



# Mill Efficiency Optimisation

**Christophe Latchoumanin, Ibitek Group, France, discusses the implementation of new software systems to optimise mill efficiency in cement plants.**

## **Introduction**

With cement manufacturers needing both to reduce costs and limit investments, and requiring a quick return on investment, software solutions for mill optimisation appear to be a perfect compromise to fit both requirements.

Ibitek Group has partnered with General Electrics to provide a flexible solution, called IbiXpert, that is easy to deploy and allows for a fast return on investment. GEIP provides the development software

with its MaxxMine solution (well known within the mining industry) and IBITEK brings 20 years of cement process experience.

## **State of the art**

Most of the existing expert systems for mills within the cement industry follow a similar pattern:

- Customers have to choose one angle of optimisation between energy efficiency, throughput increase or quality stabilisation.



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- Following this choice, a process expert must spend several weeks on site in order to study the specifics of the workshop and estimate the potential benefits (over 2 weeks on site).
- Most of the time gains will not be guaranteed by the supplier, arguing that uncontrolled disturbances such as a lack of electrical or mechanical maintenance on the customer's side have affected the outcome.
- Given the type of mill, the optimisation direction and the results of the audit, specific parameters have to be implemented within a model selected from the mill configuration on a development platform by an APC engineer (over 2 weeks).
- Once the model is decided, system implementation has to be scheduled, including both a process expert and an APC expert (over 3 weeks on site).
- During commissioning, expert systems will be connected directly to the PLC, modifying the industrial network performances.
- A benefit measurement will be carried out on site, three to four weeks after the commissioning.
- The fine-tuned expert system will then be sensitive to sensors and raw material quality deviation, requiring regular and costly maintenance.
- As the expert system is connected to the industrial network, remote maintenance will require internet access to the server hosting the expert system. In other words, maintenance will require the plant to connect to the internet and to the PLC network. This opens them up to possible risks regarding security breaches and hacking.

### New system concept

Ibitek chose GEIP as a partner because its apc module of MaxxMine was the most suitable software to take advantage of the latest technologies, in order to achieve its goal in terms of flexibility, innovation and data-mining.

Nowadays, many cement manufacturers need to benchmark plants all over the world. In order to achieve this target, they usually deploy a production data warehouse, and, more generally, business intelligence within their plants, making a huge amount of production data available on the office network.

Those data warehouses are available as both an administrative network and to the industrial network through physical firewall and specific TCP/UDP ports.

Most of the existing production data warehouses offer not only reading and archiving capacities but also writing capacities that are often untapped.

Based on its experience in business intelligence, Ibitek chose to use the existing

production database as a unique gateway between IbiXpert and the DCS system and to connect it only to the office network.

**New architecture and technologies**

IbiXpert features the following characteristics:

- Communicates with the PLC through the existing data warehouse, avoiding the need to create another gateway between the industrial and office networks.
- Brings historical data from the existing data warehouse in order to find the optimised parameters through data-mining.
- Model existing sensors determining correlation functions with the connected process values.
- Model non-existing sensors, like manual laboratory measures, allowing equipment usually untouched to be piloted.
- Simulate the process by replaying historical data in order to provide an accurate and warrantable benefit estimation on test platform, days before commissioning onsite begins.
- Allows multiple approaches to optimisation based on MPC technology.
- Is deployable in a standardised and fast way within a fleet or plant.

**Pilot plant**

In May 2015 IBITEK signed a cooperation agreement with a Moroccan cement producer to optimise a cement mill at one of its plants. The main target was to increase the energy efficiency while stabilising cement quality.

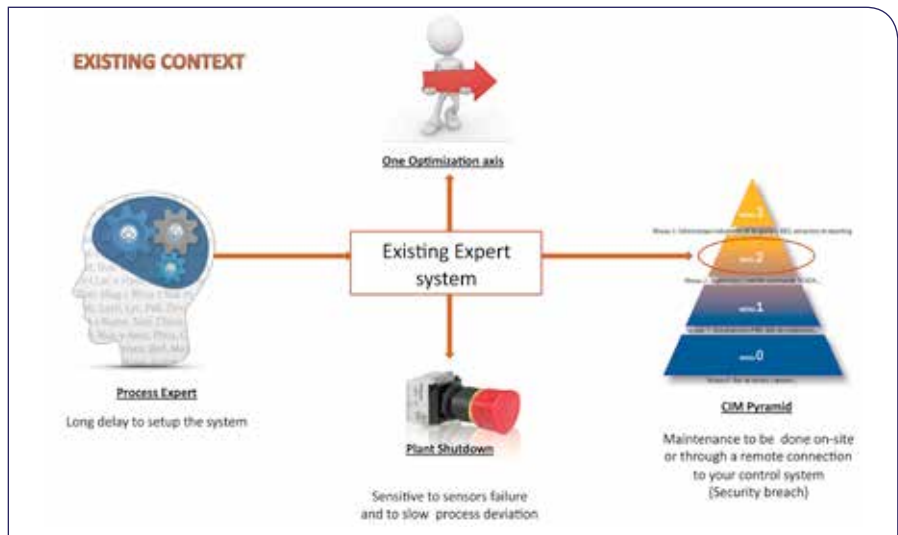


Figure 1. State of the art: Common expert system principles in the cement industry.

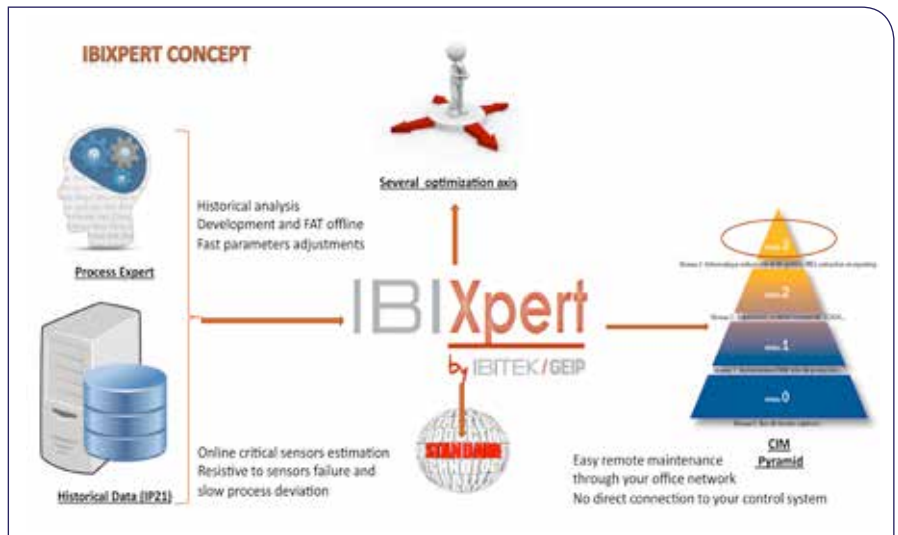


Figure 2. New system concept: IbiXpert principles up-to-date in the cement industry.

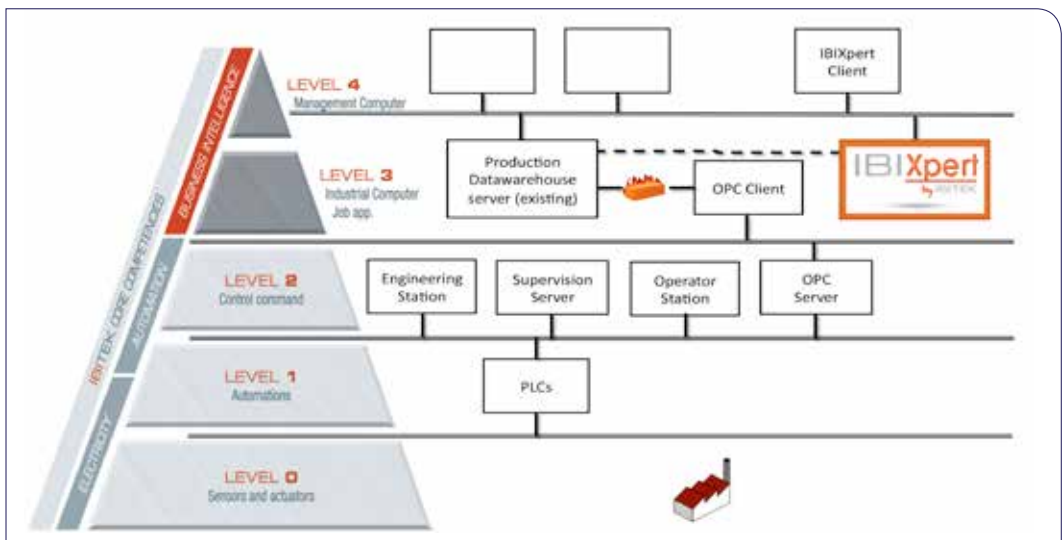


Figure 3. New architecture and technologies: Secure and efficient expert system implementation.

The closed-circuit ball mill featured a dynamic separator and an average circulating load of 4.22 t (1 t of fresh feed for 4.22 t of rejects). The mill's distributed control system (DCS) was an ABB-based PLC with a data warehouse that collected and archived process data.

The laboratory at this plant was equipped with an automatic sample preparation system that automatically supplied material samples once every two hours.

Data covering the January – April 2015 period revealed that the existing average power consumption was 32.68 kW/t while the fresh flow was 135.57 tph.

Specificities of this mill include a huge recirculation ration between fresh and rejects of around 4.22 tph of rejects per t of fresh material,

an oversized recirculating elevator, and a clearly undersized separator fan running at maximum speed.

One week on site was spent mainly collecting those four months of data, to get stability process scales. At the same time, quality targets and clogging conditions from the local process engineers were received. Ibitek connected its server to the plant's administrative network and data warehouse and got tag names in order to locate process values and setpoints within the PLC.

Two weeks were required to model the complete workshop on Ibitek's test platform at Marseille, France, and to estimate the benefits of replaying the data. At the same time, IBITEK's automation department sent a list of tasks relating to the cement mill PLC that were to be carried out by the plant to prepare the IBIXpert connection.

One week of commissioning was spent on site for step tests, automation interface checks and basic tuning.

Two additional days were necessary on remote connection for fine tuning.


After a three week trial period for the customer, energy efficiency improved by 4.05% and cement throughput increased by 4.41%. A soft sensor model for fineness based on correlated sensors showed an accuracy around 0.5% with a recalibration once a week.

Considering the measurements, electrical consumption is expected to decrease by up to 1307 MWh on an annual basis, and the rise in throughput represents additional production of up to 35 000 tpy.

Considering this pilot, Ibitek was able to validate the following concepts:

- Faster deployment due to data-mining.
- Reduced implementation costs due to shorter application time and remote tuning.
- Easier maintenance due to the connection to historical databases, allowing automatic recalibration.
- Soft sensors enabling the modelling of any kind of manual or non-cyclic measures without the need for major investment in additional equipment, such as online fineness analysers.

For this pilot test, the cost savings made by installing IBIXpert resulted in a return on investment within 3 months.

The deployment of the system in all its cement plants is now being considered. 

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