

## **Preface**

### THE CHALLENGE OF ADVANCED REGULATORY CONTROL

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Whether the instrumentation control hardware consists of local mechanical, pneumatic, electronic, microprocessor, fieldbus or wireless controls, microprocessor-based controllers, programmable logic controllers, personal computer-based controls, distributed control systems, or fieldbus controls, a keen awareness of advanced regulatory control is required by engineers, technicians, educators, managers, salespersons, and marketing personnel such that an appropriate control strategy can be applied to industrial processes.

Make no mistake—the forces of “instant gratification” are definitely at work in the “wonderful” world of process control. It is not uncommon to find support for improved control systems driven by the aesthetics of pretty pictures, “buzz” words, the need to be the “first one on the block” to have the latest thing, or the need not to be the only one without one. In these situations, little attention is truly focused on the quality and sophistication of control.

The quality and sophistication with which control strategies are developed and implemented varies with the skill of the process control engineer. This skill is heightened by a strong control engineering education, exposure to skilled process control engineers, specialization in the field of process control, and intimate knowledge of the process.

Many persons perform process control engineering on a part-time basis without the benefit of a process control education, exposure to skilled practitioners, or understanding of the process. As verified by the observation of numerous control strategy implementations, the typical result of this approach is a control system that “works.”

Such a situation can be illustrated by the author’s experience with an individual who implemented a distributed control system and enthusiastically described it, especially with regard to its flexibility and ease of configuration. After responding with silence to questions that probed the sophistication of the control strategies, this individual sat in awe as the operation of a cascade control loop was described. Despite its outstanding functional capability, this individual’s distributed control system implemented less-sophisticated control than is possible with a pneumatic analog control system. Nonetheless, it cannot be denied that the distributed control system “works,” that the plant can boast of having installed the “latest and greatest” technology, and that this experienced “expert” may influence the decisions of others who are less knowledgeable than he.

This type of implementation occurs because of a series of events that typically begins with management’s recognition and support for improved process control. Due to the skill level of the person selected to perform the control system engineering function,

inappropriate or rudimentary control strategies may be implemented, which result in the loss of an opportunity to improve plant efficiency. Operators have little choice but to accept the control system and work around its shortcomings, including operating in the manual mode (system abandonment) because the controls are inconvenient to operate or do not function properly. However, despite these shortcomings, the operators are usually satisfied because the installation represents improvement.

The control system that “works” may be regarded as a success, primarily because management is rarely versed in process control technology, has difficulty judging the technical quality of the installation, and is usually forced to draw conclusions about instrumentation from the opinions of others who are not skilled control system engineers. It is not uncommon for an experienced control system engineer to review such an installation and recognize the need for an additional control system upgrade to improve process performance and personnel safety.

Were the problem solely caused by errors, improved process control and safety could be achieved with a few more expenditures to correct deficiencies. However, the underlying problem is that an installation that “works” is deemed acceptable, regard-less of whether it truly is. What is not recognized is that the process may really be poorly controlled and/or unsafe because of inappropriate control strategies and interlocks.

The challenge of providing appropriate controls for industrial processes is a formidable task due to the many facets, details, and idiosyncrasies of industrial processes and the instruments selected to be integrated into their operation. Virtually anyone, with or without a process control background, can put together a control system that “works” with the help of a telephone and enough suppliers; however, to take advantage of technology to improve the process through the innovative application of instrumentation requires a skilled, process control system engineer.

A skilled process control system engineer can promote process improvements based upon specific knowledge of the instrumentation and the process. Such improvements can streamline the process, provide safe operation, improve efficiency, eliminate the need for equipment, and reduce installation, operation, and maintenance costs. Despite claims to the contrary, individuals who have not specialized in process control and have not exposed themselves to more sophisticated control techniques have not generally produced innovative installations that exploit the potential of control technology and open the door to additional process improvement.

Most industrial control is performed by utilizing a combination of manual and regulatory control. Despite the installation of additional field transmitters and advanced control capabilities, regulatory controls that emulate conventional pneumatic and electronic analog controllers abound. To become more productive and to improve safety, advanced controls should be appropriately and correctly applied to industrial processes.

Traditionally, for lack of a better definition, advanced control has been defined as continuous control that was more complex than regulatory control (containing one

measurement device, one controller, and one final control element). Advanced regulatory control can be segregated from advanced control strategies such as model-based control, state variable control, optimal control, dynamic matrix control, statistical process control, and the like.

Herein, advanced regulatory control encompasses continuous controls that are more complex than regulatory controls (as defined above), but still retain the measurement, the controller, and the final control element format of regulatory control. The complexities of advanced regulatory control may be due to multiple measurements, controllers, and/or final control elements as well as logical manipulation of the control loop.

Advanced regulatory control is but one tool in the process control system engineer's arsenal; however, advanced regulatory control can and should be applied to the majority of control systems. In some circles, it is believed that if advanced regulatory control were properly and appropriately applied, the need to resort to applying advanced controls would be greatly diminished.

It should be noted that some aspects of advanced regulatory control have been practiced for decades using mechanical, pneumatic, and electronic instrumentation. Distributed control systems, microprocessor-based controllers, and fieldbus control systems have dramatically reduced the cost of performing advanced regulatory control functions and have simplified their implementation.

This book is intended to describe advanced regulatory control and its application to continuous processes in a nonmathematical format and in as practical a manner as possible in order to be of benefit to all skill levels. It should be noted that some aspects of advanced regulatory control have been practiced for decades using mechanical, pneumatic, and electronic instrumentation. Distributed control systems, microprocessor-based controllers, and fieldbus control systems have dramatically reduced the cost of performing advanced regulatory control functions and have simplified their implementation.

This book is intended to describe advanced regulatory control and its application to continuous processes in a nonmathematical format and in as practical a manner as possible in order to be of benefit to all skill levels. Manual and regulatory control are described in the text as a prelude to advanced regulatory control so that their differences might be explored.

Discussions of control system hardware are avoided, because the control function, not its hardware implementation, is important in improving control of the process. This contrasts the importance of the measurement instruments and final control elements, which, if not properly selected and installed, can cause the control system to operate in the GIGO mode, that is, "garbage in, garbage out." In this mode, and despite control system sophistication, poor process measurements and/or poor process manipulation methods hamper control of the process. In many cases, poor process measurements may not show

process instability, which would lead the uninitiated to the erroneous conclusion that the control is adequate and the instrumentation is not in need of upgrading.

This text focuses on control but integrates the operation of measurement devices and final control elements into discussions, because their importance is often the limiting factor in control system performance.