PLCs, PACs, PCs or soft PLCs?

Evolution in controls

FIVE YEARS AGO WE WERE PROMISED MACHINE CONTROLS BASED ON WINDOWS AND OTHER EQUALLY FAMILIAR PROGRAMMES. BUT IT DIDN'T MATERIALISE. CONTROL TECHNOLOGY CAN SEEM JUST AS BAFFLING AS EVER. BOB DOBSON LOOKS AT WHAT HAS HAPPENED, AND CONCLUDES THAT THE DREAM DIDN'T SOUR, BUT THE DEVELOPMENTS ARE NOT QUITE AS PREDICTED.

The countdown to the new millennium held so much technological promise: electronic commerce, instant knowledge from the Internet, wireless everything and – most important for users of processing and packaging machinery – such simplification of control systems design and build that any competent engineer could do it.

But it just has not happened; control technology is still the preserve of geeks and boffins who speak a language barely discernable to mere mortal machine builders.

The thought at the time was that standard PCs would take over the entire machine control function, making PLCs (programmable logic controllers) redundant along with all the associated paraphernalia. The PCs would run programmes with easy to understand Windows-type interfaces, that anyone familiar with a word processor or home computer could intuitively use. In short, PLCs were going to be replaced by software.

Working together: *PCs and PLCs can work hand in hand for machine control*

But at the same time, in the parallel and not so distant world of plant-wide control systems the cry was diametrically opposite. They were working towards greater use of PLCs, whose robustness and reliability were seen as most attractive.

So in the late 1990s we had two sections of the engineering community with precisely opposing views. Anybody who spotted this anomaly was fairly likely to conclude that things would be turning out in a non-predicted way. What has actually happened in the half-decade since then has been driven partly by technology, partly by economics and commerce and partly by the simple realisation that the regularly-promised 'brave new worlds just around the corner' usually turn out different than expected.

The most obvious flaw in the machine control theory was that PCs are notoriously unreliable. Even back in the last century, most of us were spending a good few hours a week at a PC and so knew that they crashed with monotonous regularity.

Acceptance of systems failures

Although crash rates have improved no end, we still live with the acceptance of systems failures and have our fixes ready. (Mine is to pay someone to come and sort it out while I get on with something else; other people, of course, are more enterprising.) Today we use computers for what they are good at and know not to entrust them with time-critical tasks.

The trouble with machine control is that nearly everything is time-critical, and often to a small fraction of a second! Packaging machines, for example, may perform a dozen functions a second – opening gates, closing switches, counting products, driving actuators, monitoring for quality, applying labels, interlocking safety devices, wrapping and sealing – each sequenced precisely to several other functions. The data processing requirement is likely to be hundreds or even thousands of decisions a second.

Quite simply, PCs cannot perform at the necessary level of certitude. They can process data quickly, but not necessarily in the right order – for which the technical term is 'determinism'.

In contrast, hardwired PLCs always have this determinism; it is intrinsic to the technology. The way they scan their programmes is predictable, repeatable and in a specified timeframe, whereas a PC can be distracted by other tasks also being undertaken by the operating system.

Interestingly, PCs are in fact deterministic, but this is at a fundamental level. To exploit this, one would need to be operating in MS-DOS, having stripped out the friendly operating system and so losing all the benefits of working with Windows or another graphical front end.

Attempts have been made to launch software packages that pull the determinism of MS-DOS through the user interface software and the conflicting demands of multiple background tasks, but this has not taken off to any great extent because it reduces processing speeds, makes the system very non-standard and destroys the very familiarity that is sought.

So what has happened to control systems

technology over the last five years; how has it developed and how does this affect systems design and build? And what do the next five years hold?

Reshaping technology

In fact an awful lot has happened. The various control technologies have developed individually and collectively and show every sign of continuing to develop further.

Traditionally, a huge proportion of installed PLCs have been used for machine control, so when the manufacturers were told that this market would soon close to them they had a number of options. They went and looked for new markets, finding many niches in fitness equipment, theatre sets, the biotech industries, commercial applications and environmental control.

They also developed new products, including small PLCs or logic blocks, which are cost effective on the smallest of jobs and really useful within larger systems. But their main thrust was of course to take on the young pretenders to the machine control crown and defend their core market.

The fight back included awareness campaigns and market education to counteract the unthinking swing to PCs. Significantly it also included the introduction of a new class of PLC that is as smart and user-friendly as a PC but has the reliability of absolute determinism. In many ways these encompass little truly new technology but, rather, they import advances from other fields and marry them with an innovative restructuring of the traditional controller.

Highly modular

They are highly modular with a physical design that positively encourages you to think through your system requirements and a library of modules that meet these effortlessly. You simply clip the modules to the backplane and the integral bus does all the wiring for you.

Typically a backplane can work with multiple CPUs (central processor units – the core of any controller, computer or processor), and if this is not enough the new PLCs can be ganged together to meet your needs. There are specialist CPUs dedicated to particular functions, such as process control, motion control, temperature monitoring, safety management, and so forth.

Information technology functions such as word processing for report preparation, graphics and user interfaces are all easily integrated into the new PLCs, as are web server functions for e-mail, SMS and FTP. In short, you can very quickly build a powerful controller that exactly matches your needs.

Ten years ago this new generation of PLCs would have been the dream development of the frustrated control engineer; the fact that they are now available is testament to the manufacturers' commitment to holding onto their most vital market. Their acceptance by the users is indicated by the fact that they have developed a new name to differentiate them from bog-standard PLCs: they are increasingly becoming known as Programmable Automation Controllers or PACs (typical of linguistic developments, definitions are as yet vague and variable, but will settle down to a more precise meaning if the terminology is accepted into the language).

Similarly, The idea of PC-based machine control has acquired a new name, soft-PLC. The concept has found acceptance in certain fields: whether it can expand significantly from this toehold remains to be seen, but with robust operating systems there is no reason why they should not.

Machine control systems have been interfacing to enterprise management systems (EMSs) for many years, and it is an increasingly common requirement. This is another area of technical development. Traditional wisdom has it that machine I/O and IT data were virtually incompatible bedfellows, but easing their integration has been a development goal over recent years with the aim of creating a complete 'shop floor to top floor' EMS. The latest software packages, typically called Manufacturing Management Systems, have made this level of integration child's play compared with just a few years ago.

Mini controls: *Above: Small machines such as this airbag maker are now frequently controlled by a tiny logic block. Right: Tiny PLCs or logic blocks have carved a niche for themselves in large machine control systems as well as standalone systems on smaller items of equipment*

Fieldbus wars

We have even seen something of a truce in the 'fieldbus wars' of the late 1990s, with several protocols regularly working side by side. There is recognition that certain protocols are best for specific duties and a general agreement that Industrial Ethernet becomes the de facto standard for the system-wide long distance communication that spans the conflicting demands of commercial information formation and technical I/O determinism.

Looking at the example expectations in the opening paragraph, electronic commerce has only really developed as far as paying utility bills and booking holidays on line; the Internet's instant knowledge is in fact only fairly accessible information, and wirelessness is still in its infancy.

Each of these has the potential to advance further and almost certainly will, but there is still a long way to go.

In contrast, machine control technology has progressed significantly and, while it may not have delivered on the specific promises of five years ago, is certainly doing a lot more than it was. Real world control engineering has advanced and, perhaps most excitingly, it is clear that there are plenty more developments to come. ■