

Seamless cement logistics: creating the smart factory yard

The true value of digitalisation lies in integration - when ERP, yard management systems, and AI data models work together. Connected systems enable cement plants to automate not only data flows but also logistics decisions, creating a smart, self-optimising yard.

■ by *Axians Industrial Applications & Services GmbH, Germany*

In the cement industry, dispatch operations are the heartbeat of daily business: they directly impact delivery reliability, cost efficiency and customer satisfaction. As traditional dispatch processes are often fragmented, manual, and reactive, most producers in the bulk goods industry currently take steps towards automation, implementing yard management systems (YMS) and creating the digital yard. With the rise of AI technology, the bulk goods industry now has the chance to take the next step towards Industry 4.0 by utilising AI-powered systems that intelligently connect data across platforms and enable real-time decision-making. This article shows how AI can be used to leverage enterprise resource planning (ERP) and yard management data even further and thus create not only the digital, but the smart factory yard.

Manual processes: data silos and operational complexity

Dispatch operations in many industrial environments used to suffer from fragmented data landscapes with critical information such as order details, transport organisation and financial data scattered across different parts of the ERP system, the YMS and other stand-alone tools. Dispatchers had to manually retrieve, cross-reference and interpret this data – a time-consuming and error-prone approach that often led to delays, inefficient routing, miscommunication and rising operational costs, ultimately eroding profitability and customer trust.

Yard management systems: breaking down the data silos

The introduction of the YMS marked a significant step towards overcoming these

Next-generation ERP integration and AI can create the smart factory yard



challenges. By consolidating data from multiple sources, YMS create a unified view of yard operations, reducing manual effort and minimising errors. Instead of operating in isolated silos, YMSs integrate information and operational technologies, inventory and scheduling, ERP data and yard operations. The direct connection of contracts, orders and deliveries with current movements in the yard (such as waiting times and the occupation of loading stations) enables real-time visibility, streamlined workflows and fully automatic loading. Therefore, YMSs help to optimise truck movements, improve resource utilisation and enhance overall operational efficiency.

However, while typical YMS improve data accessibility and co-ordination, they remain largely transactional rather than analytical. They record what has happened, like the latest outgoing material deliveries, and what is scheduled to

happen, like upcoming material pick-ups. Yet, they lack the ability to process natural language queries, analyse current conditions, or generate actionable insights in real time. In other words, typical YMS provide the foundation for the smart factory yard but do not directly deliver predictive intelligence or autonomous decision-making.

AI-powered logistics: creating the smart factory yard

When traditional YMSs reach their limits, AI-powered logistics in the YMS can step in. By combining real-time data integration with machine learning and natural language processing, an AI-powered YMS can transform a reactive process into a proactive, intelligent operation capable of predicting demand, dynamically optimising routes and delivering actionable insights. Possible areas of application are:

Peak-time analysis reports build the basis for predictive demand forecasting



- **intelligent dispatch scheduling** –

Keeping an eye on traffic volume in the yard: AI-powered dispatch scheduling analyses orders, vehicle availability and real-time demand to automatically assign time slots for material retrieval and dispatch, ensuring smooth operations and increased efficiency for both drivers and the yard.

- **predictive demand forecasting** –

The use of AI in demand forecasting transforms production planning from reactive to proactive. Through an AI-based analysis of historical data, patterns can be identified in the otherwise seemingly random fluctuations in material demand. This allows not only for precise production planning but also for load balancing, distributing the brunt of material demand at estimated peak times evenly across several production plants.

- **dynamic order and truck assignment**

– AI-driven capabilities can enhance

with the most suitable trucks in real time. By combining route data, delivery destinations, the truck's position and additional live data from the yard, such an AI-supported assignment mechanism cannot only adapt routes dynamically but also determine the most appropriate production site for material pick-up. Together with intelligent dispatch scheduling and predictive demand forecasting, this creates the foundation for a self-optimising feedback loop.

- **comprehensive process analysis** – A plethora of valuable data is collected throughout the yard every day, recording every event and incident – way too much for the human operator to review and understand. Comprehensive process analysis is a prime example for possible AI use, because AI can consolidate and interpret large amounts of data, unveiling unexpected cause-effect relationships, which deepens the

dynamic order-truck assignment, shifting the focus from static planning to continuously optimised logistics processes. Instead of relying solely on route optimisation, the system will increasingly evaluate and match orders

understanding of processes and opens up potential for optimisation.

- **data queries in natural language** –

As the AI agent sources data from multiple sources, such as the ERP system and the YMS, complex data queries in natural languages, such as “list the top five customers ranked by sales revenue for the last six months”, and the subsequent creation of KPI dashboards become possible. On the customer side, AI opens up the possibility for asking for and receiving updates on the delivery status in natural language.

Use of AI in YMS today

Even though the self-optimising, autonomous smart factory yard is still a long way off, more and more AI solutions can be used in yard management today, paving the way towards the smart factory yard.

One of the most straightforward applications of AI in cement logistics is automatic vehicle identification. By using automatic number plate recognition (ANPR) at the plant entrance, cement plants can significantly speed up the check-in process.

Beyond vehicle identification, webcams and cameras provide other valuable applications in bulk goods logistics. At plant entrance and exit, AI can be used to identify the material on the truck or detect and check quality parameters. This facilitates the classification of material and waste, as well as pricing for incoming and recycling processes, and prevents incorrect deliveries for outgoing processes.

Furthermore, AI-powered camera systems can monitor loading areas for

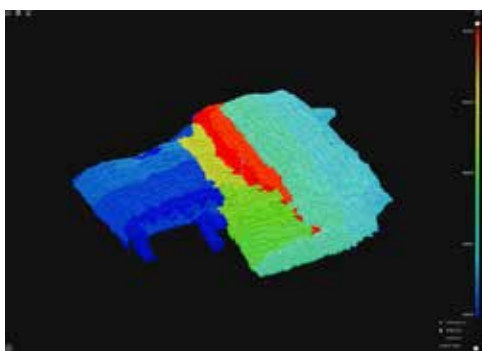
Traffic jam: a thing of the past with dynamic order and truck assignment



Conceptual visualisation of AI dashboards



Stockpile volume monitoring dashboard



© Sachtleben Technology

cleanliness (eg detecting dirt on trucks and refusing to load) or assess the condition of rail wagons during loading. For bagged goods, AI can confirm whether proper load-securing measures have been followed and automatically document this through image analysis.

AI-based camera and image processing solutions can also be used in plants with bulk storage (eg sand, gravel or calcium carbonate) to measure and monitor material volume in stockpiles, enabling precise production planning and the assignment of loading areas in the yard based on current material stocks.

Transport optimisation is another area where AI solutions are already being used today to improve logistics in cement plants: historical data, planned deliveries from multiple sites, real-time traffic conditions and truck locations need to be considered to plan deliveries more efficiently. The AI uses simulations to compare different optimisation parameters like delivery punctuality, fleet size or distance travelled. Seamlessly integrated with order taking and planning tools, the AI is able to implement real-time adjustments and optimise transport, reducing costs by up to 30 per cent while improving customer satisfaction.

Outlook: the next steps towards creating the smart factory yard

For AI solutions to work effectively, a reliable and accurate database is required. Centralised solutions, such as the Axians VAS Yard Management System, which integrate order and delivery data with ERP data and real-time data from the yard, build the basis for creating the smart factory yard.

Axians IAS has not only implemented integrations with all of the above-mentioned AI solutions into its VAS system but is also working on making further AI features available in the near future. For this, Axians IAS has partnered with Muhammad Bilal and his company, Digital Data Enterprises, which specialises in ERP system integrations and AI applications. As an insider in the cement industry and former VAS customer, user and administrator, Mr Bilal has a deep understanding of plant logistics processes and first-hand experience with the VAS Yard Management System.

The integration of AI with ERP data and yard management will not only strengthen the integration and digitisation of processes between sales and delivery but also significantly simplify the operation of such systems for inexperienced users, bringing greater efficiency and transparency along the entire value chain. ■

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