Increasing Productivity With Programmable Automation Controllers
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Introduction

As OEMs and end users face the complexities involved in integrating today’s modern production environments and the escalating pressure to increase productivity, the power of their control systems can be a competitive differentiator. Control systems today must interface with much more than simple signals from sensors and actuators; they must have network connectivity, device interoperability, and seamless integration with enterprise data.

These demands for control system capabilities have pushed beyond the scope of what traditional programmable logic controllers (PLCs) can deliver. Over the last decade, users in the automation industry have increasingly turned to programmable automation controllers (PACs), which enable multi-domain functionality—including logic, motion, HMI and process control—on a single platform.

These controllers enable control convergence and integration of plant floor operations with business systems and provide greater capability across industries without the performance limitations and significant cost and time of re-engineering required of PLCs. Furthermore, the extensive use of commercial off the shelf (COTS) products and technologies in PACs helps ensure reliability and availability of systems, deliver faster implementation, and reduce engineering costs compared to building on proprietary technologies.

However, not all PACs are built alike. PACs offer varying levels of integration, openness, performance, and communications flexibility, which all contribute to maximizing productivity as well as reducing total cost of ownership. Therefore, in choosing a PAC solution, OEMs and end users need to consider the extent of these features, not only in the context of their current technology needs but also their future needs for scalability and growth.

This white paper discusses some key PAC features and the advantages they can provide, helping users understand the depth of control system capability they may want to look for to meet their current and future application needs—ensuring value and flexibility, which are critical to achieving a long-term competitive position.

Multiple domains, single platform enables integration

Many OEMs and end users in the automation industry work in multiple domains such as process, discrete, and motion control, which often result in multiple platforms from different vendors that need to be networked together. PACs that do not enable tight integration between multiple domains—due to the processing power and performance needed to meet the application’s needs—require multiple CPUs in the system, adding to the investment cost and complexity of the system.

However, PACs that are built as a complete system without the need for separate controllers can greatly simplify your system and consolidate your controls disciplines on the same scalable, standards-based platforms. For example, GE Intelligent Platforms’ PACSystems* enables tight integration between multiple domains within one controller, utilizing a high-performance Intel® processor and a PCI backplane that processes multiple domain functions quickly and efficiently. For motion applications, it can tightly integrate with GE’s PACMotion*, which delivers tightly synchronized, multi-axis motion control and allows dynamic changeover of programs, machine parameters, cam profiles, speeds, and other elements to meet high-speed application needs for packaging, advanced material handling, and high-speed assembly.

For comprehensive process control, PACSystems controllers are part of GE’s Proficy Process Systems*, a fully integrated system that also includes an applications layer and fieldbus and I/O layer for complete process automation. It enables precise control and consistency and helps users leverage increased flexibility and enterprise-wide visibility with advanced HMI/SCADA and historian technologies and tightly integrated operations management software.

Standards-based platform enables openness, scalability, and reduced costs

Users need the ability to transfer vast amounts of data from various systems and devices on the plant floor to the automation software and controllers, and also to the enterprise management systems. A PAC that delivers flexibility and openness can protect your current and future investments by seamlessly connecting your existing systems and enabling you to leverage the intellectual property developed in your programs.

Hence, the platform technology of the PAC is critical to the longevity of the platform and its ability to adapt to future trends. PACs that leverage technologies based on standards such as the VxWorks operating system, PCI bus and VME backplanes, IEC-1131 and PLCopen programming languages, Profinet protocols, and the Intel Processor Roadmap, can help companies take advantage of the latest commercial technology while keeping product costs down. For example, GE customers can increase system performance by upgrading from a 300 Mhz Celeron to an Intel Atom 1G processor with minimal incremental cost.
An open architecture enables portability to move between processor technologies and flexibility to connect seamlessly with third-party applications, protecting investments in both I/O and applications development. It also provides an easy migration path to upgrade and embrace new technologies, instead of being “locked in” to one type of processor technology, which is a limitation for some PACs.

High speed and determinism drive productivity

Users rely on PACs to combine real-time operating systems with multiple loop operations and to handle execution priorities with high speed, deterministic safety, and reliability. The speed of the backplane bus determines the ability to optimize system throughput and prevent information bottlenecks, which is critical for performance.

Today’s applications utilize more sophisticated analog, network, motion, and specialty modules, which require more backplane bandwidth to support data and advanced diagnostics. The advanced modules communicate larger amounts of data than the traditional PLC, and therefore the backplane needs to be efficient in moving the information over the backplane for improved machine cycle time and throughput.

In high-speed applications such as material handling, packaging, and assembly—where multiple controllers are networked and there is a need to transfer huge amounts of data, operate in high noise areas, or cover large distances in real time—the ability to integrate a PAC with global shared memory capabilities improves data handling in real time between systems and eliminates the need to factor in latency for faster, more accurate production.

Unique technologies like GE’s PACSystems Control Memory Xchange (CMX) provide high-speed deterministic memory-to-memory communication between multiple distributed systems—operating like shared memory on a fiber at a speed of 2.12 Gbits/second with no software overhead. Each network node has a local copy of all the data, and it can be shared among systems regardless of processor type, operating system, and bus structure, for real-time speed and deterministic performance without the data collisions and latencies of other network technologies.

Communications options deliver increased flexibility

There are many different communications options available, and some PACs are not as flexible as others. For example, there are PACs that solely offer DeviceNet as a communications option, and if a user has something other than DeviceNet, the cost of ownership and complexity to work around this limitation is likely to increase, providing a significant disadvantage. In many cases, the only option is a third-party module or an external converter/gateway, adding to the complexity of development and support and “finger pointing” when a problem occurs.

Conversely, a PAC that uses open communication standards like Ethernet, Profibus, and DeviceNet offers strong benefits to end users. High availability systems running on Ethernet mitigate the risks of downtime and safety concerns while providing easy interoperability with third-party devices. Furthermore, Ethernet technology is continuously evolving, and because it is a mass-market technology compared to proprietary network technologies, users can benefit from the technology advances and cost advantages offered by COTS Ethernet infrastructure components.

For example, users of PACSystems have leveraged the solution’s ability to support multiple Ethernet communication protocols to run on one module such as EGD, Modbus TCP and Channels—all operating simultaneously to optimize the application. PACSystems supports Genius, DeviceNet, Profibus, Modbus Serial, DNP 3.0 Serial and other communications networks on a single platform, enabling the user to interface with a wide range of devices.
Lower total cost of ownership adds to bottom line

As discussed earlier in the paper on the advantage of standards-based platforms and openness, the migration from a PLC to a PAC should be smooth and effortless with both applications and I/O being easily brought forward to the new platform; it saves significant costs as the majority of a control system’s investment is in the I/O and the application. For example, PACSystems has a serial bus that allows all legacy I/O to be migrated forward seamlessly, and this ease of transition reduces training, spare parts and support.

Users also need to consider the cost of a complete PAC system, including power supplies, as well as future costs to develop and maintain the systems. PACs that offer a single, integrated development environment for all programming, configuration, and diagnostics will help companies leverage faster time to solution, reduced training, and more compact, efficient design. Rack size should be accounted for as well because the larger it is, the greater the footprint and costs will be as well.

Finally, large data storage capability reduces the reliance on external data storage—reducing system costs and application complexity. The larger the memory size, the better the ability for users to store the control programs, data, and machine documentation (including Word®, Adobe® Acrobat, Excel®, and CAD files) on the CPU, aiding troubleshooting and sharply reducing downtime.

Conclusion

OEMs and end users in the rapidly changing automation industry can leverage the advantages of PAC technology to increase productivity. In selecting a PAC, they should evaluate the platform technology for openness, performance, and flexibility, as these criteria will enable companies to run at full productivity today, while providing the ability to adapt to the inevitable changes that will come in the near future.

While many PACs are characterized as offering multi-domain control, common development environments, and open standards, understanding how they handle these features and the differences in the depth of capability across these technologies can help align your control system criteria to meet your specific application needs for long-term performance and a competitive advantage.

PLCs can easily be transformed into a PACSystems solution, protecting legacy I/O and application IP and enabling easy migration to the latest technologies.

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