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Capital Equipment INVESTMENT

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Capital Equipment Investment

In the ongoing battle for survival and profitability in manufacturing, having the latest technology is more important than ever. It allows shops to do more in one operation with less direct labor, produces more-consistent, higher-quality parts, and helps reduce the cost-per-piece produced.

Still, some shops, accustomed to the 'way we've always done it,' may feel old technology will see them through. It won't. At least not in this global market. The need to understand how to invest profitably and wisely is urgent—if you want to be competitive. Buying new technology is a strategic decision to ensure the future competitiveness of your company. Evaluate it properly and thoroughly.

Justifying new technology is a multistep process that requires a thorough assessment of a number of factors at work in your manufacturing operation.

- First, understand your costs:
- Use a transparent costing system.
- Evaluate *all* cost factors.
- Evaluate the influence of new technology on cash flow.
- Calculate piece-cost and evaluate the influence of investing in new technology on production cost and return on investment.

The truth about ROI in machine-tool technology

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Secondly, understand the potential of measurable benefits of CNC technology, which include productivity, reduced setup and tool-change time, improved uptime, improved throughput, lower scrap rate, reduced tooling cost, and lower maintenance cost and job-preparation cost.

There are also intangible benefits, which may not be calculable, but which can have a major impact on your machining success. Quality, accuracy, and surface finish should not depend on operator skill and should not require constant checking. A single-step, drop-off-complete process can be readily adapted to new part designs at minimum cost. If a new part comes in the door, you will be able to reprogram and quickly retool to handle it. Don't buy a machine to produce only today's parts. Preset quick-change tooling with standardized inserts saves production time—up to 15% or more compared to setting the tools on the machine, making the machine productive for a greater part of the shift. And today's CNC equipment is environmentally friendlier. With new liquid-cooled machines, heat can be recycled into the plant in cold months, or vented outside during the summer, reducing plant cooling cost. In addition, power consumption on new machines is lower due to quicker acceleration—less than 1 sec—thus using less power to reach desired spindle speeds.

Finally, understand the costs associated with older equipment. They have lower efficiencies, longer than planned setup times, and require "tweaking" to successfully run good parts. The skilled personnel to set up and operate them are a vanishing breed. Typically, older equipment is incapable of meeting today's quality requirements and can't statistically hold tolerances. Older machines produce excessive scrap, possibly throwing away, at today's material prices, \$1 each on a large 12L14 steel part. They are subject to frequent, unplanned downtime for repairs and costly maintenance.

When it comes to figuring the payback, many US companies try to justify the purchase of capital equipment based on a two or three-year payback. This approach forces the purchase of less expensive or dedicated machines at the outset, and ignores the impact of new parts and new work beyond that in 5–6 years. It may cost more today to account for the possibilities in 5–6 years, but making a farsighted decision now actually can avoid future capital expense. Remember, today's capable machines have a useful life that extends far beyond two years.

There are a number of ways to evaluate the payback of new technology. Doing a Return on Investment (ROI) analysis

can help you make a good decision on whether to buy an expensive or less expensive machine.

ROI analysis indicates how the investment will impact a company's cash flow, based upon the revenues and expenses associated with the project. ROI is given as a *percentage rate of return*.

"Remember, today's capable machines have a useful life far beyond two years."

The company performing the ROI analysis must determine the rate-of-return for the investment based on the project cost and the impact the investment would have on its cash flow. Once the rate-of-return is determined, the company must then decide if it is an acceptable rate of return. Typically a 20% or greater rate-of-return is considered acceptable.

There's more, however. This justification method does not consider important technical and strategic concerns involved in maintaining competitiveness. Quality, for instance, is one of today's top priorities for equipment end users. This factor is a good example of what is not fully recognized in an ROI analysis. Quality depends not only on the type of equipment being used, but also on the process, such as making parts complete in a single step, eliminating handling and resetting.

While the ROI analysis method has traditionally been used to analyze high-volume, multiyear projects, it can also be used to analyze the wisdom of buying a machine for low-volume production of a large variety of parts over a number of years. There are many additional factors that you might want to consider, such as tax implications regarding new machinery.

You can use an Excel formula, *Internal Rate of Return (IRR)*, to calculate ROI. The rate of return "r" is calculated on the sum of cash flows for a defined number of years, and the total of the sum (the net present value) to be zero, $NPV=0$.

The rate of return "r" is an indicator as to how fast the investment is depreciated, how long the payback period is, and how high the rate of return is. Depreciation cost depends on hr/yr runtime and number of depreciation years.

This calculation emphasizes the importance of productivity, because productivity is the key factor influencing the return rate.

Alternatively, *the detailed piece-cost calculation method* using an Excel spreadsheet is helpful in comparing different

Purchasing

types of equipment for the same project and understanding the importance of productivity.

Preparatory data consist of two parts: 27 lines of input data—overhead factors which can change slightly no matter what machine you have—from lot size to interest rate to number of labor hours per machine; and the calculated data, which are automatically calculated by Excel. These 21 factors include the plant's per-hour costs from depreciation to personnel and tooling, to programming and set up. The result is production cost-per-piece.

Note that ROI is not necessarily the same as the profitability and competitiveness. Profitability depends on the cost-per-hour rate of the machine being considered for purchase and the impact of the intangible benefits. Depending on a company's capital-investment decision, the cash-flow impact can be quite different from long-term competitiveness and profitability.

It is possible to have a high ROI and a low profitability, and the opposite is also true.

Look at a new machine purchase from both standpoints. Perform an ROI analysis, and also look at the long-term impact of the investment. Although profitability may initially be higher

when looking at a lower-priced machine, due to long-term benefits—such as durability, flexibility, reduced cycle time, and better part quality—the higher quality machine purchase can be the most favorable choice for the precision-parts producer.

In the following example, the influence of investment cost as well as the influence of productivity on the piece-cost can be demonstrated by looking at an actual case study of two machines.

Three possibilities were examined:

1. Decreasing the cost of the lower-priced machine (Investment Justification Chart A).
2. Increasing the price of the higher-cost machine (Investment Justification Chart B).
3. Increasing productivity to show the impact it can have on true piece-cost. (Investment Justification Chart C).

The detailed piece-cost calculation method using an Excel spreadsheet is helpful in comparing different types of equipment for the same project, and understanding the importance of productivity.

In each case, we began with realistic input data for each machine tool, including a 50,000-piece lot size with five lots per year, programming time of 360 min for each machine, a

Chart A Influence of Lower Investment Cost on Piece

Investment Cost machine A vs. B						-20%	-40%
Item #	Input Data	Unit	A	B	B	B	
1	Lot size	pcs/lot	50,000.00	50,000.00	50,000.00	50,000.00	
2	Number of lots	lots/yr	5.00	5.00	5.00	5.00	
3	Cycle time	sec/pc	72.00	90.00	90.00	90.00	
4	Set-up time (on the machine)	min/lot	40.00	55.00	55.00	55.00	
5	Set-up time (outside the machine)	min/lot	0.00	0.00	0.00	0.00	
6	Presetter time	min/lot	30.00	30.00	30.00	30.00	
7	Programming time	min	360.00	360.00	360.00	360.00	
8	Computer time	min	0.00	0.00	0.00	0.00	
9	Cost of replacement or purchase price of machine	\$	585,000.00	390,000.00	312,000.00	234,000.00	
10	Power consumption	KVA	45.00	45.00	45.00	45.00	
11	Space required	sq. ft.	200.00	200.00	200.00	200.00	
12	Depreciation years	yr	5.00	5.00	5.00	5.00	
13	Number of operating hours per year	hr/yr	5,000.00	5,000.00	5,000.00	5,000.00	
14	Efficiency	%	84.00	84.00	84.00	84.00	
51	Total production cost per piece	\$/pc	2.40	2.62	2.51	2.39	

In order to compete with the more productive machine, the cost for the lower priced machine would have to be reduced by 40%.

similar amount of floor space and power consumption, depreciation time over five years, and the same number of operating hours per year (5000 hr).

The main difference was that the initial cost of Machine A was 50% higher than the initial cost of Machine B.

“It is possible to have a high ROI and a low profitability, and the opposite is also true.”

Efficiency, however, was the same for each machine at 84%. Due to cycle-time advantage, however, Machine A had a 20% faster cycle time and a 27% quicker setup time.

The result was that, all other factors between the two machines being equal, total production cost per piece was \$2.40 for Machine A and \$2.62 for Machine B. Total hourly costs, multiplied by productivity (cycle time/efficiency) equals cost-per-piece.

The influence of lower investment cost on piece-cost can be seen in Investment Justification Chart A.

To show the influence of lower initial investment cost on piece-cost, we reduced the cost of the already lower-priced

Machine B by a further 20%, and again by 40%. This showed that to compete with the more productive machine, in terms of cost-per-piece, the cost of the already lower-priced machine would have to be reduced by 40%.

The factors that account for this difference are the shorter cycle time and setup time for the more-costly machine tool. Many machine tool users understand that seconds count, and do all they can to continually reduce cycle times to be profitable against global competition.

The influence of higher investment cost on piece-cost can be seen in Investment Justification Chart B.

Let’s compare the machines another way. In our example, Machine B, costing 33% less than Machine A, had a per-piece cost of about \$2.62, compared to Machine A’s per-piece cost advantage of \$2.40—due primarily to Machine A’s faster cycle and setup times.

That is actually a tough advantage to overcome. Machine A would have to cost even more—30% more—to have a per-piece cost similar to that of the less-expensive Machine B.

The influence of increased productivity on piece-cost can be seen in Investment Justification Chart C.

Chart B Influence of Higher Investment Cost on Piece Cost

Influence of increased Investment Cost on Piece Cost Machine A vs. Machine B

Item #	Input Data	Unit	Remark			20%	30%
				A	B	A	A
1	Lot size	pcs/lot		50,000.00	50,000.00	50,000.00	50,000.00
2	Number of lots	lots/yr		5.00	5.00	5.00	5.00
3	Cycle time	sec/pc		72.00	90.00	72.00	72.00
4	Set-up time (on the machine)	min/lot		40.00	55.00	40.00	40.00
5	Set-up time (outside the machine)	min/lot		0.00	0.00	0.00	0.00
6	Presetter time	min/lot		30.00	30.00	30.00	30.00
7	Programming time	min		360.00	360.00	360.00	360.00
8	Computer time	min		0.00	0.00	0.00	0.00
9	Cost of replacement or purchase price of machine	\$		585,000.00	390,000.00	702,000.00	760,500.00
10	Power consumption	KVA		45.00	45.00	45.00	45.00
11	Space required	sq. ft.		200.00	200.00	200.00	200.00
12	Depreciation years	yr		5.00	5.00	5.00	5.00
13	Number of operating hours per year	hr/yr		5,000.00	5,000.00	5,000.00	5,000.00
14	Efficiency	%		84.00	84.00	84.00	84.00
51	Total production cost per piece excl. material	\$/pc	39+45+50	2.40	2.62	2.53	2.61

Even if the more productive machine’s price would be raised by 30% it would still be competitive.

Chart C
Influence of Increased Productivity on Piece Cost

			Productivity +5%			Productivity +10%	Productivity +15%
Item #	Input Data	Unit	A	B	A	A	A
1	Lot size	pcs/lot	50,000.00	50,000.00	50,000.00	50,000.00	50,000.00
2	Number of lots	lots/yr	5.00	5.00	5.00	5.00	5.00
3	Cycle time	sec/pc	72.00	90.00	68.40	64.80	61.20
4	Set-up time (on the machine)	min/lot	40.00	55.00	40.00	40.00	40.00
5	Set-up time (outside the machine)	min/lot	0.00	0.00	0.00	0.00	0.00
6	Presetter time	min/lot	30.00	30.00	30.00	30.00	30.00
7	Programming time	min	360.00	360.00	360.00	360.00	360.00
8	Computer time	min	0.00	0.00	0.00	0.00	0.00
9	Cost of replacement or purchase price of machine	\$	585,000.00	390,000.00	585,000.00	585,000.00	585,000.00
10	Power consumption	KVA	45.00	45.00	45.00	45.00	45.00
11	Space required	sq. ft.	200.00	200.00	200.00	200.00	200.00
12	Depreciation years	yr	5.00	5.00	5.00	5.00	5.00
13	Number of operating hours per year	hr/yr	5,000.00	5,000.00	5,000.00	5,000.00	5,000.00
14	Efficiency	%	84.00	84.00	84.00	84.00	84.00
51	Total production cost per piece	\$/pc	2.40	2.62	2.30	2.20	2.09

If the productivity of machine A is increased, the piece cost decreases by about the same percentage.

An indisputable way piece-cost can be driven down is through increased productivity. Productivity (cycle time/efficiency) is the only factor that has a multiplying effect on the piece-cost. All other factors only have an additive effect on the piece-cost. These factors, as mentioned above, include preparation cost, investment and depreciation, interest, floor space and power consumption, maintenance, tooling, and wages per hour. Productivity is a big lever.

As the productivity—in this case shown as cycle time per piece—of Machine A increases, the piece-cost decreases by about the same percentage: a 5% increase in productivity reduces piece-cost by about 5%, a 15% more productive machine can reduce piece cost by 15%. This change represents money in your pocket.

Again, the faster the process, the less the piece costs. This is why successful plant floors are relentless in finding ways to shorten cycle times and have discovered many clever ways to accomplish just that, beginning with a side-by-side trial of potential new equipment for their shops.

By following the discipline of a comprehensive justification process, you will help ensure the long-term success of your

operation or area. This approach will reveal the importance of product quality and single-step processes, plus the advantages of flexibility.

Standardizing your production and piece-cost analysis will provide the solid justification you will need to purchase the best possible equipment for your tasks, and positively impact the labor content of your process and the long-term competitiveness of your operations among global competition.

4. If you really want to make your company productive, you must learn that the initial cost of the machine tool is only one factor—and not the most important one. With a 20% increase in productivity—faster cycle times, shorter setup times—you can very nearly justify a machine costing nearly 1.5x more than a lower-cost choice. If the productivity differential is greater than 20%, this differential could increase to 2x or more.

The Truth about ROI is that it is important to take a comprehensive look at all aspects of an investment. **ME**

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