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Artificial Intelligence: The Ultimate Disrupting Force for Oil and Gas Companies

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Artificial intelligence (AI) has exploded onto the scene in recent years, promising to change everything from how we live to the ways companies work, create value, and serve consumers. While the causes of this explosion—increasing processing and storage power, abundant data availability, and AI algorithmic advancements—are well known, the effects are not. Few organizations are "AI-ready."

In a joint study to be published in September, "Reshaping Business with Artificial Intelligence," BCG and MIT Sloan Management Review analyze the state of AI today and in the future in 21 industries. While very few companies have made great strides today, BCG expects a strong impact in the next two to five years. In addition, the upcoming BCG report "A Practitioner's Guide to Artificial Intelligence" will discuss cross-industry use cases that can spur competitive advantage and value creation.

In the O&G industry, several AI applications have already emerged. Other industries have also made advances that can be transferred to O&G. In this article, we examine the AI use case landscape specifically for O&G.

Upstream

AI will enable companies to optimize field development from exploration to production. O&G companies have been using advanced data processing and simulation technology for many years. These tools are now being augmented by machine learning and AI techniques. Recently, companies have started to experiment with autonomous underwater drones, which are seeing rapid innovation, similar to aerial drones. AI-enabled vehicles will bring a wide range of opportunities to the offshore O&G industry such as seabed surveys, metocean data gathering, oil spill detection, inspection, and underwater intervention. Compared to today's solutions, performance will be at a much higher level of precision and cost will just be a fraction of what we are seeing today.

In exploration, for example, AI can help to support better and faster interpretation of seismic data to identify hydrocarbon deposits. AI is also expected to help engineering firms and operators make better and faster design choices, integrating a broad set of parameters and involving a large number of companies. AI can effectively revolutionize project delivery by challenging the sequential project maturation process used by industry players today.

In drilling, AI can help to identify the best locations and optimize drilling operations. AI will likely play a valuable role in real-time modeling and prediction of drill bit and drill string performance. Overall, and also impacted by factors outside drilling, productivity improvements of AI-enabled processes can generate significant value for O&G companies.

In the mining industry, AI is already being used to help automate machinery and vehicles and minimize health and security hazards for autonomous operations. The ultimate goal in O&G is an unmanned oil platform.

We expect AI systems to play a key role in improving health, safety, and environmental (HSE) performance by minimizing direct interaction of humans with heavy equipment and by using image recognition systems to reduce hazardous situations. In addition, AI can help to ensure that the industry can leverage the experience of an aging workforce. For example, national-language processing systems can help catalog and mine the knowledge embedded in, for example, workers' notebooks, e-mails, and conversations.

Based on BCG client experience, operations optimization and predictive maintenance hold great potential. O&G companies and suppliers have already started to implement self-learning algorithms to improve optimization. They are also continuously integrating sensor and system data with predictive tools to improve real-time decision-making. Operation centers with AI capabilities can monitor operations, offer advice to engineers, and send alerts in case of identified risks. AI is also increasingly automating root cause failure analyses as self-learning AI systems move from description to prediction to prescription. As a result, engineers will have to spend less time on administrative or data-related work and can focus on value creation.

O&G companies can save millions of dollars by, for example, using AI to minimize unplanned downtime and production loss. According to Sloan Management Review, a medium-sized liquefied natural gas facility has an average of five down days a year, with an implied production loss of $125 million to $150 million. For an offshore platform, downtime losses can average $7 million per day. Especially in times of low energy prices, any reduction in operating costs is critical.
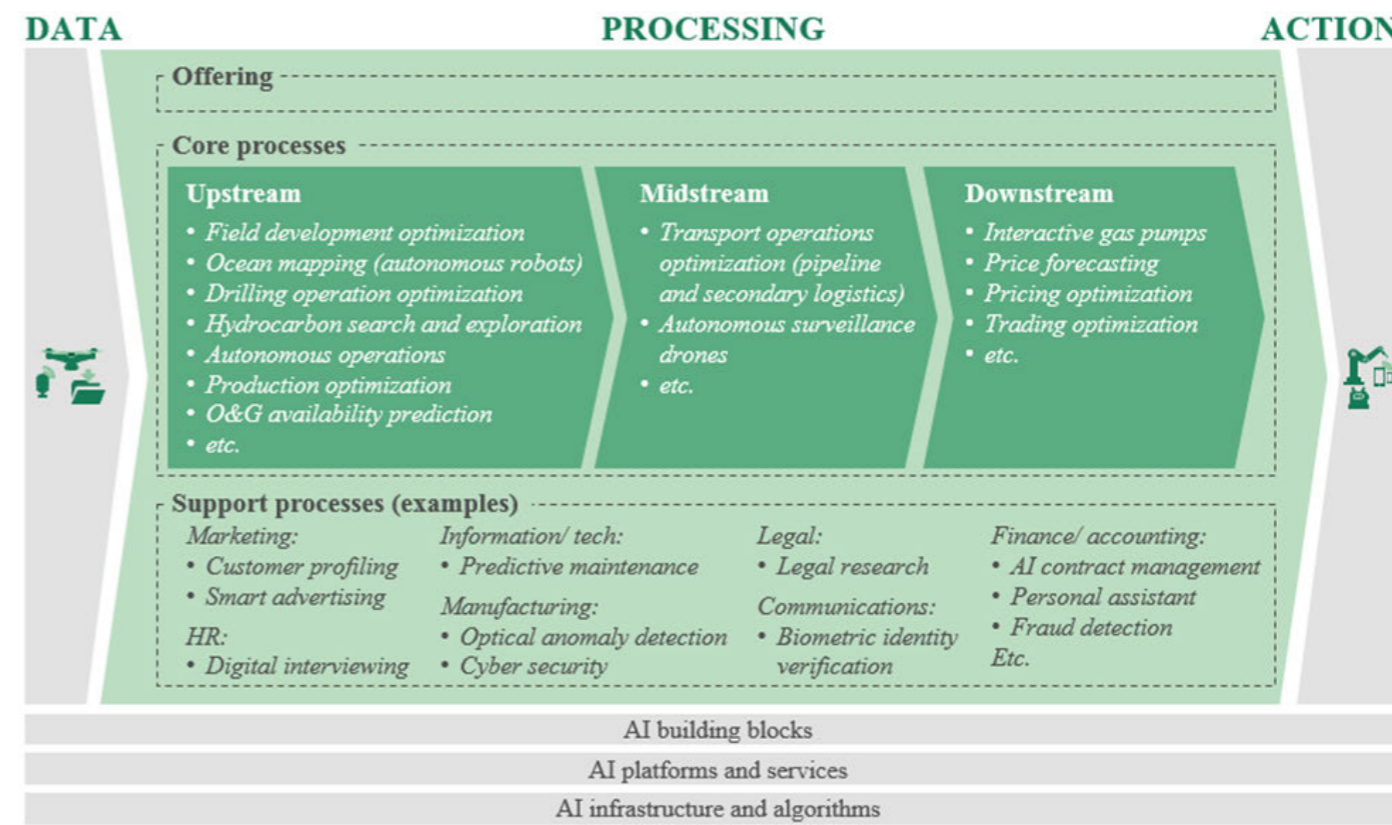
Graph 1: Relevant AI use case examples along the O&G value chain

Midstream

Companies can use AI to optimize transport operations including pipeline and secondary logistics. For example, AI will help to improve maintenance and inspection intervals of pipelines by analyzing and predicting the level of corrosion in combination with environmental and operational information. Technologies such as AI-powered surveillance drones can be used to gather the pipeline data needed for such analyses.

Downstream

In O&G trading, analytics technologies and AI are increasing the liquidity and availability of data and information and enabling advancements in pre-trade, trade, and post-trade activities. This is putting pressure on established O&G trading capabilities. Self-learning algorithms can absorb and analyze data far more thoroughly than humans and fundamentally transform O&G trading. Companies that do not enable their trading with AI are at risk. For a cross-industry perspective, BCG has published the study "Attack of the Algorithms: Value Chain Disruption in Commodity Trading."

AI is becoming increasingly important for refineries in downstream operations, especially in predictive maintenance. Machine learning helps to identify the causes of failures and unplanned outages, and suggests measures to extend machinery lifetime and load. It can

also improve and optimize scheduled operation cycles. Even when only little or incomplete information is available, O&G companies can unlock multimillion dollar savings through these measures.

In the retail business, AI is improving customer service and customer interaction. Chatbots are available around the clock to answer common customer questions. Natural language processing has not yet been perfected but increasingly offers a human-like interaction. Virtual assistants can incorporate context-related information such as product or customer data to personalize answers or recommendations. These tools have the potential to increase customer satisfaction and cross-selling while reducing churn.

Data and AI building blocks

Regardless of how AI is used along the O&G value chain, it will be critical for companies to generate, capture, and clean contextual data and to give data a new meaning and new momentum. O&G companies can enable self-learning systems and create new insights and automation beyond human capabilities by leveraging large amounts of data which often already exist. This requires some effort and foresight since data sets are often in incompatible formats, unstructured, or incomplete and thus have to be cleaned and prepared for AI use. More generally, operators will already need to establish a clear data strategy today to

systematically and efficiently leverage the power of large amounts of data generated by their operations.

In addition, different "building blocks" are essential for all AI systems. The upcoming BCG report "AI in Business: A Practitioner's Guide" further elaborates on the essential components of AI. They are more advanced than a single algorithm but not operational by themselves. All O&G AI use cases are based on single or sets of building blocks. The basic functionality of these blocks is often available in the market but needs to be tailored to individual needs.

Machine vision is the classification and tracking of real-world objects based on visual and other signals, such as pictures and videos.

Speech recognition is the transformation of auditory signals into text. Siri or Alexa are consumer examples, while Nuance's PowerScribe for radiologists is a commercial example.

Natural language processing (NLP) is the interpretation of text. NLP is used to recognize spam, fake news, and sentiments such as happiness, sadness, and aggression.

Information processing covers methodologies to derive information from unstructured text and provide answers to queries.
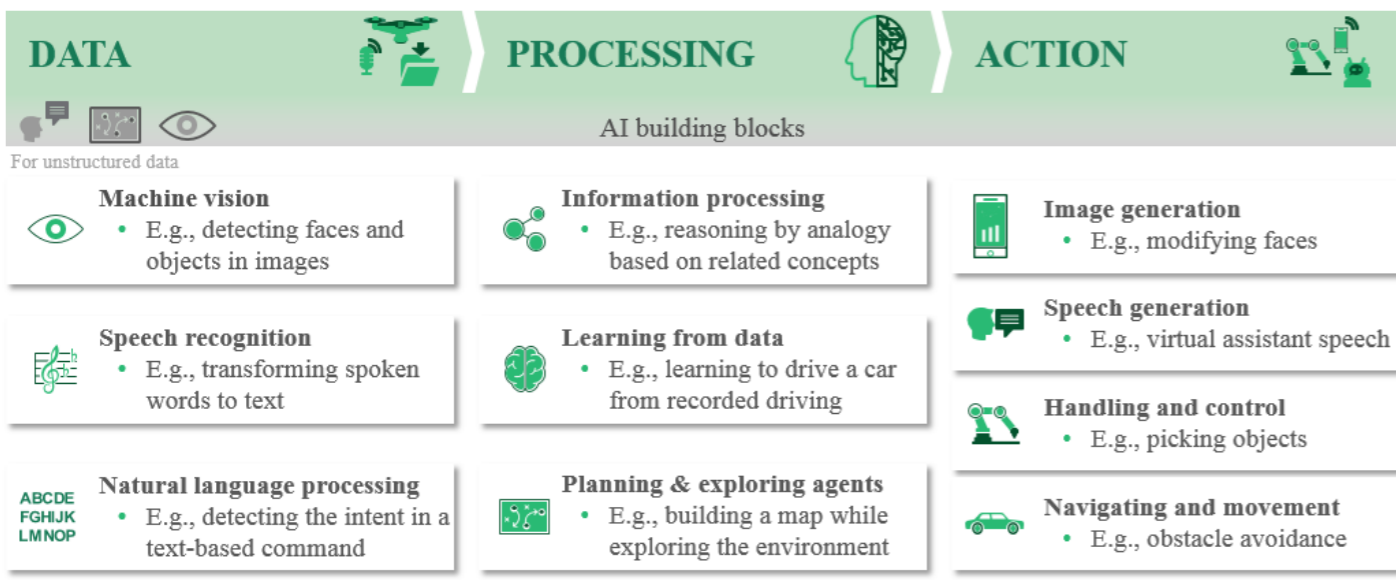
Graph 2: Breakdown of AI use cases into building blocks

Learning from data is essentially machine learning. It is the ability to predict values or classify information based on historic data and refers to the application of machine learning to new data. Anomaly detection used by cyber-security systems is an example of learning from data.

Planning and exploring agents are methods that identify the best sequence of actions to achieve a goal, such as self-driving cars navigating autonomously to their target destination.

Image generation creates images based on models. It is the inverse of machine vision and can be used to complete images that have no background or transfer oil paintings to photo images.

Speech generation covers both text generation from data and the synthesis of speech and text. Chatbots and Alexa are examples commonly used today.

Handling and control refers to interaction of robots with real-world objects, such as robots autonomously picking up and delivering items within a warehouse without human interaction.

Navigating and movement describes robots moving through difficult, unstructured environments on legs, such as robots climbing stairs or mastering sidewalks. A second, independent task is that of navigation and localization.

Getting engaged in AI means that O&G executives have to think beyond individual use cases and across different dimensions, since the business implications and requirements of AI span the entire organization. Four lenses are especially helpful: customer needs, technological advancements, data sources, and (decomposition of) processes. The BCG report "Competing in the Age of Artificial Intelligence" discusses the question of how business leaders can harness AI to take advantage of the specific strengths of man and machine.

A company's strategic direction will be significantly shaped by its ambitions and willingness to invest into prioritized AI opportunities.

A data strategy needs to be an integral part of any technology and transformation strategy. This data strategy should include data consolidation, cleaning, and acquisition, as well as priorities for new algorithms, systems, and required technologies. Finally, the company should establish a companywide data platform.

Companies will have to assess existing in-house capabilities and identify what new competencies they need to develop. This might include creating an AI and analytics team, hiring new technology specialists, or building AI competencies in product development, marketing, sales, or service.

In addition, they will need strategy- and service-oriented business models for dealing with vendors and partners. These third parties may be required for noncritical capabilities related to system optimization (for example, algorithms and platforms).

In order to turn quick wins into a long-term competitive advantage, O&G companies have to establish seamless human-machine interaction: They will need an AI-educated workforce, an enabling business ecosystem, AI-prepared data, and technology ecosystems. They should implement agile forms of working for both humans and machines. Finally, they need to create scalable, centralized AI systems and decentralized agents such as bots. All of this needs to be created in an adaptive organization that is able to embrace continuous change.

Graph 3: Future competitive advantage based on human-machine interaction