SUCCESS STORY

# OPC UA: ENABLING DATA-DRIVEN MINING OPERATIONS

**From flagship project to scalable production architecture. Imerys connects machines, data, and processes worldwide with intelligent middleware and semantic data models. OPC UA is the key to digital transformation at Imerys.**

Imerys supplies mineral products for very large construction projects.

# OPC UA PREMIERE AT IMERYS IN 2024

Imerys is a leading global supplier of industrially-mined specialty minerals and raw materials. To future-proof its production, Imerys began taking its first steps toward standardized connectivity and interoperability based on OPC UA technology back in 2019. Since then, the company has been a pioneer in the digitalization of raw materials processing. The digitalization process centers on innovative Industry 4.0 approaches, the integration of OPC UA, and the implementation of digital twins. The focus is on a transparent, scalable, and networked data landscape.

**IMERYS' COMPLEX PLANT STRUCTURE**

Imerys' extensive production network comprises 230 production sites in more than 40 countries. The machinery includes both older production machines with proprietary control systems and modern equipment with native OPC UA interfaces. The equipment includes slurry plants, conveyor technology, pump systems, agitators, and packaging plants. The starting point before OPC UA integration was a heterogeneous machine landscape and a lack of standards.

**OPC UA INTEGRATION PILOT PROJECT IN 2019**

The aim of the pilot project in 2019 was to enable employees to navigate through production areas, machines, and their statuses in a model-based manner. This involved, for example, analyzing pump performance or line speed. The development work was supported by the company's own technology center at its Lixhe site. This is where the pilot plant for research, development, and continuous process improvement is located.

Everyday production at the Lixhe plant: Large drives and pumps run continuously. Before 2019, plant monitoring took place mainly directly at the plants.

**FOUR KEY GUIDING PRINCIPLES:**
As a result of the flagship 4.0 program, Imerys developed four key guiding principles that still form the basis for working with OPC UA today:

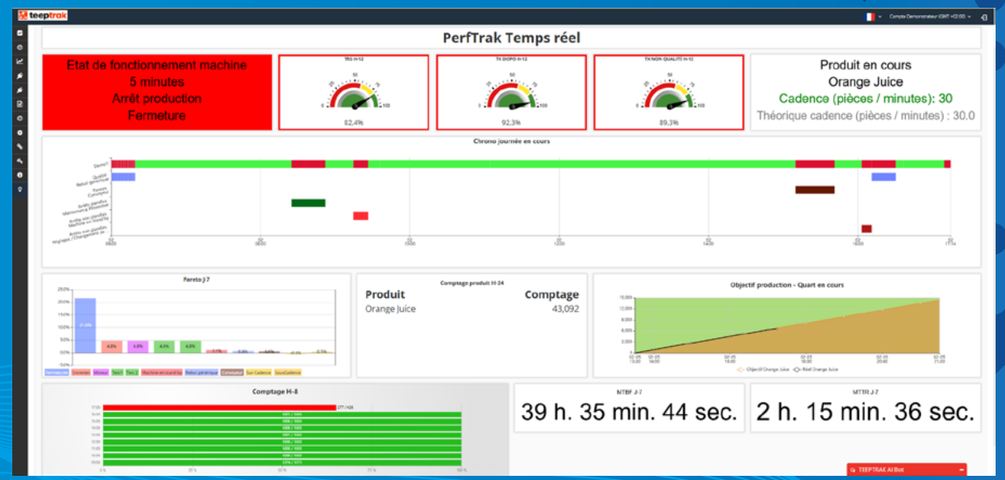
1. Manufacturer- and platform-independent interoperability
2. Semantically consistent data models
3. Scalability for global deployment
4. Reduction of manual intervention through automation

Before OPC UA integration: Plant conditions were mainly checked on site – transparency across the entire production line was only possible to a limited extent.

*“Our journey to OPC UA integration began in 2019 with a so-called lighthouse project. At that time, the term “Industry 4.0” was on everyone’s lips. Many sites launched initial pilot projects to test solutions, often initiated by the operational business. Our goal was to evaluate the potential benefits of digital applications for the entire company.”*

**DAVID FABREGUETTES,**
IT/OT Continuous Improvement Project Manager, Imerys

The PerfTrak platform allows employees in Lixhe to track machine status, speed, and downtime in real time – all OPC UA data points are consolidated in a single web-based interface.



*“The first projects since 2018, often in the form of individual “boxes,” provided valuable learning experiences. We quickly recognized the limitations of the pilot projects. The solutions were isolated, not scalable, and created data silos without a holistic view. Management responded by deciding to initiate a strategic change of course. Instead of isolated initiatives, targeted investments were made in a central flagship project – and that was the starting signal for OPC UA in 2019.”*

**CHRISTOPHE LE MOULLEC,**
IT Director, Imerys

# OPC UA PREMIERE
# AT IMERYS SINCE 2024

In January 2024, Imerys launched an OPC UA project, also at its Lixhe site, home to Europe’s largest calcium carbonate processing plant. In addition to calcium carbonate, kaolin and talc are also processed there. These minerals form the basis for the cardboard and packaging industry as well as the production of paints, plastics, and adhesives. The project in Lixhe was launched in collaboration with Teeptrak, Serfive, and 4CE. 4CE helped develop the IMERYS OPC UA information model and implement it using OOUAMiddleware, developed by 4CE Industry. Teeptrak and Serfive each contributed the downstream application and the OPC UA client, respectively. Imerys received the first beta version of the Orchestrator in June 2024. The final version was delivered in July. The Teeptrak Orchestrator acts as an OPC UA bridge between industrial plants and Teeptrak’s performance monitoring platform. It provides a secure gateway that is deployed on the OT side and enables communication between OT and IT systems. It uses information from companion specification “models”, such as PackML or UA for Machinery, if available on the equipment, to easily assign relevant OPC UA parameters, such as machine status, counters, or reasons for downtime, and to reconstruct the complete performance history of each machine. A complete performance overview is then available on a single web-based platform.

## BRINGING OLD SYSTEMS INTO THE DIGITAL AGE WITH OPC UA

The introduction of OPC UA at the Lixhe site is not just a technical measure, but a cross-organizational learning and development project. Particularly influential is the close cooperation between the OT teams (production and controlling) and IT – two areas with sometimes different approaches and working methods. At the same time as the flagship project was launched, an IT team was put together to work with the internal teams on continuous improvements, driving digitalization forward and tackling existing challenges in a targeted manner.
An important goal is to eliminate risks that can arise from outdated systems and a lack of interoperability. Many old devices pose a challenge in terms of technical connectivity. In this regard, the introduction of OPC UA heralded a new chapter for Imerys. With Teeptrak’s PerfTrak solution, Imerys is successfully connecting both modern and older machines, regardless of whether they were originally network-compatible or not.

## COMPATIBILITY AT THE CONNECTOR LEVEL

To connect the first machines, simple sensors were initially connected to existing controllers. The challenge lay not only in physical integration, but also in structured data processing. OPC UA was established as the connecting link here. The purpose of the “models” that translate OPC UA information from each machine is to gradually improve compatibility at the connector level with various companion specifications as well as with OPC UA machines that do not follow a specific companion specification. This approach ensures broad interoperability with virtually all types of devices, from CNC machines to packaging machines. Standardized models based on companion specifications and machine types are being introduced gradually. For example, models that comply with the PackML companion specification are already in operation, and customer-specific models for customer-specific machines have also been implemented.

**“WHAT DO WE DO WITH ALL THIS DATA?”**

However, a key challenge emerged. Although a lot of valuable data was available, it was not immediately clear how it could be used efficiently. The question was: “What do we do with all this data now?” The focus therefore shifted increasingly to setting up a control tower, visualization, analysis, and ultimately data-based decisions. In addition, AI-supported maintenance concepts based on OPC UA data were initiated.

This was the first step toward a digital twin. Today, OPC UA integration enables the direct collection of production data, such as machine performance, in real time. At the same time, certain downtimes can be classified manually by operating personnel if the available data is insufficient.

**TECHNICAL SOLUTION LEVERAGES OPC UA INTEGRATION**

In collaboration with Teeptrak (machine performance monitoring) and Sterfive (OPC UA software), the solution was based on two core elements:

- As a communication standard, OPC UA enables platform-independent, semantically structured data access across the entire automation pyramid.
- The Orchestrator middleware acts as a scalable, user-friendly OT/IT integration solution that aggregates and interprets OPC UA data points and makes them available via a central web platform. It reduces the complexity of configuration and the number of interfaces required. Key features include real-time dashboards, automated reports, alerts, and centralized data flows.

The success of this integration project is based on two key factors. These are: the use of OPC UA technology, and the development of the Orchestrator. This forms the bridge between OT systems – i.e., machines and plants – and IT systems, which analyze the collected data and then use it for optimization. This significantly improves operational efficiency.

**DIGITIZED MACHINE PERFORMANCE AND CENTRALIZED DATA FLOWS**

Standardized communication via OPC UA enabled the integration of all types of machines – regardless of age and manufacturer – into the central PerfTrak platform. The middleware enables the automated recording, classification, and visualization of operating states and causes of downtime (e.g., technical malfunctions, maintenance work, planned breaks). This new solution has partially automated what was previously a manual and time-consuming process. Information is now provided in real time and with greater accuracy. Manual recording processes have been largely replaced.

**ADVANTAGES OF CENTRALIZED DATA FLOWS**

End-to-end vertical integration – from the field level to the cloud – creates a unified database across all levels. The scalable system architecture also facilitates the expansion of the infrastructure to other plants. At the same time, engineering costs are significantly reduced because all data is already semantically standardized. This allows the focus to shift from pure data collection to data-driven process optimization.

**HOW DOES IMERYS IMPLEMENT OPC UA TECHNICALLY?**

Imerys is pursuing a cross-platform approach to the technical implementation of OPC UA. The goal was to create an architecture that works reliably with different automation technologies, protocols, and PLC manufacturers – both in European and US locations.

**CENTRAL ELEMENT: THE OPC UA SERVER**

At the heart of the pilot project architecture the OPC UA server at the IMERYS Lixhe site was OOUAMiddleware, supplied by 4CE Industry where the data was normalized by instantiating the information model. The middleware acquired industrial data from numerous Siemens S7-1500 PLCs using Siemens S7 communications, and also Modbus and Ethernet/IP to other assets, then exposed the structured data to OPC UA client developed by Sterfive for Teeptrak.

*“The IMERYS project demonstrates how an OPC UA information model can provide a consistent representation of industrial data across different automation systems. Developed jointly by IMERYS and 4CE Industry, the model is instantiated by OOUAMiddleware, connecting industrial data sources to OPC UA applications.”*

**MICHEL CONDEMINE,**
Founder, 4CE Industry

**FRANÇOIS COULLOUDON,**
CEO, Teeptrak

*“One of the biggest challenges was the secure and seamless coupling of the OT systems with the IT landscape. OPC UA and the Orchestrator were the most important enablers here.”*

**MODEL OWNERSHIP**

Imerys deliberately decided against using ready-made companion specifications and instead developed its own OPC UA data model. Based on generic object definitions, user-defined classes were created and instantiated for machine components such as pumps, mills, and silos in order to fully map the production plant in Lixhe. This semantically structured data is captured by the OPC UA server, assigned, and visualized in a plant-wide model. A special feature of the solution is the server’s integrated storage function, which also provides historical data that can be accessed via any OPC UA client.

**VISUALIZATION OF DATA STORAGE**

The collected data is also stored as time series data in a PostgreSQL database. For visualization, Imerys uses the open-source tool Grafana, which originally comes from IT monitoring but has also proven itself in industry as a powerful visualization tool.

However, one limitation became apparent: creating individual dashboards is technically demanding and requires specialist knowledge. Operating personnel without an IT or process engineering background cannot work with it autonomously. Initially, there was also a lack of deep integration between Grafana and the semantic OPC UA model, in particular the ability to browse the model directly and assign data intuitively.

**PROSPECTS FOR FURTHER DEVELOPMENT**

To close this gap, at the time described, IMERYS was developing an OPC UA Grafana plugin with support from 4CE Industry. This plugin will enable structured browsing, making it easier to use the complete OPC UA data model. The aim is to enable operators to navigate through production areas, machines, and their statuses in a model-based manner – for example, to analyze pump performance or line speed in a targeted manner.

In addition, Imerys uses integrated OPC UA functions such as aggregations (e.g., min/max/average) directly via the server. These functions are available as user-friendly queries – without code, simply via function calls. Furthermore, interfaces have already been created to use OPC UA data in AI applications and machine learning models.

**FUNCTIONS FOR OPERATORS IN PRODUCTION**

The OPC UA protocol is often invisible or too technical for operators and teams in manufacturing. With the PerfTrak platform, we convert OPC UA data into clear, actionable insights that the employees who actually operate the production equipment can understand and use.

Features, such as real-time dashboards, automatic alerts for deviations, regular reports, performance histories, and root cause analysis provide operators (and their supervisors) with the information they need to act quickly, optimize machine availability, performance, and quality, and increase overall plant productivity.

The performance dashboards in PerfTrak provide Imerys with a consolidated 24-hour and 7-day overview of availability, speed losses, and causes across multiple production lines.

*“By powering Teeptrak’s Orchestrator with Node-OPCUA, Sterfive transformed heterogeneous plant floor signals into a unified, secure semantic model. It proves that OPC UA can deliver high connectivity and scalability without introducing OT configuration complexity.”*

**ETIENNE ROSSIGNON,**
Founder of Sterfive & Creator of Node-OPCUA

Imerys successfully bridged its complex mix of legacy brownfield machinery and modern equipment to its enterprise IT platforms without disrupting daily operations. The implementation combined the IMERYS OPC UA information model, jointly developed with 4CE Industry and instantiated in OOUAMiddleware, with Teeptrak’s Orchestrator using an OPC UA client developed by Sterfive with Node-OPCUA. This collaboration allowed Imerys to turn complex companion specifications like PackML and UA for Machinery, as well as its own custom data models, into a plug-and-play reality across the entire shop floor. By standardizing raw machine metrics into semantically structured, real-time data on the PerfTrak platform, Imerys eliminated friction between OT/IT connectivity and created a scalable foundation for continuous operational efficiency.

Imerys modernized its global network of 230 manufacturing sites by integrating OPC UA technology to create a standardized, vendor-neutral data bridge between legacy machines and modern IT systems.

In collaboration with partners Teeptrak, Sterfive and 4CE, the company deployed custom semantic data models and middleware to aggregate raw machine metrics into a centralized web platform for real-time monitoring.

Following a successful pilot project at its Lixhe facility in Belgium, this unified digital infrastructure is being scaled across all production facilities to replace manual tracking with automated operational insights.

## GLOBAL ROLLOUT OF THE ARCHITECTURE PLANNED

This Imerys pilot uses OPC UA not only as a communication standard, but also as the semantic backbone of an intelligent production architecture. With its own data model, modular server structure, open source tools, and continuous development toward model-based visualization, the company is laying the foundation for transparent, scalable, and future-proof manufacturing processes.

Imerys plans to introduce the OPC UA-based architecture at all production sites. OPC UA will be integrated in all factories and locations where compatible systems are already in use. The goal is a fully digitized, semantically networked infrastructure for performance monitoring, predictive maintenance, and data-driven production optimization. Data-driven production monitoring enables teams to move away from routine tasks and focus more on strategic tasks such as performance optimization and continuous process improvement.

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