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The Age of With™

The future of energy, resources, and industrials with AI

The Age of With

A businessperson today can hardly open a magazine or sift through a Twitter feed without seeing the words: data, artificial intelligence, automation, IoT, bots, machines, and transformation. These words are connected to opportunity and the time to grasp it is now—we are at the turning point when everything changes. Forever.

To navigate the continually changing landscape of data, artificial intelligence (AI) becomes our roadmap. And how we start is by each of us initiating our own journey into the advancing world of technological growth.

This story can be summed up in a single word—"*with*."

What's happening around us—shared data, social engagement, digital assistants, cloud platforms, connected devices—is not about people versus machines. It's about human collaboration made greater with the machines we invent. It's a new age.

If we hope to perform, compete, and break through, we need to create a cognitive advantage by tapping the power of well-structured data with design thinking *with* analytics *with* machines.

While that feels a bit uncharted, it isn't. *With* has long been the great human advantage. We've sought it out. Benefitted from it. Built business models around it. In fact, *with* is at the core of many great inventions, from the municipality to the assembly line to the internet.

To succeed in the future, build your human intelligence where it is aided, enhanced, and augmented with AI. The potential is limitless.

Disruption within energy, resources, and industrials

The energy, resources, and industrials (ER&I) sector needs artificial intelligence. Over the last decade, while industries such as financial services, retail, and health care have made significant advancements through the application of analytics, the ER&I sector has not. It therefore has the most to gain–and lose–from the latest surge of AI into the marketplace. AI has become more affordable, achievable, and most of all, its benefits are increasingly accepted by the marketplace. AI is also becoming a business imperative. In short, the time is now for ER&I to embrace the AI revolution.

The potential for digital transformation in the ER&I sector is immense. The Fourth Industrial Revolution, or Industry 4.0—which includes the emergence of smart, autonomous systems, powered by data,analytics and AI—will drive that change.

Companies now have access to digital capabilities and the potential to accelerate near-term benefits and long-term, sustainable growth. It's not enough to simply layer digital technology onto existing processes and procedures. Companies must re-think how they operate and conduct business from the boardroom to the field. This includes tackling some of the most critical business goals in the industry, notably:

- Preventing safety and environmental incidents
- Optimizing resource extraction and management
- Improving asset performance and capital efficiency
- Increasing production and sustaining growth

As part of this digital transformation in the industry, AI is fundamentally changing the way we work, affecting the roles, skills, and manner in which we engage within the future workplace. In light of this fundamental shift in roles and relationships, companies need to put people at the centre of their technology. For a technology to be genuinely engaging and effective, its design must prioritize the needs of the people who will use it on a daily basis. By designing AI solutions that augment and accelerate the work of the workforce, employees will feel empowered and enabled by it. However, there is a reluctance to embrace this change, notably in the ER&I sector where there is a heavy reliance on tried and tested engineering principles and processes, and on the proven ability of an experienced workforce. ER&I businesses will need to figure out how to navigate the disruption AI brings while implementing the technology and keeping people part of the process.

The age of ER&I with AI

Central to the resistance to adopt AI is the fear that AI will replace humans

When AI is introduced as a capability, the discussion quickly turns to robots dominating the workplace and taking away our ability as humans to control outcomes. Our position is the opposite: AI offers great potential for executives and operators to make informed decisions based on facts and optimized for complex industry processes. In fact, AI is about making better decisions faster so humans can focus on high-value activities rather than transactional and mundane tasks. This is "the age of *with*": decision-making fueled by data, insights, and predictions that allow human operators to anticipate risks, diagnose issues, and drive performance across the value chain. The scarcity of resources and the environmental impact of the ER&I industry create an imperative to innovate. Humans working with AI need to ensure that companies are more competitive, adaptive, and continue to grow in an uncertain and volatile future environment. In contrast to other industries, there are certain factors unique to ER&I that reinforce the business case for AI.

These include:

- Historically large, unstructured data sets
- Highly complex engineering processes and operations
- Scarcity of resources and environmental impact
- Asset-intensive operations and high capital costs
- Vulnerability to cyber and other security threats

AI has some unique capabilities to address these factors and augment the work done by humans. For example, computer vision allows us to analyze large volumes of images and videos in the same manner a human would, but at a greater pace and scale. Machine learning can translate tacit knowledge into algorithms capable of rapidly analyzing massive datasets and predicting future events. Natural language processing (NLP) offers an efficient way to digest the field records, observations, and reports that until now had been buried in mountains of paper.

The scarcity of resources and the environmental impact of the ER&I industry create an imperative to innovate.


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Customers Satisfaction

Why AI, and why now?

To understand the practical value of AI and how it enhances decision-making, we need to consider the anatomy of a decision

Improve decision-making with AI

When we are faced with an issue, what steps do we need to take to arrive at a successful decision? To begin, we must ensure we have the facts, understand the problem or opportunity at hand, and the formulate our hypotheses on the best course of action. This means collecting and organizing relevant data points so we can evaluate our hypotheses. Secondly, we need to come up with scenarios and possible solutions, and make predictions so that the most viable and desirable outcome can be identified and tested. And finally, we need to be able to assess the effectiveness of the decision and potentially optimize the solution if business objectives are not being fully achieved.

Today, decision-making is mostly based on the manual interpretation of signals and knowledge acquired from experience. As algorithms become more complex and data becomes more abundant, the importance of using AI to interpret and analyze this data is only going to increase given AI's promise of faster calculations, greater computing capabilities, reduced errors, and so on. With AI, we can improve decision-making by:

- Reducing mundane tasks to improve insights
- Improving predictions to enable interventions
- Optimizing solutions to drive value and sustain growth

Reducing mundane tasks to improve insights

A significant amount of manual effort has typically been expended to process, integrate, and analyze data to report on operational performance and risks. Not only is this an inefficient use of skilled resources, but the time required to manually complete data processing and integration means that little time remains for analysis, and insights are often not delivered in time to inform decision-making. Indicators lag events and prevent decision-makers from planning interventions to improve performance and manage risks. In addition, companies have not been able to extract value efficiently from large, complex data sources and historical unstructured data sources such as field observations and reports.

With AI, the ER&I industry has the opportunity to overcome these hurdles. Advanced techniques using AI can complete data profiling with minimal human input and detect which data sets are relevant to a particular problem. Machine-learning algorithms are helping companies to identify hidden faults and failures that would be otherwise impossible to detect without a massive investment of time and resources. Computer vision allows companies to analyze imagery and video in near real time, to see anomalies that would typically take humans hours to detect—and with improved consistency. And, natural language processing means that companies can finally extract insights from years of unstructured and text-based data collection. By using AI to handle these tasks, companies can direct their human staff to more to more high-value activities and improve the quality and timeliness of insights for decisions.

Improving predictions to enable interventions

A fundamental part of decision-making is predicting the outcome of a particular action. We use data and insights to help inform our options, and try to select the option that will deliver the highest value at the lowest risk. If we cannot predict the event or outcome, then we are unable to design or implement effective interventions. Decisions today are often made with incomplete analysis, subjective assessments, or bias for a particular choice based on experience. In a highly competitive market, this approach to decision-making carries significant risk.

With AI, ER&I has the ability to predict events and outcomes with much greater certainty. A well-defined process, with known rules and limited variables, can easily be translated into algorithms. The challenge comes when there are many complex processes or variables interacting when the rules are not known. In this case, operators and planners may only be able to describe the desired outcome, and have no analytical capabilities to accurately and consistently predict the likelihood of that outcome occurring. Examples in ER&I may include determining the optimal blast parameters, process inputs, rate, or control settings. AI learns the way we do, albeit in much more complex situations. While we may be able to analyze and predict events in isolation, AI delivers the ability to predict at the much higher pace and scale that is

required for ER&I. These predictions are critical for effective decision-making in a highly competitive and evolving industry like ER&I.

Optimizing solutions to drive value and sustain growth

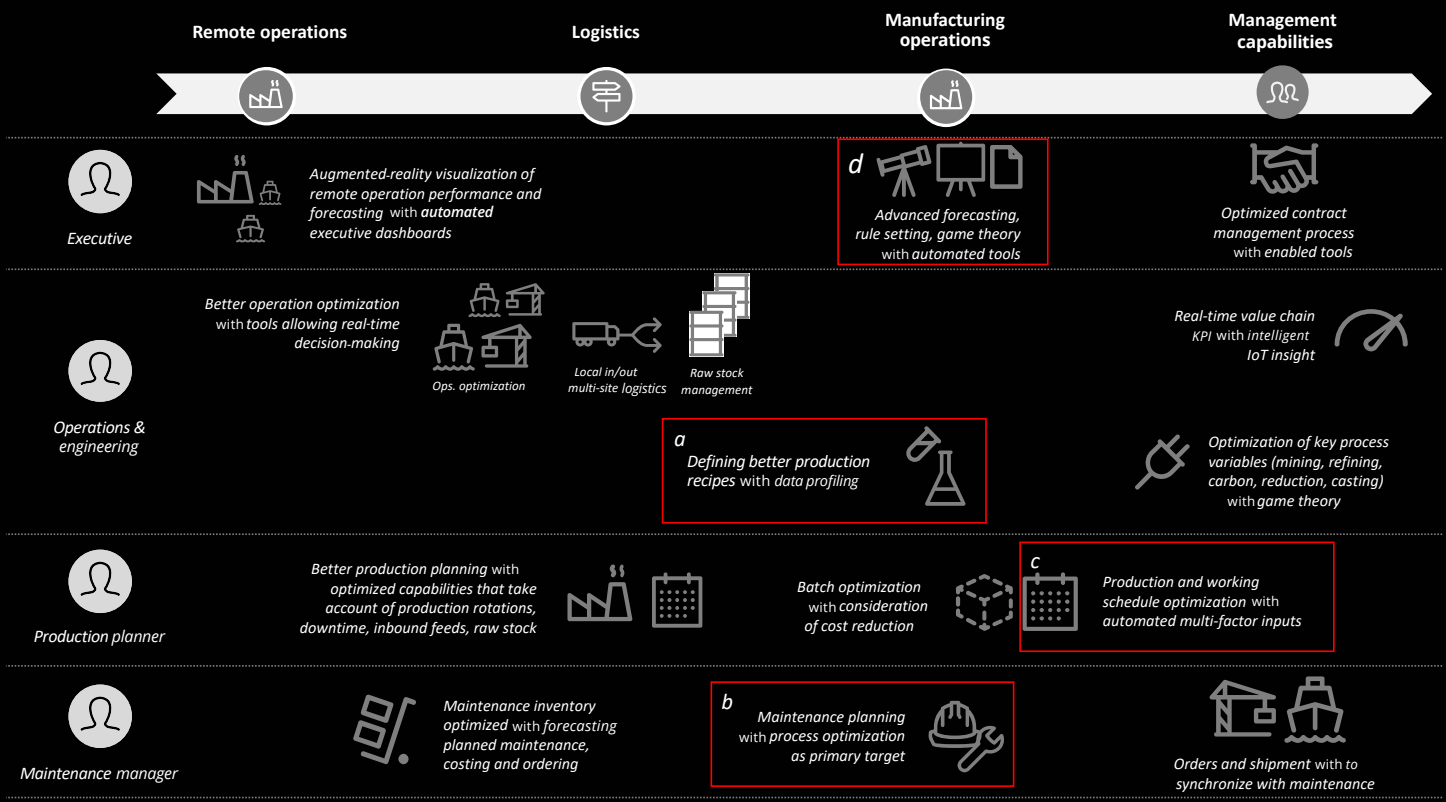
ER&I operates in an environment and in markets that are constantly changing. As such, solutions deployed must be supervised and optimized to ensure they continue to meet business objectives. AI is an ideal tool for decision-makers for strategizing and scenario-testing and therefore has the potential to deliver longer-term and larger returns.

What happens when other players in the market adapt in the same way or other forces change? In that case, AI can use game theory to mimic and predict the behaviour of stakeholders or environments. Once it figures out the most favourable outcome, AI creates a set of rules that an industry plant can use to behave as an independent agent on the market, playing against other plants, which are all trying to maximize the gains. The environment in which ER&I is operating is not very homogenous, nor predictable. As such, AI algorithms must be used in conjunction with other technologies—such as Internet of Things, computer vision, and advanced analytics—to account for varying levels of abstraction and uncertainty. Humans must vet the outcome of these algorithms to monitor that the nuances decision-making entails have been accounted for.

AI in action: ER&I case studies

This diagram shows numerous examples of how AI can be used in ER&I. We will focus on a few to present you the opportunities that stem from the application of AI to operations. Use cases will demonstrate how we integrate AI into our clients' operations workflows in two scenarios:

- to replace mundane tasks that humans traditionally perform
- to augment human-machine interaction with better decision-making



The use cases demonstrate different levels of AI involvement. In the first use case, data profiling is a well-established process with very little human input. This means that AI decides which data sets are relevant. Today it is a routine task. In the second use case, the framework is similar, but requires greater human intervention due to the undefined process. Today this is possible but it requires specialized personnel who aren't readily available. In the other two cases, the amount and the speed of information handled is such that AI takes over the execution. However, human involvement is essential for training AI for intended performance. The value of AI in these cases is enabling humans to make better decisions. Wherever there is an opportunity to automate, one should work with AI. In essence, AI helps us spend less time analyzing the problem, and more time developing solutions.

Data with precision: production planning

A mine was facing extremely high and fluctuating power prices. Using power demand data and correlating it to variables such as regional weather patterns, changes in the economy, and the power demand of other users, data scientists employed machine-learning models to analyze all the possible solutions the mine executives could implement to adjust production and minimize power cost. Each scenario was ranked based on the best electricity price for the next 24 hours, next week, or next month. The optimal solution calculated by the machine learning models helped its executives to better plan production: work demanding the highest power consumption–electricity consuming activities–would be done outside of peak hours. This resulted in switching day and night shifts, midweek days and weekend days, and performing maintenance in August when the demand on the grid is the lowest. This operational change

helped executives reduce expensive purchases of energy from utilities and bring the production cost down. In the near future, AI models could also be trained to make the most optimal decisions regarding emissions; for example during prolonged cloud coverage. Synchronizing maximum production and minimal environmental impact is a high-value application of an AI-based central nervous hub.

Analytics with insights: yield optimization

A refinery had been collecting production data for five years, but was unable to effectively use it to deliver insights for operations due to the data's volume and complexity. To prepare it for analysis, the data was classified into three categories: inputs, processing, and outputs. Using the computing power of machines and machine-learning techniques such as clustering, data scientists were able to analyze the large quantity of production data to identify and define 90 different operating scenarios. It was furthered determined that seven of these scenarios constituted 80 percent of the entire production. In addition, the results showed that five of these seven possibilities were producing a yield below the average production. This simple yet critical insight prompted the company executives to eliminate the underperforming possibilities, and thereby significantly increase production.

Prediction with focus: predictive maintenance

Down periods are part of the production cycle, as every plant has to shut down for scheduled maintenance at some point. AI can help minimize this down time by using the data collected by sensors to more accurately predict when a machine will need to be repaired. Prescriptive maintenance uses advanced algorithms to compare the data collected by sensors to known threshold levels to enable real-time decision-making based on actual operating parameters. For example, a pulp mill that generated its own power for the plant benefitted significantly by switching from two long season -dependent maintenance periods to three short dynamic periods synchronized with the supply-and-demand cycles of the municipal power grid. This AI-driven process enabled a more accurate diagnosis of maintenance demand, and improved productivity and profitability using data-driven insights.

Forecasting with purpose: smart grid forecasting

Power grids need to maintain a balance between demand and supply. Over the years, power-generating stations have learned to maintain this delicate balance, albeit for a price. However, the demand for power is dramatically increasing as a result of the exponential growth in electronic devices and equipment. This includes electric vehicles, which are either consumers or producers of electricity as they move. Their unpredictability of supply and demand will become challenging to maintain balance with simple deterministic linear models. AI provides a solution for dynamic power balancing by establishing a set of rules of engagement for each household, neighbourhood, or parking lot—while finding the optimal distribution under the constraints of pricing models. On a small scale, these solutions are already being applied today. On a large scale, the power grid of the future is poised to use these autonomous agents.

What changes are required

Advances in renewable energy sources, increases in battery capacity, repurposing mining sites, decentralizing power grids, and stricter regulations are opportunities for growth in the ER&I sector. Business leaders should be considering them, because new approaches are needed to make the industry floor more efficient, less polluting, and more economically sustainable. Netflix recommendations, Google's autocomplete search, Siri voice recognition, and Microsoft virtual and personal assistant Cortana are just a few examples of how AI is shaping our personal daily experiences. For ER&I, AI has the potential to transform business processes and operations by reducing mundane tasks, improving predictions, and helping to optimize the solutions deployed. The net benefit of ER&I with AI is driving increased productivity and profitability in an uncertain and constantly changing world.

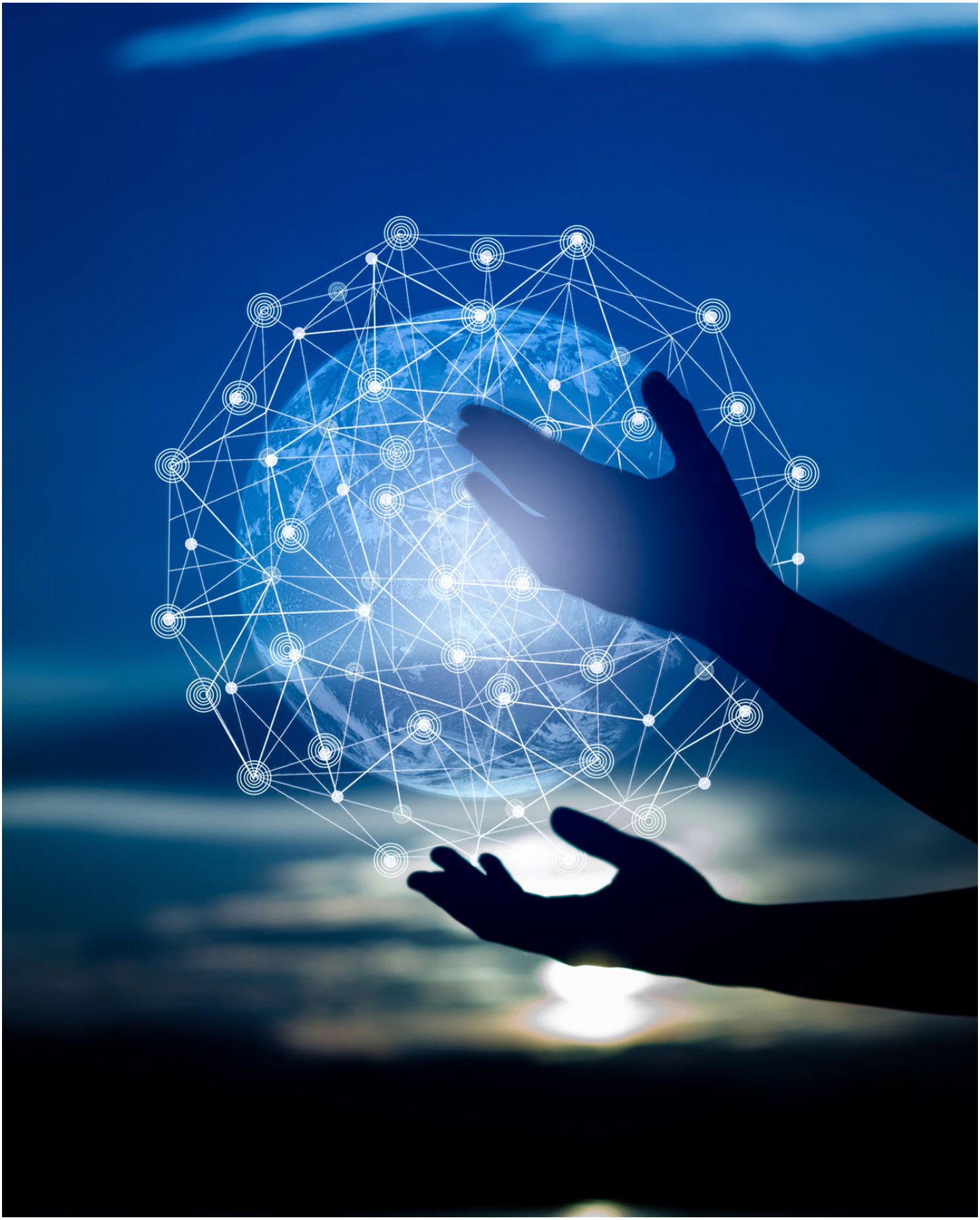
We are slowly shifting the way we interact with intelligent machines, and that is being reflected on the production floor. Understanding how machines can augment with AI the work of humans– and the potential benefits and uncertainties– is critical. The ER&I sector can benefit tremendously from the efficiencies and improved decision-making that comes from AI. The time is now to transition toward a more connected, efficient, and profitable industry with AI.

Moving forward with AI

To successfully use AI, ER&I companies must step away from ad-hoc applications, which do not return value in isolation and have limited potential for innovation. Applications of AI have the most potential when they are integrated into business and operational planning, and aligned to the value chain. To do this, certain foundational elements must be addressed, including:

- Industry leaders should foster innovative environments within their organizations that help their employees acquire the skills required to work with AI technologies
- Organizations should deliberately adopt flexible operating models that integrate internal AI initiatives
- Overall, organizations should promote a culture of data-driven decision-making. This will shift it toward being an insight-driven organization—one that embeds analysis, data, and reasoning in the day-to-day decision-making process.

Strong organizational change management is key to successful AI deployments. Managing the transformation will help reduce the uncertainties around the implementation AI. For instance, who is liable if someone is injured because of decisions made by AI? There is no consensus at the moment. Academia is creating a new field of science called machine behaviour, in which the ethics and legality of AI-based decision-making processes are the primary emphasis. In the meantime, while both the organizational change and the consequences of AI-assisted decision-making are taking place, we are crafting guidelines to best position ourselves to take advantage of the opportunity that working with AI brings.



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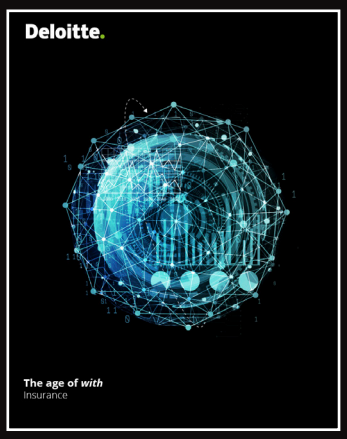

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