. Adding further value to organizations investing in a digital transformation roadmap guided by Hexagon. Companies can further enhance information connection and interoperability by aggregating operational data and enabling a digital thread framework with **HxGN SDx®**. This central asset lifecycle information management (ALIM) solution is strategically designed to capture, organize and link large volumes of information, in context and provides web-based access to your authorized personnel. Available as an on-premise or SaaS solution, it can be adopted by any facility without introducing new software or investments in IT infrastructure. HxGN SDx is a **CFIHOS**-compliant, ALIM digital platform that centralizes and unites operations, maintenance, safety, engineering and real-time data. HxGN SDx can be connected to Hexagon technology such as j5 Operations Management Solutions and third-party industrial data sources such as Aspen InfoPlus.21®, IBM Maximo®, SAP® Plant Maintenance (PM) and the OSIsoft™ PI System™ to provide a consolidated, role and context relevant view of information.

Proven Business Outcomes

Contact Energy (New Zealand)
60% alarm rate improvements by adjusting alarm setpoints, deadbands, delay times and improving control logic and **65%** reduction in long-standing "stale" alarms, contributing to improvement of operators' alarm-related workload

Deepwater Subsea (USA)
70% productivity savings in documentation and completion of inspections and **95%** saving in time retrieving and searching for quality evidence post inspection

Step 3 — Protect Your Digital Investments

On the journey to digital maturity, keeping your operations running safely, smoothly and protected from cyber threats is vital to prevent unnecessary interruption to your enterprise. There are no shortages of reports or news outlets raising the alarm on cybersecurity awareness. In fact, the ARC Advisory Group[8] (2019) reported that "many industrial operations remain at risk of costly, disruptive cyber incidents." Its analysts recommended that "all industrial companies consider software like **PAS Cyber Integrity™** as a foundational element of a defense-in-depth cybersecurity strategy." This solution also provides numerous significant customer benefits such as: discovers and automatically maintains a complete inventory of OT assets inventory and enables workflows and documentation for vulnerability remediations and compliance with ISA/IEC 62443, ISO 27001/2, NERC-CIP,[9] NIST and the NIS Directive, as well as other standards and regulations, accelerating recovery with backups of critical control system data and supporting in-depth forensic analysis. ARC Advisory Group also noted that the solution's capabilities support execution of critical tasks in the "Secure Systems" and "Incident Management" processes identified in its "Industrial/OT Cybersecurity Maturity Model." This includes functionality for developing and maintaining asset inventories, identifying, evaluating and managing system vulnerabilities, detecting and managing unexpected system changes and analyzing and visualizing system security risks.

Proven Business Outcomes

- Speeds time to recovery from major events, cyber incidents, and unplanned outages

- Reduces inventory and documentation effort by **70%** or more

- Improves productivity by **20%** to **50%** via always-on change management insight into OT/ICS configurations

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[8] ARC Advisory Group, "PAS Global Cyber Integrity Helps Secure Industrial Control Systems"
[9] NERC, "CIP Standards"

> **In industrial facilities, you typically find an array of proprietary ICS that are difficult to inventory, which subsequently makes monitoring for change and vulnerabilities a security challenge. As these systems have direct authority over process safety and production, there is unaddressed cybersecurity risk within a facility environment. Hexagon has architected its software to cover these systems, and its customers have testified to Hexagon's effectiveness in reducing security risk."

- Vikrant Gandhi, Industry Director, Frost & Sullivan, USA
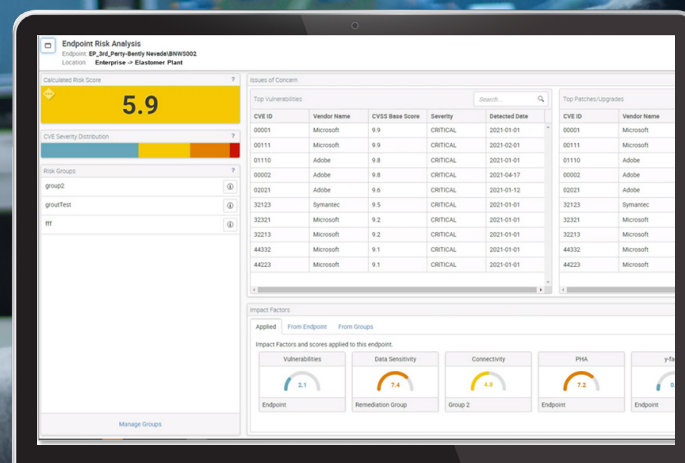
> **Digital twins are becoming a business imperative, covering the entire lifecycle of an asset or process, and forming the foundation for connected products and services. Companies that fail to respond will be left behind."**
>
> **- Thomas Kaiser, Senior Vice President of IoT, SAP**

End Goal Build, Maintain and Evolve a Digital Twin

A **digital twin** enables asset owners and operators to build and maintain an information management data ecosystem throughout the asset lifecycle, allowing for a continuous journey of operational excellence. By deploying a comprehensive digital twin, complex data can be analyzed and transformed into actionable information. The significance of this ultimate digital platform is that it opens the door to the competitive advantages made possible by using predictive and prescriptive analytics, AI, machine learning and automated decision making across the power T&D value chain. As mentioned in an article published by Forbes (2017),[10] digital twin technology helps companies improve the customer experience by better understanding customer needs, develop enhancements to existing products, operations and services and can even help drive the innovation of new business. **Hexagon's Situational Awareness solution** — powered by **Luciad** — boosts your operations and empowers your workforce by delivering to them a valuable, data-driven experience that encapsulates easily consumable, timely information regarding past events (what's happened), present facts (what's happening now) and future predictions (what could happen/what should happen/what's scheduled to happen). Therefore, seamlessly connecting your safety-critical operations processes, procedures and permits, alarm management methodology, maintenance work orders, real-time and historical process data, engineering schematics and technical documentation with 3D models, laser scans and cybersecurity safeguards enables a robust and comprehensive digital twin for your entire operation.

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[10] Forbes, "What Is Digital Twin Technology - And Why Is It So Important?"

Connect

A digital twin is a dynamic digital depiction comprised of physical entity information. It is the single version of the truth unique to a user's perspective for a point in the lifecycle with many digital levels.

Think

Data is diffused seamlessly between the digital depiction and physical entity to enable co-existence. Then advanced technologies bring data, algorithms and context together.

Do

With this comes understanding, prediction and optimization for the physical entity to drive improved business outcomes.

About HxGN SDx

HxGN SDx is a modular, on-premise or SaaS ALIM solution that digitally transforms facilities and allows companies to build a digital twin to optimize efficiency, reliability, predictability and safety across the lifecycle of an asset.

HxGN SDx is comprised of two independent, yet integrated modules that address the major asset lifecycle stages of an industrial facility. Each module provides work processes, roles and content tailored to address a specific phase of the asset lifecycle. Each module also includes a comprehensive set of capabilities with additional options that can be licensed as needed:

HxGN SDx Projects

Enables better projects planning and review, ensuring effective information aggregation and collaborative project execution, improving project efficiency and reducing risk.

HxGN SDx Operations

Increases operations and maintenance efficiency, safety and internal and external regulatory compliance through templated work processes and manages change and interoperability with other industrial systems of record.
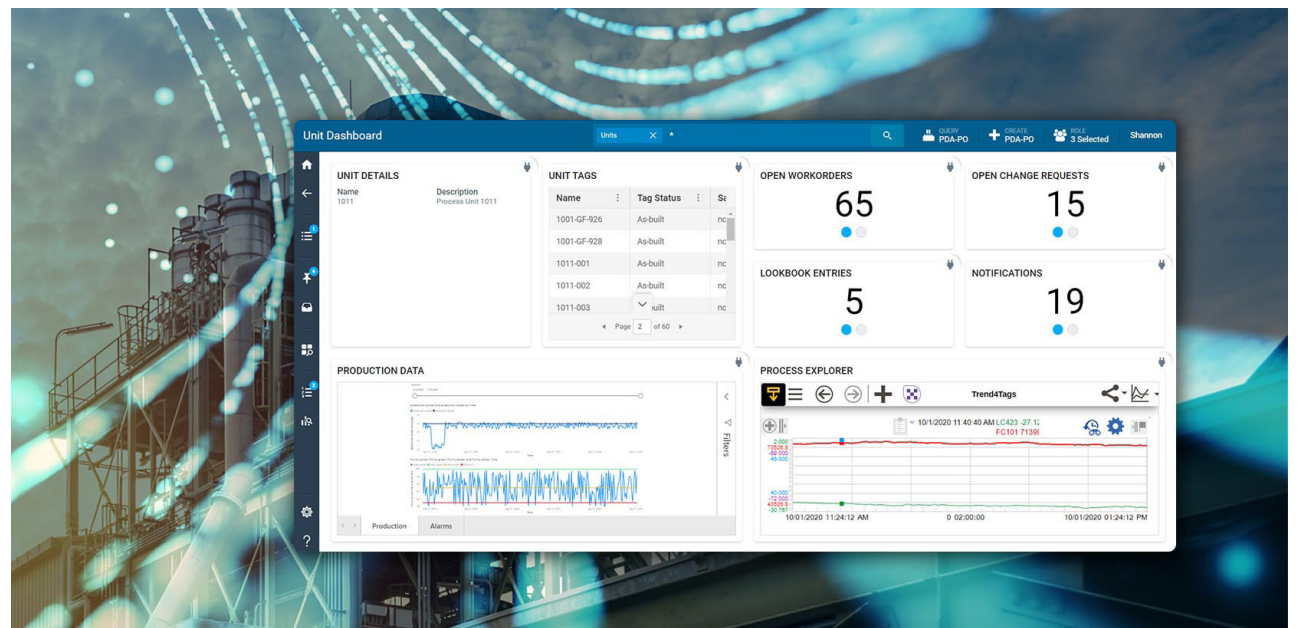
Achieve Operational Excellence in Power T&D

Employee Safety and Fatality Prevention: Risk Mitigation and Workforce Accountability

Digitalizing and automating operational processes such as area and shift handovers, permitting and inspections enables an additional level of situation data to be collected and insights into workforce compliance and efficiency. These new insights help close operational gaps that create safety risks and help improve your operations to save time and money.

Workforce Productivity: Decrease Operating Expenses (OpEx)

Optimized assets, reduced downtime, enhanced productivity and better safety compliance all contribute to lower OpEx and higher profitability. Technology is now allowing a larger percentage of an operational workforce to work remotely, which has been shown to increase employee engagement and happiness while reducing hazard exposure hours.

Asset Productivity: Increase Efficiency

Empower your workforce to make informed decisions in real-time with the information they need, when they need it and where they need it — via desktop, laptop or mobile devices. With digitalize processes, the information you need is always on hand, there's no need to search for paperwork from a previous shift or interrupt a co-worker who's on break or on vacation.

Employee Safety and Fatality Prevention: Meet Compliance

When you need clear, concise and current records for local, state or federal regulatory compliance requests and procedures, having your data locked in a physical paper trail to can lead to unnecessary delays and misinformation. Digital records allow you to instantaneously deliver accurate, current and complete information to internal and external regulators.

Workforce Productivity: Save Time

From the office to the field, personnel can save hours each day with digital access to the right information at the right time. Instead of spending precious time sorting through paper documents or multiple systems to track, access and manage vital operational information your personal can put your data and their skills to work optimizing and improving operations.

Asset Productivity: Reduce Operational Risk

Workforce safety is improved when you reduce the chances of human error due to reliance on physical paper, especially when it comes to equipment inspections and shift handovers. Digitalizing these processes ensures the right equipment and readings are inspected at the right time and assists employees to quickly highlight when equipment is operating out of its specified ranges.

Introducing R-evolution

In February 2021, Hexagon launched a new business venture, **R-evolution**, to further develop its sustainability agenda, which include climate goals to significantly reduce its own carbon footprint. R-evolution will invest in and run profit-driven, sustainable projects that leverage Hexagon's technology to accelerate the world's transition to a sustainable economy. The first set of investments, centered around renewable energy, will involve the construction and operation of solar farms in Andalusia, Spain, producing energy with 50,000 tonnes less CO_2 equivalents per annum than the grid's residual mix.
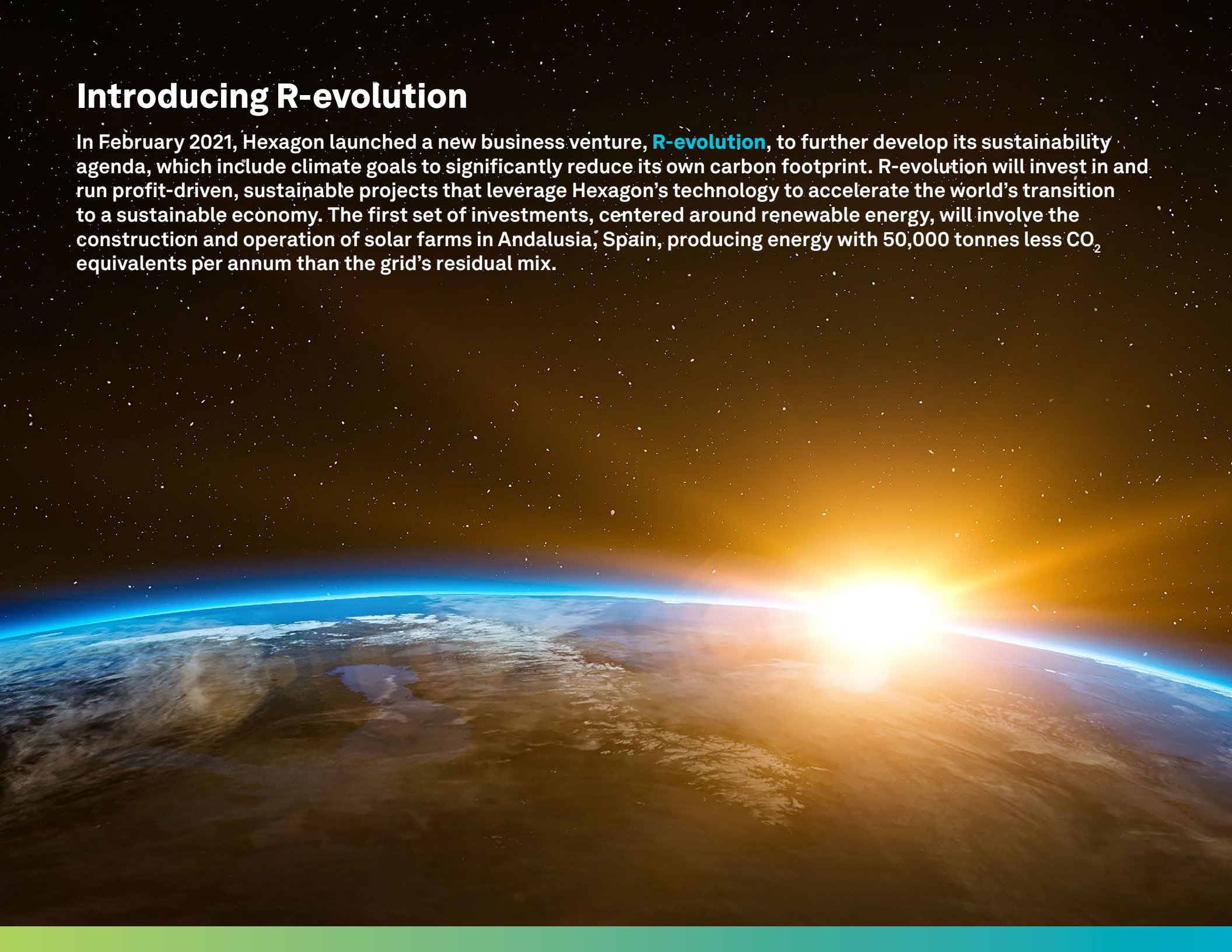
Working with a Trusted Digital Transformation Partner

As **YOUR** trusted digital transformation partner, we provide evolving solutions that allow people to design, engineer, construct, operate and maintain industrial assets with state-of-the-art technology backed by a team of global experts and research. Together, we are co-creators of the smart solutions that improve today, work tomorrow and empower adaptive change. Putting data to work — to boost safety, efficiency, productivity and quality outcomes — are values we share with you.

Our focus is on autonomy

Leveraging data to its fullest potential is the outcome we want – **moving beyond automation to autonomy**
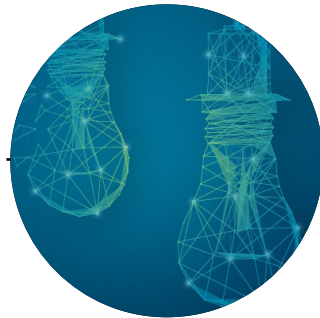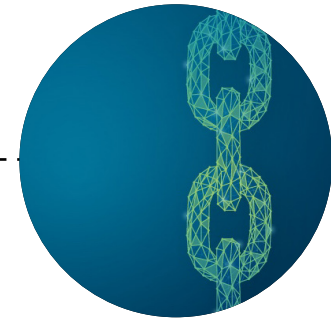
Our commitment is to innovation

With **nearly 4,000 employees in R&D and more than 3,700 active patents** our technology leadership is clear
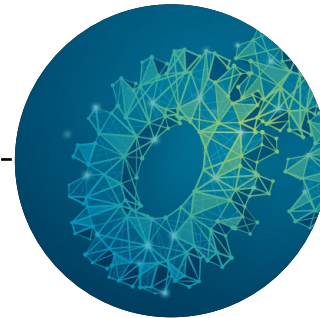
Our value is strategically vital

Efficiency, **productivity** and **quality** results in scalable sustainability – fewer resources, less waste, less pollution

Our stability is consistently proven

Sales growth from €500 million in 2000 to **€4.3 billion** in 2021 with **approximately 22,000 employees across 50 countries**

About Hexagon's PPM Division

Hexagon's PPM division is the leading global provider of enterprise engineering software, enabling smarter design and operation of plants, ships and offshore facilities. With 50+ years of experience in delivering innovative industrial software, Hexagon solutions transform unorganized data into intelligent, actionable information that enables smarter design, construction and operation of industrial projects across the asset lifecycle.
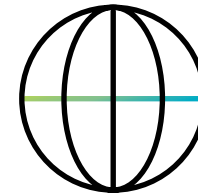
Revenue Distribution

34% **37%** **29%**

Awarded Solutions Provider

Ranked No. 1 over 13 consecutive years, across **5 different categories,** recognized in 2019 by ARC Advisory Group
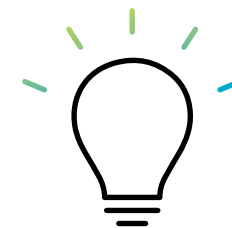
Global Presence

More than **4,000 employees,** with offices in **50 countries**

R&D Focused

More than **19%** of total revenue invested in 2021

Innovative

More than **40 registered patents** around the world

HEXAGON

About Hexagon

Hexagon is a global leader in digital reality solutions, combining sensor, software and autonomous technologies. We are putting data to work to boost efficiency, productivity, quality and safety across industrial, manufacturing, infrastructure, public sector, and mobility applications.

Hexagon's PPM division empowers its clients to transform unstructured information into a smart digital asset to visualize, build, and manage structures and facilities of all complexities, ensuring safe and efficient operation throughout the entire lifecycle.

Hexagon (Nasdaq Stockholm: HEXA B) has approximately 22,000 employees in 50 countries and net sales of approximately 4.3bn EUR. Learn more at hexagon.com and follow us @HexagonAB.