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Long live the PLC

Rumors of the PLC's demise have been greatly exaggerated. In fact, the PLC appears to be stronger than ever. Here's why the PLC remains king of the controllers.

by Chris Elston, Yamaha Robotics

The general health of the programmable logic controller (PLC) market is a thing to behold. According to Frost & Sullivan, the global PLC market has witnessed growth across all regions. The market, which experienced a strong decline in the early part of the decade, has bounced back strongly and is expected to reach \$14.58 billion in 2018, up more than 40% from five years earlier. This growth includes the mature markets of North America and Europe, where uncertainty about economic standing had precipitated an earlier decline. Of particular interest, Frost & Sullivan note, "the small and medium PLC segments will be instrumental for market development."

Those segments are the domain of traditional PLCs.

Much has been made in recent years about the looming demise of PLCs. Critics predicted that PLCs would be rendered obsolete with the advent of process automation controllers (PACs) and more advanced computer-based controls. But the market says otherwise.

FROM THE BOTTOM UP

Chris Elston, senior controls engineer at Fort Wayne, Indiana-based Yamaha Robotics, says PLCs remain extremely relevant. "Probably 95% of machine builders still use PLCs as the controller of choice when they design a piece of machinery," he says. "There really aren't a lot of people out there who have switched over to something like PACs or PC-based control or anything of that nature."

One of the reasons there hasn't been an overwhelming rush to implement new control technology at the plant level is that many end users aren't positioned to support it at the business end of things. "It can be boiled down to this: There's a lot of skill set out there in the manufacturing industry, particularly with maintenance personnel or automation technicians, that is oriented to using ladder logic," says Elston. "Most of them don't understand a scripted language, so they are comfortable working with PLCs. It's a workforce issue at that level."

Don Fitchett, president of St. Louis, Missouri-based Business Industrial Network underscores this point. "On the automation side, a lot of OEMs want to push 'the end of the PLC' idea; but it's not going to be the end because the end users drive the market," he says.

Fitchett compares the current situation to the vendors' introduction of soft PLCs two decades ago. "When the industry came out with soft PLCs and pushed that approach, end users went out and bought any old computer instead of industrial computers. So when things collapsed, they pointed the finger at soft PLCs and went back to legacy PLCs," he says. "Even

though vendors still sell soft PLCs, they're not pushed anymore because end users pushed back. A similar situation exists with the process automation controller and other new technologies for the entire plant. They're not user-friendly for maintenance personnel."

The fact that manufacturers are finding the depth of the skilled labor pool a significant issue at this time only increases the impact of bottom-up resistance to switching out PLCs. "It's really an issue of education, and also a generational one," notes Elston. "Many machine builders are really cutting edge, but the issue with adoption is one of support after the fact. There is always a lag time between builders and users, and end users are typically reluctant to change control platforms. Maintenance personnel will even put PLCs back after they are switched out. They've been doing that for years because the

PLC is something they have deep experience with and understand."

APPLICATION BREADTH

Industry analysts at ARC Advisory Group and VDC Research estimate that

- 80% of PLCs are used in small applications (1 to 128 I/O points)
- 78% of PLC I/O is digital
- 80% of PLC application challenges are solved with a set of 20 ladder-logic instructions.



PLCs such as the just-released MicroSmart FC6A from IDEC deliver new levels of power, flexibility, expandability, configurability, dependability and ease of use.

These statistics support what some have called an 80/20 rule: if 80% of applications incorporate simple digital and analog control, the boundaries of control applications are being pushed by a 20% minority. This ratio acts to preserve the viability of traditional PLCs.

Another reason for the resilience of PLCs is the robustness of the hardware, says Elston. “Almost anyone who has worked with something that has a hard drive in it has experienced some kind of failure with the drive,” he says. “Just remember the famous ‘blue screen of death.’ Those kinds of experiences don’t lead to comfort, whereas PLCs are extremely robust, resistant to environmental threats, such as vibration, and have set a standard in terms of interfacing. There’s a vast array of compatibility built into the neatly designed package.”

At a basic level, the simplicity/complexity paradigm can be used to determine where PLCs are likely to remain the choice in machine-building applications. Consider Yamaha. It isn’t known for big six-axis robots; it does a lot of single-axis robots that move products from point to point. They are relatively inexpensive—less than \$2,000 for everything, including mechanical assembly—and provide a set of add-on instructions that a user can program in ladder logic.

“This setup does a couple of things,” says Elston. “If most of the industry has the capability to use or wants to use ladder logic, they can be intimidated when they see a robotic come to their floor that requires more exotic programming and so are reluctant to change. Our approach eliminates this.”

BIN’s Fitchett says the manufacturing industry will be the last to come around to networking all of their assets, and this will keep the PLC a major player in the sector.

“Things like strappers will be networked because they need data from other machines in the plant, for example, to know the size of the product coming down to be strapped,” he says. “But in small manufacturing, presses will be a stronghold for PLCs, because of the cost of upgrading and because the need to interface isn’t as high. A simple press with a cylinder going up and down doesn’t have the need to transfer data to other equipment.” Such applications will retain the legacy PLC, which lasts decades without the need for replacement.

Moreover, many companies have invested many man-hours and dollars in sending their personnel to schools and are much more comfortable in adding assets that can be programmed in a familiar environment. “Most of the time we see that comfort in ladder logic,” says Elston.

COST CONSIDERATIONS

Michael Tiller, general superintendent with an engineering, construction and fabrication services company, says that PLCs continue to provide a combination of low cost and functionality that still makes them attractive choices for the end user. And heavy use in process applications often will drive acceptance and longevity in discrete manufacturing, as well. “There are some companies such as Triangle Research that have built a lot of functionality into legacy PLCs, enabling networking without a lot of programming skills,” he says.

Tiller cites his work with Oklahoma-based Chaparral Energy, a privately owned company that has grown to become a major energy player in the mid-continent region, with more than 1 billion barrels of oil equivalent and approximately 480 employees. Tiller designed solutions for a variety of Chaparral applications at its Ponca City, Oklahoma, facility. “They are going to stick with the PLC everywhere, including a couple of PLC-based edge devices that I’ve put in,” he says. The facility uses PLCs for applications ranging from process skids to tanks and tank arrays.

EVOLUTION

While there are compelling reasons the traditional PLC has remained so prevalent, change is inevitable as technology such as cloud-based solutions and the Internet of Things (IoT) begin to move more prominently into the manufacturing ecosystem.

“There is a convergence of price, functionality and power that is beginning to enable the IoT in the manufacturing sector,” says Tiller. “This is starting to be embraced, but there remains a real learning curve

“Probably 95% of machine builders still use PLCs as the controller of choice when they design a piece of machinery. There really aren’t a lot of people out there who have switched over to something like PACs or PC-based control or anything of that nature.”

- Chris Elston, Yamaha Robotics

“One reason they chose the legacy PLC solution was because of cost advantages,” says Tiller. “Compared to more complicated solutions, it was a magnitude less expensive. They do the job. There’s no need for expensive software packages, and regular electricians can program them because there’s no high-level language involved.”

The low initial investment clearly provides strong support for the ongoing use of PLCs. “It’s three times higher to buy a PAC than a PLC,” says BIN’s Fitchett.

that average users of automation need to climb to be able to program this technology, to put systems together regardless of implementation scope and size.”

But PLCs continue to evolve to meet the needs of the IoT. In IDEC’s new MicroSmart FC6A, for example, IoT capability is provided by custom web pages that can be configured for remote monitoring and control. These web pages are stored in the MicroSmart PLC, which functions as a web server when its built-in Ethernet port or the HMI Ethernet port is connected to the Internet. These web pages can be accessed via any web browser running on

any Internet-connected device such as a remote PC, a tablet or a smartphone.

Connecting the MicroSmart or the HMI Ethernet port to the Internet also provides email and text notification functionality, which can be used with third-party email servers such as Gmail and Yahoo.

Some reliability and stability issues linger from earlier experiences with computer-based controls—something that still contrasts to the long history of PLC performance. “People choose PACs or higher technology if they need really high speed or machines to communicate to each other. But even in highly regulated plants, such as nuclear power facilities, if the machine is stand-alone, there is less maintenance, less overhead, and higher reliability with PLCs,” comments BIN’s Fitchett.

And control suppliers continue to develop PLCs with power that rivals PACs while maintaining the benefits

of the PLC. IDEC says its MicroSmart FC6A offers PAC power in a small, low-cost package that makes it an ideal fit for a wide variety of applications.

Elston notes that certain industries, such as medical-device manufacturers, will be early adopters of new technology because there are stringent mandated regulations to meet. At that point, PACs or computer-based control is a better choice, because of the need to interface databases with systems such as MES or ERP. In these cases, the PLC is problematic because it doesn’t easily lend itself to such integration.

But for most applications—especially those requiring control of standalone machines, process skids, vehicles and small-scale systems—the PLC continues to offer the power, flexibility, dependability and ease of use machine builders and end users prefer. And it appears that will be the case for years to come. ■

Combining control and operator interface

Although relatively new on the scene, combo units have seen significant adoption by machine builders.

By Dan Hebert

A combo controller and operator interface can save big compared to separates.

As the miniaturization of electronics continues its relentless march across the personal-consumer-device landscape, it's only natural for it to proceed apace in machine and robot automation systems. One consequence is the combination of what were once separate components into a single housing, as with a machine controller and an operator interface device.

Although relatively new on the scene, these combo units have seen significant adoption by machine builders because they are less expensive than separates, require no wiring or integration between the controller and the operator interface, and take up less panel space.

For many applications, these benefits more than negate disadvantages, which include a single point of failure for both control and operator interface and a lack of the highest-end functionality, particularly for basic units.

These combo units come in two main flavors. The first combines a PLC with an operator interface terminal (OIT) to create a unit designed for basic machines. The second marries a PC-based controller to a full-featured HMI, creating a unit capable of providing control and operator interface for the most complex machines.

Combo PLC-OIT units were initially introduced with limited features and functions, but more recent products have upped the ante by adding more sophisticated capabilities. “The newest addition to our FT1A Touch micro programmable controller series of combo HMI+PLC units is the FT1A Touch 14 I/O, with new features making it suitable for advanced analog monitoring and control,” says Don Pham, a product manager at IDEC.

“The FT1A Touch 14 I/O provides up to 158 discrete and analog inputs and outputs, using FT1A controllers as remote I/O slaves, PID control, Ethernet communications and a built-in 3.8-in touchscreen HMI in a compact package costing less than \$500,” adds Pham.

This is obviously an attractive price point, one hard to match by purchasing a separate PLC and an OIT, particularly when the cost of wiring, integrating and installing two separate units is taken into account.

These combo units can be a good fit for machine builders not requiring large HMI-type screens, hundreds of I/O points or advanced control functionality. For applications requiring those features and functions, the next step up the line are combo PC+HMI units.

Readers over 40 years old may have not-so-fond memories of the sheer size, bulk and weight of older PC-based control systems. Not only was the CRT-based screen a monster, so was the industrial PC. Add, in some outboard I/O, the entire package was cost- and size-prohibitive for all but the most high-end applications.

But times have changed, and new units simply tack a PC-based controller onto the back of a flat-panel screen, creating a slim panel-mount package with reasonable weight and not much more depth than a monitor alone. ■

5 must-have controller programming features

Machine builders want ease-of-use, support for multiple programming languages, ability to reuse code, global acceptance and the ability to accommodate motion and robotic control along with traditional PLC functions.

By Dan Hebert

What are the most important programming software features? When I posed this question to suppliers, I received the following answers: ease-of-use, automatic connection to the controller, one programming package for an entire family of controllers, ability to reuse code, and support for multiple programming languages.

Machine and robot builders agreed with suppliers on three of these five features—ease-of-use, support for multiple programming languages and ability to reuse code. However, the machine builders listed two other features of greater importance to them—global acceptance and the ability to accommodate motion and robotic control along with traditional PLC functions.

Ease-of-use covers a wide range of attributes expressed by Mike Roth, electrical controls engineer for automated packaging equipment builder Massman Automation. “Flexible tag naming, array structures, motion instructions and PID instructions should be available and well supported in the programming environment with online help and concise information pertaining to compilation errors. Features such as drag-and-drop, cut-and-paste and autofill fields all help reduce programming time and errors,” explains Roth.

Daren Myren, controls engineer at packaging system supplier Aagard, says programming software should have these three ease-of-use features—programming that’s easy to navigate and search, responsive communication with the PLC/PAC while online and trending/scope capabilities to monitor tag values and transitions.

Support for multiple programming languages is important to OEMs and suppliers alike, as is the closely related feature of support for a wide variety of instruction types. “At minimum, programming software should support ladder logic, structured text and sequential function charts (SFCs),” says Kevin Alexander, unified support manager for Bastian Solutions, a material handling systems integrator.

“For machines operating very sequentially, SFCs provide a very robust and streamlined method for controlling a sequence of operation, while providing easy troubleshooting. Structured text is best for programming communication sockets as it’s much cleaner and more efficient than ladder logic. A wide variety of pre-built instructions allows a programmer to mitigate complexity and streamline code, and custom-built instructions that can be reused within the code should also be available,” adds Alexander.

As Alexander notes, a wide variety of instruction types allows for scalability and reusability, a third feature important to OEMs. “Software that works for a variety of platforms allows a programmer to generate standards that can be used from project to project, improving reliability and allowing for much quicker implementation,” concludes Alexander.

A feature cited by OEMs, but not suppliers, is global acceptance by the customer base of the software and its supported controllers. “The software must be globally accepted and utilized by factory managers, engineers and technicians,” says Roth. “End users must be able to extract production data, make program changes and troubleshoot factory floor equipment. Poor performance, downtime and uncertainty can be attributed to the lack of availability, familiarity or ability to use PLC/PAC programming software. Rockwell Automation has an extensive distribution and support network in the United States and Canada. Because of this, most of our North American customers either mandate or readily accept equipment with their control platforms and programming software. It’s apparent that Rockwell Automation has also made gains in Europe because of an increase of the acceptance of its use with Massman’s customers outside North America.”

Roth says the final feature of importance is the ability to accommodate PLC, motion and robotics. “Having to learn just one programming software package for multiple automation disciplines increases efficiency and creates an environment that brings an automation team together. Time and energy can be spent on the automation task at hand versus learning multiple software packages,” notes Roth. ■

Keep it simple with ladder diagram

Ladder diagram is all that is needed for typical machine control applications. Do yourself a favor and use it.

By Dave Perkon, technical editor

Standards are important. But often only a portion of a standard is widely used. The IEC 61131 Open Programmable Logic Controller standard is an example of that. Although the IEC 61131 standard has four programming languages and a structural component and defines data well, just sticking with ladder diagram, the de facto standard for PLCs and PACs in discrete manufacturing and process skid applications, will save you money and keep you efficient in the future.

Although personal preference plays a role, using just ladder diagram programming for machine sequence control keeps things simple for an integrator's controls department and the customer's support and maintenance department, and that's what most machine builders want. The quicker the customer can support the equipment, the better. Sticking with ladder diagram helps, as the majority of programmers have little need or awareness of the IEC 61131 specification even though it has been around for more than 20 years.

Although the IEC 61131 standard is useful and has its place in more complex applications, most programmers do not save time or money by using multiple programming languages. Ladder diagram and maybe some function block programming is all that is needed. Mixing several different languages in a single program is less efficient from a programming and support standpoint.

It adds more time and costs during development, testing and maintenance of the program. It can also make it more difficult for the next guy to figure out the program when using multiple programming methods. The syntax is different between each type of program and must be learned before it can be supported, and some are just a waste of time.

Sorry instruction list programming—the days of low-level programming are over, and I cannot think of anything but the most limited applications where you would want to write single instructions in a line-by-line format. I did work on a machine from Germany several years ago that strangely used instruction list. They like it, but it is impossible to comprehend why a large integrator would write a program for a \$5 million machine using instruction list. It was massive and very difficult to understand where to start or what the program structure was, and it was in German. Nein! If you ask me, instruction list programming is not necessary and a bad idea, so don't use it.

Structured text has its uses for data handling, string functions and math, among others, but most can be done using ladder. It's also good for iteration loops, but doing it in ladder eliminates the need to understand another syntax and tie two different programs together.

The sequential function chart structure may help to define process or machine sequence flow, but each block in the chart has additional programming behind it that must be managed within the program. There are too many bits and pieces. Just reset a sequence in the middle, and there will be many small

sections of logic that will need to be cleaned up, reset and initialized, and the chart structure hides it nicely. Not my favorite.

HOW-TO: THE IMPORTANT STANDARD

A how-to standard can better help the average PLC programmer, technician and maintenance worker by creating well-thought-out ladder diagram programming techniques, as opposed to defining what ladder diagram, function block, structured text and instruction list programming languages and sequential function chart structure are. The programming environment typically doesn't need the "what"—at least not in the United States—they need the "how." The what has been done already.

Often the reason software costs so much to develop and maintain is that the program is poorly written. I've seen a program that was a single rung with 200 branches. The programmer thought the structure was great, and so was the gray code he used to control the sequence, until right before he was fired. Most often, I see what I call scatter code—the incredible wandering PLC program where rungs of logic are just randomly placed with no thought to purpose, function or organization. Focusing on proper programming structure and techniques is what is most important.

It's not the complexity of the sequence or process as much as it is the poorly written program that makes it difficult to support. It's really the programmer who sets the program architecture, and this is where improvements can really be made. A well-written and simple ladder-diagram program includes sensor back checking, mode and cycle

control, step sequences, output logic and fault logic at a minimum. Keeping these functional blocks of code separate is a good starting point. Let me know if you are interested, and we can expand greatly on these techniques.

The key here is the ladder-diagram step sequence. When a program is written, started up and run for a year before anyone touches it again, there is nothing better than ladder diagram and a well-written and documented step sequence to quickly understand program function. Reading through the coil descriptors in the ladder-diagram step sequence should read like a sequence of operation. The steps

define the operation chronologically and display the condition of the logic graphically.

When there is a problem or an enhancement needed, the new guy can get up to speed quickly and not have to wade through multiple programming languages. If you don't do it every day, simpler is better. Opening a program and finding the main step-sequence ladder diagram, the programmer, technician or maintenance personnel can understand what's going on with the equipment with little study or review needed. While you are at it writing a great step sequence in ladder diagram, be sure to consider ways to make it reusable code. ■

IDEC's newest PLC packs PAC power in a small, competitive package that's ready for the IIoT

MicroSmart FC6A offers very fast processing speeds, high capacity programming and data memory, and ability to handle up to 126 analog I/O.

IDEC Corporation's MicroSmart FC6A, released in the United States in March, is a powerful PLC with up to 520 I/O. IDEC says the MicroSmart PLC provides the power of a PAC in a low-cost controller with a small form factor, making it an ideal fit for demanding applications in industries such as oil & gas, chemical, solar, marine, packaging, food & beverage, material handling, utility vehicles, and OEM machinery and process skids.

Within these industries, a wide variety of applications are a good fit for the MicroSmart PLC—especially those requiring control of standalone machines, process skids, vehicles and small-scale systems.

Basic instructions can be executed in 0.042 microseconds, and program memory is 640 kB. There are 1,024 timers, and six of the 512 counters are high-speed at rates up to 100kHz. These capabilities are combined with extensive data and bit memory, double the capacity of a typical micro PLC. These features allow the MicroSmart PLC to handle large programs with complex control requirements such as PID, flow totalization and recipes.

Three MicroSmart PLC models are available, each with 24 Vdc or 100-240 Vac input power. The 16 I/O model has 9 inputs, and 7 relay or transistor outputs. The 24 I/O model has 14 inputs, and 10 relay or transistor outputs. The 40 I/O model has 24 inputs, and 16 relay or transistor outputs. Each model also includes an integral 0-10 Vdc analog input. The 16 and 24 I/O models can accommodate one plug-in analog cartridge, and the 40 I/O model can accommodate two plug-in analog cartridges. Each cartridge has two analog I/O points, either two inputs or two outputs.



Up to 12 expansion modules can be added to the 16 I/O model, and up to 15 expansion modules can be added to the 24 and 40 I/O models.

Up to 12 expansion modules can be added to the 16 I/O model, and up to 15 expansion modules can be added to the 24 and 40 I/O models. These modules can be of any type with no restrictions as to the number of analog and specialty modules. This gives the 40 I/O MicroSmart PLC the capability to handle up to 520 I/O with a maximum of 126 analog I/O, much more than a typical micro PLC.

The MicroSmart PLC is programmed with IDEC's WindLDR PC-based software, which includes no cost updates for the life of the product, and which can be used to program IDEC's entire line of controllers in a simple and intuitive manner. Software programs from IDEC FC4A and FC5A PLCs can be automatically converted by the WindLDR programming software for execution on the FC6A MicroSmart PLC.

PLC programming languages include ladder and Script, the latter similar to the C programming language. The Script language can be used to create more complex programs, particularly those with multiple sub-programs and custom function blocks.

All models have a built-in RJ45 Ethernet port, and an RJ45 RS232C/RS485 serial port. A plug-in cartridge adds an additional RS232C/RS485 port. An SD memory port and a mini-B USB port can each be used for data logging, program storage/transfer, firmware updating or recipe storage. The Ethernet port supports the Modbus TCP protocol, and the serial port supports the Modbus RTU protocol.

An optional HMI module can be added to the CPU to provide operator interface via its display and control

buttons. The HMI module can also accommodate an optional plug-in analog cartridge, and it has an integral Ethernet port. Using the operator interface functionality, any PLC parameter can be updated.

IoT capability is provided by custom web pages, which can be configured for remote monitoring and control. Web pages are created using simple drag and drop functionality with no HTML programming required, a major advantage over competing products.

These web pages are stored in the MicroSmart PLC, which functions as a web server when its built-in Ethernet port or the HMI Ethernet port is connected to the Internet. These web pages can be accessed via any web browser running on any Internet-connected device such as a remote PC, a tablet or a smartphone.

Connecting the MicroSmart or the HMI Ethernet port to the Internet also provides email and text notification functionality, which can be used with third-party email servers such as Gmail and Yahoo.

The 40 I/O model can be powered by 12 Vdc, making it an ideal fit for solar- and battery-power appli-

Click to learn more about the MicroSmart FC6A

<http://us.idec.com/CMSContent/FC6A/index.html>

cations. The 40 I/O model also includes support for the Society of Automation Engineers (SAE) J1939 protocols. The SAE J1939 protocol is often used in diesel engine applications for various types of vehicles and vessels, and for mobile power generators.

IDEC offers free tech support for the FC6A MicroSmart PLC, with no service or support contract required. For complete specifications or additional information, contact IDEC Corporation at 800-262-IDEDEC (4332), or <http://fc6a.idec.com/>. ■

About IDEC: Headquartered in Osaka, Japan, IDEC Corporation is a global manufacturer known worldwide for more than 65 years for its reliable control and automation products. In the United States, IDEC has more than 30 local sales offices to assist customers with choosing the right switches, relays, power supplies, PLCs, I/Os, sensors and more. A leader in the industry, IDEC produces only the highest quality products. For additional information, visit www.IDEC.com/usa