A Process for Plant Optimization

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ABSTRACT

An optimization process was piloted at GPM Gas Corporation's Okarche plant, located northwest of Oklahoma City, and subsequently has been initiated at four other GPM facilities. Optimization opportunities at these five facilities have been identified and initiated operating changes that will increase operating income an estimated $0.03 Mscf of inlet feed gas. Because of the revenue sharing nature of many of GPM's gas purchase contracts, many of the producers who provide the raw gas feedstock to GPM's facilities will also benefit from the optimization process with higher net-back values.

THE OPTIMIZATION PROCESS

Optimization is the continuous process of managing plant performance elements and enablers so as to maximize the profitability of a facility. It is a work process, like a risk management process or an employee development process and is not a performance element or enabler. Optimization is not automation.

Performance elements are 'things' that can be measured. For example, 'operating cost' is a performance element and represents the cost of manpower, feedstock, goods and services required to operate a facility. Enablers are things that enable performance by the design and quality of the enabler. For example, culture or organization is an enabler and the design and quality of an organization can either enhance or minimize business performance.

Figure 1 is a simplified business model that demonstrates how these elements, enablers and work processes combine to generate cash flows.

If your present business focus is on minimizing operating costs, you have a working optimization process. This may not be the best long-term solution for an optimization process because the process fails to take into account the other performance elements. So how do you allocate the limited resources available in the correct proportions to the right performance elements or enablers?

To properly implement an optimization process you will need to establish:

- A set of performance measures
- An environment and structured system for continuous optimization

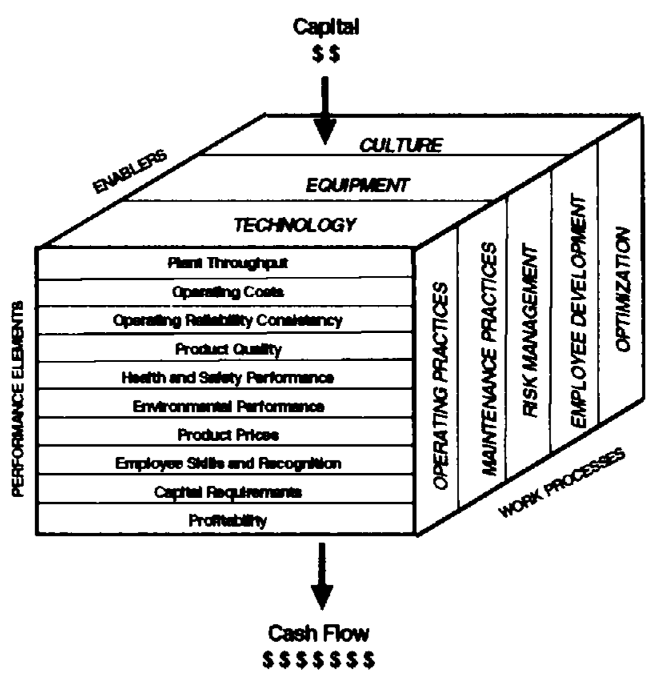


Figure 1. A business model.

PERFORMANCE MEASURES

The proper set of performance measures will drive performance improvement by informing employees about how the plant is performing relative to its performance elements. These measures should be recorded and displayed for employees to review on a frequent basis.

Performance measures for a gas processing facility would include:

1. Plant throughput–Are you maximizing production? What is creating the variability in the plant's throughput?
2. Product quality–Do the products meet the customers' quality specifications? Are "higher than specification" products reducing throughputs and production? What is creating the variations in quality?

3. Operating reliability and consistency–Are the facilities operated and maintained such that the plant has no unscheduled downtime and operates with minimal process variations?
4. Operating costs–Are employee, feedstock, goods and services expenses competitive, if not best in class?
5. Capital requirements–Do the capital requirements provide returns significantly above the cost of capital?
6. Product prices–Is the facility receiving market value, or above, for the products produced and sold?
7. Health and safety performance–Are employees getting sick or hurt while operating and maintaining the facility? Is the facility operated and maintained so as to comply with PSM and OSHA regulations?
8. Environmental performance–Is the facility operated and maintained so as to comply with environmental regulations?
9. Employee skills and recognition–Are employees obtaining the training and skills necessary to perform their jobs at a continuous high level of performance? Are employees recognized for implementing process improvements or maintaining a continuous high level of performance?
10. Profitability–How much profit is the plant generating?

AN ENVIRONMENT AND STRUCTURED APPROACH FOR OPTIMIZATION

Optimization is a work process, like maintenance of equipment, and requires structure or a methodology for doing the required work. A supportive work environment is also needed to initiate and sustain the optimization process.

There are many working processes for implementing optimization. Look around and model one that is operating in your company. If you don't have a good model, the following describes the optimization process that has been implemented at several GPM plants.

The Environment

An environment that continuously supports optimization must have an organizational structure that supports the work process. The facility manager should have responsibility and accountability for the profitability of the facility and have access to the people needed to accomplish that assignment. Functional organizational silos need to be minimized so that employees are associated with a facility and accountable for its performance.

If you are in the process of installing the optimization process, the facility manager needs to sponsor the initial effort. That sponsorship shows employees the importance of the effort and will be critical for fostering an optimization environment in the future.

An Optimization Process

The optimization process is a six step process based on performance improvement concepts and the use a full time, cross functional team to initiate the process. The purpose of this effort is twofold:

1. Identify and implement process improvements that will have the greatest and quickest impact on improving the facility's profitability.
2. Provide the structure and methodology needed to implement an ongoing optimization process. The six steps of the process are:
   - Plan
   - Initiate
   - Gather and analyze data
   - Prioritize
   - Implement
   - Audit

While the steps in the process are discrete, the process is continuous as shown in Figure 2.

Plan–The sponsor (usually the facility manager) of the effort will:

1. Determine deliverables (targets and goals).
2. Establish schedule start and end dates for initial effort.
3. Select team members.
4. Review team skills and competencies and determine training requirements.
5. Draft a project objectives letter describing items 1 through 4 above and forward to team members with the date and agenda for the kickoff meeting.

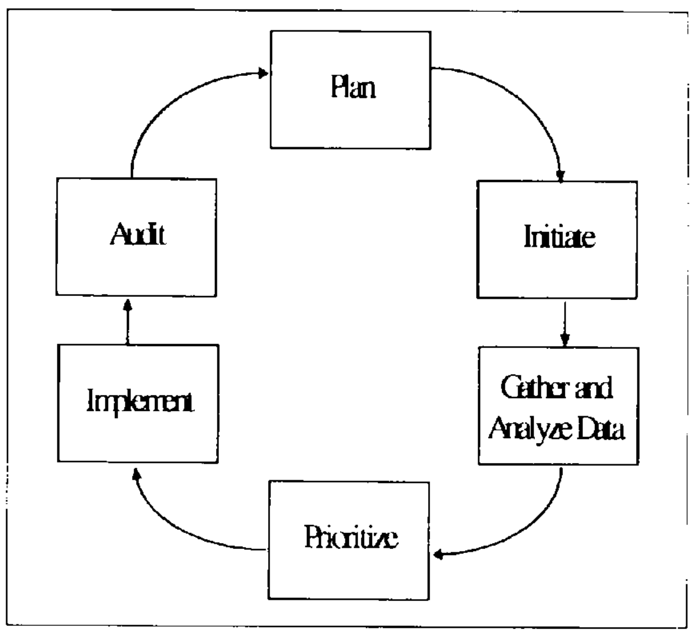


Figure 2. The optimization process.

Initiate

1. At kickoff meeting, the sponsor will details roles, responsibilities, targets and schedule.
2. Team members will draft a team mission statement and develop rules of conduct and a conflict resolution process.
3. Team members will take training, as needed, understanding team performance, brainstorming, problem solving and control charts.

Gather and analyze data

Team members will:

1. Gather and analyze data–generate new ideas.
2. Develop run and control charts for major process variables as inlet feed, product quality, key temperatures and pressures.
3. Gather data on facility and equipment downtime and determine the loss in income due the downtime.
4. Gather past design and performance test data.
5. Initiate performance or multivariable plant tests.
6. Develop plant process models.

Prioritize

Priority–Team members will:

1. Perform system reviews of each of the plants sub-systems, inlet receiving, stabilization, treating, dehydration, electrical, refrigeration and separation. These system reviews should focus on reviewing process constraints, mechanical failures, control problems, comparing actual performance to design or test data and the previously generated ideas
2. Utilize the information collected (ideas, problems, constraints) to synthesize specific action items. These action items may be about immediately correcting a "found" problem, collecting additional information so as to find a root cause of a problem and developing cost estimates.
3. Develop a simple project analysis matrix to assist the team in prioritizing actions and projects, Figure 3. Estimates of costs and value should be "guestimated" and should be plotted on a relative basis. Don't worry about being exact - this exercise is to separate the wheat from the chaff.
4. Develop feasibility level cost estimates, designs, schedules and economics for 1st and 2nd priority level projects
5. Reprioritize the projects based on the feasibility grade economics and develop action plans for implementing.

Implementation

1. For projects requiring sponsor approval, team members will review the projects with sponsor and seek approval for proceeding. For projects within the authority of the team, team members should proceed as per action plans.
2. Team members should be assigned to follow all projects beyond the team's initial schedule. The sponsor may alternatively elect to assign a project coordinator.
3. Team teleconference should be held monthly to report progress on all projects. The teleconference should continue until the audit is conducted.

Audit

1. Six months to one year after the initial team was formed and after the bulk of the projects have been implemented, a sub-team from the original team members should reconvene to determine the success of the effort. Each project should be audited to determine its performance. Was the income generation as expected? Was the cost as expected? What best practices were discovered? Where could improvements be made in future efforts?

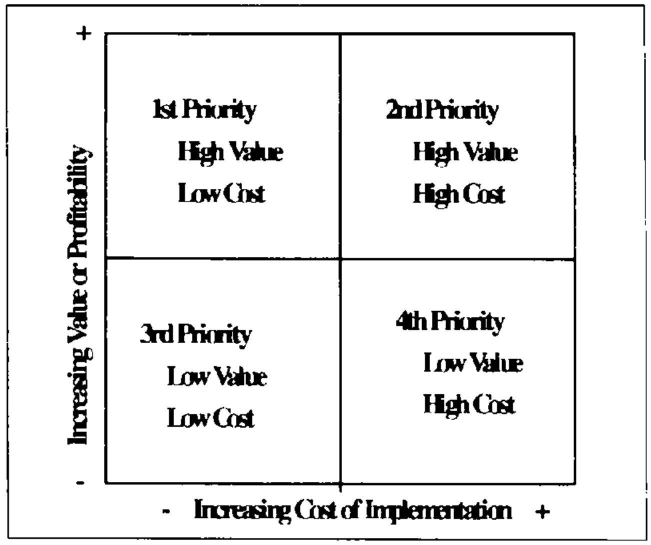


Figure 3. A project prioritization matrix.

2. Employees should be surveyed to determine how they viewed the success of the effort. Did they feel involved in the initial process? Are they involved now? Is there an ongoing process optimization effort in place? Has the effort improved performance?
3. Audit results should be shared with the sponsor, facility employees and the original team members

EXAMPLE

During the data gathering and analysis phase of the Okarche plant optimization effort, it was noted that the product quality of the stabilizer product and crude oil varied significantly. On average it was of a higher quality than required by the purchaser. Figure 4 is a simple process diagram of the stabilizer system. Further investigation found that the feed flow to the stabilizer varied significantly each day due to limited feed storage and that the stabilizer reboiler required cleaning every three months due to fouling.

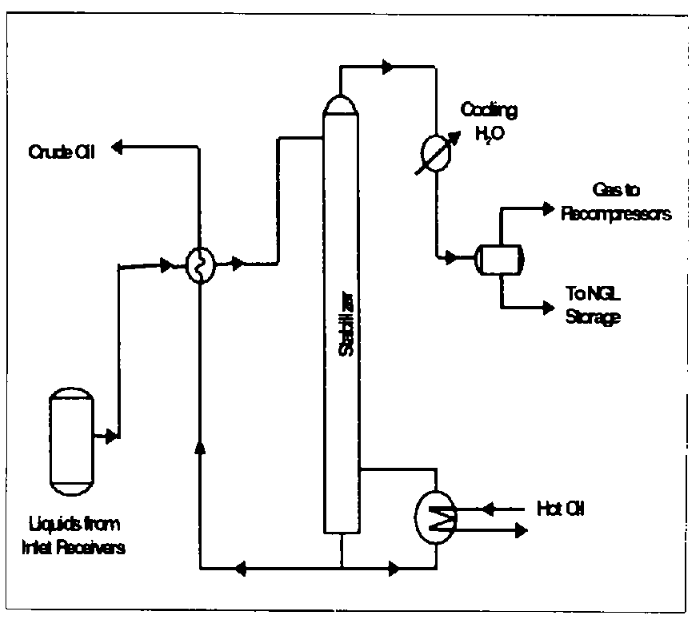


Figure 4. Stabilizer system.

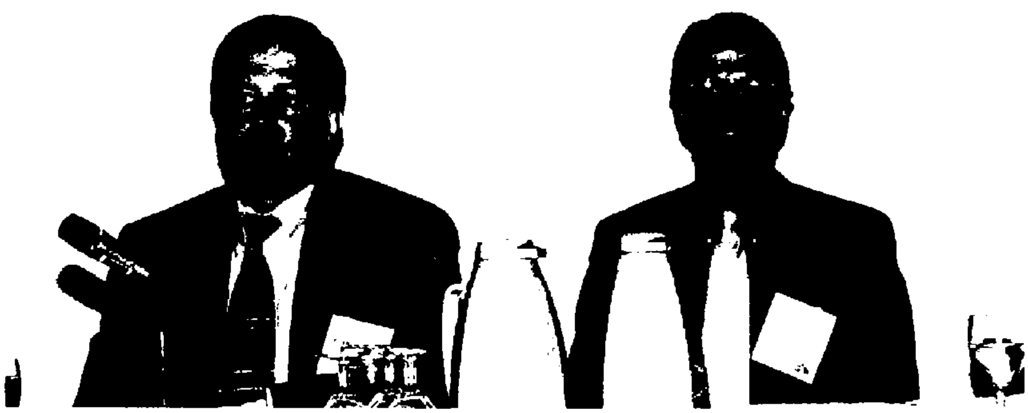
Table I
Stabilizer changes during optimization process

Variable	Unit	Before optimization	After optimization
Feed rate	gals/min	0 to 85	25
Column pressure	psig	90	60
Hot oil temperature	°F	500	400
Column bottoms temperature	°F	375	290
Fraction of feed to bottoms	%	20	50
Bottoms product gravity	degrees API	<60	<65
Reboiler foulings/cleanings	#/yr	4	2
Increase in operating income	$/yr	-	130,000

Performance and multivariable tests were performed and a process model was constructed. The team determined that income could be increased by over $100,000 per year by simply adjusting operating parameters. These operating changes increased income and improved the operating performance of the unit - requiring less operator intervention and fewer reboiler cleanings. Table I provides a summary of the changes made to the stabilizer during the optimization process.

CONCLUSIONS

Optimization is a work process that needs to be integrated into your business process to ensure continuous performance improvement and maximum profitability year after year. GPM is in its second year of installing the optimization process in its facilities. Results to date suggest increases in operating income could be as much as a $0.03 Mscf feed gas.



Francis Foret (l), Warren Petroleum Co., and Jack Whiteside, Barnes & Click, Co-chaired Section A Facilities Design Forum.

Kent Carlisle (r), Texaco E & P; Chris Lindenberg, Hawkins Filtration Products and Rex Specht, Western Gas Resources at the Chapter Officers Meeting.