The Next Generation of Industrial Automation: Programmable Automation Controllers

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Thesis: Programmable automation controllers (PACs) are more preferable among other industrial automation systems by providing enhanced technical properties, ease of use and financial benefits.

I. Improved technical attributes
   A. Operational features
      1. High degree of control system
      2. Offering various signal operations
      3. Simultaneous data management
   B. Hardware capabilities
      1. Hardware integration
      2. Ability to perform complex calculations
      3. Greater input-output and memory capacity
   C. Safety
      1. Robustness
      2. Well established application
      3. Adaptability
II. User friendliness
   A. Ease of programming and development
      1. Easy and powerful programming
      2. Easy deployment techniques
      3. Fast development process
   B. Flexibility
      1. Multi-discipline development environment

2. Multi-domain functionality
3. Simple and modular architecture

C. Communication and interface

1. Data integration
2. Support for standard communication protocols
3. Large scale network and monitoring

III. Economic advantages

A. Profitability

1. Efficiency in terms of cost
2. Low power consumption
3. Reduced cost by built-in capabilities

B. Large scale of usage area

1. Small applications
2. Industrial applications

C. Support

1. Serviceability
2. Inexpensive maintenance
3. Backward compatibility

Most of the tools and products of many areas such as food, technological equipment, textile, automotive and so on, have been manufactured by using computers and robots instead of human labor. Operating a manufacturing process by using a computer mechanism to control and monitor mechanical elements of that project is called industrial automation. Personal computers (PC), programmable logic controllers (PLC) and distributed control systems (DCS) can be given as the common industrial automation solutions with different advantages. A fairly new technology to industrial automation, programmable automation controllers (PAC) can be used to combine those advantages together. Programmable automation controllers are more preferable to other industrial automation systems by providing enhanced technical properties, ease of use and financial benefits.

Firstly, one of the major benefits of PACs is the improved technical attributes which are mainly operational features, hardware and safety. To begin with the technical advantages, operational features can be presented with the control system of high degrees, various signal operation capabilities and managing the present data simultaneously. Industrial computers are needed to have the ability of effective multitasking and satisfactory processing speed, especially in broad manufacturing processes. With an embedded real-time operating system (RTOS) accompanying a processor with high capability, a control system with a great strength is provided by typical programmable logic controllers, therefore programmable automation controllers ("PC vs. PLC: Key Factors in Comparing Control Options", 2011, p. 2). In an industrial process with lots of sensors and network connection, the industrial computer should provide effective signal operations. Functional and malleable signal sensing, conditioning and multiplexing are some other programmable automation controller facilitations in that manner ("Understanding Programmable Automation Controllers (PACs) in Industrial Automation", 2007, p. 5). An industrial computer has to be able to operate a various data types since different sensors variations and systems transmit messages in a

diversity of data structures. Analog data, serial data and digital values, from temperature sensor outputs, RFID (radio-frequency identification) readers, fieldbus and device networks respectively, can be received by programmable automation controllers with convenience and concurrence (Bark, 2013, p. 2). Industrial computers have to satisfy technical expectations for almost every kind of manufacturing systems. With this whole set of knowledge on technical attributes, PACs are definitely preferable among other industrial computers. Continuing on technical property enhancements in PACs, hardware capabilities such as functional integration, performing complex calculations and larger input-output capacity play an important role in this point of view. One of the main problems in industrial automation comes from the transaction between different phases of operation and industrial computers are needed to integrate these. Various branches such as sequential, process, motion and drive control are granted by PACs to be integrated into one particular control system (Smith, 2003, p. 45). As the systems are desired to perform tasks with difficulty and complexity, it is expected from industrial computers to handle the corresponding calculations and operations. PACs help engineers to boost complicated control and transduction into the current system conveniently and cancel the need of studying specific mechanisms (Walter & Bell, 2006, p. 4). In case an industrial project goes larger in size, the industrial computer should provide sufficient input-output mechanisms and memory resources. For bigger projects and complete system widths, a much larger input-output facility and size of user memory are ordinarily provided by PACs (Payne, 2013, p. 3). To have a high performance in engineering applications in industrial systems, the computer in use should manage all the connections and calculations required successfully. For this purpose, PAC is a favourable choice since it combines the main aspects of hardware requirements demanded from an industrial computer. Some of the technical improvements in PACs are the safety features such as robustness, well established application and adaptability, which are absolutely meaningful in terms of being an

advanced automation solution. Speaking of safety, any control system is desired to be potent and sturdy in operation. The standard commercial programmable logic controller is able to resist severe conditions for an incredible number of operations because of its structure without any mobile elements ("PC vs. PLC: Key Factors in Comparing Control Options", 2011, p. 3). It is very convincing to know a specific industrial computer application is already being successfully used exemplarily. Safety programmable logic controller applications are entrenched in terms of system safety and increasing drastically in the field (Macdonald & Mackay, 2004, p. 190). In case of a change in the system, either for the entire system or just for a section, the industrial computer being used should be adaptable and reusable. Due to their malleable calibration and modification properties, PACs are supplied sufficiently ("A Comparison of PACs to PLCs, 2013, p. 3). Taking these aspects into account, PACs satisfy the expectations about the industrial computer safety.

Apart from improved technical attributes, PACs are also easier to use platforms than other industrial automation systems. PAC technologies allow easy and powerful programming technique. According to Design News article (2013), PACs are simpler to develop complicated systems which has different units like process management and large data processing but PLCs are generally used for machine control. With a PLC like outlook PAC merges; PLC's control reliability, PC's ease of connection methods and DCS's process management ability. PAC's these abilities can be substituted by PLC's with some additional components, but these are PAC's default properties (Bark, 2013, p. 52). PAC shows its advantages when programming interfaces and methods are compared. However programming and development are not the only phases of automation, deployment techniques become important when development ends and actual devices start to show up for work. Deployment options can be key factor for decide right automation techniques. With help of LabVIEW development environment, applications can be deployed easily on a wide range of platforms,

from mobile devices like pocketPCs and handhelds to real-time operating system devices like PCs and PXI with extra graphical capability advantages ("A Comparison of PACs to PLCs", 2013, p. 2). In "A Comparison of PACs to PLCs", PAC's easy and wide development techniques are highlighted. On the other hand development time of an automation system can be a problem to business. If development process can be shortened, it would save significant resource to business. PACs can achieve this by its simple software development environment. High process capability and easy to use interface of FieldPoint PAC integrated development environment, a complete control system can be developed in a short period of time rather than slow traditional automation tools ("A Comparison of PACs to PLCs", 2013, p. 3). PACs easily handle combining fast development time with efficiency, thus it passes one step forward among other automation techniques. In addition to user friendly development process, PACs are also very flexible industrial automation platforms. Firstly PAC has advantage of multi-discipline development environment. In "PACs for Industrial Control, the Future of Control" (2012), it is pointed out that PACs are designed for sophisticated applications like multiple domain implementation. Due to the nature of PACs, they also need sophisticated software to run. For making these systems efficient, their software are developed as single and integrated instead of combining separately designed software modules for different purposes which is not planned to work with each other. So with a one multi-discipline development environment, PAC can contain mutual database to reach all functions and parameters in its development environment (p. 1). This makes it clear that PAC's should be considered as most flexible industrial automation platform. Besides PAC's multi-domain functionality supplements its flexibility. In a magazine article, Bark (2013) indicated that, various automation domains such as tracing and controlling industrial devices and processes can be done by a single PAC solution. A typical PAC platform consists of several built-in properties like USB logging, a WEB server for distant monitoring and

controlling and an LCD display for increased usability and diagnostic (p. 52). With correct functional property choices, it is clear that a PAC gives best multi-domain automation functionality. In addition to these, simple and modular architecture of PAC simplify usage of industrial automation systems for new users. As mentioned in the article "Understanding Programmable Automation Controllers (PACs) in Industrial Automation" (2007), modular design & structure, extendable neat architecture and connectability with other devices & systems are some of the PAC's remarkable features. Especially for entrepreneurs, effective processing and wide range of integration opportunities with other systems are noticeable aspects of PAC (p. 2). Taking all these facts into account, it is clear that PAC's simple and modular architecture captivate users who want flexibility in automation. Additionally, PAC's are also preferable with their advanced communication and interface possibilities. Easy data integration opportunity is one of these advanced interface possibilities. "Understanding Programmable Automation Controllers (PACs) in Industrial Automation" (2007, p. 5) article mentioned that, a single integrated PAC system provides sophisticated control mechanism, device harmony, wide system integration and easy information linkage abilities which are similar to features of PLC or PC based automation techniques but PAC satisfies different necessities at the same time for recent contemporary industrial areas. This clearly indicate that data linkage is one of the most powerful abilities of PAC. Also PAC supports standard communication protocols by default. Payne (2013, p. 30) explained that, PAC provides interoperability with other peripheral devices, networks and corporate systems while it can communicate, monitor and control over different networks since it is enhanced with standardized network technologies and protocols such as OPC, Ethernet and SQL. From the examples given above, it is clear that PAC supports widely used communication protocols. Besides that, again Payne (2013) highlighted PAC's large scale networking and monitoring abilities by stating that Single PAC platform can manage multiple domains like motion and

process control also PAC's modular structure makes easy to expand system, add or remove sensors and peripheral devices without any need of wiring. These modular structure simplifies adding, monitoring and controlling of thousands of input-output points with its unique networking capability (p. 31). For this reason very large scale industrial automation systems can be easily established. All in all, it can be safely said that PAC's are highly user friendly and easy to use automation systems.

Thirdly, economic advantage which is significant property of programmable automation controller (PAC) can be listed as profitability, large scale of usage area and support. To begin with the economic advantages, profitability can be submitted with the efficiency in terms of cost, low power consumption and reduced cost by built-in capabilities. Efficiency in terms of cost is one of the most important features of programmable automation controller (PAC) that ensures being ahead of the other types of products which are in competition. In contradistinction to programmable logic controller (PLC), programmable automation controller (PAC) accommodates calculated reserves, such as sliding-particle processors and significant store, to commit these signals adequately which are off-the-shelf hardware with a real-time running regulation to ensure an expense-productive platform for control engineers (Hoske, 2005, p. 53). So that, PAC is cheaper than other products of its class. With the increasing use of programmable automation controller (PAC) in all sorts of applications, low power has become a very important parameter while choosing controller. Owing to their diminished energy expenditure and purchasable cost, adjusted-point processors are widespread in many buried implementations ("A comparison of PACs to PLCs", 2013, p. 2). By using innovative engineering and design, programmable automation controllers (PACs) offer you solutions that use less power and save lots of money. Reduced cost by built-in capabilities is another significant characteristic of PAC. Bark emphasized that PAC which has large internal memory, and strong operation capacity can be used to monitor and control wide

regulations surrounding various fields of a whole foundation and service area (2013, p. 2). In addition to monitoring and controlling wide regulations, a PAC reduces costs by simplifying the communication of data. 77 percent of programmable logic controllers (PLCs), in other words, less than 128 I/O are utilized in small applications; 12 percent of programmable logic controllers (PLCs) I/O are numerical; and 80 percent of programmable logic controllers (PLCs) application challenges are analyzed with a sequence of 20 ladder-logic directives and this information is assumed by experts from ARC, Venture Development Corporation (VDC), and the online PLC training source PLCS.net (Bell, 2005, p. 37). The automotive industry is one of the largest users of PACs. Nowadays, in many industrial applications, programmable automation controllers (PACs) can immediately take high righteousness measurements which are used to monitor the status of turning round mechanism, specify reparation schedules, detect motor abrasion and set control algorithms for pulsation or power qualification implementation at hundreds of thousands or millions of examples per second, authorizing engineers to pull info straight into their control systems in place of other methods of measurement (Walter & Bell, 2006, p. 28). It is obvious that programmable automation controller (PAC) is available to replace its components and it can be easily repaired. Costs of repairing and replacement of programmable automation controller (PAC) are more convenient and this factor permits us to say that programmable automation controller (PAC) has serviceability. Programmable automation controller (PAC) can be easily modified out a regulation or its elements and it has a stationary root pool of backup components with long-dated availability ("PC and PLC: key factors in comparing control options", 2011, p. 3). PACs are the brains of the operation of an application. When the PACs are not functioning properly, thousands of operations can be damaged, consequently, PACs need maintenance. Nowadays, OEMs and end users are conscious that depending on decreasing processing and repairing expenses, efficiency should be raised (Bark, 2013, p. 1). So that, repairing of PACs

are not expensive. In case of a newer version of the industrial computer is going to be used for an extensive system, it will not be efficient to rebuild the system for that computer all over. Examining the table in “PLCs vs. PCs for Industrial Control”, it is implied that PLCs and PACs are backwards compatible (Smith, 2003, p. 46). All things considered, we can easily say that PACs are economically advantageous.

In conclusion, relying on all the knowledge discussed, by ensuring advanced technical attributes, user friendliness and commercial gains, programmable automation controllers are superior to other industrial computers. In this age of technology, an automation system with extended capabilities of operation along with ease of use will grant success and comfort in manufacturing projects and facilities of any sector inside the economy. Furthermore, profitability for both the seller and consumer will contribute the research and development on this computer technology. Since the automation industry is dominated by PLC technology, PACs should be marketed and developed by PLC manufacturers. Therefore, the automated industry will grow better and improve easier.

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