Need to upgrade your old control system… without killing the budget?

CAPEX – Capital Expenditure
CPU – Central Processing Unit
ERP – Enterprise Resource Planning
HMI – Human Machine Interface
LIMS – Laboratory Information Management System
MES – Manufacturing Execution System
OEM – Original Equipment Manufacturer
PLC - Programmable Logic Controller
SCADA – Supervisory Control and Data Acquisition

Abbreviations

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Is your plant a mixed bag of different manufacturer legacy PLCs that are not networked? Would you like to upgrade to the latest control system functionality? The author's company has invested several years of research and completed several plant migrations to the latest technology with zero downtime and at a fraction of a complete upgrade cost. This article considers a phased approach to upgrade your system in a cost efficient way.

The issues today, when looking at upgrading the control system on an existing plant, are as follows:

- All CAPEX budgets have been squeezed to do the work and these major upgrades severely affect the cash flow of the company.
- A phased approach to upgrading the plant while still setting a technology foundation for future upgrade phases.
- No company can afford to shut down their plant for any length of time. Down time of a plant is not possible so the upgrade will have to be done slowly during planned outages.
- There is a risk that the upgrade will result in production down time.
- The new software will have lost all the optimisation and system tweaking done over the years. Thus the new system will have to be completely re-optimised over many months to get back to the levels of optimisation of the old system.
- Time is required for the plant personnel (eg plant operators, maintenance personnel) to familiarise themselves with the new technology. One must minimise the resistance to change and get the responsible personnel to buy into the latest technology and changes.
- Standards need to be implemented over a range of various makes of PLCs.
- Product life cycles are becoming shorter. Clients are looking to extend their investments in the control systems in order to maximise their return on investment.

The author's company has developed methodologies using various products and engineering 'know how' to be able to give the client a new control system, using the latest technologies and tools without breaking the budget. Thus all the functionality of a new control system can be achieved without replacing all the control systems hardware and software. The implemented technologies set the foundation for future expansion and modification. There are four phases of system upgrade:

Phase 1

The first step is to install a new redundant Ethernet ring to connect all the existing PLCs onto one network. With the aid of several OEM products, SAM can connect the major PLC brands to the same network and communicate to any SCADA (Supervisory Control and Data Acquisition) system. This allows the installations of new SCADA systems, historians and other IT related products such as the LIMS, MES, Version Control Software and ERP systems such as SAP.

Phase 2

With the aid of several products from suppliers in Europe, the next step is to replace the CPUs in the old Siemens Simatic S5 range of PLCs with a new X5/X7 CPU. The X5/X7 CPU can execute both the Simatic Step 5 and Step 7 programmes simultaneously. The CPU also has a two port Ethernet switch on board. This allows one to run the existing S5 inputs and outputs as well as the existing Simatic S5 software on the new X5/X7 CPU and communicate with the SCADA. By using the existing software, the changeover of the CPUs and connection to the Ethernet can be achieved in a matter of hours. The PLCs that are from other OEMs will be connected to the new Ethernet using several makes of Ethernet converters. A combination of old and new PLCs can be networked.

Thus one can immediately get the functionality of the latest technologies offered at the SCADA/MES level with minimal change out of PLC hardware. Further, the old HMI/SCADA can usually be run in parallel with the new SCADA system. This allows one time to check whether the new system is functioning correctly and gives the plant personnel time to accept the new technology while still having the old HMI/SCADA functioning. At this stage 'Advanced Control Applications' can be introduced into the system, to improve plant production, product quality and yields. Should the customer be satisfied or have budget constraints then the client can stop at this stage and run with the new SCADA/MES and old PLC input and outputs.

Phase 3

Once the client is convinced that the system is stable and is satisfied with the operation of the plant, the new PLC software can be developed and tested. On maintenance shut downs, the old software can be disabled , the new software downloaded and tested.

At this stage 'Controls/Software Standards" can be developed that will include functionality such as 'Intelligent Alarm Management', 'Plant Sequencing', 'Work flows', 'Intelligent Maintenance Systems' etc. Furthermore, links to the ERP system can be established for data exchange between the SCADA/MES systems and ERP.

If the engineers encounter problems with the new software while testing on the plant, they can always reinstate the old software and get the plant up and running, without any risk of production loss. The fact that this feature is available means that the engineers are not under excessive stress to get the new software running; this allows

- Many system upgrades are constrained by the available CAPEX.
- Plant shutdown to upgrade a system is often not possible.
- A methodology exists that is cost effective and phased – and does not impact on production during upgrade.

Take note

the engineers to concentrate on developing quality software. Several iterations of the above will be needed in order to complete the change over to the new software in the PLCs.

The client again can elect to stop the upgrade at this stage and run with a combination of old PLC I/Os and new PLC software, network and SCADA. SAM has secured the agency of several companies which specialise in repairing and supplying old PLC modules, thus eliminating any problem with legacy spares.

Phase 4

Once the new PLC/SCADA software has been proven to the satisfaction of the client, the client can elect to replace the old PLC hardware. This can also be done on a 'PLC by PLC' basis, during normal maintenance shutdowns. At this stage, the client can elect to introduce technologies such as fieldbuses, remote I/O in the field, new intelligent instrumentation, as well as intelligent energy meters. By introducing these new technologies, a vast amount of additional information can be extracted, stored in the historian and used for data analysis and production optimisation.

Conclusion

This methodology allows the client to proceed cautiously with the upgrade and manage the upgrade phases in accordance with his cash flow. This approach minimises the client's risks, both in terms of production down time and cash flow.

The latest control and automation technologies can be deployed rapidly and the client can take advantage of these technologies to maximise his return on investment at a fraction of a complete control system upgrade. Depending on the client's particular plant and respective needs, the above four phases can be extended to incorporate several combinations and intermediate steps into the upgrade plan.

The issues related to controls system upgrades and initially stated can be addressed and their impacts minimised by utilising the experience gained and methodology developed by SAM over several years. The above is a synopsis of what is needed to achieve a control system upgrade. This will trigger many questions that have already been asked by our clientele, and have been addressed and answered by the SAM engineers.

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