

EBOOK



The Practical Guide to Industrial AI

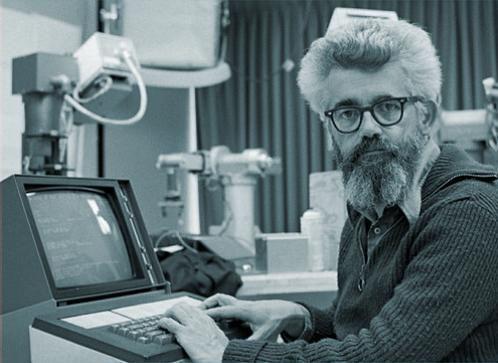
BENEFITS AND IMPLEMENTATION



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ARTIFICIAL INTELLIGENCE: Why Now?



John McCarthy at his AI lab at Stanford

Artificial intelligence (AI) is certainly not a new topic. The term was first coined by John McCarthy for a Dartmouth conference on the subject in 1956. However, the field has seen starts and stalls, as many of AI's successes have been promising for research progress, but haven't necessarily translated into applications for businesses or consumers.

With new technological developments and new, impactful case studies from many major companies, AI has skyrocketed to the top of the hype cycle. Companies feel the pressure to incorporate AI in order to remain relevant, but they may not be sure how to best use the technologies or who to trust in the space.

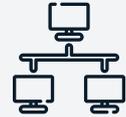
To that end, this booklet will help companies navigate the artificial intelligence space. SparkCognition was founded in 2013, and our CEO literally wrote the book on AI (*The Sentient Machine*). We have helped leaders in critical industries from energy to defense incorporate an AI strategy to evolve their systems and operations.

This ebook will arm you with the knowledge to help your company navigate this changing digital landscape.

In the last few years, all that has changed. The current iteration of AI is primed for commercial usage thanks to three recent developments:

Computing power

Thanks to an accelerating technology curve, today's computers have the capacity to analyze terabytes of data and extract critical insights at a fraction of the cost.



Abundance of data

From clicks on a website to vibration on a drill bit, everything is measured these days. This massive amount of generated data gives algorithms the information needed to produce accurate, predictive models.



Research breakthroughs

The advent of neural networks and deep learning has greatly expanded the capacity of AI. By mimicking neurons in the human brain, these technologies solve complex nonlinear problems in new and innovative ways.

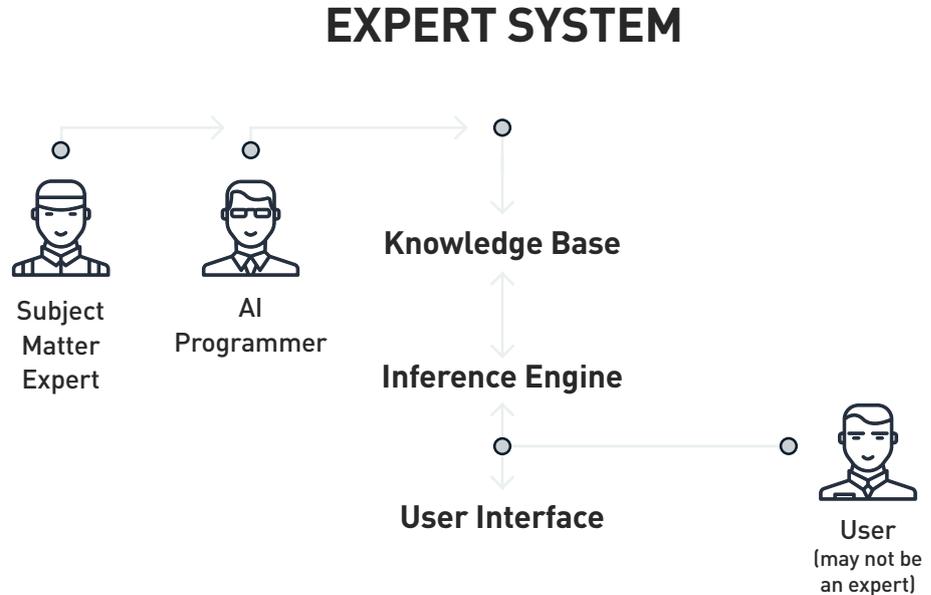


APPROACHES TO ARTIFICIAL INTELLIGENCE

Old Approach to Building AI

Expert Systems

- First, an AI programmer interviews a subject matter expert (SME) to discover the logic behind the task to be automated.
- Next, the programmer writes a computer program called an expert system. The core of the expert system is a knowledge base, which typically consists of hundreds of “if-then” rules.
- Even users who are not experts themselves can use the expert system to solve problems that were previously solved by subject matter experts.



NEW APPROACH TO BUILDING AI

Machine Learning

- In thousands of applications, machine learning has proven to be better than conventional programming for building AI systems.
- Machine learning automatically discovers patterns in large data sets.
- In one approach, called supervised machine learning, the data consists of examples of the task successfully performed. For instance, if the task is interpreting x-ray images to detect tumors, the examples are specific images with labels indicating “tumor” or “no tumor.”
- In another approach, called unsupervised machine learning, the data does not include labels. In this case, machine learning is used to find patterns in the data set that enable clustering of the examples in useful ways. For instance, machine learning might form a cluster of images that contain tumors.



5 SUCCESSFUL APPLICATIONS OF SUPERVISED MACHINE LEARNING

- 1 Approve or deny credit applications
- 2 Route emails to the correct department (e.g., accounting, returns, or support)
- 3 Identify the type of impending failure in a machine that is deviating from normal behavior
- 4 Identify which person matches the image of a face
- 5 And many more

SUCCESSFUL APPLICATIONS OF

Unsupervised Machine Learning

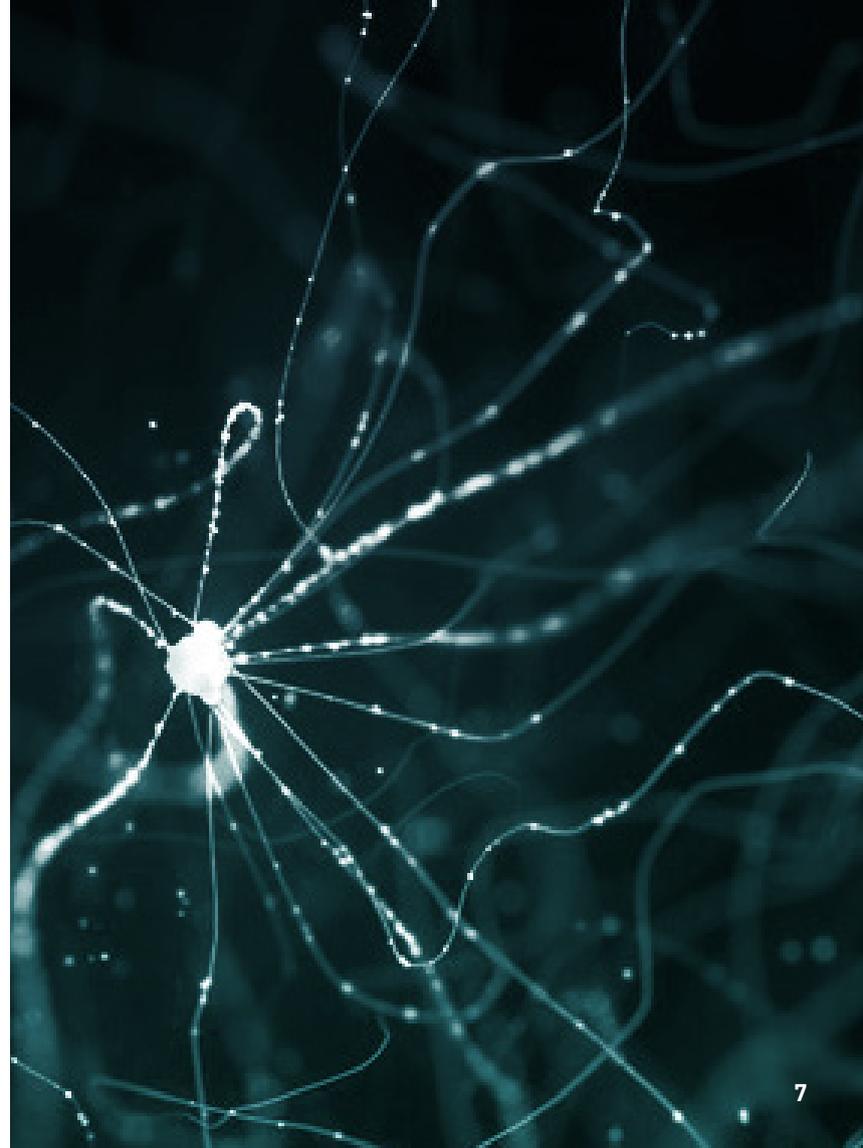
- Normal behavior modeling: Learn to recognize normal machine behavior and deviations from the norm based on time-series data of a machine's operation
- Anomaly detection: Identify a behavior as unusual to accomplish, such as determining if a website visitor is a bot rather than a human
- Customer segmentation: Discover sub-groups of similar customers across a population of customers to develop targeted marketing and advertising for each sub-group

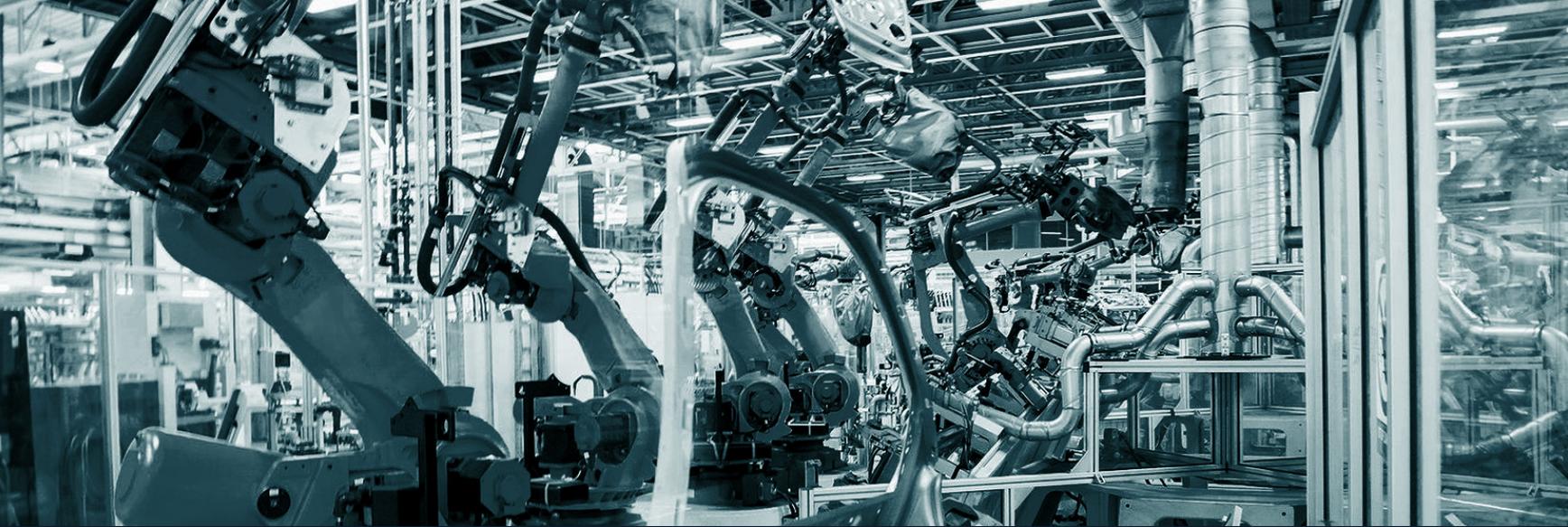


MACHINE LEARNING BY

Neural Networks

- A neural network is a particular approach to machine learning that is loosely inspired by neurobiology.
- Deep learning refers to a neural network with multiple hidden layers of nodes in the network between the input layer and the output layer.
- Deep learning is able to solve complex problems, often with superhuman levels of competence. It has been successfully applied to computer vision, predictive maintenance, and difficult strategy games like chess and Go.





THE BUSINESS CASE FOR **Industrial AI**

Headlines about AI may focus on consumer applications like home assistants and self-driving cars, but the technology is greatly affecting the industrial world. Stale business models in utilities, oil and gas, and aerospace no longer stand up to rapidly evolving markets driven by changing consumer expectations, increasing digitization, and next-generation analytics. And, as recent history has shown us, companies late to embrace these digital trends face imminent disruption.

To mitigate these market risks, industrial companies must leverage AI to capitalize on emerging opportunities and pursue new revenue streams and profitability. In fact, a 2018 report from **McKinsey & Company** found that 80% of extensive AI adopters had better financial performance than their peers, while research from Accenture indicates that AI will fuel profitability gains of up to 39% by 2035. This improved financial position is key to maintaining technological leadership, competitive advantages, and stability in dynamic market conditions.

TOPLINE:

New Revenue Streams

AI is not simply a way to save money. McKinsey has found that the most advanced adopters of AI use it to find new revenue streams and see the most dramatic return on investment (ROI). With AI comes scale and the potential for more value through new, digitally-enabled service offerings.

BOTTOM LINE:

Profitability

AI is well-equipped to enable smarter decision-making and overall process optimization, leading executives to pursue AI as a direct enabler of profitability. As industries move away from high-touch, high-overhead practices to more streamlined processes, multiple AI disciplines will be on display, from better predictive analytics to on-demand, unstructured data synthesis fueled by natural language processing.

Industrial Original Equipment Manufacturer (OEM)

○ Traditional Business Model

- Operators are responsible for monitoring complex assets onsite

○ AI-Enabled Business Model

- Operationalize asset monitoring at scale
- Package remote monitoring services as a value-added service to customers
- Operators focus on production while OEM adds subject matter expertise to prevent asset failures

Equipment Maintenance

○ Traditional Maintenance

- Performed on a schedule
- Time-consuming process to determine root cause of warnings or alerts

○ AI-Enabled Maintenance

- Performed as needed
- Explainable AI provides user-friendly analytics to drill into a specific failure
- Increased availability by eliminating unnecessary maintenance and unforeseen downtime

WHEN AND HOW DO I SEE A Return on Investment?

Industrial stakes are high and you're likely asking yourself this (literal) million-dollar question. Companies that adopt digitization and AI will reap the benefits of their investments and defend against disruption. AI is not going to be optional in the years to come; it will be a baseline necessity for a business to thrive.



ROI can manifest itself in multiple ways. It might mean:



Reducing sensor deployment costs because AI provided comparable monitoring results from a smaller subset of sensors



Using AI to keep a \$30M capital investment from catastrophic failure within four months of installing AI-based predictive modeling



Increasing oil production capacity of a \$1B well by 1% over a year, resulting in a \$10M topline opportunity

CHARACTERISTICS OF A Successful AI Project

An AI system is a powerful tool—but like using a fire hose to put out a candle, it is not always the most appropriate solution.

AI excels at finding subtle patterns in data sets, particularly under complex or changing conditions. Sure, a linear regression model is probably sufficient for predicting housing prices, which have a limited number of input variables and clear relationships. However, imagine coding a formula to identify all the types of malware, or to look at the hundreds of sensors in a combustion turbine to predict when any of its thousands of moving parts will break. Trying to wrangle all of that data is a task beyond what data scientists can achieve without help from AI.

A good machine learning project is one that's tractable. Machine learning isn't a magic bullet that will solve all of your problems, so it's important to pick something that can be achieved. If there's an abundance of data and a highly complex scenario that maybe only a few experts understand, there's a strong chance that machine learning can add value.

Given the breadth of AI applications, it's difficult to generalize what makes a good AI project. However, data [ideally from labeled and organized data sets] is an absolute necessity across the board. If you're trying to predict when a machine will need service, it must have sensors and historical data; if you want a drone to recognize cracked turbine blades, there must be pictures to train on.

Starting with a high-impact problem is essential to a good machine learning project. The next critical part is the data needed. The data should not present an obvious solution nor should there be an explicit pattern that's easily recognizable. To continue the project, a pipeline of collected data should be available.

While we could write a long, scintillating book solely about data requirements, the data needed depends on the kind of problem you're trying to solve. Further, the data sets an AI vendor would like to have and what a company has available are usually two separate things.

The most important thing when considering an AI project is that the data you have is mapped to the problem you're trying to solve and the value you're looking for.

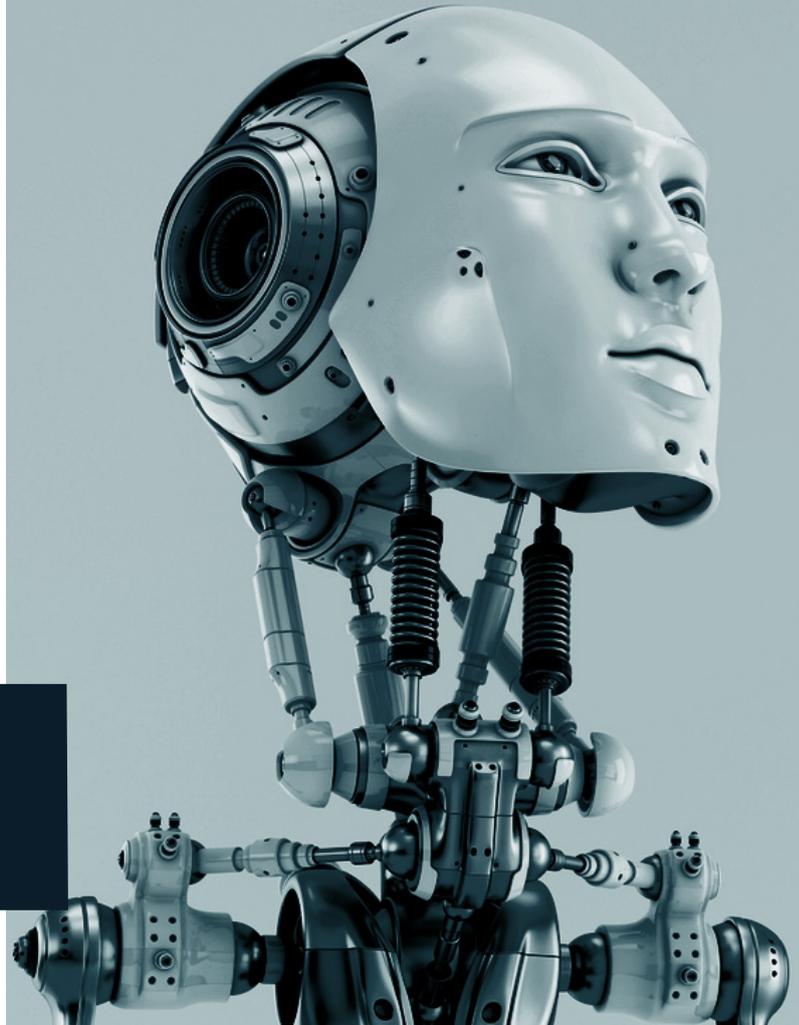
Getting the needed data may require coaxing and coordinating across different business units.

Thus the question becomes: What problem are you trying to solve? Keep this simple and well-defined, but choose something with a real business impact—there is such a thing as fruit that's too low-hanging. If success on the project doesn't mean anything to the company, it's unlikely to see AI as a valuable tool.

CONSIDER THESE Questions

- What are the desired outcomes?
- What does success mean? How will it be measured?
- What will the output look like?
- Who will be the end user?
- How will the results impact customers, employees, and workflows?

Thinking through these questions before implementation will ensure clarity on the project and cultivate buy-in throughout an organization.



BEST PRACTICES FOR Change Management

Any new technology may initially be met with resistance at different levels of an organization. As an AI vendor, we've heard it all, and have learned how to navigate different scenarios to ensure successful adoption and implementation. Here are practices we've found that will lead to success.



Be collaborative

Everyone, from engineers to executives, should understand the overall impact the project will achieve. This larger vision will help keep focus should difficulties arise.



Take a bottom-up approach

While leadership can identify value buckets, validating them requires SMEs. The experts using the technology every day must see the value, or the tools won't get used properly.



Drive from the top

The C-suite should make it clear that implementing AI is a priority, and be prepared to take a stance on the project if encountering resistance.



Be present

One client described how their CEO attended every meeting on progress updates, and the implementation manager was regularly on-site. His presence helped communicate that the project was not simply a directive from management, but something the company was truly invested in.



Fail fast

As one client recently put it, "We could have taken years to overdesign a system to have no failures, but it was more expedient to implement a solution and fix problems quickly." Teams should feel comfortable bringing up issues so that they can be solved. Don't tie each project to personal success—instead look for overall value and lessons learned.



Adapt to shifts

Employees may resist AI out of fear the technology will replace them. While unlikely, workflows and job duties will likely change. For example, vibration specialists who once watched for anomalies may shift to confirming issues and fixing them, which requires an entirely different skill set. Management should be prepared to help navigate these transitions.



Celebrate success!

Share positive results and congratulate stakeholders on a job well done to build trust for future projects.

WHAT TO LOOK FOR in an AI Vendor

With so many companies claiming to offer AI solutions, it's difficult to distinguish between those offering real AI from those selling buzzwords. Here are five characteristics to look for in an AI vendor.



1

Background and inclination toward AI

The best AI vendors have a deep-seated motivation to contribute to the field. For many older, larger vendors, AI is little more than an afterthought tacked on to existing products. Be on the lookout for companies with a forward-thinking mindset, an organic AI inclination, and substantial time and resources dedicated to research. Given the rapid progress of AI, a strong research department is critical in delivering effective solutions.



2

Quality talent and research capabilities

It's likely that fewer than 10,000 people in the world are qualified to tackle serious AI research, with many of them working in academia or for tech giants like Google and Amazon. Therefore, a smaller company's ability to attract AI talent is a strong indicator of the quality of its solutions. Look for things like patents, published papers, and advanced degrees among a vendor's data scientists, and don't be afraid to ask questions, however simple, to assess their technical knowledge.



3

Track record of successful deployments

Sharp websites, brochures, and proof of concept projects are no substitute for a vendor's actual results. Sound product and services strategies, as well as general internal stability, signify an AI vendor capable of long-term projects for enterprise clients. Challenge the vendor on its strategies for scaling AI solutions to generate business value, and seek out referenceable accounts that can speak to the vendor's past work.



4

Sound delivery model for projects

Preparing a company for AI technology is a difficult task. Actually implementing solutions is even harder. Whereas service vendors tend to offer one-off implementations, product companies are better poised to maintain consultative relationships with clients and assist with end-to-end solutions. A strong network of partners often signals a vendor's trustworthiness and its ability to deal with unforeseen issues.



5

Domain expertise in relevant fields

An advantage of AI is adding new perspectives to existing products, services, and challenges for businesses. Still, domain expertise is critical in the adoption of technology for particular use cases, not to mention the overall success of a project. Ensure that a prospective vendor has enough domain expertise to bridge the gap between their AI systems and your company's work.

With so many apocryphal claims circulating about AI, business leaders are right to feel skeptical about vendors' claims. But make no mistake: AI can deliver real value. By choosing a vendor with these characteristics, you'll find a strong partner that can deliver on AI's true value to your business.

CASE Studies

Curious to see the problems AI is solving today?
Here are a few real-world use cases from SparkCognition's client files.



Utilities

Problem

After investing in a new fleet of combustion turbines, a major energy company experienced a turbine malfunction from an unknown manufacturing defect. The company asked for SparkCognition's help in protecting against such events in the future.

Solution

The company leveraged SparkCognition™ Maintenance Advisor product to analyze streaming turbine data and identify new failure indicators using unsupervised machine learning.

Result

Within four months, the Maintenance Advisor product identified a persistent anomaly on a turbine, pointing to problems with its inlet guide vane wheel. The company's engineers found a faulty blade retaining key, averting a catastrophic event that could have destroyed a \$200M asset.



Aviation

Problem

An airline's technicians were spending hours troubleshooting problems with its aircraft. Grounded planes were causing scheduling mishaps across the airline's fleet, resulting in lost revenue from the aircraft being out of commission. The company sought a solution to streamline the troubleshooting process.

Solution

By analyzing reports from the airline's maintenance logs, cognitive diagnostics found patterns undetectable by the company's traditional maintenance process. They found that faults under certain conditions had a root cause not listed in manuals and additionally that certain maintenance behaviors could be optimized through training to speed up repair time and optimize cost.

Result

The airline's technicians are getting planes off the ground faster when maintenance is required, with savings estimated at up to \$40 million annually across its global fleet. Cognitive diagnostics is also unlocking more information in the company's vast maintenance logs, improving the accuracy of its repair orders and ensuring the mechanical health of its planes.



Oil and Gas

Problem

A major exploration and production (E&P) company faced costly, risky repairs on its oil wells due to equipment malfunctions. Full workovers cost up to \$100K and forced workers into the field to service faulty equipment under stressful emergency conditions.

Solution

With month-to-month data on oil, gas, and water production, SparkCognition™ Oil and Gas Maintenance Advisor automatically built models that helped the company's process engineers predict workover, rod change, and cleaning operations.

Result

The E&P company is predicting maintenance needs on its wells with up to 80% accuracy, allowing it to replace emergency repairs with more strategic maintenance events. This enables a greatly improved focus on the most productive wells and increases output by 1-2%, translating into millions of dollars.



Maritime

Problem

When a coupling became misaligned in a cargo ship compressor, the vessel went out of service for three weeks. Between repairs and lost revenue, its operator faced millions in costs and significant negative publicity. SparkCognition was brought in to predict asset failures and to understand the factors leading to them.

Solution

The Maintenance Advisor product used sensor data from engine room assets to identify the main signals of a potential failure. With a model using eight of the main signaling features, Maintenance Advisor predicted failures in propulsion motors up to 10 months in advance, and failures in alternators up to six weeks in advance.

Result

The maritime operator is now predicting the failure of shipboard assets in advance, allowing technicians to order parts and plan maintenance beforehand. In addition, the operator is now using data to monitor specific features of asset degradation, making its maintenance operations more precise.

ABOUT SparkCognition

SparkCognition's award-winning AI solutions allow organizations to predict future outcomes, optimize processes, and prevent cyberattacks. We partner with the world's industry leaders to analyze, optimize, and learn from data, augment human intelligence, drive profitable growth, and achieve operational excellence. Our patented AI, machine learning, and natural language technologies lead the industry in innovation and accelerate digital transformation. Our solutions allow organizations to solve critical challenges—prevent unexpected downtime, maximize asset performance, optimize prices, and ensure worker safety while avoiding zero-day cyberattacks on essential IT and OT infrastructure.

To learn more about how SparkCognition's AI solutions can unlock the power in your data, visit www.sparkcognition.com.

- Driving customer success with deep domain expertise
- Committed to explainable AI and evidential outputs
- Actively advancing the science of AI



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