Fieldbus 403

Control design

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Overview

Should I put control in the host system or in field devices?

One of the advantages of using FOUNDATION fieldbus is that you can choose where control algorithms execute. You can put control in the host system, in intelligent field devices, or both. It's really up to you.

Moving control to the field may give you higher reliability, lower costs, and better performance than traditional host-based control. But the key is making the choice that best supports your plant's needs. This course will help you make the right choice.

Hint: As you go through the topics in this course, watch for answers to these questions:

- *Which is better, control in a valve or control in a transmitter?*
- *How does control location affect purchasing?*
- *How can control in the field increase reliability?*

Plant philosophy

The decision on whether a transmitter, a valve, or a host system will control a specific loop can affect process performance and reliability.

But what about the next loop? Will it require another "start-from-scratch" decision-making process? And will every engineer on the project reach the same conclusion?

They can if you implement a consistent plant philosophy on where to put control. An engineering standard would be even better.

A well-thought-out philosophy can guide decision-making — resulting in a smoother, faster design process. It can also maximize fieldbus benefits and help minimize future maintenance costs.

Your philosophy should be tailored to your plant. It can identify a preferred approach as well as specific exceptions. It can even evolve to address new situations and lessons learned.

The rest of this course covers several of the issues that can shape your philosophy.

The PlantWeb advantage

All Emerson fieldbus-based field devices and the DeltaV and Ovation systems have the same algorithms for process control. This means the control action will be the same regardless of where you place control.

It’s more than PID

Control is commonly equated with PID. But PID is only an algorithm that receives a signal input from a measurement device and provides a calculated signal output to a final control element.

There's a lot of "control action" even before the PID algorithm receives the input signal — including signal-conditioning functions such as

- Temperature, pressure, and differential pressure measurements to calculate mass flow
- Characterizer functions to linearize inputs
- Calculations to derive parameters such as density
- Integration for flow totalization.

It makes sense to put these pre-PID functions as close as possible to the actual measurement — in other words, in the measurement device.

Why? If a calculation requires several inputs, processing them in the transmitter reduces links and traffic on the fieldbus segment. Also, the blocks in each transmitter are typically chosen to provide the specific type of signal conditioning required for that application.

Likewise, functions performed on the signal output after it leaves the PID algorithm are best done as close as possible to the final control device that will actually implement the control action — for example, a valve.

Of course, if the control function you need — such as advanced or supervisory control — isn't available in a field device, then host-based control makes sense.

The PlantWeb advantage

PlantWeb architecture provides a single configuration environment for configuring control in the DeltaV or Ovation host and in FOUNDATION fieldbus devices. The same configuration, documentation, simulation, and test and debug tools work for both.

In fact, the same control configuration can be used anywhere — for control in the host, for control in field devices, or for both. Simply assign the configuration to the appropriate location, and go.

Control modularity

With control in the field, an entire control loop — including inputs, outputs, and control algorithms — can operate in the devices on a fieldbus segment.

This allows a more modular approach than traditional host-based control. As your process grows and you add more field devices, you're also adding control capacity.

With host-based control, on the other hand, extending control to new process areas can result in increased loading on the same host controllers. The net result could be slower control in the host.

This modularity can also give control in the field the edge in process reliability. Only field devices, segment power, and wire continuity are required to maintain process control. If one or more of these components fails, only that one segment is affected.

Host-based control requires the same components plus

- An input card, controller, and output card
- Intra-card communications for the host
- Power for the host
- Significantly more wiring

Many of these components are shared by a large number of loops, making the impact of a single failure quite extensive. This is usually addressed with redundancy, which is a more expensive option.

Field control location

Control in the transmitter and control in the valve both seem equally effective. But there are other considerations that may make one location more appropriate.

For example, if a problem causes loss of automatic control, the operator's ability to manually control the process can be affected by where the PID block was running, as well as by the host system's capabilities.

1. **If the PID is in the valve**, **and the transmitter fails:** The operator assumes manual control by placing the PID in manual mode and manipulating its output using the host's loop faceplate display of the PID block. [The PID output is normally sent to an analog output block which actually controls the valve position.]

2. **If the PID is in the transmitter, and the transmitter fails:** If access to the transmitter's PID block is also lost, the operator must take manual control at the analog output block. However, many host operator interfaces don't support direct access and control of the output from an analog output block — it must be done from the PID. In this case, manual control may not be available.

3. **If the PID is in either the valve or transmitter, and the valve fails:** Control of the PID is meaningless since the final control element — the valve — will go to the failsafe position and can no longer be manipulated.

If your host system doesn't support direct manipulation of the analog output block, as in the second example, you may choose to put PID in the valve controller rather than the transmitter.

The PlantWeb advantage

The DeltaV and Ovation operator interface used in PlantWeb allows the operator to view and manipulate any function block. This means control can be anywhere -- the transmitter, the host, or the valve -- and the operator can still access and manipulate the final control element.

Potential exceptions

Once you've defined a control location philosophy or standard, stick with it — unless there are overriding considerations that require an exception.

Here are some examples.

Cascade loops may require an exception if you want to put PID in the valve. You can

- Place the outer-loop AI and PID, and the inner-loop AI, in transmitters.
- Place the inner-loop PID and AO in the valve.

Device capability and capacity. Remember that even interoperable devices may have different capabilities and capacities.

- PID may be supported in a device from one vendor but not from another.
- A device may have its entire capacity used for calculations or other functions, so control must be placed elsewhere.

Other functions may override the standard location for control. For example,

- A device may need PID capability to perform statistical process monitoring or other device-resident diagnostics for control loops
- A device may require the PID block to use its autotuning capability.

Document all deviations — and whenever it makes sense, update your standard to deal with similar situations in the future.

You can also reduce the need for deviations by standardizing on devices that meet your plant requirements.

Maintenance and purchasing considerations

Where you decide to put control affects more than just operations. A consistent approach to this decision also offers benefits in purchasing and maintenance.

Standardizing on a single location for the PID block simplifies instrument purchasing as well as spare parts procurement, storage, and usage. That's because you'll need fewer types of instruments to implement the project, and fewer types of spares.

For example, if you always put PID in the transmitter, you can buy every transmitter — originals and spares — with PID capability. If you don't use a consistent approach, you'll need to stock some transmitters with control capabilities and some without, and some valve controllers with control and some without.

Your maintenance technicians will also appreciate a consistent approach. They'll know which kind of replacement device or parts to take into the field, and whether the transmitter or controller they're about to disconnect from the segment is likely to contain control functions.