How Control Engineers Can Deliver the Most Value

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Summary

Control Engineers are a scarce and valuable resource for process plants. When applied to the right tasks, control engineers can easily deliver 10X their annual salary in results. This paper discusses the various tasks that a control engineer typically performs, and examines ways to help focus these valuable resources on the areas that yield the greatest returns to the business.

Overview

How Control Systems Deliver Results

The control system acts as the nervous system for the plant. It provides sensing, analysis, and control of the physical process. The control system sits directly between the operator and the process…almost all of the operator’s information comes from the control system, and all of the operators commands are carried out by the control system. When a control system is at peak performance, process variability is reduced, efficiency is maximized, energy costs are minimized, and production rates can be increased.

Responsibilities of Control Engineers

Control engineers are often responsible for a wide variety of tasks, ranging from control system design and installation, to troubleshooting, maintenance & upgrades, networking, security, training, project management, continuous improvement, and just about anything else that relates to the control system, instrumentation, software, and databases. Indeed, most control engineers take on so many of these diverse responsibilities that they often feel that management has no idea what they actually do!
The Value of Control Engineers

How Do Control Systems Deliver Value?

To understand how control engineers deliver value, we must first address the value of the control system itself. The control system provides value in two ways. The first is ensuring that the plant can be operated. This includes:

- Gathering, tracking, and reporting data from the process
- Displaying meaningful information to operators
- Stabilizing the process by handling changing materials & conditions
- Automatically handling normal and abnormal situations
- Allowing the operator to intervene when necessary

If some advanced controls are in place, we can add:

- Automatically pushing the process toward its best performance

How Do Control Engineers Deliver Value?

Control engineers can deliver results in many roles. Table 1 below shows some of the ways that control engineers can deliver value.

<table>
<thead>
<tr>
<th>Role</th>
<th>What is involved?</th>
<th>Business Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manage control system portion of capital projects.</td>
<td>Project management, as well as technical definition, design, implementation, and start-up.</td>
<td>Ensure value of the solution. Typical savings might be 1% of the overall project budget. (10% of the control system budget)</td>
</tr>
<tr>
<td>Troubleshooting and Maintenance</td>
<td>Troubleshoot and diagnose problems with all control system components.</td>
<td>Reduce valve maintenance budget 50%.</td>
</tr>
<tr>
<td>Continuous Improvement</td>
<td>Eliminate interactions, identify constraints, improve tuning, control strategies, and alarm management.</td>
<td>Typically 2% to 6% of operating costs annually. Includes energy, quality, and production benefits.</td>
</tr>
</tbody>
</table>

Table 1. Control Engineer Roles

Of course, each scenario is different, but this table provides a general idea of what is possible.
Maximizing the Delivered Value

In this section, we will examine each control engineer role, and look at ways to maximize the value delivered as they carry out each role.

Maximizing Value During Project Execution

Some aspects of control system project execution can be outsourced. Outsourced work may result in savings from lower cost personnel and greater efficiencies from experienced systems integrators. Other aspects of the project should almost always be retained internally. Be sure to leverage the skills and knowledge of internal people to deliver the highest value.

Some primary functions to be retained include:

- Development of functional specifications and performance requirements
- Measurement and confirmation of system performance
- Oversight of the contract (may be handled by a project manager)

To deliver the best value with these aspects, control engineers will need to establish key control system performance metrics, and to enforce the required system performance. These metrics can be built in to the functional specification or performance requirements. Example metrics are shown in Table 2.

<table>
<thead>
<tr>
<th>Metric</th>
<th>How Measured</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of Time not in Normal Mode</td>
<td>% of time that control loops are in manual or other sub-optimal mode</td>
<td>&lt; 10% of control loops in</td>
</tr>
<tr>
<td>% of Time at Limit</td>
<td>% of time that valves are fully opened or fully closed.</td>
<td>Any valves exceeding 30% time at limit will be considered undersized.</td>
</tr>
<tr>
<td>Max % Open</td>
<td>The maximum valve % opening.</td>
<td>Any valves with Max % Open &lt; 10% will be considered oversized.</td>
</tr>
<tr>
<td>Variability</td>
<td>Process variability.</td>
<td>&lt; 1% of instrument span.</td>
</tr>
<tr>
<td>Valve Travel</td>
<td>Amount of valve movement per hour.</td>
<td>Loops must demonstrate &lt; 3000 % valve travel per hour.</td>
</tr>
</tbody>
</table>

Table 2. Key Performance Metrics and Related Affects

During commissioning, performance metrics and diagnostics can identify equipment, strategy, and tuning problems. These tools should be used daily by the start-up team.
Maximizing Value During Maintenance & Troubleshooting

“In process plants, 50% of maintenance completed is not required, and 10% is actually harmful.” – Study by the Gartner Group

Control engineers often spend considerable effort in troubleshooting plant problems. Often, they are seen as the only person with the right combination of skills to solve complex problems. Their knowledge includes:

- Process and equipment knowledge
- Process control understanding
- Instrumentation
- Operational Issues

The control system is blamed for a variety of problems, but the root cause may often be equipment failure, instrumentation issues, process upsets, or improper operational procedures. It is often left to the control engineer to determine the true root cause. When the control system is suspected, a “guilty until proven innocent” mentality often sets in.

When applied correctly, the control engineer can accelerate the troubleshooting process. For example, it is often possible to reduce control valve maintenance costs by up to 50%, with better diagnostic advice. When the control engineer is supported by appropriate diagnostic tools and training, they can provide this advice in a very expedient manner.

For example, using the test shown in Figure 1, the control engineer can precisely determine the extent of control valve mechanical problems. Note that this test can take less than 10 minutes to perform. The engineer can provide a confident diagnosis, and the maintenance planning effort can be very focused on the specific problem at hand.

Figure 1. Example Test for Control Valve Mechanical Problems
Maximizing the Value from System Administration

System administration is an essential function for any control system. There must be appropriate control of the system, management of change, and security. Control engineers have a responsibility to improve safety, reduce risk, and prevent system failures.

In many plants, the IT department has absorbed the system administration role. In this way, control engineers are freed up to perform activities that have a greater impact on the bottom line. The skill sets of IT and control engineers have some overlap in the areas of networking, security, and system administration. The IT department may offer some cost savings for some of these skills, but may be completely unfamiliar with control system vendors and requirements. Local “turf wars” have often broken out over this topic.

Local politics must be put aside: there must be close coordination between the control engineers and the IT department. Sharing administrative functions with IT may be a useful method for getting more value directly from control engineers.

For System Administration, the key to maximizing the value of control engineers is to engage IT where they can offer lower cost services for system hardware, networking, and administration, while focusing the control engineers on the application of the technology.

Maximizing Value from Continuous Improvement

Continuous Improvement offers the greatest return on the control engineer’s effort. In many cases, a single week’s effort may deliver over $1,000,000 in savings. One of the best ways to deliver results with control engineers is to keep them focused on the continuous improvement opportunities.

With these efforts, control engineers deliver value by managing the performance of the control system. “You can’t manage what you can’t control, and you can’t control what you don’t measure.” [3] So you must measure control performance if you want to improve it.

The most important metrics for control system performance often go unmeasured. Most control engineers do not measure, track, or otherwise pay any attention to how many controllers are in MANUAL. And yet, this is probably one of the most telling statistics about the effectiveness of the control system.

There is great opportunity here, because most plants are running with as many as 30% of control loops in MANUAL. The effect on safety, environment, and profitability is substantial.

Table 3 lists some of the highest value activities for control engineers, and describes the tools needed to support these activities.
<table>
<thead>
<tr>
<th>Activity</th>
<th>Business Value</th>
<th>Tools Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eliminate root cause of oscillations</td>
<td>Most often, energy savings and process stability. Sometimes production increase.</td>
<td>Oscillation detection and analysis.</td>
</tr>
<tr>
<td>Identify Process Constraints</td>
<td>Production increases, often for very minor investment in valve trim.</td>
<td>Performance metrics for % Time Valve at Limit.</td>
</tr>
<tr>
<td>Identify faulty valves</td>
<td>Reduce maintenance budget and improve planning.</td>
<td>Diagnostic tools &amp; training.</td>
</tr>
<tr>
<td>Controller tuning</td>
<td>Process stability, reduced safety risk, and improved quality.</td>
<td>Control loop optimization tools including tuning, linearity analysis, and other diagnostics.</td>
</tr>
<tr>
<td>Alarm Management</td>
<td>Improve operator attention. Reduce risk of upsets getting out of control.</td>
<td>Alarm management software.</td>
</tr>
</tbody>
</table>

Table 3. High Value Continuous Improvement Activities

**Focus Efforts with the Right Information**

Most control engineers do not have the right information to make good business decisions. They simply do not use the tools that are discussed in Table 3. Why not? In the past, it was difficult to use these tools in real-time. Custom databases and programming were required. Today, however, software can monitor and report on these metrics using real-time information directly from the control system.

Today, a Performance Supervision System like PlantTriage, can automatically provide these metrics and diagnostics, as well as the tools required to solve the root-cause problem. This helps the control engineer to stay focused on those areas where they can have the biggest business impact.

It’s not about working harder, it’s about working smarter. When you have better information, you can make better choices. Today’s control engineer needs focused information, so they can make the best choice about how to improve the business, each and every day.
Figure 2 shows a “Biggest Payback Loop” display. This display guides the engineer directly to the most important issues in the plant. This display is developed from a combination of real-time performance data and economic value.

Biggest Payback Loops identifies the top 10 issues in the plant, based on technical and economic factors. With this list, plant personnel stay focused on the top issues in your plant. New issues appear on the list, often before operators have had a chance to report them. Software automatically develops the list, using proven engineering techniques.

Industry studies have shown that plants that use these real-time metrics and dashboards deliver better bottom-line results. [1]
Once the priorities are set, it is important to resolve the issues efficiently and effectively, the first time. For example, many engineers practice control loop tuning using trial-and-error methods, known as “tune by feel”. Setting their pride aside, most engineers will admit that software can make loop tuning more reliable, repeatable, and consistent. Control loop optimization software is an absolute necessity for any competitive process business.

Like other technologies, the technology of control system improvement has come a long way in the past 20 years. Be sure that your engineers have current knowledge of industry best practices. This includes training on effective techniques, as well as methods to determine economic benefits. A combination of training and tools can increase the effectiveness of plant personnel by as much as a factor of five, [2]

While most plants today have process data historians, very few plants are making use of the data. To do the job right, you must convert that real-time data into meaningful information about the process. Using performance supervision tools, with drill-downs and dashboards helps to get the job done quickly and effectively, the first time. An example dashboard is shown in Figure 3.

Control engineers and technicians can deliver excellent business value. With the appropriate tools and training, these personnel can be much more effective in helping the organization to achieve cost, quality, safety, and production goals.
Measuring & Documenting Results

Engineers often fall far short of management expectations in this final area. They may seem content to solve the technical problems, without any understanding of the business impact. This makes it difficult for management to assign value to the work that was done. The manager is unsatisfied, and the engineer feels misunderstood.

Measuring improvements in process plants is sometimes straightforward, and sometimes quite difficult. There are a few key steps to ensure documented results. Every engineer should be trained to document and report results in business terms.

Results & Expectations

Control engineers have a tremendous capability to improve plant operation. Typical improvements for process plants are shown in Table 4.

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Typical Range</th>
<th>Conservative Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Reduction</td>
<td>0.5% to 2%</td>
<td>0.5% to 1%</td>
</tr>
<tr>
<td>Production Increase</td>
<td>1 to 10%</td>
<td>1 to 2%</td>
</tr>
<tr>
<td>Valve Maintenance Budget</td>
<td>10% to 50% reduction</td>
<td>10% to 20%</td>
</tr>
<tr>
<td>Quality Improvement</td>
<td>5% to 50% improvement</td>
<td>5% to 10%</td>
</tr>
<tr>
<td>ROI from Performance Supervision</td>
<td>3 to 9 months</td>
<td>1 to 2 years</td>
</tr>
</tbody>
</table>

Table 4. Typical Results of Control System Improvements

Of course, the full extent of the benefits depends on your starting point, and how much focus is put on control system improvement.

Example

A control engineer applies PlantTriage tools to a chemical plant in the Southern U.S. After installing the software and completing training, the engineer focuses on the furnace efficiencies. Within 2 months, the operation has seen an 11% drop in energy per ton, and a 10% increase in production. The return on investment has occurred in less than 2 months.

Conclusions

Most process plants will see a 2% to 6% reduction in operating costs, and a return on investment within months, when focusing control engineers on control system performance improvements. To accomplish these goals, control engineers need management support, real-time metrics and tools.
**Recommendations**

1. **Control engineers should be leveraged.** They should be focused on those tasks that yield the highest business benefit to the company. Other tasks may be outsourced, or re-allocated to maintenance or IT.

2. **Use real-time metrics and diagnostic tools to focus time and effort.** Engineers are often working hard at the wrong thing.

3. **Train control engineers to report business benefits.** Engineers need to move beyond the technical benefit, and learn to report their value in terms of bottom-line business impact.

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**About ExperTune**

**About the Author**

George Buckbee is V.P. of Marketing and Product Development at ExperTune. George has over 20 years of practical experience improving process performance in a wide array of process industries, George holds a B.S. in Chemical Engineering from Washington University, and an M.S. in Chemical Engineering from the University of California.

**About PlantTriage®**

PlantTriage is a Plant-Wide Performance Supervision System that optimizes your entire process control system, including instrumentation, controllers, and control valves. Using advanced techniques, such as Active Model Capture Technology, PlantTriage can identify, diagnose, and prioritize improvements to your process.

**Glossary**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCS</td>
<td>Distributed Control System. A centralized process control system that typically provides data collection, operator interface, and control functions.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>KPI</td>
<td>Key Performance Indicator. A metric that can be used to monitor overall performance.</td>
</tr>
<tr>
<td>OPC</td>
<td>OLE for Process Control. An industry standard communications protocol, allowing</td>
</tr>
<tr>
<td>OPCHDA</td>
<td>OPC Historical Data Access. An enhancement to the OPC protocol that allows data to be pulled directly from standard data historians.</td>
</tr>
<tr>
<td>ROI</td>
<td>Return on Investment. Measured as the amount of time needed to fully recoup an investment.</td>
</tr>
</tbody>
</table>

**References**