Distributed Control System (DCS) vs Programmable Logic Controller (PLC): Which is Best for My Project?

Should we use a DCS or a PLC on this project?

- “Just get a PLC. It’s cheap and our people can have it running in a few weeks.”
- “The DCS has more features which we can use in the future.”
- “Can we add advanced application software when we want?”
- “Have we considered the cost of software upgrades and version control? What about cybersecurity?”
- “Which is the most cost-effective solution over the life of the system?”
Executive Summary

Advisors provide different opinions on the best way to choose the appropriate control solution:

- “Taking the time to select the right type of controller for the application will result in the simplest, smallest, and least expensive control system.”

- “A successful evaluation should start by developing a clear picture of the requirements of your application and the needs of your engineering, maintenance, and operations personnel.”

- “Balancing short-term needs with long-term vision is critical for operational certainty and improving plant operations and maintenance.”

- “It may surprise you to know that PLC, HMI and SCADA implementations today are consistently proving more expensive than DCS for the same process or batch application.”

- “You can pay more upfront for the [DCS] software, or save money upfront and pay more down the road in engineering time [for the PLC/HMI solution].”

When evaluating the better solution, users should consider controller type, process application, upfront costs, and the total ownership costs over the 20-30-year life span of the system.

The best control system solution is one that is designed to meet the needs of a wide variety of process applications while making future add-ons and enhancements easy.

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Introduction

DCS or PLC?
Which is Best for My Project?
This is a common question in today’s processing plants. It was easier to answer in the past, when PLCs and DCSs strengths and weaknesses were better differentiated. But over the past 40+ years, PLCs have improved and their functionality has evolved to include Programmable Automation Controllers (PACs) and Industrial PCs (IPCs). At the same time, the prices of DCSs have come down significantly and have added functionality to address many PLC applications. These solutions now have significant overlap.

- How do you decide if the DCS or PLC-based system is the better choice for your specific project?

Controller Type

The January 2017 Control Engineering article, “How to choose the best controller for each application”, opines:

- “Many applications can be controlled by a PLC [Programmable Logic Controller], a PAC [Programmable Automation Controller], or an IPC [Integrated PC-based Controller] – but one type of controller usually fits best.” (See Table 1)

The article concludes with:

- “There are many considerations that go into choosing the controller, and the selection process begins with the application.”

- “Taking the time to select the right type of controller for the application will result in the simplest, smallest, and least expensive control system.”

<table>
<thead>
<tr>
<th>Typical Applications</th>
<th>PLC</th>
<th>PAC</th>
<th>IPC</th>
<th>DCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine Control</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Basic and Simple Systems</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Coordinated Motion Control</td>
<td>○</td>
<td>●</td>
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<tr>
<td>Integrated Vision Systems</td>
<td>○</td>
<td>●</td>
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<tr>
<td>Process Control (PID)</td>
<td>○</td>
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<td>●</td>
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<tr>
<td>Distributed Control</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>●</td>
</tr>
<tr>
<td>Batch Control</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

Table 1  ● = Best Fit  ○ = Poor Fit

Another article from Control Engineering takes the discussion farther with, “How a PC-based control system is an option for every application”:

- “Controller specification is the most important stage of the development process for every automation application.”

The problem is most facilities have many processing areas that are characterized by different types of applications. Selecting the best type of controller for each application results in a mix of technologies that create islands of automation that complicate the integration of them into a plant-wide system.

- Choosing the best solution in this scenario then shifts the focus away from “controller type” to “system attributes.”
System Attributes

Table 2 expands the selection criteria beyond “controller type” or “application” and introduces attributes commonly found on control projects. Users can compare their project requirements against each attribute to see if a DCS or PLC Custom Integrated solution is best suited for their application. (“PLC Custom Integrated” combines the PLC/PAC/IPC controller types and includes the integration work required to build a working system):

<table>
<thead>
<tr>
<th>System Attributes Favoring DCS or PLC Custom Integrated Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PLC Custom Integrated</strong></td>
</tr>
<tr>
<td>Machine / Stand-alone</td>
</tr>
<tr>
<td>Low (Simplex)</td>
</tr>
<tr>
<td>Small / Self-contained</td>
</tr>
<tr>
<td>High Speed</td>
</tr>
<tr>
<td>Local / Panel Mounted</td>
</tr>
<tr>
<td>Local</td>
</tr>
<tr>
<td>Local</td>
</tr>
<tr>
<td>Ladder Logic - Frequently Known by Plant Personnel /SI</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>Very Low</td>
</tr>
<tr>
<td>Minimal</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>Controller</td>
</tr>
<tr>
<td>Layered</td>
</tr>
<tr>
<td>Purchase Price</td>
</tr>
</tbody>
</table>

Table 2

A key decision criteria is often price; with the common assumption that the PLC/PAC/IPC-based solutions are cheaper. Control Engineering Europe reported in 2011, “It may surprise you to know that PLC, HMI, and SCADA implementations today are consistently proving more expensive than DCS for the same process or batch application.”

- “Integrating independent PLCs, the required operator interface and supervisory functionality, takes a lot of time and effort. The focus is on making the disparate technology work together.”

The article, “Choosing What You Need: Distributed Control System (DCS) vs Programmable Logic Controller (PLC)” summarizes the cost impact between the two types of solutions. “The choice can be summed up in the declaration – Pay me now. Or pay me later.”

- “You can pay more upfront for the [DCS] software, or save money upfront and pay more down the road in engineering time [with a PLC / HMI custom solution].”
Cost Impact

When evaluating which system has the lowest cost, users need to consider the total cost of ownership over the 20-30-year life span of the system. (Figure 1)

- Who is responsible for setting it up and making it all work?
- How are compatibility issues resolved?
- How do future additions and HW/SW updates get implemented?
- What about compatibility issues in the future associated with upgrades, hardware and software revisions, enhancements, and cybersecurity?

![Total Costs Of Ownership](image)

Figure 1
The decision to buy based on a low initial purchase price of the PLC/PAC/IPC often leads to lost benefits and increased costs in the future. The ARC Advisory Group documented this impact on long-term cost of ownership issues in their Overcoming Automation Objections report, see Figure 2.

- The controller and automation system cost is only 2% of the Project Spend, but accounts for up to 30% of the improvement in impact to long-term Operations cost.

- “ARC believes that, when applied properly, [the well-integrated system will] offer the potential to reduce installed project costs by at least 30% and significantly reduce time-to-value, while yielding significant cost reductions in the much longer operate and maintain phase of the plant or facility.”

![Figure 2](image)
Application

Finally, the article, DCS or PLC? Seven Questions to Help You Select the Best Solution*, suggests a successful evaluation should start by developing a clear picture of the requirements of your application and the needs of your engineering, maintenance, and operations personnel.*

1. Is this a stand-alone solution, or part of an integrated facility?
   - Stand-alone applications favor PLCs/PACs/IPCs; integrated favors DCSs.

2. Is the application high-speed, discrete-oriented, machine control, process-oriented, continuous, or batch?
   - High-speed / high discrete counts favor PLCs; process, batch and continuous favors DCS.

3. Do you have the in-house expertise to set-up and maintain the system?
   - DCSs often require specialized training whereas PLCs frequently use Ladder Logic - which is more commonly understood by plant personal and System Integrators.

4. What is the impact of system downtime to your process?
   - The higher the cost of unplanned downtime, the more the DCS is favored.

5. Do you have needs for a plant wide historian, MES applications, asset management, etc.?
   - Both PLCs and DCSs offer solutions, but the DCS provides superior integration and data flow.

6. Do you envision the need to update the system for software enhancements or cybersecurity?
   - The integrated design of the DCS typically makes future upgrades and revisions easier than PLCs/PACs/IPCs.

7. Is this a small or large system? Do you intend to growth the system in the future?
   - Smaller solutions typically favor PLCs. Larger systems often benefit from DCS technology.

Conclusion

Many questions drive the decision on which solution is best for your project. In addition to controller type, system attributes, cost impact, and application, understanding your long-term direction helps focus the decision-making process.

The article, "Choosing the right control system" recommends documenting the long-term vision for the facility instead of focusing on just the best type of controller for each application.

- "While PLCs might be cost effective for the time being for a small facility, a DCS provides a more economical expansion with a higher potential return on the initial investment."
- "Balancing short-term needs with long-term vision is critical for operational certainty and improving plant operations and maintenance."

Combining aspects from all these recommendations leads us to the conclusion:

- The optimal control system solution is one that is designed to meet the needs of a wide variety of process applications while making future add-ons and enhancements easy.
DCS versus PLC:
Which is Best for My Project?

References:
1 - January 2017 Control Engineering article, “How to Choose the Best Controller for Each Application”
2 - Control Engineering article, “How a PC-based Control System is an Option for Every Application”
3 - Control Engineering Europe report, 2011, “DCS and PLC/SCADA - a comparison in use”
4 - Innovative Controls article, “Choosing What You Need: Distributed Control System (DCS) vs Programmable Logic Controller (PLC)”
5 - The ARC Advisory Group report, Overcoming Automation Objections
6 - Control Engineering article, “Choosing the Right Control System”
7 - Per the article, “DCS or PLC? Seven Questions to Help You Select the Best Solution”

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