Profitable efficiency – the new DNA of process control

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Executive summary

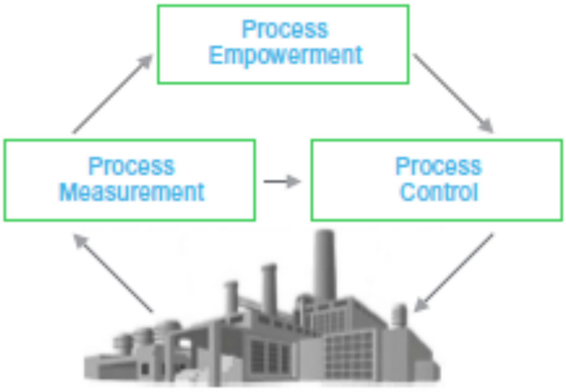
As new technology has influenced factories and plants, new approaches have appeared to improve operational profitability, safely. Profitable Efficiency, by ceding profitability control to process control, represents one new approach that realizes 100 percent ROI in a very short time, often under six months, with sustainable results that last and improve over the years.

Since the sepia-toned days of a century past, industry has sought effective ways to control their manufacturing and production processes. As new technology has influenced factories and plants, new approaches have appeared to maximize benefits realized. One such idea is Profitable Efficiency, which is profitability control cascaded to process control to maximize operational profitability in real time. While this is a new execution method, the concept is deep within the DNA of process control.

The primary objective of process and logic control is to improve the efficiency of an operation. This has traditionally been measured by determining if throughput has increased while energy and material consumption have decreased. To improve efficiency, a feedback control loop measures the variables that need to be controlled, determines the variation from the desired set point and adjusts the variables to move toward the set point (**Figure 1**).

Figure 1

Process Control for Improving Efficiency



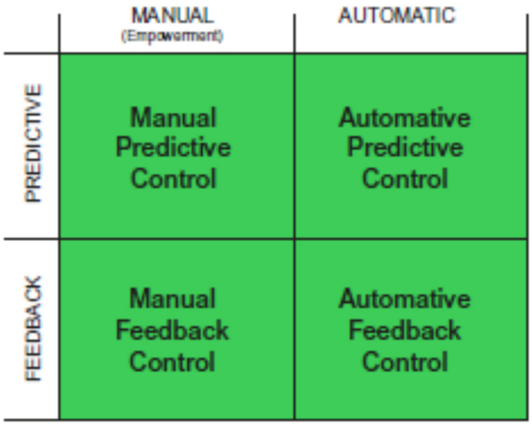
However, since the 1960s, the state-of-the-art in process control has advanced significantly beyond single-loop feedback control. For example, multi-loop cascade control, feedforward control, and coordinated multiple variable control utilize dynamic process models to enable very sophisticated control strategies.

Fundamentally, real-time control involved making and acting on decisions within the period defined by the time constant of the process being controlled. In other words, the timing is defined by the process being controlled, rather than human time schedules, e.g., daily, weekly, monthly, etc. Decisions being made on human schedules are referred to herein as management decisions, while decisions made on process schedules are referred to as control decisions.

Traditional control strategies can be categorized into four basic types. There are manual and automatic control strategies, as well as feedback and predictive strategies, which can utilize automatic or human control. When humans are provided the information they need to make effective real-time control decisions, as well as the tools they require to act on that information and to realize a positive result, we say they are “empowered.” Therefore, the empowered workforce means providing operators with the tools necessary for them to effectively serve as controllers.

Figure 2

Types of Control Strategies



It was understood that any improvements in efficiency could be translated directly into improvements in operational profitability. But this is no longer the case. Since the early 2000s, the speed of industrial business has steadily increased, triggered by the deregulation of electric power. As electrical power was deregulated, the supply-to-demand ratio on the grids started to fluctuate. Energy suppliers and grid managers tried to deal with these fluctuations by increasing the price of energy when the demand was high and supply was low and reducing the price of energy when the demand was low and supply was high.

This pricing variation on the power grids threatened to create turmoil among energy consumers, causing governments to regulate the pricing periods. For example, in the United States, the price of energy can only change every 15 minutes, while in the United Kingdom it can only change every 20 minutes. This meant that electricity consumers, such as industrial plants, might actually decrease their energy consumption, but their energy bill could increase: They consumed more electricity during the higher price periods.

The frequent fluctuations in electricity prices caused a domino effect across other energy sources and raw materials. To try to deal with the unstable costs, industrial companies started changing the price of their products more frequently. This effect is most easily seen in energy markets, but it affects consumer production as well. Today, in an increasingly speedy industrial market, not only must plant managers decide how much to produce, but the operators must also determine the best time to produce, which can sometimes diminish the importance of operational efficiency, i.e., it might be more profitable to run the plant less efficiently, according to the traditional efficiency measures, to more cost-effectively meet market demand and opportunity.

As a result, process control for improved operational efficiency no longer had as direct an impact on improved operational profitability. Traditional process control was necessary, but not sufficient. New approaches were required to deal with the ever-increasing real-time dynamics of industrial business variables. Executives struggled with how to address this issue for years, and were often heard remarking that their processes were in control while their profitability was out of control.

The first response of industry was to turn to the IT departments and enterprise resource planning (ERP) suppliers for solutions. Few, if any, realized the desired results, primarily because the IT teams and ERP software were both experienced in solving traditional management problems, but not real-time control problems.

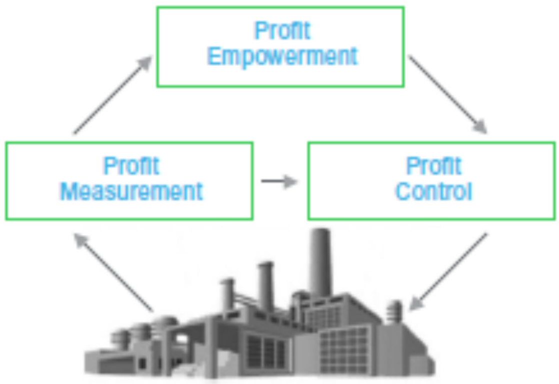
The correct solution involved understanding that as operational profitability fluctuated faster and faster, management decisions had become control decisions. In other words, the solution had to be approached from the perspective of real-time control.

Real-time control is predicated on the availability of real-time measurements. The first problem to be addressed was measuring operational profitability in real time. Engineers developed a number of very clever engineering-based approaches to try to solve this problem. New key performance indicators (KPIs) with monetary context were calculated, but they had little credibility with the cost accounting teams who actually measure the performance of the operations because they used different metrics.

It turns out that the correct approach involves calculating the accounting factors of the operation in real time. This can be done by using a combination of sensor-based data from the process and financial data to calculate the cost and profit points across industrial processes. This is referred to as real-time accounting (RTA).

Figure 3

Real-Time Profit Control Loop



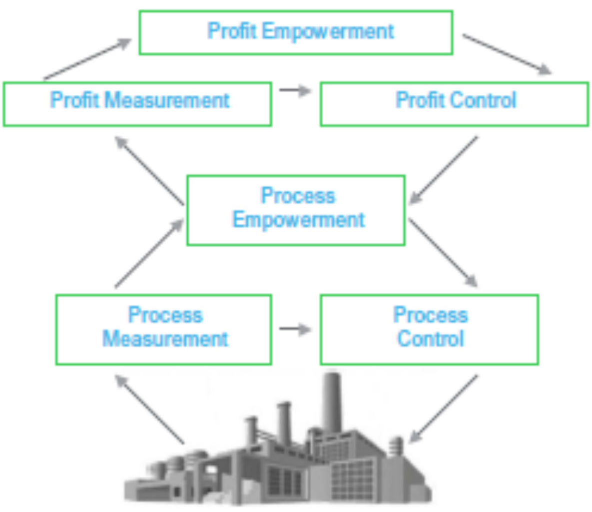
Once these RTA factors became available, they could be used to control operational profitability very dynamically. Earlier, during the Industrial Revolution most of the control was done manually by plant operators who looked at dials on gauges and used that information to determine how to effectively control process loops by turning hand valves. Today, a similar manual control approach can be used to increase the operational profitability of plants. Providing real-time feedback to operators so they can determine the financial impact of their actions empowers them to learn how to operate the process most profitably. The result is manual, real-time profit control. As engineers gain more insight into the factors that drive the decisions made by operators, automated control will eventually be developed (**Figure 3**).

The next challenge was determining the relationship between traditional process control and real-time profitability control. Clearly, operational profitability cannot be manipulated if the efficiency of a plant is not well controlled. In fact, there is a very classic control relationship between profitability control and efficiency control. It involves a cascade control strategy with profitability control as the primary loop, cascading set points to the process control, serving as the secondary loops (**Figure 4**).

Figure 4

Profitable Efficiency

Cascading Profit Control to Process Control



Implementing profit control strategies over process control strategies results in a new class of real-time control strategies, referred to as Profitable Efficiency. Implementing Profitable Efficiency throughout an industrial operation tends to drive new and improved levels of operational profitability that realize 100 percent ROI in a very short time, often under six months, with sustainable results that last and improve for years.

Making the real-time accounting measures the primary performance indicators of industrial operations ensures their sustainability and often enables continual operational profitability improvements for the life of the plant. Additionally, embedding the RTA models throughout the operation enables you to measure operational profitability for any initiative that impacts the performance of the operations. With these measures, managers can learn on how to shift focus of their resources on activities that fetch more value.

The field of real-time control is expanding from traditional process and logic control for operational efficiency improvements to other real-time domains, such as operational profitability. As new control strategies are applied to new domains, the performance of industrial operations will improve significantly, to levels never before expected. Profitable Efficiency, by ceding profitability control to process control, represents one new approach. It has proven to drive strong results because it allows you to keep both your process and profits in control.

About the author

(Dr. Peter Martin) is a recognized leader and innovator in automation and control. He has been a practitioner in the field for over 37 years; has authored three books, coauthored two, and been a contributing author for three more; and has published dozens of articles and papers in these disciplines. He holds or has pending multiple patents in the areas of real-time business measurement and control. He was recognized by Fortune as a Hero of U.S. Manufacturing, by InTech as one of the Fifty Most Influential Innovators in Control, and by Control as a member of the Automation Hall of Fame; he has also received ISA's Life Achievement Award. Peter Martin has a B.A. and an M.S. in Mathematics, an M.A. in Administration and Management, and a Ph.D. in Industrial Engineering, as well as a Masters and a Doctorate in Biblical Studies.

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