The Habits of a Systems Thinker

In Order to Maximize Production Throughput and Efficiency It's Essential that Staff be Able to See the Proverbial Forest for the Trees

From advances in internal production practices and supply chain integration to innovations in technologies and information systems, manufacturers have been the beneficiaries of developments that are improving production throughput and efficiency. Many improvements have been strictly technological in nature whereas others have been limited to the methods or procedures by which manufacturing is performed.

control station

Process Control Solutions for Improved Production Throughput and Efficiency

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An alarm flashes on the HMI. Whether HiHi or LoLo – a predetermined control condition is exceeded. The panel operator takes note of the change in status and clicks the monitor while notifying Engineering. A review of basic performance metrics confirms increased process variability consistent with the alarm condition. Plant staff utilize available systems to isolate the root-cause. Operators check the logs. Maintenance techs evaluate the associated instrumentation. Engineers evaluate system diagnostics. Collectively they pinpoint a feeder system that temporarily went unstable. The system's controller was overwhelmed when demand for flow peaked across multiple lines. The team recommends adjustments to the process architecture and modifies system settings. The changes prevent instability and protect production. Case closed.

Scenarios such as this are increasingly common as industrial automation continues its forward march. From advances in internal production practices and supply chain integration to innovations in technologies and information systems, manufacturers have been the beneficiaries of developments that are improving production throughput and efficiency. Many improvements have been strictly technological in nature whereas others have been limited to the methods or procedures by which manufacturing is performed. In the aggregate the impact of these advances has been astonishing particularly in the last half-century.

Macroeconomic data from 1800 to 2000 shows that global productivity has increased steadily on a year-over-year basis. According to a data collected in conjunction with the Maddison Project, productivity per capita grew nearly eightfold during that 200-year span as represented by World Gross Domestic Output – a measure that serves as a proxy for throughput and efficiency. The study highlighted a notable uptick in the pace of productivity beginning in the 1950s. An estimated 80% of the global production increase corresponds with the introduction of computer-based control systems and methodologies that simplify production processes. These advances have enabled manufacturers both to capture and analyze production data and to streamline the means of production.

Today's world-class manufacturers are capitalizing on the confluence of improved production data and practices and fostering a Systems Thinking culture. Such companies promote best-practices for problem solving. Symptoms of poor performance are systematically distinguished from problems, allowing unintended consequences to be minimized or avoided altogether. Equipped with information that provides a complete view of a factory's many production systems along with the associated linkages, manufacturers that employ Systems Thinking in their day-to-day operations possess a meaningful advantage over others. With even a basic understanding of Systems Thinking the benefits to modern-day manufacturing become quite clear.

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Systems thinking is often defined as an approach to problem solving that characterizes issues in light of the complete system rather than an individual isolated component. In the context of industrial process manufacturing it's a methodology whereby multi-discipline teams ask questions about the system as a whole in order to understand how the big picture affects the little one. With a fuller understanding of the interrelationships between and among different parts of a complete production system, practitioners avoid the linear cause-and-effect thinking that focuses narrowly on obvious symptoms and often results in other negative and unintended consequences.

The Waters Foundation recommends that practitioners habitually consider systems from a variety of vantage points:

Examine:
Observes How Elements Within Systems Change Over Time

"The final control element used to handle start-up of the System with no challenges. What has changed?"

Changes Perspectives to Broaden Understanding

"We need to contact Maintenance and learn about recent System changes."

Consider:
Considers Both Short and Long-Term Consequences

"If we increase the process' flow rate, what impact might that have on instrumentation and other System elements?"

Anticipate:
Identifies the Circular Nature of Complex Cause-and-Effect Relationships

"When more than one line operates at peak demand the System is overwhelmed and becomes unstable."

Envision:
Seeks to Understand the 'Big Picture'

"Let's look at other Systems — units, instrumentation, loops, equipment — to learn if similar issues exist."

Recognizes that a System's Structure Generates its Behavior

"We need to check with the System owner. He knows the interactions between the relevant Systems."

Finds Where Unintended Consequences Emerge

"Let's investigate how the new System control scheme might affect downstream processes."

Validate:
Checks Results and Changes Actions if Necessary

"The next start-up should be slowed by 5% so we can see if the System settles out quicker."

Surfaces and Tests Assumptions

"Let's track the System's performance on the next run to determine if control remains consistent."

Considers an Issue Fully and Resists the Urge to Draw Quick Conclusions

"These trends should allow us to track System interactions during the next several batches and confirm our assumptions."

Considers How Mental Models Affect Current Reality and the Future

"We shouldn't draw conclusions without sufficient supporting data from the System."

Recognize:
Applies Understanding of System Structure to Identify Possible Leverage Actions

"Each department needs to observe the next System start-up and participate in our analysis process."

Recognizes the Impact of Time Delays When Exploring Cause-and-Effect Relationships

"The last shift recorded a similar System issue which slowed our ability to cut-over from one line to another."

Industry Viewpoint: Examining The Forest as Well as the Trees

A key to Systems Thinking is the questions asked by a given facility's staff. Whereas the right questions can improve understanding and facilitate both analysis and decision-making, the wrong questions can unnecessarily prolong the corrective process and even exacerbate production issues. Engaging different groups from Operations and Engineering to Maintenance and Management assures that appropriate subject matter expertise is brought to bear. The collective input of these different constituencies allows for issues to be thoroughly and thoughtfully examined, thereby minimizing errors in analysis.

Like good questions it is equally important that a facility's staff have access to relevant and accurate information with which to perform their analysis. While most production facilities utilize data historians as the primary repository for production-related information, the historian is often limited in the amount of data that is stored. Data is routinely compressed in order to accommodate the large volume produced by the average facility. What's more the data is just that — data and not information on which a Systems Thinker can act.

Due to the limitations of historians most facilities look to other and complementary sources of data. Performance and maintenance logs as well as advanced diagnostic tools are commonly used to equip Systems Thinkers with valuable detail. Logs can offer meaningful information that often captures other relevant facility events. A limitation of logs is that they typically capture information on a scheduled basis. As such they offer a picture that is often incomplete.

Advanced monitoring and diagnostic tools are increasingly used in the process industries to provide Systems Thinkers with a comprehensive understanding of performance issues. These tools constantly capture relevant data and present it in the context of actionable information. Most analyze individual Systems as well as the interactions among and between Systems. In so doing, they help System Thinkers to examine both the forest and the trees and to maintain efficient and profitable production.

Damien Munroe
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Diagnostic Tools for the Systems Thinker
Improve Decision-Making with Plant-Wide Monitoring

Most production processes are highly dynamic and constantly changing. They are highly interactive. Finding issues is rarely a challenge. But isolating the root-cause is often a different matter altogether.

PlantESP monitors control loop performance and it keeps a constant watch for issues that negatively affect production throughput and efficiency. It equips your staff with what they need most — system-wide insight!

♦ **Plant-Wide Monitoring of Control Loop Performance**

♦ **Targeted KPIs and Advanced Forensic Tools**

♦ **Timely Alerts and Detailed Reports**

PlantESP is enabling manufacturers across the process industries to accurately diagnose complex control loop performance issues and to quickly correct them for increased production and enhanced efficiency. **PlantESP can be a fundamental component of your Systems Thinking solution!**

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