Progression of Control Systems

The implementation of control systems by individual manufacturers can be a very personal and emotive issue. Each system component vendor extols the merits of their product and each manufacturer by virtue of familiarity strongly believes in the adoption of their particular system as the best for their product. Many factors influence the selection of a control system… price, availability, vendor support, suitability for process control, ability to provide information, integration and connectivity and most importantly the in-house ability to service, modify and improve.

The days of the PC being used just for visualization and production data acquisition in control and automation applications, is rapidly becoming a thing of the past. The PC is now increasingly recognized as an open and powerful hardware platform, which can provide effective and reliable control, with no requirement for additional processors or complex hardware additions. This recognition is being brought about by the successful development and implementation of powerful software based control solutions, designed to run on dedicated Industrial PCs, with particular advantages being apparent in areas such as information provision, record keeping and database connectivity.

Traditional automation and control systems typically comprise a number of hardware and software elements… a PC for process visualization and user interface, PLCs with Analog expansions and I/O for process and switching control, large cabinets with various power supplies, terminal rows, usually kilometers of wiring, and a selection of software operating systems and programming languages. The disadvantages of this approach being high hardware and software costs, complexity of system design and build plus, in most applications, limited functionality. Control is now changing with the introduction of reliable and effective PC based solutions, faster processors and Windows 32-bit functionality.

The emphasis on adding value in the automation marketplace is gradually shifting from hardware to software. This trend bears a marked similarity to the experience in the commercial computing market, where availability of portable, packaged application software and standard hardware allowed users to upwardly migrate their hardware while protecting their software investment. With PC-based control and monitoring software running on standard hardware, medical and health care organisations can benefit from the same flexibility that comes with hardware independence. The ability to better integrate the hardware while preserving the software investment is a key benefit.

A good illustration of the latest PC based control software is the M3 Touch Screen sterilizer control system from Mercer Medical, which is designed to provide sterilizer process control, documentation and tracking system connectivity using Windows 98 / NT / XP. The M3 offers integrated ‘PLC type’ control with Analog and I/O via industry standard iDAM RS485 bus modules. Advantages over traditional control configurations include a centralized structure, reduced hardware costs, fewer interfaces, easy upgrade paths, full integration and high reliability.

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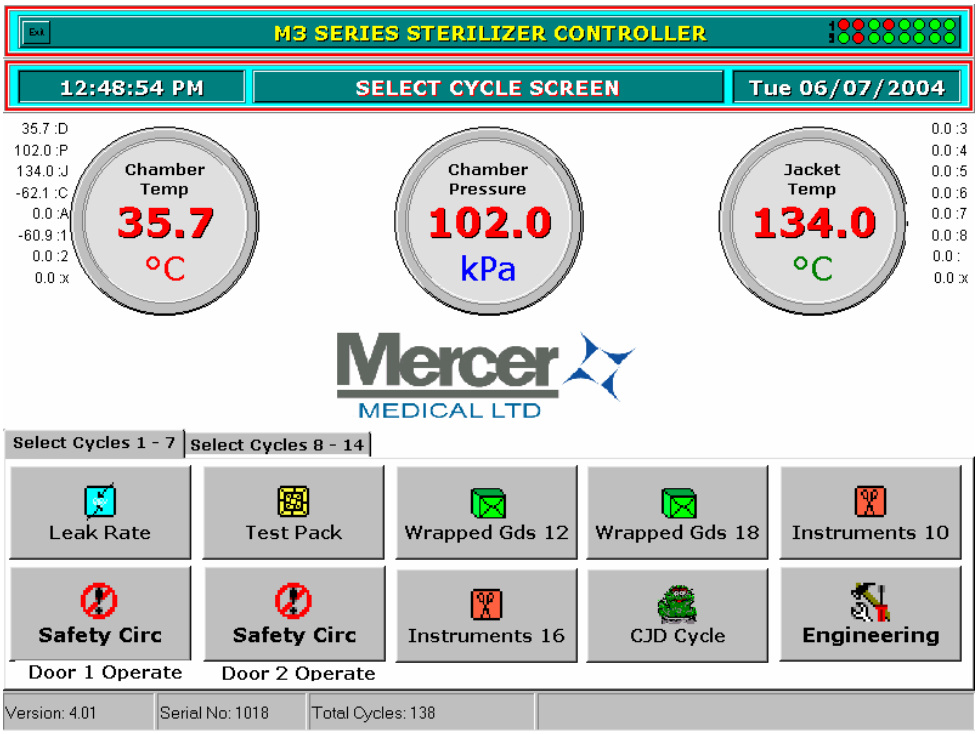

The boundaries of performance for PC control are constantly expanding. Software based products such as the Mercer Medical M3 offer a complete application solution for the execution, editing and analysis of control programs in real time, without the need to be an operating systems expert, the focus being very much on the practical application of PC technology in control and automation solutions, with all the benefits it brings it terms of both costs and performance. This results in a sophisticated system that is extremely user-friendly.

Benefits of PC-Based Control and Monitoring

1. Lower Cost
2. Easier access to data/information by all control and monitoring and business applications
3. Software portability to new hardware platforms
4. Ease of integration of control and monitoring, HMI, and programming functions
5. Ease of network integration, communication and remote connectivity
6. Independence from proprietary control and monitoring systems

Costs and complexity can rise exponentially when a PLC is asked to perform complex tasks such as networking to higher-level computing systems, advanced control, and database manipulation. Using a PLC for these types of applications can ensnare a process control professional in an inescapable trap of rising costs and diminishing performance.

Table I: Top 10 Reasons for Using a PC vs. a PLC

When you require…
1. Networking to higher-level platforms.
2. Advanced control algorithms.
3. Extensive database manipulation.
4. Human - Machine Interface (HMI) functionality in one platform.
5. Integrated custom control routines.
6. Complex process simulation.
7. Very fast CPU processing.
8. Memory requirements exceeding PLC specs.
9. Interfaces through multiple protocols.
10. Secure record keeping with database access.

PCs will probably never replace PLCs for simple applications. Micro PLCs with eight discrete inputs, four relay outputs, and an integral programming and HMI LCD panel can be purchased for under $1000. It is difficult to envision a PC-based control system that could be competitive at this price point.

PC-based control systems instead excel at more complex applications. The good applications for PC-based control are ones where you need to integrate data processing, networking, and advanced control and you don't want to have to tie together multiple pieces and boxes. The PC-based platform is very compelling at that point.

Recognizing that application software represents the lion's share of value added and the core strategic asset in many control and monitoring systems, every effort should be made to take advantage of accelerating life cycles of computer hardware. Adoption of PC-based control and monitoring achieves this goal, while at the same time allowing you to preserve your software investment.

In response to the challenge from suppliers of PC based controls, PLC manufacturers have been enhancing their products by providing more flexibility, scalability, connectivity, and easier programming. In doing this there is becoming somewhat of a blur in what distinguishes some PLCs from PCs, indeed some ‘PLCs’ offer Windows NT-based solutions.

PCs Everywhere

PC costs are rapidly declining, real-time embedded operating systems are widely available, and industry standard I/O can be purchased from a variety of vendors.

It sometimes seems that PLCs are anachronisms, like corks in wine bottles. (Corks are used instead of screw tops because of tradition, even though corks are more expensive and inferior in every way.)

Could PLC use also be driven by force of habit? Some vendors think so, and they promote PCs as across-the-board replacements for PLCs. They believe that end users are clinging to outdated technology for no practical reason.

But engineers and technicians are nothing if not practical, and they have their reasons for not using PCs everywhere. The main and most obvious reason is cost. A PLC with a combination of 128 discrete and analog inputs and outputs can be purchased at a cost that PC-based control solutions cannot compete yet.

Plant personnel have learned to trust PLCs, and that same level of trust is not always present with PC-based control. PC-based control vendors are working hard to dispel legitimate user concerns and perceptions with respect to high costs, reliability, and platform stability. Advances in commercial technologies promise to reduce costs. Embedded systems have the potential to increase reliability and alleviate concerns related to platform stability. This will result in increased use of PCs for process control.

Perception Versus Reality of PC-Based Control and Monitoring

Perception	Reality
PCs are not reliable	PCs are just as reliable today as other control and monitoring products
Third-party I/O is not robust enough for critical applications	Several PLC companies have developed interfaces to connect their I/O with PCs
PCs are not designed to withstand harsh environment	Industrial PCs are available for harsh environment
PC operating systems do not have the multitasking capabilities needed for real-time control and monitoring	Windows NT has built-in multitasking capabilities
PCs invite engineers or operators to load unproven software	PCs can be dedicated to perform just control and monitoring
PC software suppliers do not have experience in process control and monitoring applications	PC-based control and monitoring systems can now be purchased from several control and monitoring companies

PC-based control is widely used in process control applications, but mostly in those applications that exceed PLC capabilities. The PLC is still the controller of choice for the majority of systems. Vendors that want to take market share away from PLCs must first exorcise the PC perceptions and demons.

The Curse of the PC

Many users do not perceive PC-based controllers as reliable substitutes for PLCs. Why is this so? The very flexibility and openness that makes PCs so useful for complex control systems may also be their curse in control applications.
PLCs cannot run 'Solitaire' or surf the Internet, but PCs supposedly dedicated to control functions are often used for other purposes. The occasional crash of Windows has often been cited as a weak spot of PC-based control. The origin of most of these types of failures was the general nature of the Windows environment that allowed the addition of practically any new program. Embedded Windows NT / XP and CE systems address many of these problems.

PC-based controls can be very effective in open systems with complex control requirements. A major US chemical processing company system uses HMI and Paradigm PC-based control products. According to a plant engineer, "*We strictly limit the software applications that run on the control machines and as a result have had excellent results in regards to reliability. We view PC-based control as the future for control technology. The system also has the flexibility to communicate with various I/O and Data Acquisition systems."*

Efforts to establish open systems on the plant floor are contributing to a backlash against proprietary control and monitoring environments typically seen in the PLC marketplace. Software standardization in the form of the IEC 61131-3 specification holds significant promise for future portability and openness. With the I/O and its associated proprietary environment displaced by standard device networks, a similar move is afoot to reduce reliance on proprietary controllers wherever possible.

PLCs are often the best low-end solution, but PCs will continue to replace DCSs for complex applications because of the rapid introduction of new hardware and software technologies. These technologies are converging to create extremely powerful, low-cost, and open PC-based control systems.

Play Well With Others

PCs are often better than PLCs when extensive connectivity to other controllers is required. Interfaces to sensors, analyzers and other field devices allow PC-based systems to gather and process information and control processes.

PCs are a logical choice for control system applications that are too complex for PLCs. These applications used to require a dedicated control system (DCS), but PCs can now perform many traditional DCS functions at a much lower cost. PCs also can perform these functions more reliably because of new real-time operating systems, solid-state memory, and industry-standard network protocols.

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Mercer Medical uses its M3 PC-based system to process data that supports preventive and predictive maintenance programs. *"Maintenance and service support is a major part of our software implementation and system connectivity gives us the ability to have system configuration, cycle data, error logs and abort errors emailed to us instantly. Very often we know if the sterilizer has faulted even before the user. This holds true for any of our M3 sterilizers anywhere in the world"* states a Mercer Medical design technician. *"In addition the use of today's technology such as Web cams, SMS mobile communication and texting, and Remote Administration are included as standard functions for the system."*

Standalone control systems with no connection to other control systems, computing systems, or the Internet are becoming a rarity. There is a push for PC-based control to support open communications standards and protocols beyond OPC and TCP/IP. These protocols have been around for some time but are just finding their way into industrial automation. XML is an example of an Internet-popularized protocol finding its way into industrial automation.
Internet connectivity is more than a buzzword--it can deliver real benefits to users. There is a shift in automation to have information available via browser-based devices including mobile pads, phones, and other thin-client devices. This push is driven by user demand for lower maintenance costs and faster response times.

Networking capability is a must. Ethernet is growing rapidly, and other networking technologies may soon come into play. Both hardware and software must be capable of easily connecting to the network and sharing data and control information with the rest of the enterprise. Connectivity is a strong point of PC-based control systems.

Figure 2 shows some of the methods used for connecting PCs to clients.

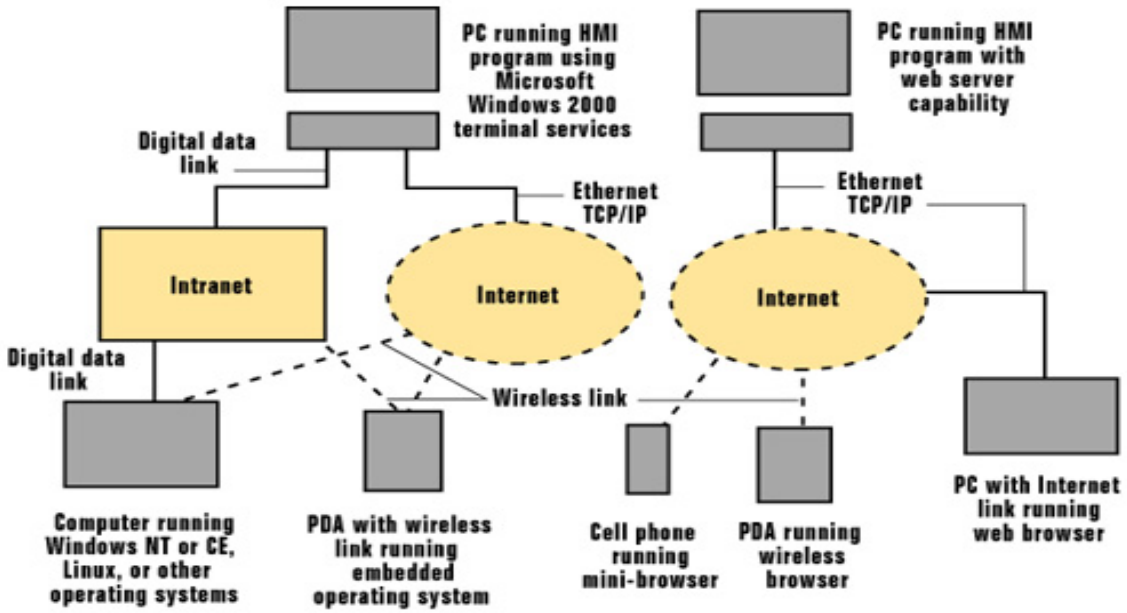

Figure 2: PC technology and web support offer a universe of commercial connectivity options.

Handle Data with Ease

Projects with extensive data-handling requirements are often good candidates for PC-based control. Data handling also can be used to improve system support and troubleshooting. PC-based control gives the ability to link alarms and events to recordings of audio visual advisories and troubleshooting directions. These messages can be selectively attached to faults and alarms to aid the operator through machine or process troubleshooting.

Database access requirements are often the primary driver to PC-based controls. The main advantage of PC-based control is the ability to easily access data from multiple remote PCs to perform real-time analysis of the operation. Data acquisition and database management are simpler when the PC platform is used for both control and data handling.

The ability to tightly couple control with data gathering and logging is an area where PC-based control excels. When tracking batch production information, the data often must be acquired from the control system and transformed to meet the structure of a corporate database. In this case, the PC-based system can offer a better environment because all control and data operations can be captured within one system.

Limited by your imagination.

Adoption of the PC platform can further preservation of software investments, while at the same time offering compatibility with standard operating systems, networks, and user interfaces. Hardware can be upgraded as needed without disrupting the software investment - a marked departure from the typical control and monitoring upgrade scenario.

The massive install base of PCs in both commercial and home use has seen enormous development by a vast number of vendors for software, hardware and accessories and with this comes competitive pricing. Upgrades of hardware and software give the ability for the control system to remain up to date and new technology often means the addition of features or compliance as industry standards require. A PLC system that can integrate with today's technology won't necessarily be able to do so in 2, 5 or 10 year's time.

Almost everybody uses a computer on a daily basis. People are less daunted by the PC now and indeed take them almost for granted. Whenever you turn on your PC at home or work do you hold your breath and wonder if it will work? No! You may crash it from time to time… but how often does it break down.

Simplicity of additions is the single biggest advantage of the PC controllers open architecture structure with product choice being almost unlimited. For example to add a printer to a PC controller it is as simple as 'Plug and Play'. Virtually any printer from any manufacturer, local or networked can be fitted. By contrast a PLC system is vendor specific. One must purchase a printer interface and driver software and the specified printer as well from the PLC vendor, if indeed this is even an option at all.

You should be asking yourself one question; **Q. Why should I use PC-based control?**

A. With the abundance of high-performance, low-cost PC platforms available and the large number of people comfortable using PCs at work and home, it is a logical progression for process automation and control. Historically, PLC-based systems have meant dependence upon a single hardware manufacturer and a relatively high cost/performance ratio for their products. Additionally, all of the software development tools (ladder logic, sequential function charts, etc.) are completely proprietary in nature and are also not cross-platform compatible.

Where as **PC-based control versus Conventional PLCs** offers;

Attribute	Conventional PLCs	PC-based control
Primary Product	Hardware	Software and PC
System Software	Proprietary	Standard
Programming	Proprietary	Standard
CPU	Proprietary	Standard
Memory	Low	High
Response Time	Fast	Fast
I/O Capacity	Varies	Varies
Cost Per Point	Medium to High	Low
Ease-of-Use	Medium	High
Software Portability	Limited	Yes
Ease-of-Integration	Improving	High

A case study of the M3 control system is available from Mercer Medical covering the path from mechanical to PLC, to DOS based PCs to the current Windows based M3 controller.

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www.mer-med.com

Sources:

Mercer Medical and Various Automation companies and the Internet