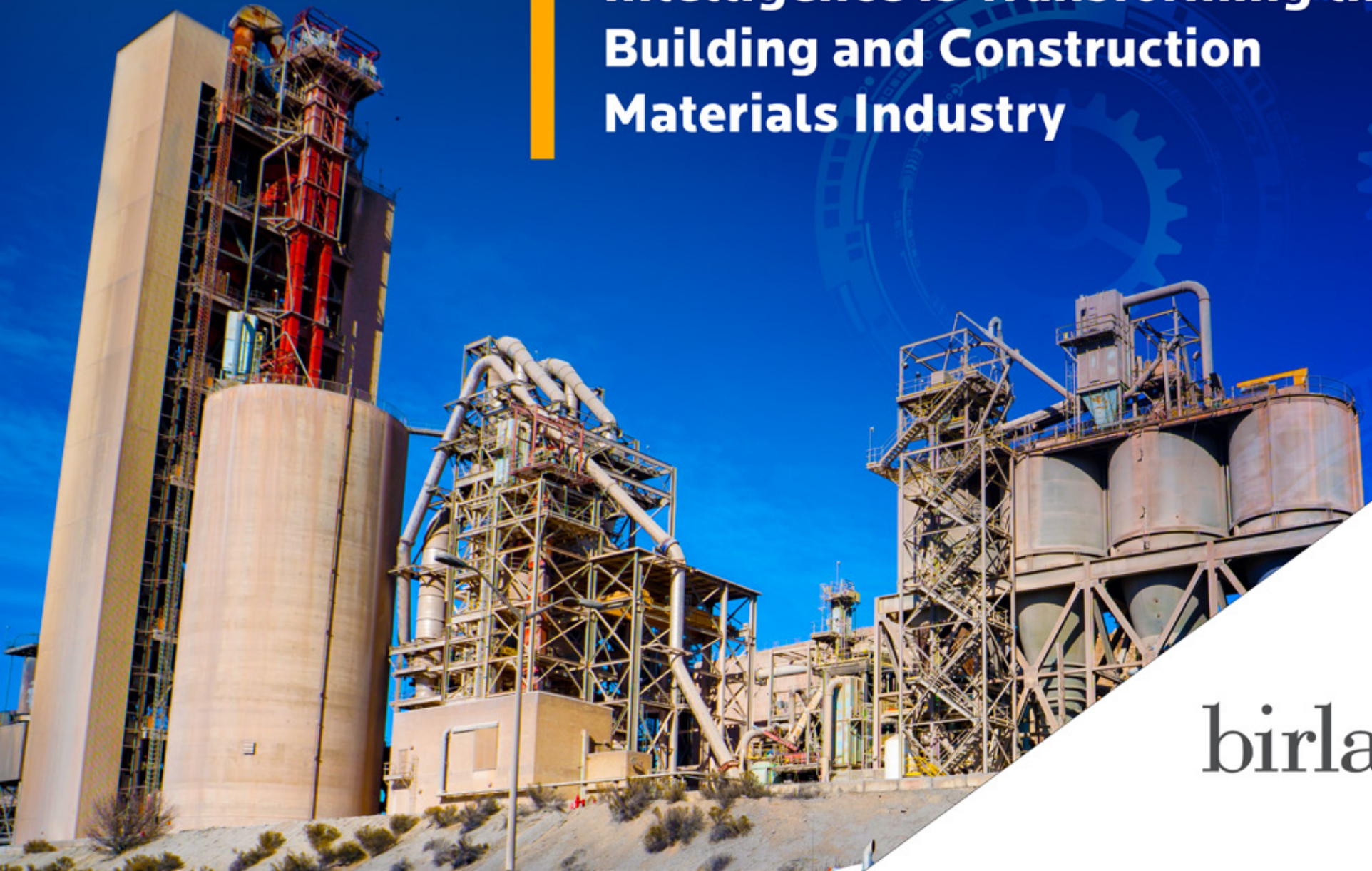
Seven Remarkable Ways Artificial Intelligence is Transforming the Building and Construction Materials Industry



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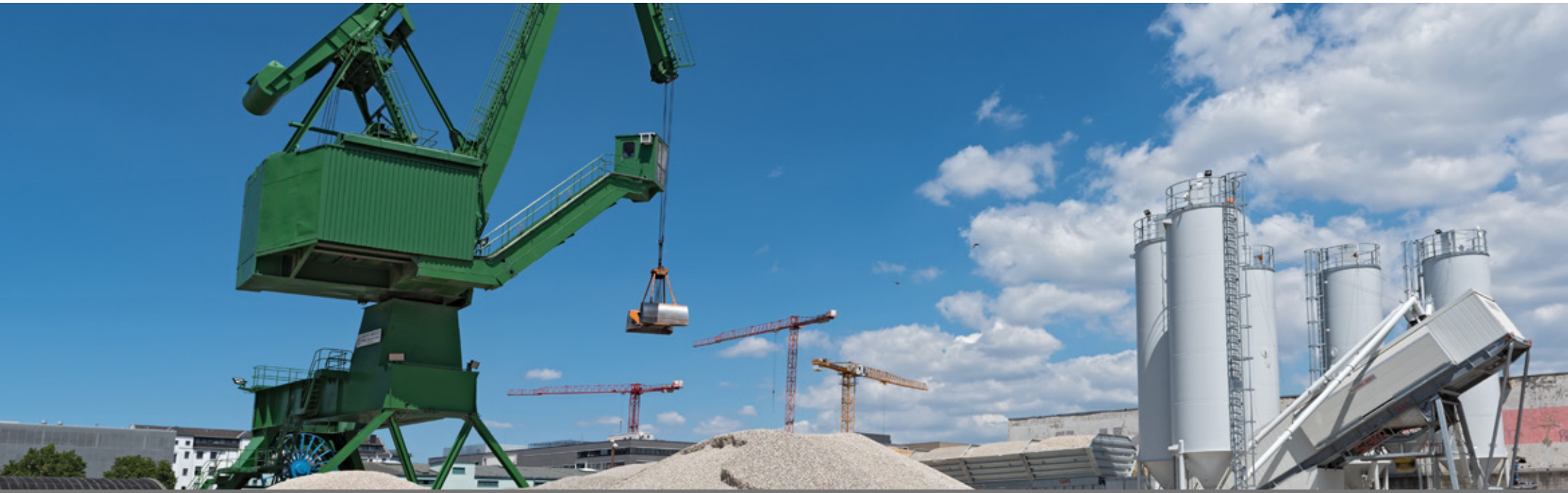
WHAT'S INSIDE?

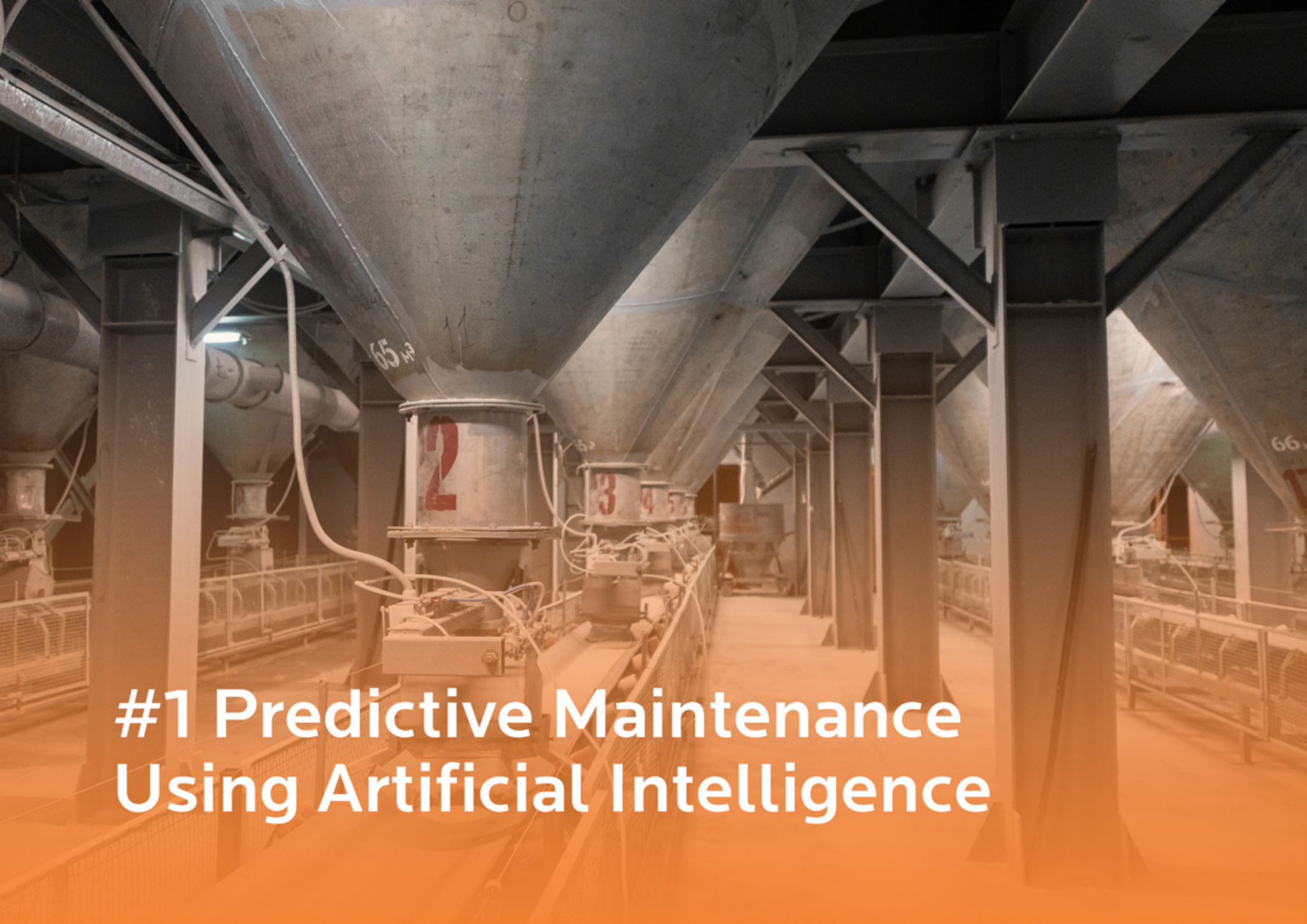
The State of Building and Construction Materials Industry

The global demand for cement peaked in 2014, and since then, the growth in surplus capacity has not only eroded utilization rates, but also increased pricing and efficiency pressures on the cement industry as a whole. While demand has contracted in developed nations, emerging economies continue to show a solid demand growth down the line.[1] However, in addition to changing demand dynamics and international trade factors, sustainability and compliance concerns are throwing new expectations of performance, capital and energy efficiency, supply chain orchestration and manufacturing operations.

While most industries exhibit better KPIs with increasing levels of digital maturity and innovative use cases of emerging technologies, the cement industry has been late to join the march towards the Industry 4.0 paradigm. However, this factor doesn't necessarily work against cement producers - with most use cases of technologies like Internet of Things (IoT), Artificial Intelligence (AI) and machine learning (ML) reaching optimum levels of maturity, the global cement industry stands at a turning point - where selective implementation of high-value and low-cost use cases can redefine the leadership equation in this sector for years to come.[2]

Here are seven such use cases of AI, that can reinvigorate the cement value chain from start to finish.





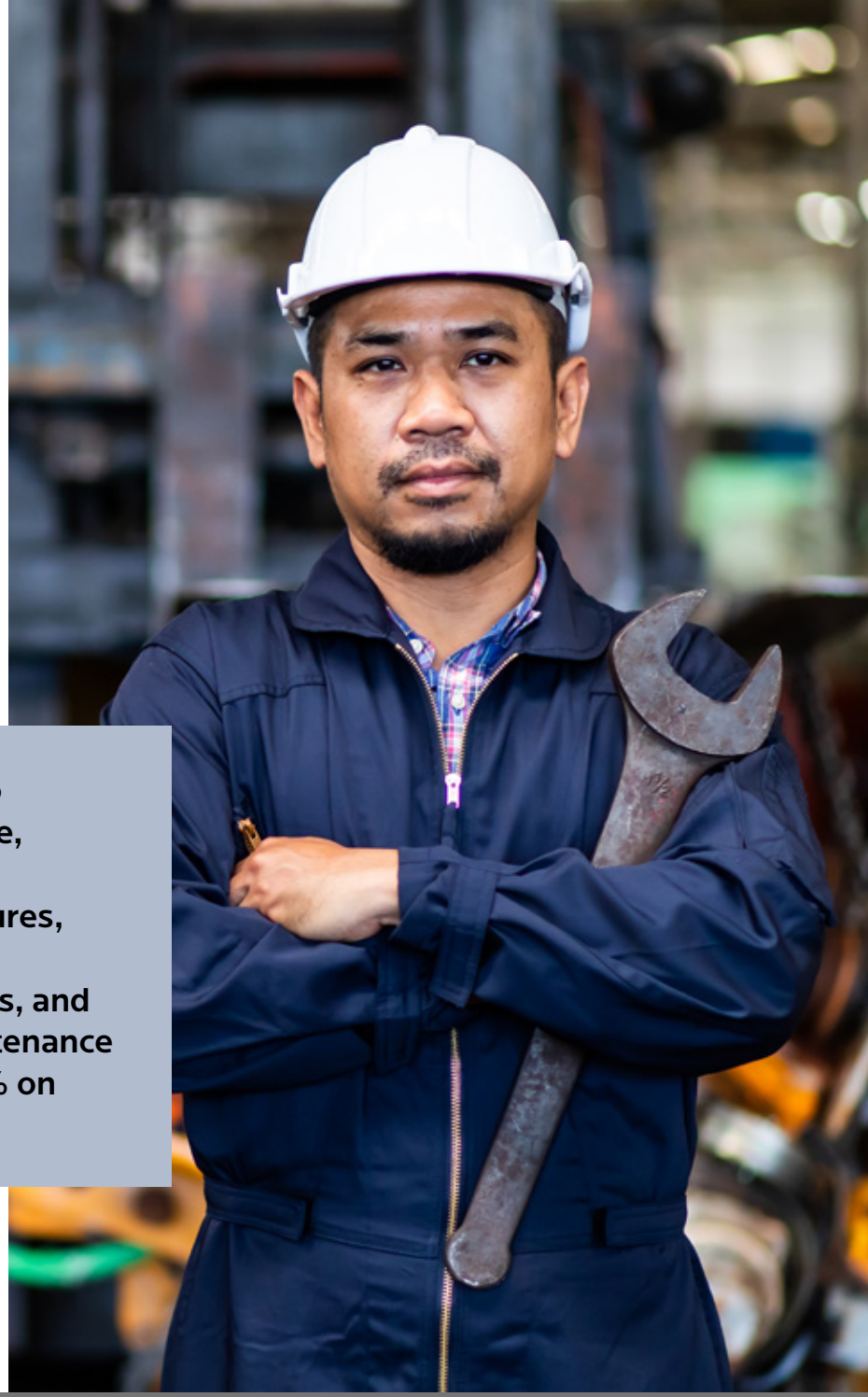
#1 Predictive Maintenance Using Artificial Intelligence

Predictive Maintenance Using Artificial Intelligence

Predictive maintenance technology helps producers predict a potential failure of critical machinery with high accuracy. To make this happen, sensors that record heat, pressure and triaxial vibrations are placed on the machinery and connected to a public cloud, where the data is stored in data warehouses or data lakes. By examining past failures of the equipment in terms of their correlation with numerous other factors through neural networks, Fast Fourier Transform (FFT) and advanced AI techniques, the system can notify the right process owners about a potential risk of failure and most probable root cause/line of action - which helps reduce operational costs by up to 20%, save on routine replacements and diminish costs associated with unforeseen downtime.[3]

While predictive maintenance solutions for stacker reclaimers have already made inroads into the industry, other equipment like kilns and grinding media that are unique to the industry require tailored solutions targeted to capture production-specific environments.

By integrating such solutions into the end-to-end maintenance cycle, producers can even simplify their operational maintenance procedures, increase uptime, eliminate over-maintenance and inventory spares, and achieve greater operational maintenance efficiency with savings of 30-50% on annual maintenance budget.[4]



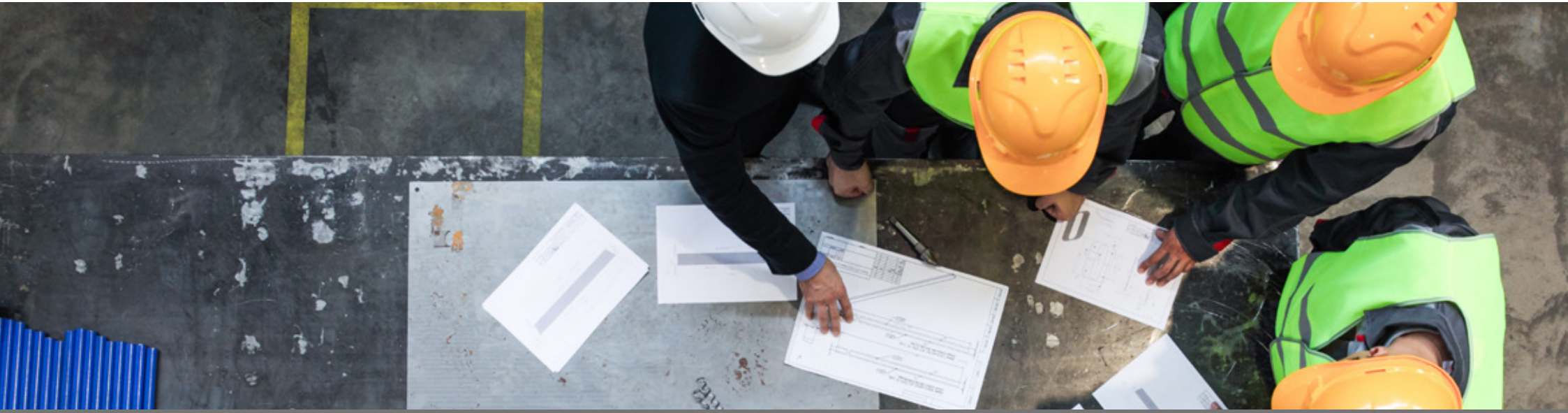
#2 Demand Forecasting Using Machine Learning Models

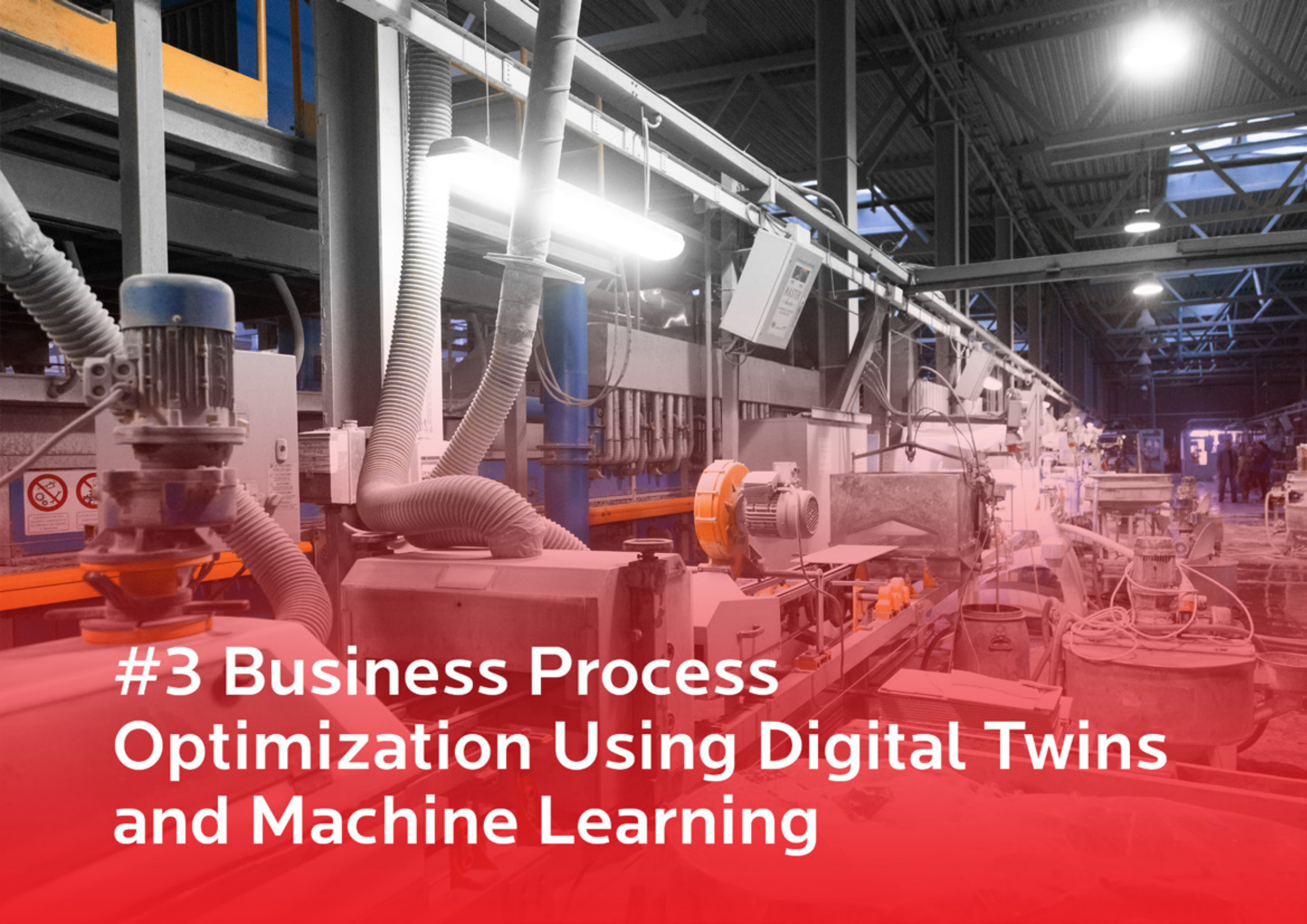
Demand Forecasting Using Machine Learning Models

While demand forecasts are a critical part of production planning for cement producers, traditional methods are not only resource intensive, but also raise questions on reliability of results. Cement producers have relied on qualitative models, that leverage market surveys and opinion analysis through a panel of forecasting experts - such models are subject to bias, and cost expensive man-hours while staying agnostic to critical signals of the larger ecosystem.

Machine learning techniques that leverage quantitative models like time-series based/ causal forecasting can help producers accurately forecast demand for multiple scenarios by taking past trends and other causal factors into account - which brings greater reliability to forecasts and lays the ground for better production planning.[5] While multivariate regression models have been deployed, recent studies indicate that ANN, ARIMA and Moving Average (MA) models can bring better precision to the results.

By accurately forecasting demand across multiple scenarios, cement manufacturers can improve their profit margins and resource allocation, while simultaneously enhancing their risk management function. The final result? A financially revitalized, lean manufacturing model that can free up costs and make room to finance promising pilots of other use cases.





#3 Business Process Optimization Using Digital Twins and Machine Learning

Business Process Optimization Using Digital Twins and Machine Learning

A new-age approach to process optimization entails laying a low-cost IoT network that captures data from devices across the production line, and making use of this data to drive business process improvement using machine learning models - also called digital twinning technology. With this technology, it is possible to replicate entire systems - consisting of resources, movements and actions digitally by capturing millions of data points across hundreds of devices every second. Machine learning models leverage this data to simulate situations across different boundary conditions, thereby facilitating cutting-edge optimization of end-to-end processes.

Digital twinning not only builds real-time visibility and control of the production plants, but is also feasible at varying scales and levels of digital maturity. In order to realize gains fast, producers should target the most critical and inefficient sub-processes with a machine learning-led approach to process optimization.

A staggered approach to widening the expanse of digital twins can be a cost-effective way for producers to innovate in the long run. After laying the groundwork, senior management can also benefit from insights distilled through granular awareness of their production environment and thereby take critical decisions fast, with confidence.

#4 Loading and Unloading Time Prediction

Loading and Unloading Time Prediction

The loading and unloading process accounts for a significant chunk of handling time in the production-to-market cycle in the cement manufacturing industry. In the manual world, trucks often take over eight hours to move from loading to security checks. In fact, research has been conducted to speed up the pneumatic unloading process in the cement value chain to avoid traffic at critical checkpoints beyond the production line.[6] **Optimizing the loading-unloading process can improve turnaround times of the fleet, boost picking accuracy, and drive productivity gains.**

An industry 4.0 approach to optimized loading and unloading captures data from critical checkpoints, such as loaders and hauling units while tracking containers inside the facility with RFID tags. By learning from historical data, machine learning models can provide insights into real-time status of batches, and predict loading and unloading times with high accuracy. Researchers have also suggested solutions that optimize weight of loads through pit-loader scales, to improve the lifespan of trucks while delivering with the least number of shipping cycles.[7] **Accurate forecasting of loading/unloading times makes way for better decisioning, and further optimizes the supply planning process.**

#5 Cement Logistics and Fleet Optimization

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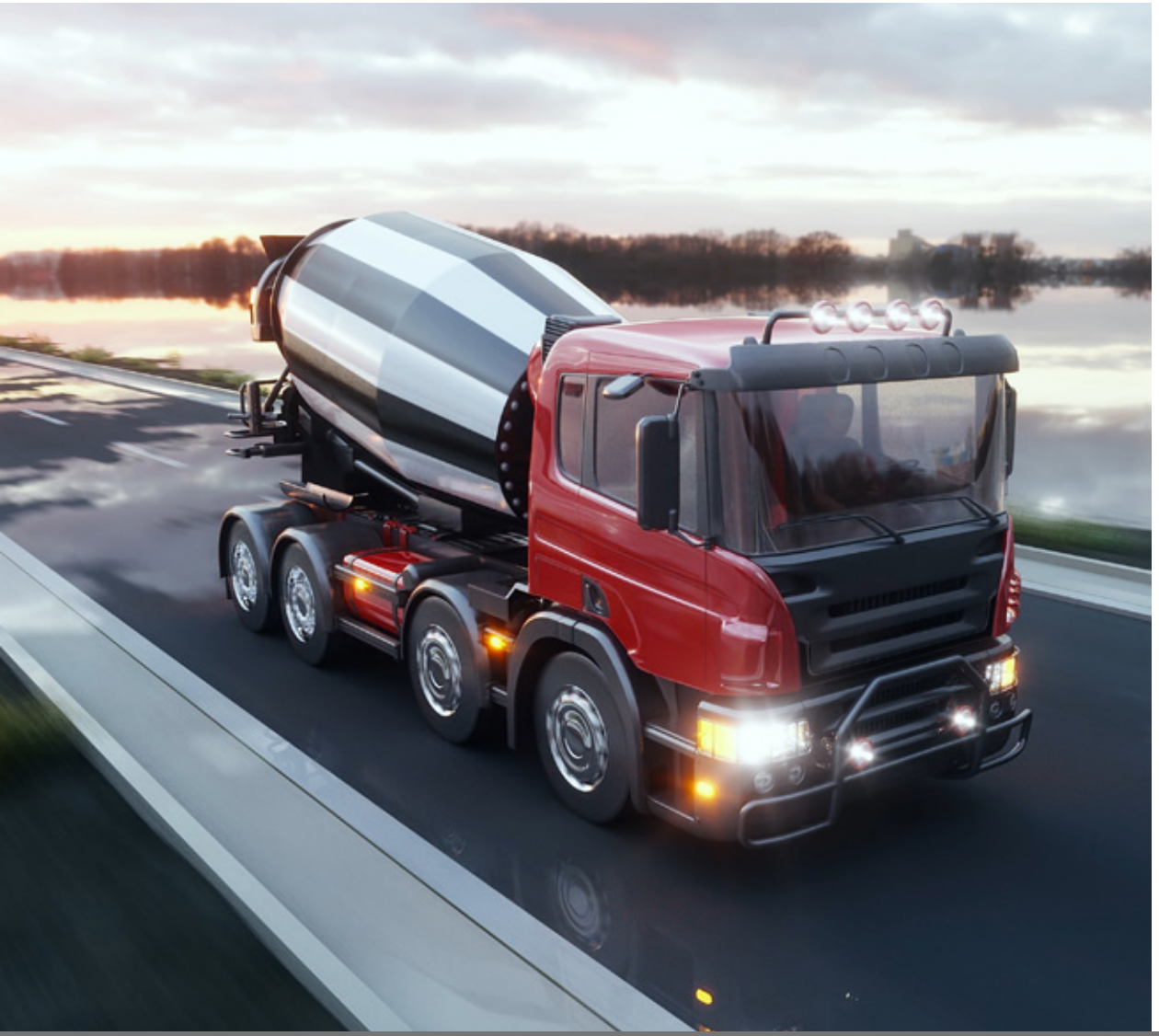
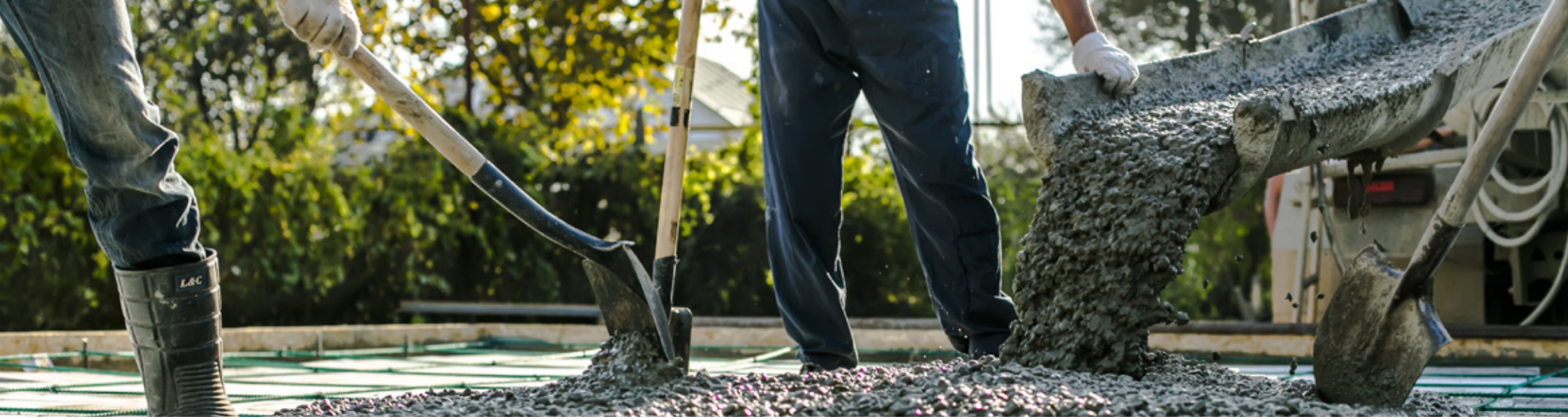


In its current shape, the cement industry's logistics processes require a high degree of manual intervention - from loading to payment, trucks undergo a number of checkpoints. In fact, a number of high-volume cement producers report logistical challenges which lead to suboptimal resource utilization and diminish satisfaction along the downstream value chain. Machine learning based solutions that make use of positioning sensors, RFID tags and computer vision can bring major improvements in end-to-end logistics processes.

The recent pandemic showed some excellent examples of how AI and IoT-driven logistics can not only help enterprises withstand major disruptions, but also reduce costs and waste.[8] **Fleet optimization solutions make it possible to dynamically plan delivery routes, increase the uptime of the fleet, and reduce logistics costs by up to 3.6% in highly optimized delivery networks - cement producers therefore have an opportunity to bring significant revenue improvements by reinventing their logistics with machine learning solutions.**[9] What's more, the opportunity to optimize logistics within the plant is an immense one too - digital twins based technologies and machine learning helps optimize the movement and flow of materials in the production stage.

#6 Clinker Quality Improvement Using Machine Learning



Clinker Quality Improvement Using Machine Learning

Clinker quality measurement has traditionally been conducted through lab assessments on samples, which are not only cost and time-intensive, but also make it impossible to follow a closed-loop approach to monitoring free lime content. In addition to introducing unnecessary delays (often lasting over a month due to the testing process) in the system, traditional methods employ an audit-based approach to quality control. However, digital technologies can help reinvent traditional means of assessing and improving clinker quality in cement plants.

Existing use cases have shown success with soft sensor technology, based on back-propagation neural networks.[10] Soft sensor technology captures coal feed rate, inlet temperature, kiln RPM, and other variables, and outputs clinker quality corresponding to the composition of the raw feed. This data is then analyzed through ensemble learning techniques to accurately predict and monitor the quality of batches in real-time. While ensemble learning has demonstrated high levels of accuracy, precision declines strongly with reduced image quality, gaussian white noise and salt-and-pepper noise. Armed with insights from deployments in demanding physical environments, cement producers can target implementations with the right outcomes and challenges in purview.

Where producers are currently compensating for the lack of insight into their product quality by utilizing high quality limestone and additives, an machine learning-based approach to clinker quality assessment and control can help achieve critical cost advantages in the long run.

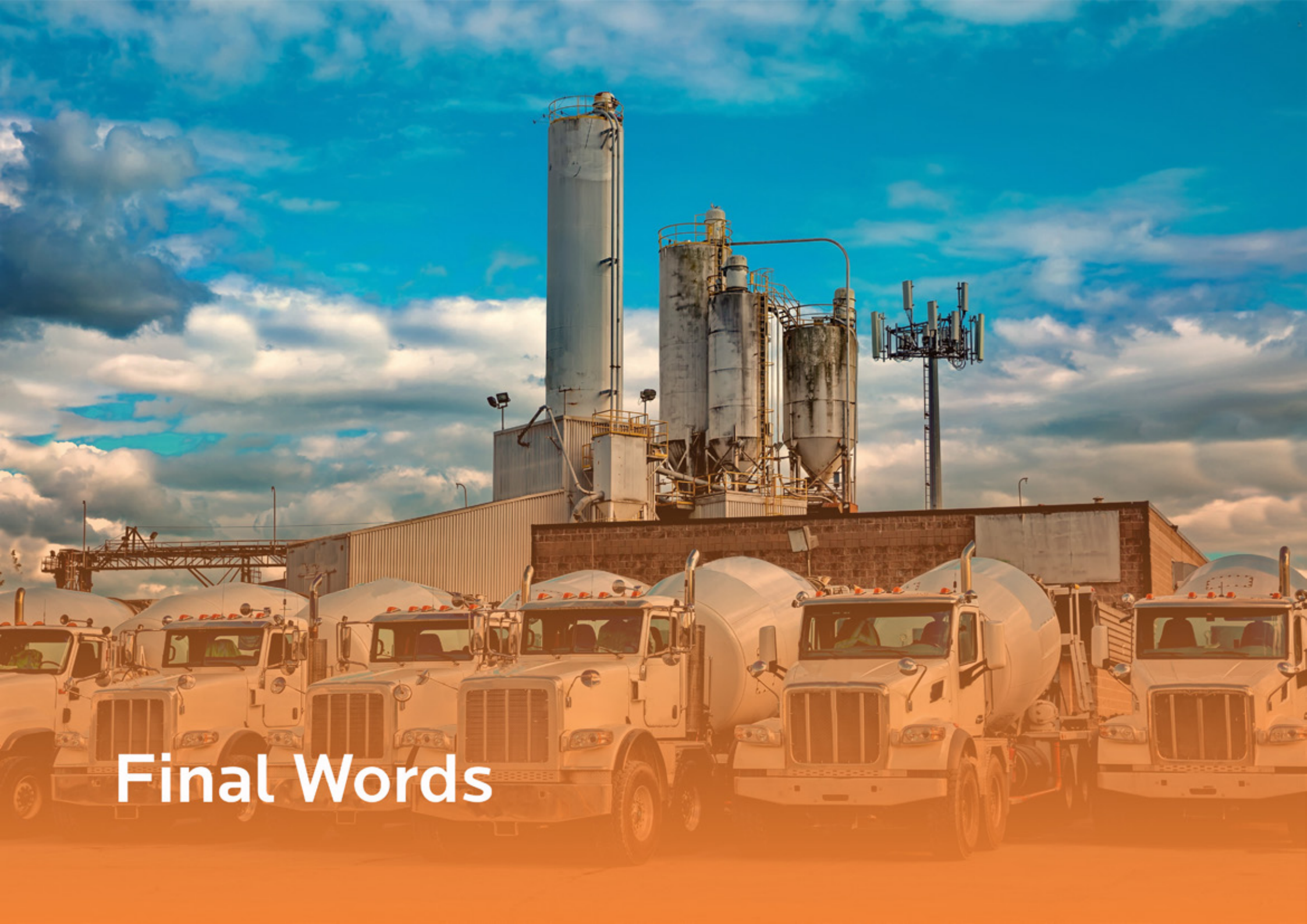
#7 Smart Reporting Using NLP

Smart Reporting Using NLP

Natural Language Processing technology makes use of AI techniques to process and generate text in human-spoken languages. At the core of NLP use cases are constructs that render intelligence to the NLP engine of a digital solution. Working in tandem, NLP-based solutions find use cases not only at the customer support stage, but also in maintenance, sales and reporting-based processes. NLP essentially facilitates conversion of unstructured data into meaningful insights in human language.

Some example use cases of NLP include automated machine failure notifications, conversion of customer issue tickets into actionable recommendations, automated performance reporting and even front-facing interaction support.

By leveraging AI-backed NLP solutions for reporting, producers can build the foundations for better decisioning at lower costs, eliminate manual errors from the reporting process, and schedule generation of reports across various functions.



Final Words

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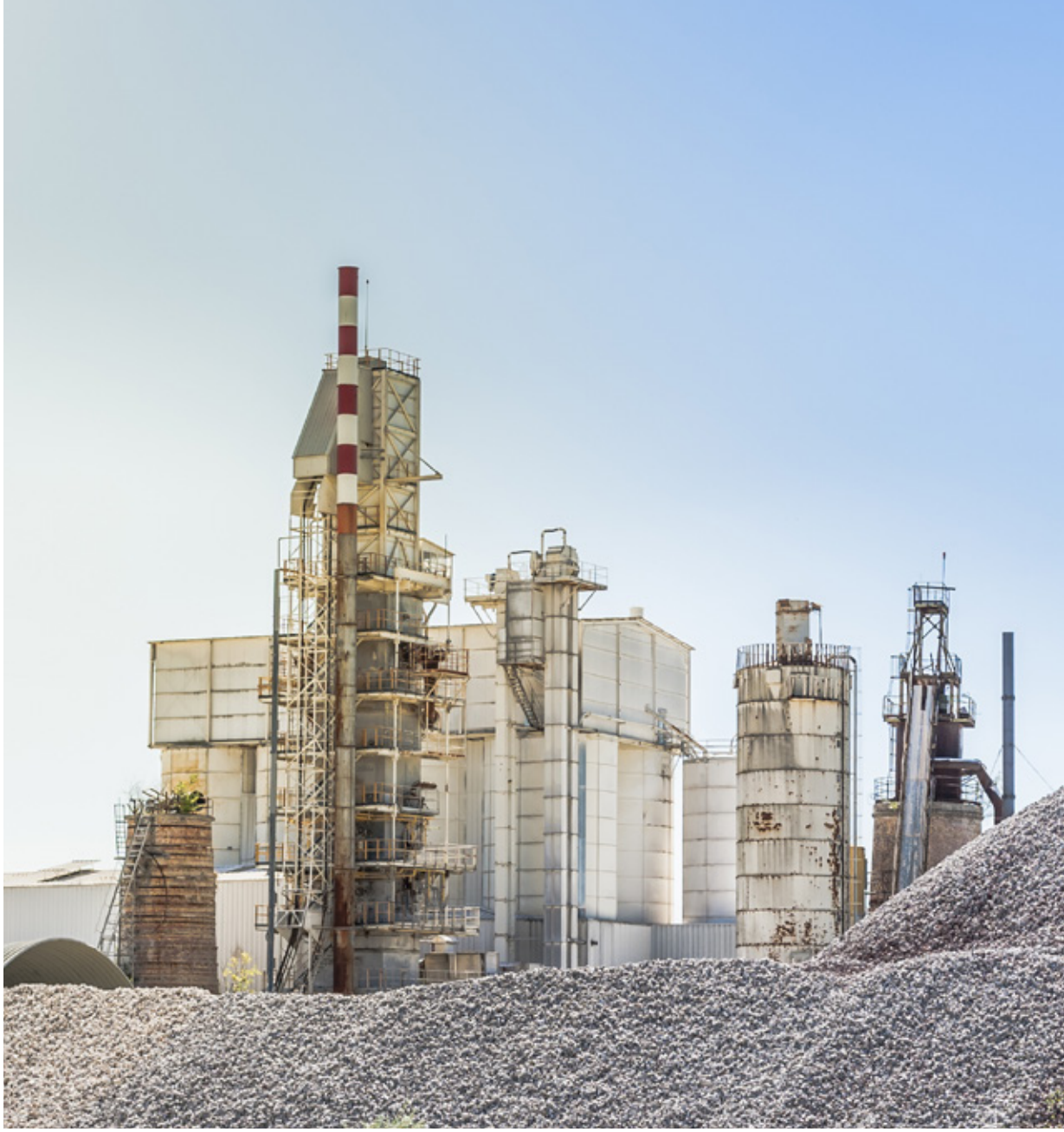
Going forward, as more production capacity is added in parallel to the slowing demand, enterprises are likely to see competitive pricing, efficiency and experience improvement-related pressures. In addition, a sizable carbon footprint of the industry as a whole should also bring compliance and emission reduction pressures onto the senior management's radar. AI has shown high-value opportunities across a number of checkpoints in the cement value chain. Soon, these use cases will become the baseline - as industry leaders are already developing concepts for digitally interconnected green cement plants. It is time for cement producers to shift the needle, and reinvigorate their plants with AI-based digital solutions.



Authors

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Shobhit has varied industrial and technology experience, focusing on building value-based solutions for the last two decades. He is a firm believer in business-aligned IT-driven strategy and a harmonized zero defect delivery for customers. He leads delivery for the process manufacturing business for Birlasoft, and the construction and building materials industry sits at the heart of it.

Raj Pradhan

Head of Delivery, Construction and Building Material Business

Raj has multi Industry background with a specialization in the Cement industry. Raj comes with Data and Analytical background and has his foundations laid in Business Processes. Raj likes to push the Delivery Management parameters for Business Performance KPI's and has a key interest in challenging the business process boundaries. He currently leads the Building Materials Industry business for Birlasoft and has strong domain skills.

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