The conductor directs this orchestra

By Michel Ruel

What are the resources needed to optimize a control system?

How to prepare an optimization plan: budget, methodology, schedule, team, and training. What are the benefits?

What is the return on investment?

SHOULDN'T YOU EXPECT RESULTS

Process performance depends on effective use of process control. Included in process control are transmitters and control systems (logic, algorithm, interlocks, and more) but also pumps, valves, pipes, and other process equipment.

Optimizing a process is similar to a conductor directing an orchestra: coordinate, accelerate here, slow down there, and synchronize other parts. The "conductor" must know about control, but also about the process itself. To optimize a control system, one must understand the process perfectly.

When optimizing, it is important to consider design, equipment performance, control strategy, operation procedures, performance monitoring, logic, and special control strategies for start-up, shutdown, grade changes, and abnormal conditions.

Transmitters such as level and pressure have reached accuracy levels, for the most part, in the range of 0.1%. Powerful distributed control systems have also proven effective over the past fifteen years. It is also possible to obtain high-performance control valves. With this superb technology, modern control loop performance should be sensational.

In reality, it is not the case. Contrary to promises made, a complete shift from pneumatic instrumentation to ultramodern equipment has often made no improvement in the quality and quantity of finished product. Only a small percentage of control loops are properly tuned.

The biggest error one can make is to forget that a loop is only as efficient as the sum of its parts. The structure of the control loop chain contains more than the three conventional links (transmitter-controller-valve). The F-PID (controller filter proportional, integral, derivative) parameters form an integral part of the chain. How can we achieve maximum process performance monitoring, logic, and special control strategies for start-up, shutdown, grade changes, and abnormal conditions.

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Each control loop costs between $5,000 and $35,000 on average. Calculate the control loop investment in your plant (example: $15,000 average times 500 loops = $7,500,000). Is it not justifiable to invest one or two hours of tuning time per loop? By doing so, your control loops will operate efficiently rather than just being functional.

Because of ever-increasing consumer demand, performance criteria are more sophisticated. To meet the market's demanding objectives of today and tomorrow, it is vital to possess sound technical knowledge and analytical tools for control loop tuning.

With controls properly tuned, there are fewer process upsets. Control loops can do what they were designed to do: maintain consistent process results. Process start-ups will be smoother and more consistent, and operations can quickly move into full production. With the process under control, there are fewer alarms. Product or grade changes can take place smoothly and quickly with a minimum of scrap.

Finally, operation will be better. Each of the benefits reduces the amount of required operator attention for routine operation. This frees the operator to work on other tasks.

AMORTIZED OVER FIVE YEARS

In a typical plant, trained people use proper tools. This does not include the workforce to calibrate, repair, and program.

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If the organization tunes (eight loops/ day)/person, two times/year, 240 days/year; then the organization tunes about (1,000 critical loops/person)/year.

Other loops should receive verification every two years or each time a process change occurs. Changes would include modifications, replacing a piece of equipment, resizing, equipment wear, and process problems. In this case a person can tune about 4,000 loops per year.

In other words, the workforce necessary for process optimization for a plant with 5,000 loops is one person to maintain optimization on 1,000 critical loops and another person to maintain 4,000 noncritical loops.
At $75,000 salary per year, one person can maintain 2,500 loops at a cost of about $30 per loop per year.

As to necessary materials to optimize, the price for software, hardware, networking, and configuration varies greatly. A well-reasoned average is $50,000. If amortized on a five-year period, this works out to about $10,000 per year. For a plant of 5,000 loops, this represents $2 per year per loop, and for a plant of 500 loops, this represents $20 per year per loop.

For training and administration the cost may be $50,000 per year for a large plant and $20,000 per year for a small plant. On a per loop basis, this translates to a price between $10 and $40.

The total of all these figures puts the yearly price tag of keeping a single loop in optimal working order at about $100.

OPTIMIZE THE PAPER MACHINE

A mill (Canada) produces newsprint paper. For many years, one of the mill's older machines had a low efficiency compared to the others; the uptime for this machine was 83%, which was below the budget.

The variability for this machine was high-1.4% for the basis weight and 6% for the moisture content. The quality needed improvement, and the machine broke too often.

The employees verified the process, mechanical parts, electrical components, and operation procedures: the improvements were minimal. Then the process control department suggested a more global approach to optimize the paper machine.

They trained the staff to analyze and optimize the process. They went through the entire paper machine, analyzed each part of the process, and repaired or modified when necessary. They used a process control consulting company to train plant staff on the methods. This company also provided support for the more complex problems.

Technicians, engineers, and supervisors received training in process control basics, troubleshooting analysis, and efficient use of optimization software. They used loop optimization software for analyzing and troubleshooting the process.

The results originated not only from the instrumentation effort, but also from operation, production, and management.

The following average results were on the most important loops:

- The oscillations of the loops reduced by a factor of over 200.
- The variability of loops reduced by a factor of two.
- Valve movement reduced by a factor of at least five.
- The overall variability-basis weight, humidity, and dry weight-reduced by a factor of two.
- The uptime-efficiency-increased from 83% to 87%.
- The time to reach steady state after a grade change greatly reduced.
- The production people learned a lot from the optimization process and began to pinpoint problems in process operations on their own.
- Valve maintenance went down as valve movement greatly reduced.

The computable benefits are:

- The paper machine performs better-it starts easily after a grade change and breaks less often.
- The paper machine has better efficiency.
- The production rate increased.
- There is an additional $1.8 million per year to the margin.

The costs covered:

- training and support by a consultant
- purchase of analysis and data acquisition software
- labor time for optimization process
- maintenance by mill staff

The total investment for this mill was $68,000, which translates to a payback time of about two weeks.
A mining plant in the North uses a kiln to dry minerals. The efficiency of this kiln was low, and shutdowns happened often, resulting in loss of production and process problems.

The stability was bad, such that the set point for the temperature had to run at an elevated level to ensure the proper mineral moisture content value. Cycling occurred, and the process often reached alarm state.

Finally, the start-up time was long (often over forty minutes), glitches on controller output produced wear on the valve, and emergency shutdown happened occasionally, costing $25,000 each time.

Programming improved, as the plant added cascade control and feed forward, tuned loops, and programmed in interlocks and start-up procedures.

The set point is now lower. Start-up time is now below twenty minutes and fully automated. The average flow of natural gas reduced by 5%. The operation is better. There are no shutdowns anymore!

The time spent on this optimization was less than two days.

The investment included:

- equipment $0
- time (technicians, engineering, operations) $3,200

The return on investment:

- better operations $2,200 per week
- savings on natural gas of $925 per week, which translates to a payback of about one week

These two examples highlight that process optimization is one of the biggest returns on investment plants can undertake today. The objective is to make sure the equipment you already own works at its best.

In process optimization, you plan to use the equipment at its best. You do not necessarily need new installations with all their procurement, engineering, installation, and future maintenance costs.

The noncomputable gains are:

- better knowledge of the process
- better operation
- people better trained to troubleshoot a problem
- better product quality
- replicable expertise for other processes
- smooth operation
- no more abuse of the equipment
- tools and data in place for predictive maintenance
- reduced maintenance for the future IT
Conducting is the art of directing a musical performance, such as an orchestral or choral concert. It has been defined as "the art of directing the simultaneous performance of several players or singers by the use of gesture."[1] The primary duties of the conductor are to interpret the score in a way which reflects the specific indications in that score, set the tempo, ensure correct entries by ensemble members, and "shape" the phrasing where appropriate.[2] Conductors communicate. However, in rehearsals, frequent interruptions allow the conductor to give verbal directions as to how the music should be played or sung. Conductors act as guides to the orchestras or choirs they conduct. An orchestra is a group of musicians who play together on various instruments. Sometimes it performs alone, at other times it plays along with a group of singers. Orchestras give concerts and play for ballets or operas. Every musician only sees the notes that he or she plays. The conductor stands in front of the orchestra and directs the musicians. An orchestra can have up to 20 kinds of different instruments. Large symphony orchestras can have a hundred musicians. Orchestra’s tuning up. Sharptoothed 246256 A conductor directs an orchestra. CK 21577 I’m going to join the school orchestra tonight? Sharptoothed 55948 This is the fifth concert by this orchestra. CK 1046971 I play trumpet in a symphonic wind.

Instrumentation investment

In the first year the investment is large. The second year it is less important. In the following years the outflows are only for spare parts and replacement equipment. For a typical project, the second year is the period when the benefits are the greatest. After the second year, the system degrades slowly as does the margin.

Instrumentation and optimization investment

When optimizing the control loops, the bottom line benefits in the third, fourth, and fifth years are more and more. By refining control strategies, detecting valves with problems, and doing the proper maintenance, you increase your benefits, and this results in pure profits.