A step-by-step approach from SCADA to MES using 21st century enabling technologies

by Futuristix

"The wealth of information at our fingertips has resulted in being able to resolve issues with suppliers – online and in real-time. While anyone can make a mistake, it's useful to have instant access to historical reality that shows the exact status of processes at the time required."

Martin Volkwyn, Group Project Manager, SCAW Metals

Company Overview

SCAW Metals - Wadeville, Gauteng, South Africa

SCAW stands for Steel Ceilings And Windows - the company's original brief when it was started decades ago. Today, the company no longer makes steel ceilings and windows and has evolved to become one of the largest foundries in South Africa. The SCAW Metals Group is part of an international group, wholly owned by Anglo American plc, manufacturing a diverse range of steel products. Its principal operations are located in South Africa and South America. The group consists of five main product lines: rolled steel, Haggie® wire rope and strand, McKinnon Chain®, Moly-Cop® forged grinding media and cast steel and alloy iron products. The South African facilities include wire and steel wire rope operations, steel plants, rolling mills, steel foundries and chain manufacturing operations. These facilities produce steel wire rope, pre-stressed concrete wire and strand, reinforcing bar, wire rod, cast and forged grinding media, steel castings, high chromium iron castings and plain carbon and low alloy steel chain and fittings, supplied to the construction, railway, power generation, mining, cement, marine and agricultural markets worldwide.

While many companies have burned their fingers and cheque books implementing Manufacturing Execution Systems (MES), SCAW Metals evolved into the productive world of MES through natural and gradual evolution - an evolution that would not have been possible without the industrial application architecture of Wonderware's ArchestrA.

What started as a conventional automation and control system, evolved over a period of six months into a site-wide MES solution integrating SCADA systems across three plants within SCAW Metals' Wadeville facility in Germiston. The initial intention was not to build an MES system but to streamline aspects of production. It soon became apparent, however, that the project would only streamline islands of automation and contribute little to the integrated picture of their production facilities SCAW Metals wanted - unless a new approach was used.

Background

SCAW Metals' three main plants required various levels of automation ranging from completely new installations to various upgrades. The recommendations shown were devised by the appointed system integrator for the project, Ram-Tec Systems (Pty) Ltd. The topology diagram is shown on the back page.

High Chrome Ball Plant No. 3 (HCBP3): This was a green field project that included multiple sub-plants and the added complication of a separate Original Equipment Manufacturer (OEM) for each system in the plant.

This would be adressed by implementing:

- A conventional SCADA and PLC automation and control system for the arc furnace and Sorting Plant and integration with the Sand Plant, Extraction Plant and Heat Treatment Plant;
- A centralised SCADA and PLC engineering station that would be used as

viewing platform and for development work;
- A data historian and reporting tool;
- A monitoring system for all plant network communication links between the SCADA systems and PLCs

Hille Mill Plant: SCAW Metals decided to change over to natural gas, which meant a radical upgrade to the furnace in this plant.

This would be handled by conventional SCADA and PLC automation and control system for the gas reheat furnace.

Morgan Mill Plant: The PLC security problems at this plant initiated the search for a solution that would not only address the needs of the Morgan Mill Plant but those of the other plants as well.

One way to handle this problem would be to install an automatic backup facility that would provide an auditable trail of PLC changes while allowing for the re-installation of working software at a moment's notice.

Business objectives

SCAW Metals was looking for:

- Three well-run functional plants using conventional SCADA/PLC automation technologies that included proper alarming and good monitoring of the processes under scrutiny;
- Realisable project delivery deadlines for each plant;
- The resolution of technical interface requirements at the various sub-plants including:
  - The interoperability of six dedicated OEM systems, (e.g. DISA plant, furnace lab interfaces, etc.);
  - The resolution of inter-PLC issues (e.g. Siemens, Allan Bradley, soft PLCs);
  - Centralised monitoring and engineering development

'We were looking at three different plants each with different processes and layouts, different technologies supported by different suppliers/contractors and different SCAW personnel,' says Alberto Pontiggia, MES Business Development Manager for System Integrator Ram-Tec Systems. 'The logical deduction was to initiate three different projects that would each focus on exactly meeting the needs of each client. But this would have led to a situation where there were three islands of automation separated by no repeatability or propagation of standards, no sharing of data or knowledge and no integration. It would have been made to work but looking at this scenario within the broader context of SCAW Metals, something didn't ring true. Martin Volkwyn was the right person at the right time and with the right vision to take SCAW further.'

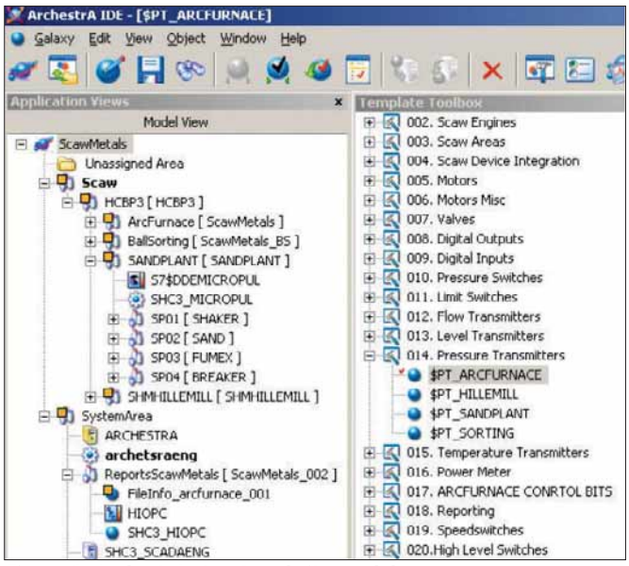

Figure 1: ArchestrA structured site model

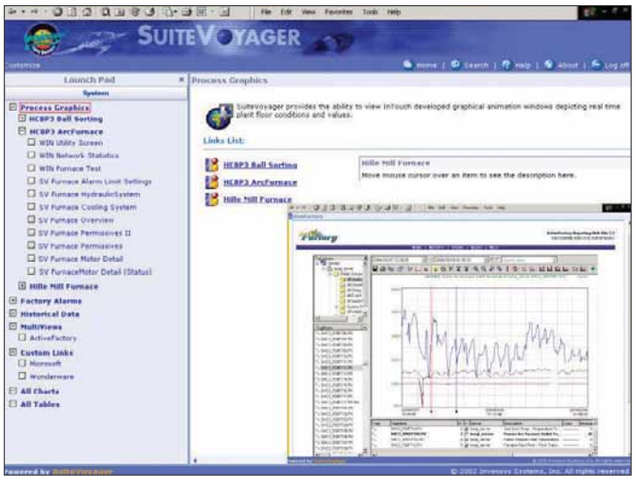

Figure 2: SuiteVoyager web portal with ActiveFactory used as a condition monitoring diagnostic tool

'We had to look at the bigger picture,' says Martin Volkwyn, Group Project Manager for SCAW Metals. 'It was time to create a centralised automation department and the required supportive structures. It was also time to think ahead. SCAW is a vast undertaking and we were only scratching the surface. Ultimately, we were looking for a unified company with cooperative and informative operational processes. The next hurdle was to convince the company executives to buy into this vision. Just as SCAW was once Steel Ceilings And Windows, it changed to cope with the realities of the time. Today, new technologies

allow us to do the same. Would our executives see it the same way now as they did so many years ago? The only way to go was to get everybody involved.'

Operational requirements

In order for SCAW's processes to operate within the bounds of business expectations, operations management would need to know all about yields versus quality and downtimes. Operators would need to know about trends, temperatures, rates and quality while Maintenance would need information pertaining to reliability and downtimes experienced for repair purposes.

Because of the nature of SCAW's business, it would be required to supply a scaleable and flexible automation infrastructure to accommodate plant design changes and additional plants while a centralised software change management facility was also high on the agenda.

Selecting the solution

Matching SCAW Metal's needs to available technology led to the investigation of ArchestrA from Wonderware. ArchestrA was selected because if offered an open framework for creating industrial automation and information products, applications and services. ArchestrA also fulfilled other SCAW Metals requirements including:

- The concept of a galaxy of information repositories spanning multiple plants and platforms;
- A system platform that integrates plant intelligence across multiple sources;
- A structured plant modelling process;
- A multi-user development environment;
- Project standards that resulted in reduced engineering costs and the time to develop multiple new projects.

The key benefits of using the ArchestrA Industrial Application Server were:

- **The development of reusable standard component templates** to ensure plant-wide standards and therefore easier maintainability;
- **Architectural freedom** allows SCAW to have local servers ensuring a high degree of system and information availability;
- **Integrated security**, resulting in a common security model that would be used throughout the site;
- **Scalability:** SCAW would be able to expand the system at any time without affecting the running plant;
- **The ability to handle more than one type of SCADA system** meant that there would be a common and site-wide information platform (apart from InTouch, SCAW Metals was also using another SCADA system).

Solution implementation

One of the primary goals was to reduce the engineering effort given a variety of SCADA systems

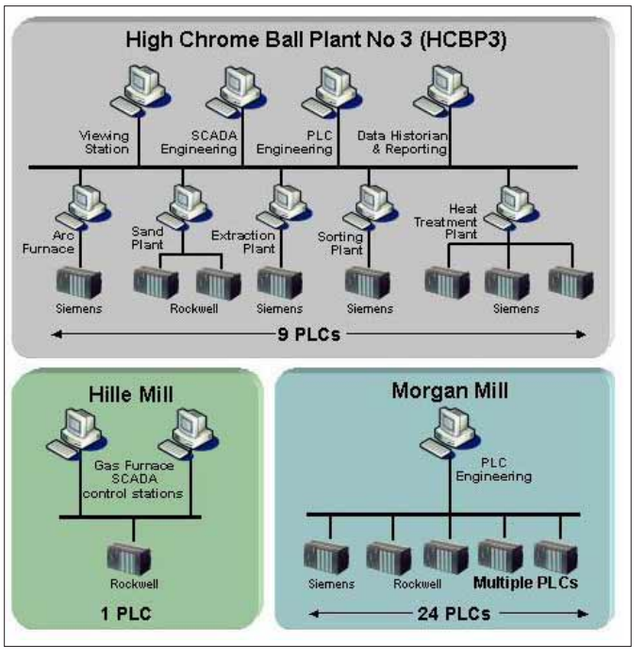

Figure 3: Components of the three SCAW Metals plants

and PLCs. Provision was made for a common SCADA engineering development environment across all plants that would also cater for integration with various PLC types. This led to the need for templates, automation objects (e.g. motor controls, valve controls, etc.), standards, alarming, tag naming conventions and structures.

'When we started the implementation, we had several goals,' says Pontiggia. 'The first was to make each plant as intelligent as we could and that plant data and SCADA screens across all production areas and all plants would be available in real-time to office-level personnel and management. This information was to be made available irrespective of the SCADA system involved.

'Then came flexible reporting through staff-definable formats. Third was the integration of laboratory results through a system of common file handling and

interplant communications – this was important because the information about the concentration of various elements would prompt operators to take immediate and appropriate action. Lastly, we wanted a centralised and secure information repository that included full access security.'

The following are noteworthy aspects of the implementation:

- Ram-Tec was able to deliver the first plant for commissioning within 8 weeks of the start of the project. And because of ArchestrA's architecture, the company was able to commission new sections of plant whenever required without affecting running plant.
- The entire project was completed in 16 weeks and satisfied additional requirements once the power and flexibility of the ArchestrA application became more clear to end-users.
- As a result of SCAW Metals' clear strategy to have an excellent inter plant network system running in parallel, but separate, to the IT network infrastructure, the power of ArchestrA and the SuiteVoyager web portal were maximised from a data integration point of view. The SCAW Metals ArchestrA system automatically logs all PLC/SCADA data tags to the IndustrialSQL Server historian thereby providing authorised users access to any chosen plant information over any desired time period. The ease-of-use of this functionality appealed to management who are always mindful of plant performance factors. This has now resulted in an internal initiative to broadcast and leverage this newly acquired technology to all necessary users, from plant operators, plant maintenance and plant engineers to production managers, project managers and senior management.
- As shown in the topology diagram, each of the 3 plants are able to run as stand-alone plants - however they all belong to a single galaxy. To the engineering user, this means that the total plant is seen as a single "virtual PC" in spite of the fact that it's spread out over such a wide area.

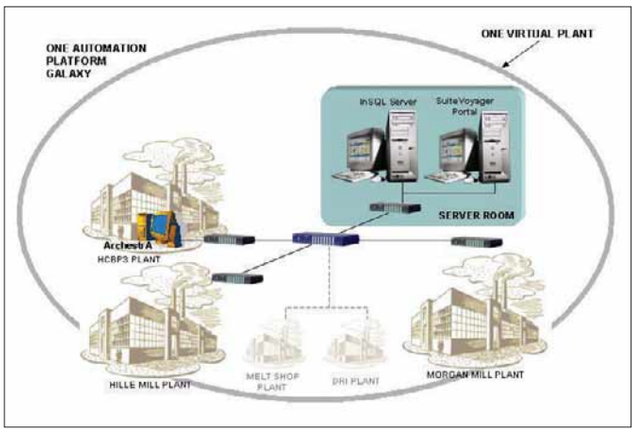

Figure 4: The three plants at SCAW Metals are now treated as a single virtual plant

'From an inter-plant communications point of view, we would have ideally preferred two entirely separate physical Ethernet networks,' says Malcolm Heathfield, Ram-Tec Systems Project Manager (i.e. the industrial plant-wide Ethernet and the commercial office Ethernet). 'However, because plants were spread over such a large site area, it would have been too expensive to run a new fibre-optic network throughout and so the decision was made to use the existing office/IT infrastructure but keep industrial and office traffic separate by making use of VLAN topology. This meant establishing close working relationships with IT departments and paying due consideration to classical IT concerns such as security.'

SCADA interoperability was a critical requirement that was resolved using the ArchestrA Galaxy solution. In the overall HCBP Plant there were a number of sub-plants involved, each with their own SCADA/PLC systems. Because all these had to work in harmony, it was important that operators in either control room knew what was happening in the rest of the plant. Giving the operators the ability to view either plant from any control room by using conventional SCADA applications would have meant developing two separate SCADA systems with the inevitable duplication of information and screens. 'This would have made development and future software management difficult,' says Heathfield. 'However, by using ArchestrA, we were able to develop one application and then simply deploy the necessary sections into each area, thereby greatly reducing the present and future engineering costs.'

Realised benefits

Development of engineering standards: The ArchestrA methodology made it easier to centralise and enforce standards for such things as repeatable standard automation objects, tag naming, alarming, etc. across all the plants;

Centralised plant data visibility across all 3 plants: While ArchestrA provided a single site-wide galaxy of

information, SCAW also needed a web-based reporting platform. This was achieved by using the SuiteVoyager web portal, which includes access to the ArchestrA platform, IndustrialSQL Server real-time historian and ActiveFactory diagnostic tool;

Multiple SCADA systems across all 3 plants: ArchestrA's single Galaxy concept provided a flexible, scalable, multi user, open automation system environment (ArchestrA Server). This gives SCAW a common information layer independent from PLC types or SCADA platforms;

HCBP3 success: The successful implementation of the High Chrome Ball Plant pilot project using the new technology provides a credible track record for similar developments in the future;

ActiveFactory win: ActiveFactory is used as a condition monitoring diagnostic tool for such things as vibrations, temperatures, currents, pressures, flows, etc.;

Reduced engineering and downtime cost: Centralised engineering ensures that the same standards are deployed across the site. These standards are well tested which in turn ensures a significant reduction in engineering, implementation and downtime costs;

Single automation department in control of all 3 plants: Whereas each plant retains local control over its own processes, there is central engineering and information facility that can supervise the entire site as well as disseminate information, formulate standards and deploy solutions;

Painless expansion: There is the opportunity for further expansion without incurring major costs or re-engineering efforts.

Future plans

Expand ArchestrA to include the DRI (Direct Refuse Iron) plant, the shear / shredder plant and the melt shop plants by:

- Expanding the network;
- Converting SCADA to ArchestrA view nodes and by deploying relevant objects;
- Initiating SAP integration with the plant systems;
- Study the feasibility of using DT (Down Time) Analyst as an additional diagnostic tool with regard to determining our Overall Equipment Effectiveness;
- Closing the MES gap through a controlled step-by-step approach where everyone concerned can see where the next benefit is coming from and what ROI it will yield.