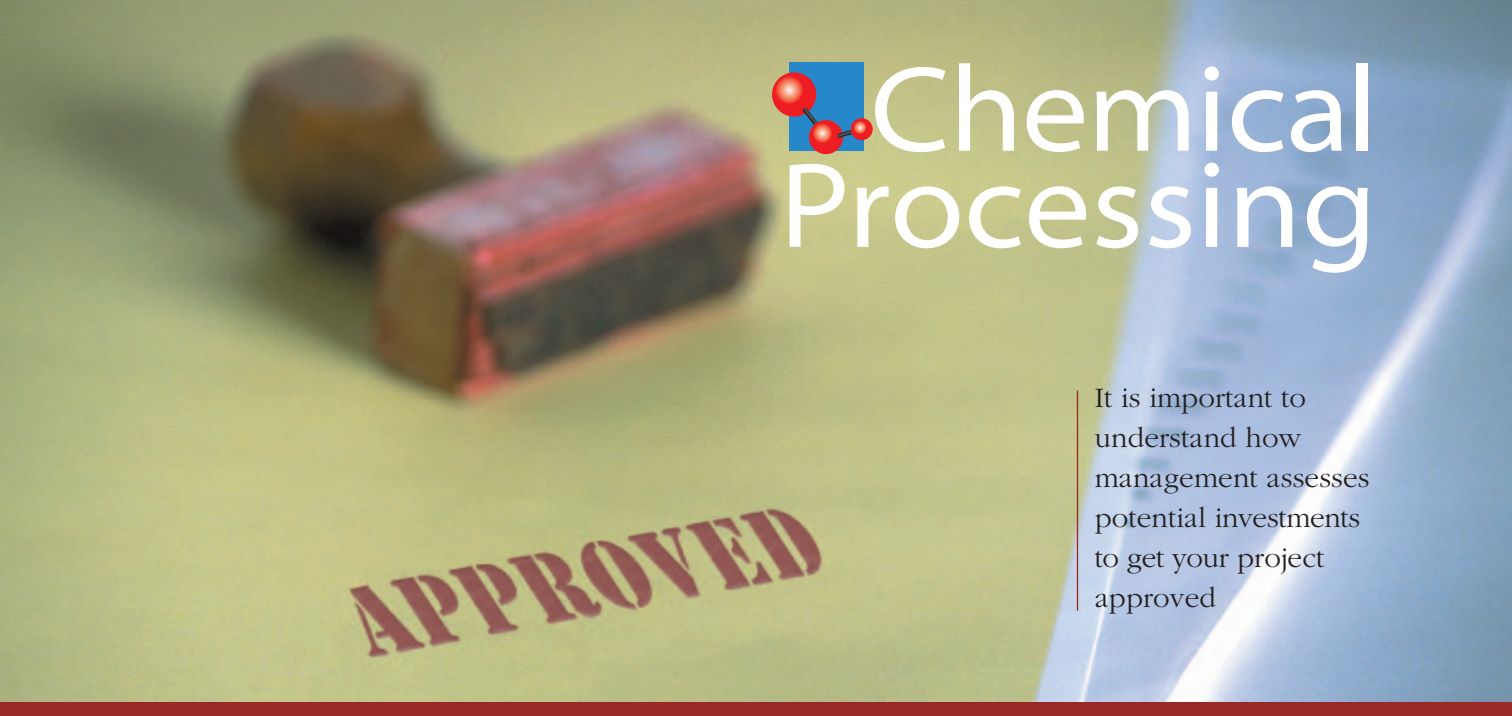

Chemical Processing

It is important to understand how management assesses potential investments to get your project approved

IMPROVE YOUR PROJECT'S PROSPECTS

By Douglas C. White, Emerson Process Management

"NOT AGAIN," BOB THOUGHT. "THE NEW SYSTEM we proposed is not on the approved projects list. This is the second year in a row it hasn't made the cut. I thought everyone here supported the purchase. It would make the plant run better and sure make our lives a lot easier. I just don't understand how those in the head office make decisions. I bet they've never worked in a plant."

Perhaps Bob's comments sound familiar to you. Automation specialists often consider new technologies in terms of the opportunities they provide for improved performance. In contrast, plant and corporate management look at business issues and overall plant profitability. This difference in view frequently leads to misunderstanding and confusion.

Every company has a limited amount of capital available for investment and cannot fund all proposed projects. To stand a chance for approval, new technology must provide a suitable financial return. Many articles have revealed the potential economic advantages and return on investment (ROI) from upgrading automation technology at process plants. Unfortunately, the claimed benefits often are unrealistic and unsubstantiated. This leads to significant credibility issues when the forecast results don't materialize and contributes to management's skepticism about proposals in this area. To overcome such concerns, you must perform an accurate financial analysis for these technologies. We will explain how. This can help you obtain support for your next automation investment.

Understand plant economics

The first step is to realize that the plant is a financial asset. We may think of plants as a collection of equipment and personnel that converts raw materials into products. From a financial point of view, a plant is an asset that consumes money and produces money — it should generate more than it uses. Figure 1 details the major monetary components of a project.

By convention, financial inputs are classified either as expense or capital. Expenses include all the ongoing production costs, such as raw materials, net utilities (those used minus those produced) and operating and maintenance expenses. Capital has investment and working components. Investment capital refers to the cost of major equipment or system additions that will last for several years and can be depreciated for tax purposes. Working capital is the value of inventory and required short-term financial funding.

To prepare a precise investment evaluation, we must understand the language and objectives of financial managers. We can only provide a quick overview; a more comprehensive review appears in standard financial analysis references, such as Brealey and Myers [1].

A company's management strives to increase the long-term financial value of the corporation to its owners. This value can be measured in many ways, most of which, like stock-market valuation, ultimately reflect financial performance. A popular method for evaluating this performance (Figure 2) is return on invested capital (ROIC). This not only is a good internal measure but also correlates with long-term stock-market results. Consulting company McKinsey [2] recently published results of a study of 130 publicly traded chemical companies in the United States and Europe and their financial and

>> Financial Asset

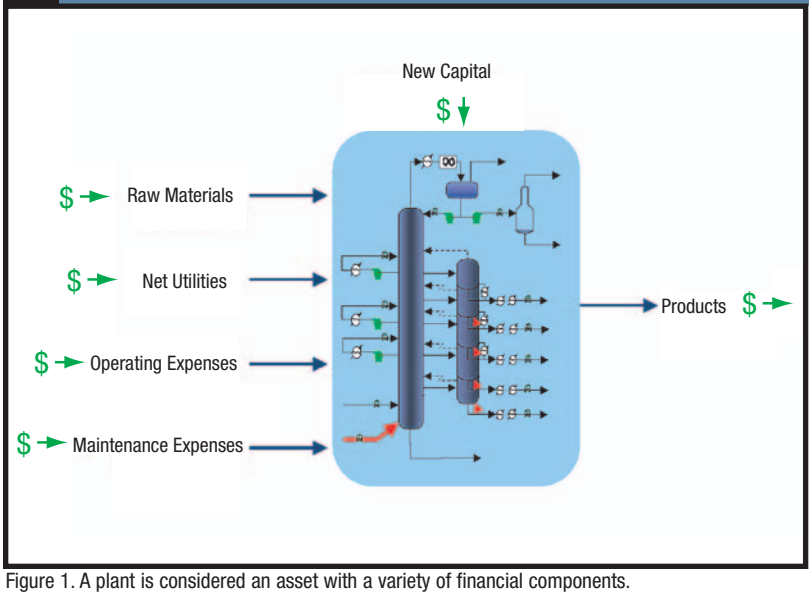

Figure 1. A plant is considered an asset with a variety of financial components.

market performance during a 40-year period. Its conclusion: "Only returns on invested capital drive market-to-book valuations."

The yearly ROIC equals the profit measured as after-tax net income, cash adjusted (ATCA), divided by the invested capital at the start of the year. Invested capital consists of fixed and working capital, plus other assets. The boxes at the bottom of Figure 2 list the primary manufacturing variables that affect ROIC. These variables represent decisions made by plant personnel that impact financial results, and exclude other costs, such as land taxes, for example, outside the control of staff. ROIC typically is evaluated as an average over several years to smooth yearly fluctuations and give a better long-term measure.

From a financial point of view, a plant aims to maximize long-term ROIC. How can automation and advanced automation affect manufacturing cost and revenue components?

Realize potential benefits

To increase ROIC, a plant must reduce capital or increase profit or, preferably, do both at the same time. The boxes at the bottom of Figure 3 illustrate the primary areas where automation and advanced automation savings are normally found. When considering a project, evaluate all possible savings areas.

Potential capital savings include both fixed and working capital components. For instance, an opportunity often exists to cut costs of the automation project itself in areas such as:

- engineering;
- procurement;
- purchase price;
- installation, configuration, calibration and commissioning;
- and project execution.

Working capital can be reduced by lowering inventories of raw materials, intermediates and products and also by decreasing stocks of equipment spare parts. One Middle Eastern refinery estimated a savings of $11 million per year from reduced inventory carrying charges. Capital deferred also results in savings due to the time value of money. (Longer equipment life from better control or more production from the same equipment, which allows postponement of plant expansion, can lead to deferred capital.)

Operating cost savings can accrue from lowering energy/utilities usage and decreasing raw material costs by increasing yields of desirable products. In special cases, it may be possible to substitute a lower-valued raw material.

Improved automation performance and enhanced monitoring of process equipment can cut the costs of all types of maintenance. Specific savings can include reductions in:

- unscheduled maintenance;
- number of routine checks;
- time to perform necessary tasks;
- maintenance materials purchase; and
- number and cost of required activities during scheduled shutdowns.

One Gulf Coast refinery projected savings of $2 million per year by reducing the number of unscheduled equipment shutdowns and slowdowns. A European chemical company realized savings of $1 million per year in maintenance costs at each of seven plants.

Reduced off-specification material can decrease reprocessing costs and, in select cases, allow lower average staffing levels. It also can cut waiting-time penalties from delays in loading ships, etc.

Abnormal event prevention deserves some special comments. Reducing health, safety and environmental concerns is at the top of every plant manager's agenda. Better automation is often a key to decreasing these types of risks. If your proposed investment will result in safer operation or lowered emissions, definitely mention that in the justification description even if no quantitative economic value can be attached to these improvements.

Also factor in the possibility of an increased average selling price for products. Automation can contribute to this goal by boosting the yield of more valuable products. This reduces the amount of lower-valued byproducts and thus raises average revenue per unit feed. Better control also can curb production of off-specification material, which usually must be sold at a discount. Occasionally, an increase in product quality due to improved control will actually permit selling the existing product(s) at a higher price. For instance, a Gulf Coast chemical plant estimated more than $3 million per year in incremental revenue due to higher-value products.

Automation projects also can lead to increased production. For instance, better control can allow a process to operate closer to production limits at constant product quality. Greater output also can result from reduced unscheduled downtime for equipment due to better reliability, shorter batch

cycle time, lower grade-transition time, less product reblending, and decreases in scheduled shutdown duration and frequency. The shutdown frequency can be cut, for example, by lengthening furnace runtime between required decoking or by not having to clean a heat exchanger prematurely.

However, when considering the benefits of potential production increases, the key question is whether the additional product(s) can be sold. More output only provides financial value for production-limited plants, i.e., those manufacturing products for which the market can absorb the increased production. Otherwise, no benefits can be claimed for the improvements.

To estimate the potential magnitude of the overall savings, examine normal expenditures and look for specific quantifiable areas in which savings are possible. Often historical data will provide a basis for this analysis. External consultants with experience in this area also can help ensure that potential savings are not overlooked and are properly documented.

Examine investment costs

Next, you must estimate the necessary investment. When performing such an analysis, it is important to consider the full life-cycle costs, not simply the initial purchase price, of new equipment and software systems. Many studies have shown that more than two-thirds of their life-cycle costs occur after installation.

In assessing initial costs, make sure to include:

- hardware purchases;
- installation costs;
- required infrastructure upgrades, such as networks, etc.;
- software licenses;
- application-specific services like design, configuration, custom coding, database population, system installation, integration and commissioning;
- training for both system support staff and end users; and
- project expenses, such as for management and purchasing.

Then, estimate ongoing maintenance and support costs by considering these aspects:

- hardware support agreements;
- hardware upgrades;
- software support agreements;
- internal support costs;
- necessary ongoing infrastructure upgrades;
- new release migration costs;
- continuing training of system support staff; and
- ongoing user training.

Don't forget the last item — be sure to budget for ongoing training. The best long-term job security today is maintaining your skill level, as well as that of your staff. It is easy to fall into the trap of being so busy with day-to-day problems that you lose sight of the longer-term requirements.

Perform the analysis

We now have benefits and costs. How are these converted into an overall project financial analysis? How can we demonstrate that the proposed investment will increase the long-term corporate ROIC more than other potential investments?

Specific investment-evaluation protocols vary from company to company and you need to follow your company's guidelines. However, all center on comparing the net present value of the incremental after-tax benefits generated to the net present value of the required investment. If the value is greater than the investment, the project is considered for funding. Net present value implies discounting a sequence of net cash flows (receipts less expenditures) back to the current time. There are many subtleties, though.

Initially, it might seem that the proper discount rate simply needs to be a little higher than the average corporate ROIC. After all, if the investment value were positive, then the ROIC would increase and the investment would be justified. However, the correct selection of the discount rate is more complicated. Three interrelated factors must be considered. The first is how much the corporation must pay to get additional funds used for investments. This cost is significant and differs for each company. It is based on the relative use of debt and equity and therefore is called the *weighted average cost of capital*. Investments obviously must produce a return that exceeds this cost, so the discount factor needs to be at least this amount.

The second factor reflects a corporation's alternative options for both internal and external investment. The discount rate must be greater than the return from standard financial investments or else the company will invest its money there. (Alternatively, the firm could pay a dividend to shareholders with the cash and the shareholders themselves could invest in these standard investments.)

The third factor, closely related to the second, accounts for the differ-

>> Return on Invested Capital

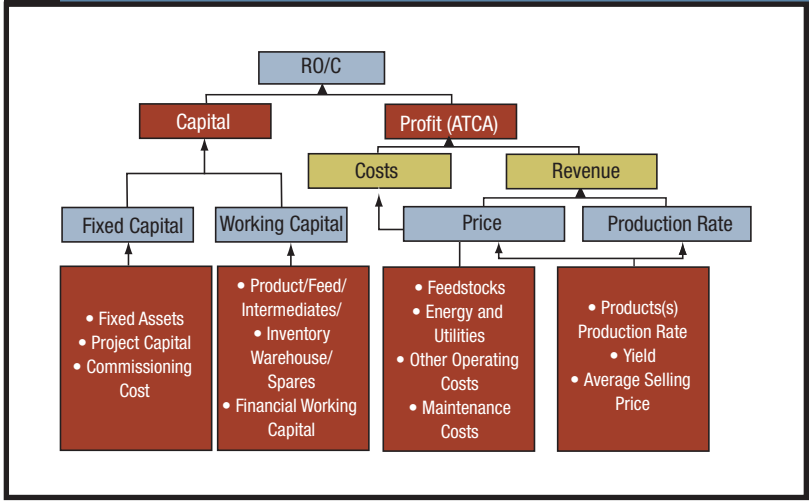

Figure 2. This critical measure of performance equals profit divided by capital.

>> Potential Automation Effects

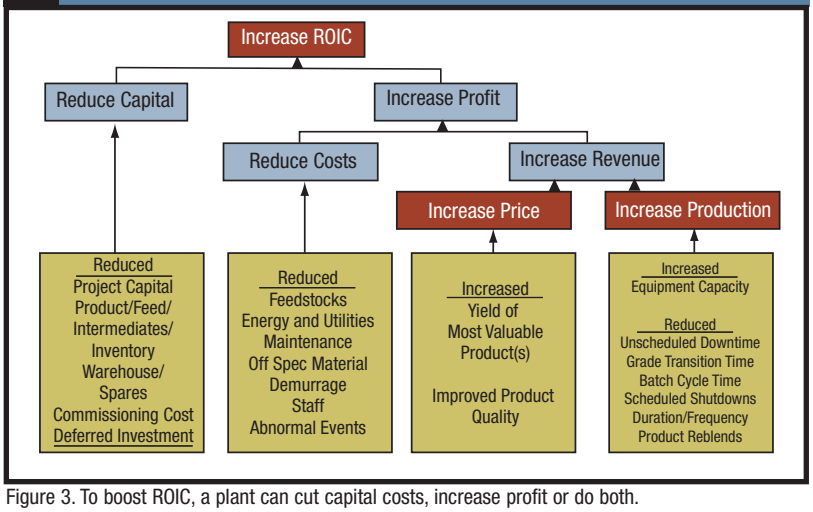

Figure 3. To boost ROIC, a plant can cut capital costs, increase profit or do both.

>> Cash Flow Profile

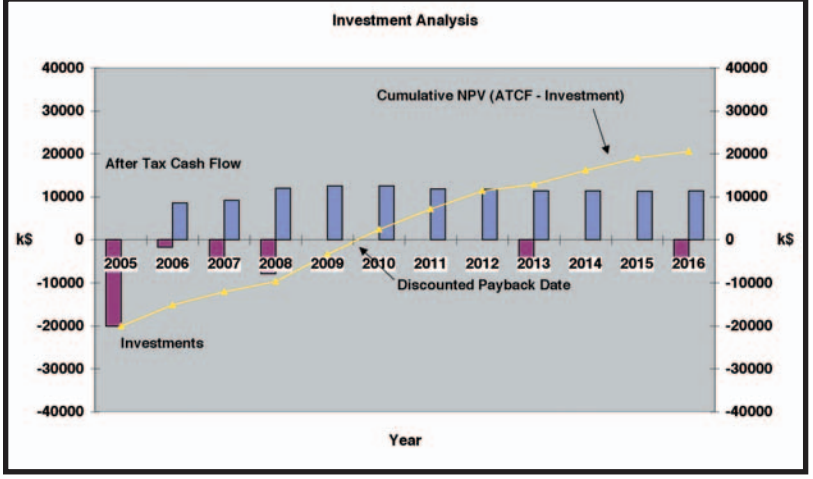

Figure 4. This chart illustrates how quickly payback on investment will occur.

ences in the predictability of the cash flows produced by investments. The cash flow from a new pump is likely to be much more predictable than that from a new software system that has never been installed in the plant before. In accordance with financial analysis theory and practice, when the actual value of the cash flow is not fixed but can only be estimated, a risk premium that recognizes the uncertainty or *riskiness* of the estimated cash flow should be added to the discount factor. More complete explanations of these factors are available in financial analysis texts such as Brealey and Myers [1]. Again the standards used by your company should be the ultimate guide.

The financial analysts will then compare the profitability of various investment proposals from all parts of the corporation and rank them. One key ranking is the profitability index:

$$PI = 100 \times \frac{NPV\,(ATCF) - NPV(IC)}{NPV\,(IC)}$$

where $NPV\,(ATCF)$ is the net present value of after-tax cash flow generated by the investment and $NPV\,(IC)$ is the net present value of invested capital. Reference 1 provides details on the equations underlying this expression.

It is common to graph the sequence of investments and resulting cash flows as shown in Figure 4. The elapsed time to reach a positive cash flow, i.e., the time at which the discounted cumulative cash flow crosses into the positive region, is important. This is sometimes called the discounted payback period.

Companies obviously favor investments with a higher risk-adjusted profitability index and a shorter discounted payback period than others.

If your project gets funded, the analysis is not over, however. A key to successful long-term project financial management is to regularly, rigorously and objectively post-audit major investments to see whether they achieved their predicted ROI. The first step in this process is to capture a set of base operating data prior to system installation. Comparing these data with operating results after installation of the new system or technology allows calculation of the improvement. (Often this requires correction to standard operating conditions or adjustments due to changes in raw materials or operating conditions.) This analysis can identify areas in which there were unanticipated problems or benefits and lead to better evaluation of future investments.

Make the right case

We all want our preferred investments to be approved. The prospects for success will improve if we understand the criteria by which corporate financial management allocates available funds. We can build the credibility of the value of an automation project by realistically estimating its benefits and costs. **CP**

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