Optimizing renovation and modernization of control systems – shaping the future

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ABSTRACT:

The study proposes a solution for a time optimal and cost effective solution in renovation and modernization of control systems.
With the advance technologies in control solutions, now there are more options open to select for the same end product. The proposal suggests engineering of renovation and modernization with hybrid modules for various control requirement of a power plant in a truly distributed manner. This would not only optimize time and cost involved but also will take care of obsolescence and will be less maintenance prone.
To establish the theory, a pilot project on a small area can be taken up initially. Once the effectiveness is proven, this can be extended to future R&M of all required areas.

INTRODUCTION:

NTPC is carrying out Renovation and Modernization of Control and Instrumentation systems in old units with DDCMIS (Distributed Digital Control and Management Information Systems).
DDC systems are being installed in R&M of old stations. Installation and commissioning durations of these packages varies between vendors, sub vendors, and stations in particular. NTPC is losing generation on this account with associated financial losses.
Huge amount of cables are laid and sometimes cable galleries are full, with cables piled up. This has caused fire and generation losses on account of the same has been incurred.
In current scenario of regulated power sector, both time and cost of generation has a multiple effect on successful running of a plant.
On the other hand, renovation and modernization of old systems is also essential for improved performance especially for future scenario with increased share of renewable power generation.
Hence an optimal solution which will balance and take care of all aspects, is absolutely necessary.

PROBLEM FACED IN R&M OF CONTROL SYSTEM:

Installation time - R&M of DDCMIS is being proved time consuming.

Increased Cable requirement/cost involved - Distributed Digital Control (DDC) is not actually distributed, cables are routed to Control Equipment Room (CER).

Increased Energy requirement - Large Control Equipment room (CER) calls for huge energy requirements in air-conditioning.

Obsolescence and vendor dependence - All DDCMIS systems become obsolete in 10-15 years. Expertise with each system is required which results in narrowing skillset, and increasing dependence on DDCMIS vendors

The issues as mentioned above raise the requirement of a system which uses fewer cables (preferably only communication cables), easy to replace hardware from any available vendors, and very low replacement time irrespective of site, location, contracts etc.

SOLUTIONS:

PLC OR DCS?

Over the past decade, the functionality of different control systems has been merging. Programmable logic controllers (PLCs) now have capabilities once found only in distributed control systems (DCSs), while a DCS can now handle many functions which previously was thought to be more appropriate for PLCs.

So, what's the difference between the two control approaches?

Where's the dividing line?

Are there still reasons to choose one over the other?

Earlier, PLCs grew up as replacements for multiple relays and were used primarily for controlling discrete manufacturing processes and standalone equipment. If integration with other equipment was required, the user or the system integrator typically had to do it, by connecting human-machine interfaces (HMIs) and other control devices as needed. The DCS, on the other hand, was developed to replace PID controllers and is found most often in batch and continuous production processes, especially those that require advanced control measures. The vendors handled system integration, and HMIs were integral part of DCS.

As users demanded more production information, and open system, PLCs gained processing power. Networking became common. PLC-based control systems began to function like a mini-DCS.

At the same time, the DCS hybridized to incorporate PLCs and PCs to control certain functions and to provide reporting services. The DCS supervises the entire process, much like the conductor in an orchestra. Protocols, like OPC, have eased interactions between the two control systems.

SELECTION OF PROCESS CONTROL SOLUTION:

For manufacturers in the process industries, the procedure for selecting the best automation technology is not as easy as it once was. In the past it was fairly easy to determine whether a PLC or a DCS was right for your application, because their strengths and weaknesses were well understood.

In recent years this has become more difficult, thanks primarily to the advancement of the microprocessor, which has allowed the technologies to merge. With the trend toward flexible manufacturing in industry, many of the applications in the process industries now share the *requirements* traditionally thought to be exclusive to either DCS or PLC. These hybrid applications typically require a process control system that can deliver *both* PLC and DCS capabilities. Thus, understanding the merging of PLC and DCS functionality is important for selecting the best system for our company.

Large processes with more than 2,000 physical I/O points and a few hundred PID loops might be best served by a traditional DCS. Smaller processes could probably be controlled adequately by a mini-DCS, hybrid control system, or PLC/HMI solution. The costs of these other solutions were about equal, and ran 44-48% less than that of a DCS. One of the most important criteria is that of I/O selection and mixing (analog, discrete, advanced process control, etc.).

But perhaps even more important than a conclusion is the methodology used to evaluate control selection. Selection requirement should be,

- A thorough analysis of the process and its control needs, including types of control, I/O, and communications interfaces.
- Consider the strengths and weaknesses of the various control platforms (DCS, PLC/HMI, mini-DCS, etc.).
- Design considerations along with an analysis of control architecture and where and how control should be implemented (including scan times, system response, etc.). Capital cost comparison (per I/O point or other reasonable comparison)
- Benefits comparison based on both current and projected needs.

Selecting the right technology and the right supplier can help our company in following ways:

- respond quickly to changing market conditions in a way that creates a sustainable competitive advantage
- minimize Total Cost of Ownership (TCO) over the life of our plant
- create a system which is easily maintainable/ upgradeable for the long-term

- achieve its future goals and vision

But more than the technology, it is about the *requirements* of our application and which supplier has the best solution, heritage, experience, and breadth of knowledge to meet our *needs*, today and tomorrow.

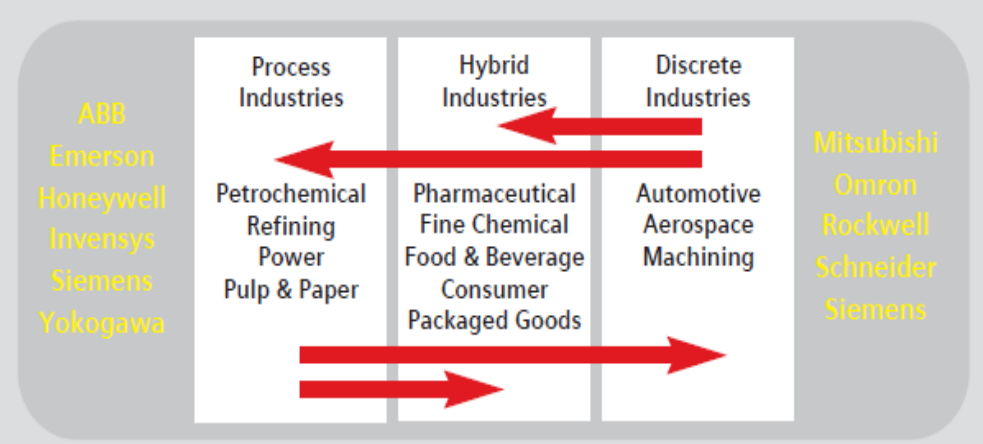

Fig1:

Characteristic	PLC	DCS
Market Introduction	1960s	1975
Replacement of . . .	Electromechanical Relays	Pneumatic & Single-Loop Controllers
Products Manufactured . . .	"Things"	"Stuff"
Classic Application	Automotive	Refining
Type of Control	Discrete	Regulatory
Redundancy	"Warm" Backup	"Hot" Backup
Engineering Mindset	"Programming"	"Configuration"
Operator Interaction	Exception Basis	Man in the Loop
Operator Interface	Simple Graphics	Sophisticated Graphics
Size/Footprint	Compact	Large
Up-front cost	$$	$$$$
System	"Open"	"Closed" (Proprietary)

Fig 2:

Although PLCs are less expensive and can now perform much like a DCS, it would not make sense to convert everything to PLCs. Here are six key factors to consider:

Table 1: Key factors for system selection

	PLC	DCS	Remarks
Response Time	Fast, Response time is one-tenth of a second	takes much longer to process data	PLC is ideal controller for near real-time actions such as a safety shutdown or firing control
Scalability	can only handle a few thousand I/O points or less	can handle many thousands of I/O points and more easily accommodate new equipment, process enhancements and data integration	large facility or a process that's spread out over a wide geographic area with thousands of I/O points, a DCS makes more sense
Redundancy	Not suitable for power or fault tolerant I/O	Offers high redundancy	PLCs for the purpose would equal or exceed those of a DCS
Complexity	Do not have advance process control capability	Suitable for advanced process control	Complex industry process like oil and gas, water treatment and chemical processing should go for DCS
Frequent Process change	best applied to a dedicated process that doesn't change often	Suitable for frequent adjustments or for analyzing a large amount of data	But the flexibility of a DCS system also makes it much more vulnerable to "meddling" by operators that can cause spurious shutdowns.
Vendor support	Offers more flexible platform, almost independent of vendors if judiciously designed	DCS vendors typically require users to employ them to provide integration services and implement process changes.	Designing customized system for specific purposes which are simpler, with PLC sounds more logical

Many of the stereotypes of yesterday are now being replaced, thanks to the convergence of PLC and DCS. This convergence has opened up a new set of options for hybrid applications and for those process plants that traditionally used PLCs to control their electrical infrastructure (such as motors, drives, and Motor Control Centers (MCCs), while utilizing DCS for regulatory control.

RECOMMENDATION

Looking into all aspects given above, a hybrid system is a solution.

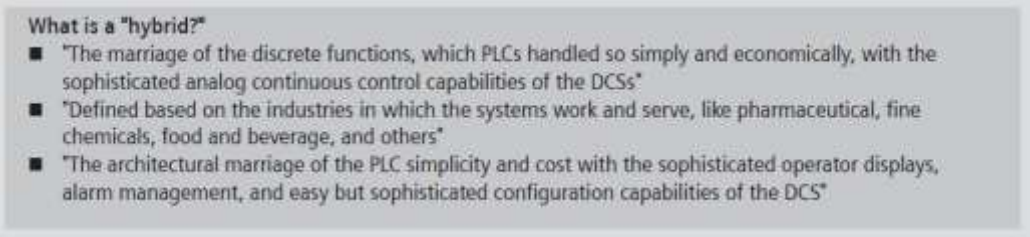

Fig 3:

Certain functions of DDCMIS need to be built with micro PLC's and it needs to communicate preferably by Modbus to the HMI. The micro PLC's would be provided in the field, near the sensors / inputs. These micro PLC's shall be replaceable / programmable with that of any manufacturer during routine maintenance.

As micro PLC's processing power is increasing, all controller software can be migrated to micro PLC's. The HMI can be replaced whenever obsolescence occur. The replacement period of Micro PLCs is around 7 days.

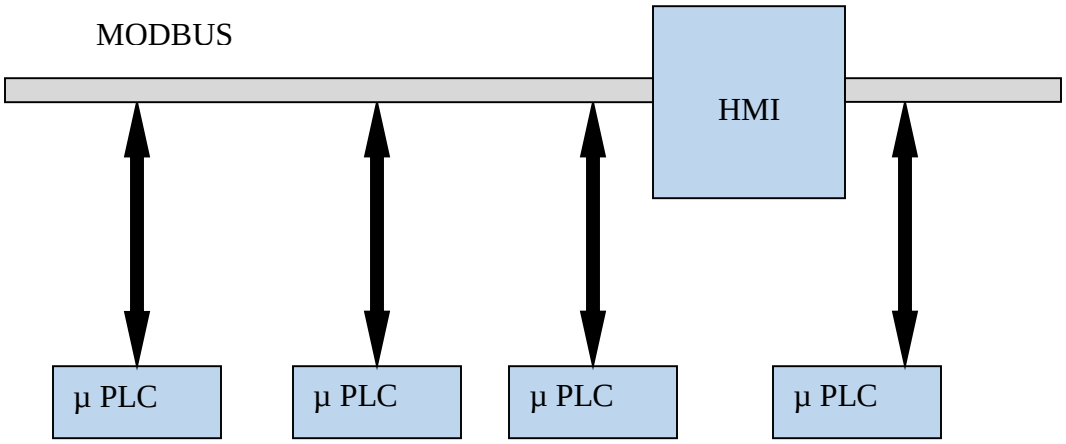

Fig 4:

By adopting a topology as given above, benefits expected are

- Reduction in cost: amounting to 40%
- Down time: around 10 days for installation.

CONCLUSION:

As the above discussion suggests, the process requirement for individual process in the power plant control system, needs to be considered carefully in order to achieve a feasible R&M solution for old plants, to optimize the cost and loss of generation, adhering to all norms and regulations.

It is required to migrate from “one size fits all”, vendor driven DDCMIS approach, to in house engineering and design for solutions that uses open technologies, with easy replacement, cost effective maintenance and independent from particular vendor, reducing obsolescence.

Following the recommendation, a pilot project can be designed using a hybrid model. Once, it is proven effective, moving beyond the area of R&M in old plants only, it will pioneer a paradigm shift in the field of DDCMIS in process industries.