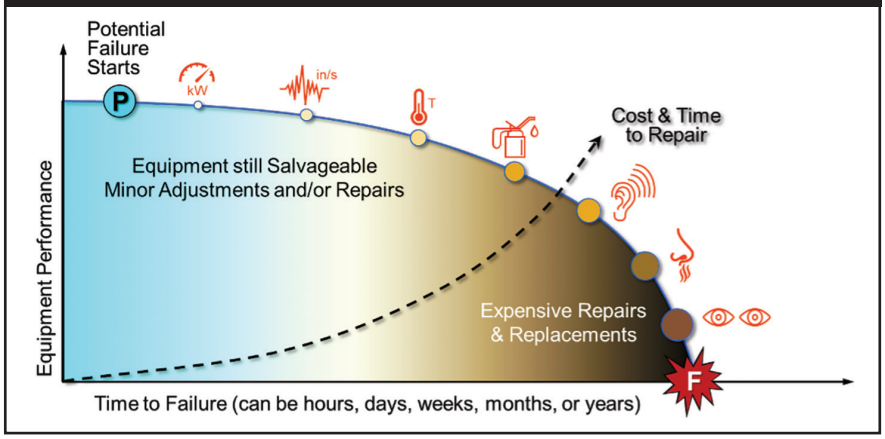
Three lines of defence

Digitalisation has enabled cement producers to increase the uptime of their equipment as artificial intelligence (AI) has alerted them to current or future equipment failure so swift action can be taken through the plant's maintenance and repair programme. This reduces lengthy and costly downtime.

■ *by **Mary Beth Kramer**, Kramer Consulting, USA*

Predictive maintenance with artificial intelligence (AI) are heavily-used terms in today's industrial manufacturing describing the benefits of digitalisation. However, prescriptive maintenance represents the pinnacle approach to getting the most effective, economical use of industrial equipment. Fundamentally, prescriptive maintenance seeks to recognise a potential failure before it fully manifests. This failure defence strategy tops real-time monitoring and robust preventive maintenance with the notion that costly failures and downtime can be avoided or at least minimised. A more complex understanding of plant operation parameters and the ability to analyse differences in operating data in real-time drives AI-based prescriptive maintenance, which can be applied from end-to-end of cement production, from the quarry to the finished cement load-out or bagging operation.

Detectable failures at early stages save on repair costs and reduce downtime



AI in the cement industry

The cement industry is still in the early stages of fully utilising AI in its manufacturing and maintenance functions. Some cement companies may approach the increasing digitalisation with trepidation. However, it is becoming clear that to tackle ongoing issues of maximising production, cost reduction and decreasing emissions simultaneously, it is necessary to tap into the higher power of AI.

CemAI Inc is a Titan affiliate that offers the only cement manufacturing focussed, predictive maintenance solution, powered by Precognize's AI software, which combines cement industry knowledge with technical expertise. "If your plant is heading through digitalisation," says George Pantazopoulos, senior vice president of Titan America Cement Operations and Corporate Engineering and one of many on-demand "experts" in CemAI's arsenal of cement AI expertise, "then you need industry specific AI experience."

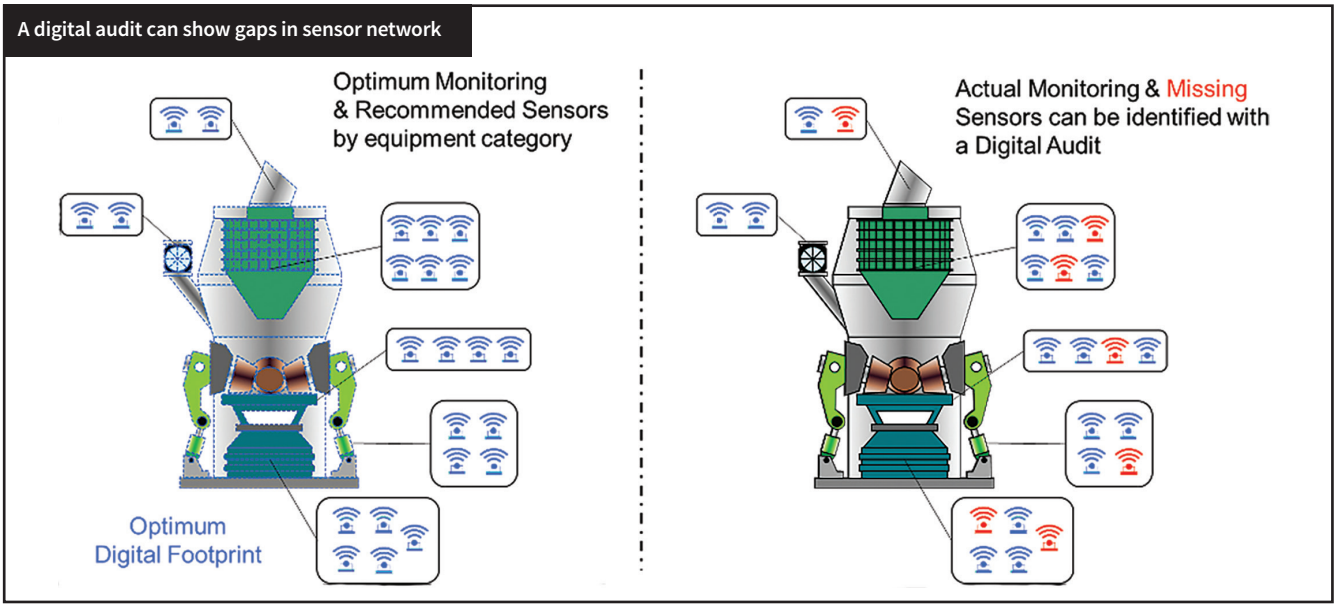
Mr Pantazopoulos, who has nearly 30 years of cement manufacturing experience, observes that there are three lines of defence against potential production failures: a robust maintenance management programme, real-time condition monitoring, and AI for failure detection. "I see this well-understood curve on time to failure for production equipment (above) as an unassailable endorsement for AI analytics application to the maintenance function," says Mr Pantazopoulos. "The earlier a potential problem or malfunction is appreciated and addressed, the lower the cost. Early detection means early cure, leading to lower cost and better production."

The cement manufacturing industry's capital-intensive nature has always propagated significant capex budgets for maintenance, obsolete equipment replacement and modernisation investment. The industry goal, of course, has been to optimise the useful life of assets, maximise their productivity and minimise downtime and repair expense. Equipment maintenance and replacement planning are directed by operational budgeting and line managers' decisions, utilising their personal experiences, equipment manufacturers' recommendations and worker feedback. The process has been generally effective and time-tested but also ad hoc and limited by a dependency on plant personnel judgments that cannot always be easily measured and assessed.

Benefits of digitalisation

The digitalisation revolution has enabled a never before available understanding of the manufacturing process. Operating data in terms of sensor recordings of temperature, vibrational status, lubrication parameters and other plant conditions is now widely obtainable and capable of preservation and study. Control room alarm systems signal dangerous developments in real-time but provide little predictive value, especially because those alerts are on selected and specific indicators. With AI, the number of simultaneous signals processed can reach hundreds or thousands and analytics can predict possible deviations from normal operations even before any alert in the control room is triggered. Just as the analytics utilised in baseball and other sports opened coaches to new insights on the game, data generated

A digital audit can show gaps in sensor network



in cement production and analysed can be used for critical maintenance and operational decisions. AI enhances current maintenance and operational support to reduce failures – it does not replace workers but rather enhances their understanding and optimisation of the machinery. The data analysis power and CemAI's interconnectivity algorithms create a "smart factory" that can only benefit local managers.

The hidden power of AI

CemAI's software can be installed and function online with currently available sensor data from the plant. The average single kiln line cement plant may have between 1000-5000 sensors/data sources being tracked. CemAI can perform a digital audit to develop recommendations on what types of additional sensors and data would be helpful for analysis. The data sources include temperature readings, vibration data, air flow, pressures, current, etc.

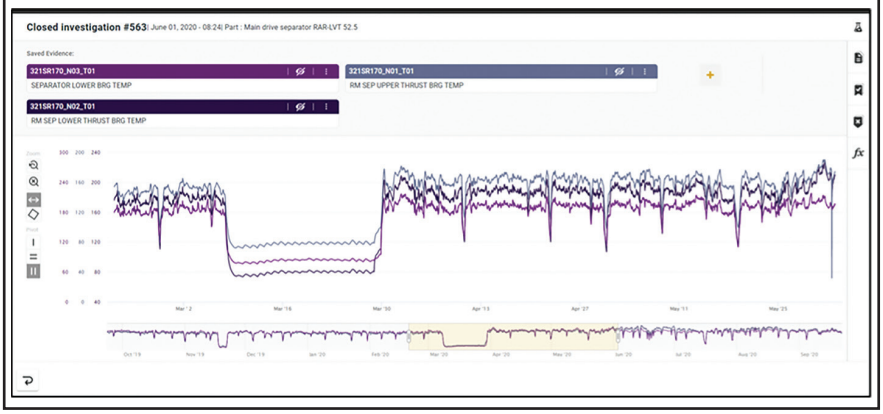
The CemAI start-up effort creates a "digital twin" from existing plant data and then expands the database by assessing slight variations from real-time monitoring. The digital twin evolves over time, becoming increasingly sensitive to changes in sensor data from operations that could predict a potential, preventable failure.

Modern cement plants have been using centralised control room monitoring for decades and the industry has enjoyed a wealth of benefits from the increased control and oversight provided. However, control room settings alone cannot cover the complex interaction of data readings that CemAI algorithms allow.

Hidden correlations are revealed when the power of AI can work on all data changes simultaneously.

Cesar Constantino, vice president of sales and marketing for CemAI, explains actual case studies with significant impact: "The CemAI algorithm and monitoring centre team can help end-users save on repair costs and downtime. A recent temperature change prompted inspections indicating lubrication flow issues that would have resulted in a raw mill bearing replacement of nearly US$500,000 and multiple days of downtime to repair. The early alert allowed for the inspection and corrective action prior to any damage to the equipment."

Temperature relationship change in a vertical roller mill separator



'Work smarter, not harder'

The "cement plant of the future" works through the human interaction with AI's third line of defence for predicting production failures. AI algorithms alone are not a cure all. CemAI enhances existing cement maintenance and operational support and improves decision-making. CemAI experts collaborate regularly with maintenance teams at the local level. Together they review closed events and the failures that have been avoided. The consultations cover missed events and opportunities to promote continuous improvement and ultimately enhance the model's effectiveness. A library of responses to data changes is developed and available 24/7 worldwide for local managers through the CemAI Remote Monitoring Center programme. KPI tracking and reporting keeps everyone informed and up-to-date.

Scott Ziegler, CEO of CemAI, believes that strong tools make good workers. "In our development of the CemAI system and expert consulting for diagnosis, troubleshooting and resolution, we are guided by the adage, 'Work smarter, not harder.'" The CemAI system raises the bar for success by arming plant teams with the best possible cement maintenance technology end-to-end. ■