

Understanding Pump System Fundamentals for an Energy Efficient World (Part Three): Calculating Cost of Ownership

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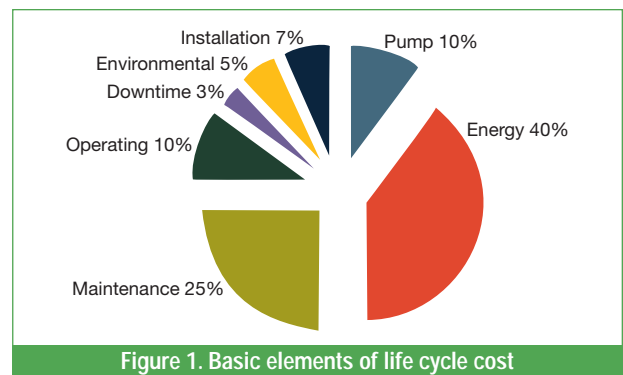
This is the third part of a series based on *Optimizing Pumping Systems: A Guide to Improved Energy Efficiency, Reliability, and Profitability*, written by pump systems experts. This new guidebook continues the mission of Pump Systems Matter™ (PSM) and the Hydraulic Institute (HI) to advance knowledge on pumping systems.

Introduction

In today's business environment, technical and managerial skills are not enough to keep a company at the forefront. Requirements to understand the economic impact of proposed and implemented projects are increasing. Using financial measures to justify projects is becoming paramount. Financial justification is required, not simply desirable, to win project approval and make sound long-term decisions. Fortunately, systems optimization projects can often be justified based on a lower total cost of ownership. Because industrial and municipal pumping systems often have life spans of 15 years or longer, it is valid to consider the total cost of ownership—including energy, maintenance and other elements—for each project.

Life Cycle Cost

A life cycle cost (LCC) analysis is one proven way to determine and compare the total costs for projects. The LCC of any piece of equipment is the total "lifetime" cost to purchase, install, operate, maintain and dispose of that equipment. LCC is a management tool for selecting an optimal solution to create economic and environmental value over the life of a system. Figure 1 shows the basic elements of



LCC. Minimizing life cycle cost often requires trade-offs between cost elements, such as paying a higher initial or installation cost to reduce overall maintenance, energy and downtime costs.

The LCC process will show the most cost-effective solution within the limits of the available data. Pump initial cost and rated efficiency, although often given top priority, are usually only a small portion of total life cycle costs. Studies have shown that in many cases 20 to 60 percent of the energy consumed by pump systems could be saved through piping, equipment or control system changes.

Analyze the Life Cycle Costs Before Making a Decision

Using a life cycle cost perspective during initial system design will minimize operating costs and maximize reliability. A growing number of industrial stakeholders are beginning to promote the use of life cycle costs in pump system specification. The Hydraulic Institute and Europump, both pump manufacturer trade associations, have developed a life cycle cost guidebook to increase industry awareness of the subject.

A highly efficient pumping system is not merely a system with an energy-efficient motor. Improving total system efficiency, instead of the efficiency of one component, is the key to maximizing cost savings. To achieve optimum pump system economics, end users should select equipment based on lifetime operating costs and maintain the equipment at peak performance operation. As presented in the Hydraulic Institute/Europump LCC guidebook, the LCC equation for identifying and quantifying all components is as follows:

$$LCC = C_{ic} + C_{in} + C_e + C_o + C_m + C_s + C_{env} + C_d$$

Where:

- C_{ic} = Initial cost or purchase price (e.g., the pump, pipe, auxiliary equipment)
- C_{in} = Installation and commissioning costs (including training)
- C_e = Energy costs (predicted for entire system, including controls)
- C_o = Operating costs (labor man-hours for normal system supervision)
- C_m = Maintenance costs (e.g., parts, tools, labor man-hours)
- C_s = Downtime costs (loss of production)
- C_{env} = Environmental costs (leakage losses and permit violations)
- C_d = Decommissioning costs (disassembly and disposal)

These elements should also include the administrative costs associated with loans, depreciation and taxes. Energy consumption is a major element in pump life cycle costs. Since excess energy consumption is intrinsically linked to higher maintenance costs, these two elements usually account for the majority of total life cycle cost.

Optimizing Pumping Systems presents several methods for evaluating the economic impact of investment in systems. These are described below.

Return on Investment

The basic idea of return on investment (ROI) is that capital is entitled to a financial return on its use. *Return on* refers to

Table 1: Advantages and Limitations of the Payback Method

Advantages	Limitations
<ul style="list-style-type: none"> • Simple, easy to calculate and understand • Excellent vehicle for screening many capital investment proposals • Measures cash recoverability • Time expression can help to evaluate investment in terms of risk, with appropriate emphasis on cash flows 	<ul style="list-style-type: none"> • Does not take into account the time value of money • Does not consider the benefits of earnings after the investment has been repaid; it is a breakeven measurement, not a profitability measurement • Does not consider the timing of cash flows

some additional amount of money expected from an investment beyond what the company paid for the initial investment. *Investment* may be defined as the use of an economic asset such as money, equipment and manpower, with the anticipation of a gain in the form of additional income (revenues), appreciated value, greater productivity (efficiency) or cost savings.

There are different approaches to evaluate the return on investment.

The Payback Method

The payback method measures the amount of time during a project's life, in years and months, to recoup the investment. Payback does not measure profitability, but cash recoverability. Payback tends to show the risk factor by pointing out the recovery time of an investment. In today's market volatility, the faster the payback, the better. The larger the capital investment, the longer the payback usually takes.

Average Rate of Return

This method evaluates investment alternatives by determining an average return over the full life of the investment. The average rate of return is given by:

$$\text{average rate of return} = \frac{\text{average annual net income}}{\text{average investment amount}}$$

Any return on investment, depending on project type, usually has a corporate guideline attached to it, such as meeting or exceeding the set hurdle rate of the corporation. The hurdle rate is the minimum expected return the company would consider in accepting investment opportunities.

Time Value of Money

The concept of the time value of money recognizes that dollars received earlier are worth more than dollars received later. Neither the payback nor the average rate of return methods account for the time value of money. Two investment analysis methods used to take into account the time value of money are net present value and internal rate of return.

Net Present Value

The net present value method (NPV) discounts future cash inflows and cash outflows to their present value (PV) and then totals these values to arrive at a net positive or negative result. If the present value of cash inflows and cash outflows is positive,

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then the investment will provide a return in excess of the discount factor (hurdle rate) used by the company. The NPV is a financial tool for evaluating economic value added. NPV compares the value of a dollar today to the value of that same dollar in the future, taking inflation and returns into account.

Internal Rate of Return

While the NPV method produces a positive or negative dollar figure that indicates whether the proposed investment will earn a return greater or less than the company's hurdle rate, the result of the internal rate of return (IRR) method is a percentage amount. This percentage figure represents the actual rate of return earned by the investment. The IRR of an investment is determined by trying different discount rates in the NPV calculations until the resultant NPV equals 0. The IRR is the rate at which the present value of an investment's future cash flow equals the cost of the investment.

Looking at ROI from a Broader Perspective

When evaluating the return on an individual investment, keep in mind that the firm needs to look at how all assets (current and long-term) are used. Companies with high ROIs attract more investors. One of the primary goals of management is to use all forms of capital (i.e., cash, equipment and plant) and labor in such a way as to maximize the rate of return. Strict return on investment policies, measurement tools combined with intuition and sound business judgment will be needed in the complex, competitive world of the 21st century.

Companies will invest heavily in more information technology and advanced automation equipment in the next decade, so greater use of ROI is anticipated. Specifically, ROI techniques have the following benefits and applications.

A company has a number of options available to them when faced with investing in a relatively large capital project. Both short- and long-term business health depends on the financial decision-making process.

Life Cycle Costing methods are integral to the decision-making process for optimizing existing pumping systems. This concept will be explored in greater detail in Part Four of this series of articles based on *Optimizing Pumping Systems: A Guide to Improved Energy Efficiency, Reliability, and Profitability*, now available for purchase at www.PumpSystemsMatter.org or www.Pumps.org or call 973-267-9700 ext. 18.

P&S

Launched in 2006 by the Hydraulic Institute as an educational initiative, Pump Systems Matter helps North American pump users gain competitive business advantages through strategic, broad-based energy management and pump system performance optimization.

Table 2. Advantages and Limitations of the Average Rate of Return

Advantages	Limitations
<ul style="list-style-type: none"> • Consistent with and relates to accounting data; i.e., profit and cost of investment • Provides a rough financial guideline to screen opportunities • Relatively easy to calculate • Reasonably accurate with projects that have long lives and consistent cash flows • Doesn't require access to detailed company records 	<ul style="list-style-type: none"> • Does not recognize the time value of money • Does not give weight to the amounts or timing of cash flows • Assumes that the investment and benefits will last for the depreciable project life • Too simplistic for major investments that would affect overall business performance

Table 3. ROI Benefits and Applications

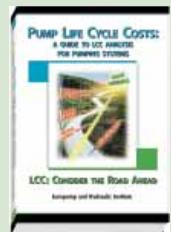
Benefits	Applications
<ul style="list-style-type: none"> • Aids in planning and decision making • Better evaluates investment opportunities • Measures management performance 	<ul style="list-style-type: none"> • Make or buy decisions • Lease or purchase decisions • Major acquisitions or divestments • Improving asset utilizations

PSM strives to provide the market with education, training, tools and collaborative opportunities to integrate pump system performance optimization and efficient energy management practices into normal business operations. For more information, visit www.PumpSystemsMatter.org.

*An additional resource available to further understanding of the total cost of ownership of pumping systems is *Pump Life Cycle Costs: A Guide to LCC Analysis for Pumping Systems*, developed by the Hydraulic Institute and Europump. This guidebook logically and clearly presents engineering, design, specification and analytical methodologies for optimizing pump systems designs and maximizing pumping system lifetime cost savings. It describes essential pumping system components and considerations necessary to specify, design and operate the system for minimum life cycle cost.*

The Pump Life Cycle Costs Guide includes:

- LCC formula and step-by-step calculation chart
- System design for maximum ROI, minimum cost
- Analysis of existing pumping systems
- Extensive life cycle cost analyses
- Bibliography supplemented by case histories and over a hundred cost-saving curves, formulas, flowcharts and diagrams



The Pump Life Cycle Costs Guide is available for purchase at www.Pumps.org or www.PumpSystemsMatter.org or call 973-267-9700 ext. 18. This guidebook includes the tools needed to maximize LCC savings, including the management of pump systems, methods for analyzing existing pumping systems, LCC analysis examples, procurement examples, inspection and LCC calculation.