

ACHIEVING HUGE ROI THROUGH CONTROLLER TUNING AND OPTIMIZATION©

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ABSTRACT

Controller tuning and optimization provides one of the highest returns on investment in industry today. At a time when energy costs are high, and available capital is limited, optimization efforts can become a key part of any manufacturer's strategy. A general approach, and several case studies are presented to show that investment of a small amount of time and money can yield huge returns, with pay-outs measured in days or weeks, not years.

INTRODUCTION

Most companies are always in search of a way to deliver savings and increased profits, without make large investments in capital equipment. Controller tuning and optimization can satisfy both of these needs. In fact, the Return on Investment (ROI) of tuning and optimization can be so great as to make capital projects pale in comparison.

Return on Investment reflects the payback received, for the investment given. One convention for reporting ROI is to measure the time required to get back the investment. For capital projects, this is

typically measured in years. Another way to measure ROI is the equivalent rate of “interest” earned by the investment. For typical projects, this number will be in the range of 20% to 100%, pre-tax. Most companies will establish some basic “hurdle rate” for ROI, and will not fund projects that do not meet this basic requirement.

TUNING & OPTIMIZATION

Tuning and optimization typically require very little capital. But they do require some investment of time, training, and effort. They may also require a small outlay for equipment adjustments, repairs or replacements. In the context of this paper, we will focus on tuning, optimization, and repair of control loops and related equipment.

Tuning and optimization will typically consist of the following:

- Identifying sources of variation
- Identify and repair valve stiction and hysteresis
- Evaluate and correct process and valve non-linearities
- Evaluate and correct control design deficiencies
- Select optimal controller tuning (P, I, D, and Filter)
- Confirm the effect on the process
- Update operating procedures as required

Most of the above work is purely effort. Correcting design deficiencies usually means relocation of existing equipment or modification of control strategy, and can also be completed with limited capital. Typically, the only capital required is for the replacement of bad valves, or the purchase of positioners.

EXPECTED BENEFITS

The results of tuning and optimization will be a combination of the following:

- Reduced process and product variability
- Reduced scrap, waste, or recycle material
- Increased throughput or production capacity
- Reduced energy costs
- Reduce cost of additives
- Improved process reliability
- Reduced maintenance costs
- Smoother operation
- Faster grade changes

The extent of these benefits depends on a wide variety of factors, including:

- The age of the plant & condition of equipment
- Quality of existing controller tuning
- Type of DCS algorithm used
- Control strategies employed
- Degree of adherence to standard operating procedures
- Size of the facility
- Type of process (refinery, paper mill, steel mill, utility, etc.)

While the degree of benefits varies, the following numbers are typical from Top Control's experience:

Type of Process	Variability Reduction	Response time (to remove a disturbance)	Production Increase	Approximate Benefit
Paper machine	50% Reduction	20% Reduction	1% to 10%	\$200K - \$3MM
Refinery or Chemical Plant	30% Reduction	35% Reduction	0.5%	\$500K - \$5MM
Steel Mill	50% Reduction	30% Reduction	1% to 5%	\$200K - \$1.5MM
Boiler / Utilities	50% Reduction	15% Reduction	0.5% to 1.5% (energy savings)	\$100K - \$2MM

CASE STUDY: PAPER MACHINE OPTIMIZATION

In this case, a team of engineers and technicians investigated a paper machine over a period of one month. The team assessed the existing controls, evaluated valve conditions and controller tuning. As a result of their analysis work, they made the following interventions:

- Repaired 4 valve positioners;
- Repaired 6 valves;
- Replaced 4 valves;
- Relocated 2 valves ;
- Repaired 1 transmitter ;
- Configured 2 transmitters ;
- Modified 2 control strategies;
- Modified the PID tuning parameters on 42 loops mostly reduced proportional gain, and reduced integral time added filtering on 21 loops.
- Modified the process operation pressure in the rejection tank; valve opening for cleaner cyclones; vacuum control in rejection tank.
- Modified the process removed a buffer tank; modified piping arrangement.
- Replaced pieces of equipment: a mixer, manual valves.

The total cost, including valve repairs & replacements, personnel time, and contracted support and training from Top Control was \$68,000. The benefits received were:

- Basis Weight and Moisture Variability reduced by 50% each. (see Figure below)

- Paper machine up-time increased by 4%.
- Reduced Sheet breaks
- Faster Start-Ups and smoother operation

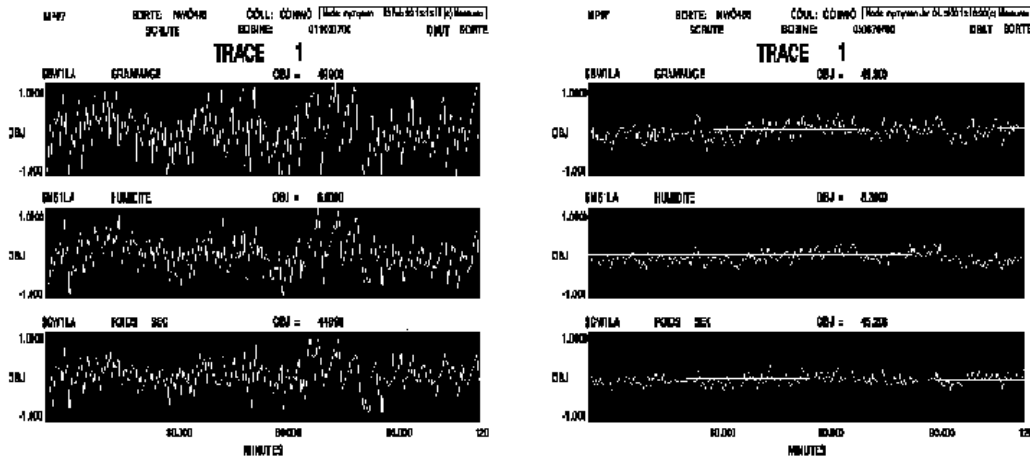


FIG 1. BEFORE & AFTER : BASIS WEIGHT AND MOISTURE

The total of all these benefits was well over \$1 Million per year in added profit! A quick ROI calculation would show that the pay-back on this effort was less than 2 weeks!

CONCLUSIONS

Tuning and optimization provide a huge return on investment. It is quite typical for this work to have a pay-out time of less than one month. Typical ROI equivalent interest rates are in the thousands of percent per year. Since this work requires little capital cost and equipment, the work can be completed with very little lead time.