For Toyota SA Motors to meet its goal of 220 000 units per annum by 2009, it would have to extend the capacity of its two existing paint plants at the company's Durban factory. It was decided to add a third paint plant and to use a basic design in line with five other paint plant facilities currently being constructed across the world and to automate this plant with the help of Wonderware industrial software solutions.

Background

While most items for the new paint plant could be imported from Japan, this would not cater for the utilities functions, which were to be done locally. This involved all power, gas, air, and water utilisation and control together with the air purification and humidity control. The project was divided into three plant areas:

- The power control and monitoring including the standby generator and UPS control.
- The HVAC (Heating, Ventilation and Air Conditioning) control which included the boilers, chillers and fresh air ventilation system.
- The Reverse Osmosis (RO) plant was added to the project at a late stage, as this was originally a stand-alone system that was completed by another supplier.

The easy integration of these three areas highlighted the flexibility and expandability of Wonderware's ArchestrA. So much so that the next two plant areas are currently under discussion as to when they can be added to the system (plant alarms to security and body shop 2).

The project goals for the paint plant 3 control and reporting system included:

- **Utilities cost breakdown** - the main project goal was to ensure accurate utility cost breakdowns per plant area and manufactured vehicle.
- **Centralised engineering** - the new control system had to achieve a central development environment with a common database structure.
- **Ensure a stable and sustainable platform** – the new system was to provide a stable base, which is flexible enough to be expanded when Toyota grows their production facilities in the future.
- **Deliver process optimisation / consistency** – to be achieved through rigorous production and performance measurement and management
- **Production flexibility** – the system needed to be easily adaptable to cater for production variations
- **Improve reporting** – the real-time nature of the system would ensure that timely and meaningful production information would be available at all times
- **Knowledge transfer and skills development** – Toyota was to be in a position to "own" and control the system without outside help

LEAD THE WAY TOYOTA

About Toyota South Africa Motors

Toyota South Africa was formed in 1961 when founder Dr Albert Wessels imported a first batch of 10 Toyopet Stout Vehicles form Japan. The company soon progressed to local manufacturing and in 1971, commissioned the Prospecton Plant in Kwa-Zulu Natal. It remained independent from Toyota Japan until 2002 when it was agreed that Toyota Motor Corporation could take a majority stake in the South African operation. Toyota SA has been market leaders in South Africa for the past 27 years.

Globally, Toyota Motor Corporation is the 2nd largest motor manufacturing company behind General Motors but it is widely expected that Toyota will be the largest manufacturer by the end of 2007.

Toyota SA Motors has committed to produce 220 000 units per annum by 2009, half of which will be for the export market.

Toyota SA Motors' Durban plant

- **Simple to maintain** – Toyota needed to be in a position to maintain the system by themselves - a major step towards reducing the cost of ownership

Solution selection

Wonderware was selected for various reasons one of which was their comprehensive product offering which meant the seamless integration of other applications in the future. But one of the main reasons for the choice was that Toyota is an existing Wonderware user and the service they have received has been excellent.

"ArchestrA's flexibility and scalability was a good fit for Toyotas business growth strategies," says Jaco Delport of Toyota SA. "As our needs grow in the future, we will be able to simply add application servers and continue to work in a single '*galaxy*' with virtually unlimited tags. With multiple manufacturing plant areas on site, ArchestrA also provides a central point of configuration, which make maintaining the system easier."

Deport: *"We've got the elbow room to expand almost indefinitely."*

Toyota SA chose ArchestrA-certified system integrator Convenient Software Solutions (CSS) for the project implementation. "We have developed a set of software standards and this was made available to Toyota SA, saving them time and money on engineering costs," says Pieter Venter of CSS. "Also important was Wonderware's partnership with connectivity and network solution suppliers like Software Toolbox who can connect to almost any device. Not many other suppliers can readily connect to Toyopuc PLCs, for example."

Implementation

During the conceptual design phase, all the software structure for PLCs, ArchestrA and the InTouch View stations were defined. A new tag name convention in line with the ISA standards was implemented to be more descriptive of plant areas and devices. This was expanded to include the addressing structure at the PLC and ArchestrA levels and defining how they interact via Smart Symbols. During this phase the plant operators and production personnel were consulted to ensure an operator-friendly graphical interface and navigation screens.

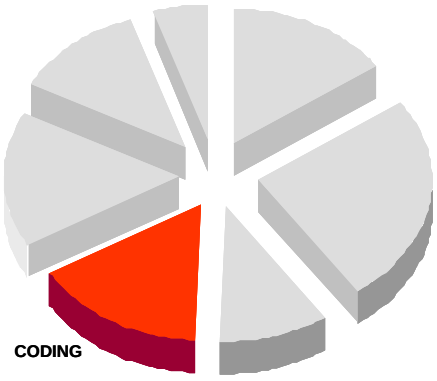

Figure 1: Showing the short time allocated to software engineering in context of the overall project timeframe. The rest is absorbed by the development of standards and design as well as testing and commissioning.

Since most of the data required in the supervisory system came from different device types, it was necessary to define the communication methods and rules as the system spanned across various networks and protocols.

During the detailed design phase, all the ArchestrA objects and smart symbols were created and alarm management philosophies were defined while security levels were set up for various user groups. A complete thin slice of the system was set up and tested before initiating the rollout.

"Once we completed the design phase," says Venter, "all plant devices like power meters were created using instances of the objects and smart symbols as designed. This is where ArchestrA really comes into its own as it greatly reduces engineering time. As we were working in a real-time environment while the plant was still being built, we could deploy objects in use as the installation people completed sections of the plant, allowing them to commission while the installation was in progress."

Final acceptance testing was completed during the thin slice testing in the design phase and was redone at various stages of the rollout phase. Final commissioning was completed on a progressive basis as this was dictated by the availability of the plant.

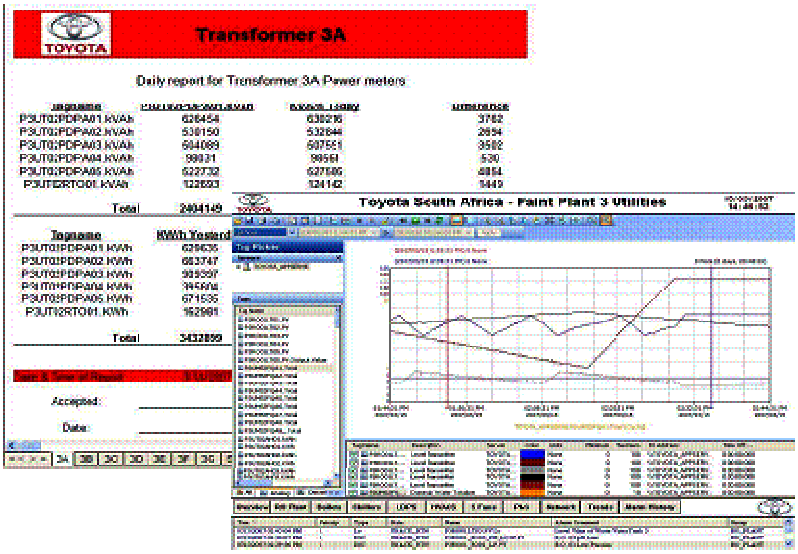

Figure 2: some examples of reports

To enable reporting, all critical plant data was logged to the IndustrialSQL Server real-time historian. The reports were generated using ActiveFactory and Microsoft Excel and then shared via ActiveFactory WEB to other ActiveFactory users on the network. The reports, which focus on power, air, gas, water and effluent, include shift information as well as daily, weekly and monthly summaries.

"Since commissioning, these reports and the management decisions based on their accuracy has ensured an important reduction in plant operational costs and a project ROI time significantly shorter than originally anticipated," adds Delport.

Benefits

- **Improved utilities management** - control over the paint shop's utility costs was never possible like it is now. Toyota SA can now monitor all areas of the plant and their respective utility utilisation.
- **Centralised control** - all the important elements needed for stable control of the plant like water, gas, air and power can now be managed from a central location although some view stations are located across the plant.
- **Operational cost per unit** - the primary goal to have accurate reporting in place was achieved in such a way that a cost can now be allocated to each manufactured vehicle.
- **Safety Health and Environmental** - tracking the effluent produced has resulted in improved control over its production. This has allowed Toyota SA to not only comply with set environmental standards, but to exceed them.

- **Centralised development environment** - having a centralised control environment has led to a skills transfer between the CSS engineers and Toyota SA's plant technicians.
- **Pool of skills and resources** - this has resulted in a pool of resources capable of maintaining and enhancing the system without outside help.
- **Improved reporting** - this has enabled the control room operators to be more proactive in controlling the critical plant parameters. Improved reporting is also contributing to sound business decisions based on actual facts rather than guesswork.

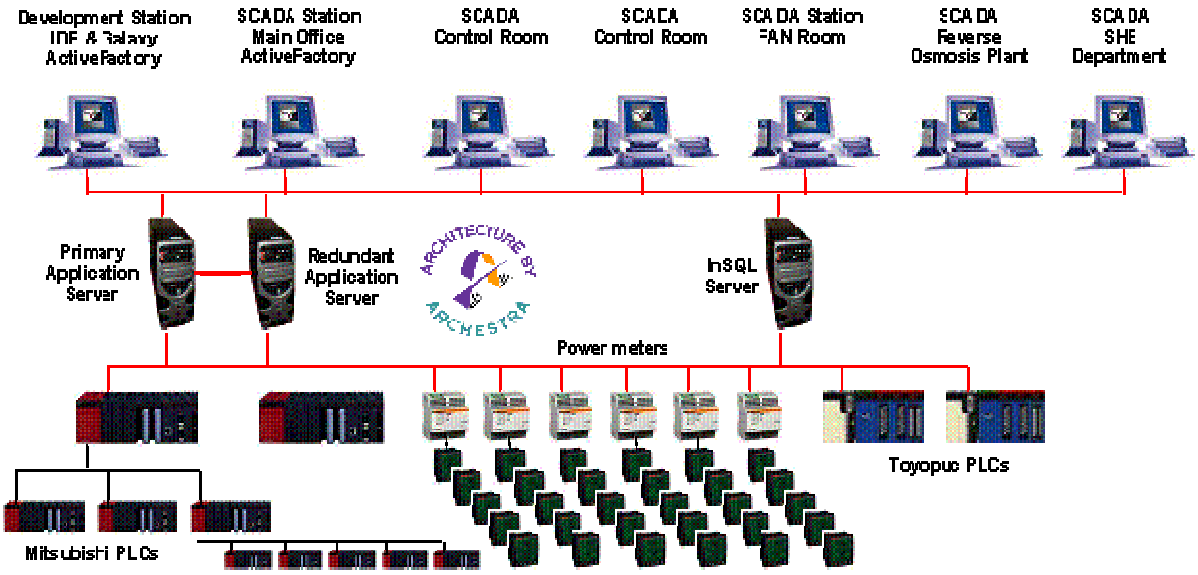

Figure 3: Toyota SA Motors' paint plant 3 topology diagram

Summary and conclusion

The scheduled start-up date for production was November 2006. However, Toyota Japan decided to surprise everybody by launching the new Hilux IMV earlier than scheduled. The market demand was such that it forced the launch date to be brought forward by two months, which forced the completion of priority areas earlier than intended in order to support the start-up process. All other areas were completed during the next two months after start-up and despite these hiccups, the project was completed within the original time period.

Because of the success of the implementation and the user-friendliness of ArchestrA and, in particular, ActiveFactory, other plant areas are currently looking at implementing the same system.

Ends

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