Using Return on Investment (ROI) to Compare Purchase of New or Used Equipment

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Introduction to the Use of ROI in Investment Decisions.

A critical factor in every investment in capital equipment is an analysis of how much profit will be generated as a percentage of the amount of investment. This is known as "return on investment" or simply "ROI".

Presumably, capital investment is being made either to replace existing capacity or develop additional capacity. Additional capacity can be expansion of existing products or adding to a product line. The business planning inherent in the decision must take into account the company's market and market position, ability of the market to absorb more production or accept a new product, and a list of factors well beyond this article. Once the desired capacity is determined, planners must turn theory into practice, and arrange for the design, purchase, install, staff, and start up the new plant.

One of the initial decisions on an expansion project is a project budget. No company, no matter how large, has infinite resources. Every aspect of the business competes for limited resources. Money spent on capital equipment competes with demands for more production personnel, more marketing, more R&D, reduction of debt and ultimately, more payments to ownership. Each claimant to resources (other than distributions to owners) makes it case that "if my department had more resources, the enterprise as a whole would have more money." ROI is a way of determining where to allocate limited resources. Of course each allocation of money will increase the activities of the area of the business to which it is devoted. The key question for finance departments is whether the allocation to capital goods ultimately will produce a greater return to ownership than an alternative allocation such as marketing, R&D or debt reduction. Strategic planners ask the question, if I allocate $x to capital goods instead of more marketing, which alternative will produce a greater return (profit) on the investment.

The analysis can't be short term only, as the return on capital goods will not be immediate as an increase in marketing. Returns must be viewed over time. Funds devoted to marketing will have a sharp decrease in profits after the initial marketing campaign. Funds devoted to capital spending to produce a new product or more efficiently produce an existing product will increase profits year after year. The long term analysis must also take into account that profits earned in the future from a capital investment today may not be worth the same as profits obtained today if there is significant inflation in the meantime. A detailed analysis of return on investment is a search for internal rate of return for the investment over time where profits in each year might not be steady, and must be converted into "today's money" at some inflationary discount rate. This article will simplify many assumptions, but the complexities that are skipped will be at least noted.

It doesn't take a detailed knowledge of finance to see that unless additional investment yields ever increasing returns, it's a bad investment. If a company is already producing all that a market can

absorb, capital expenditures to increase production will not increase return. Assume that manufacturing assets of $25,000,000 is producing $5,000,000 of bottom line income per year, for a 20% ROI on assets. If production is doubled at a cost of an additional $25,000,000 but sales do not increase, the ROI on manufacturing assets drops to 10%. Nor do finance personnel earn promotions for being the first one in the company to understand that if you were able to produce the original capacity for only $12,500,000 instead of $25,000,000 without lowering the $5,000,000 bottom line, the ROI would double to 40%.

Factors to Consider in Making the Decision to Buy Used Equipment.

Used equipment costs less than new equipment. If all things were otherwise equal, it might be possible to get the same production from $12,500,000 of assets as $25,000,000 of assets. Stated simplistically, that doubles ROI. In the competition for the limited resources of an enterprise, used equipment would command a greater allocation.

Of course, all things are not necessarily equal. Used equipment may require more maintenance than new. It may be less energy efficient. If less automated, it may require more personnel. There may be more waste. The remaining useful life of the used equipment is likely to be shorter than new equipment, especially if from the same manufacturer or competing manufacturers of similar quality. Analysis of ROI must be on a net return basis.

Price of New vs. Used

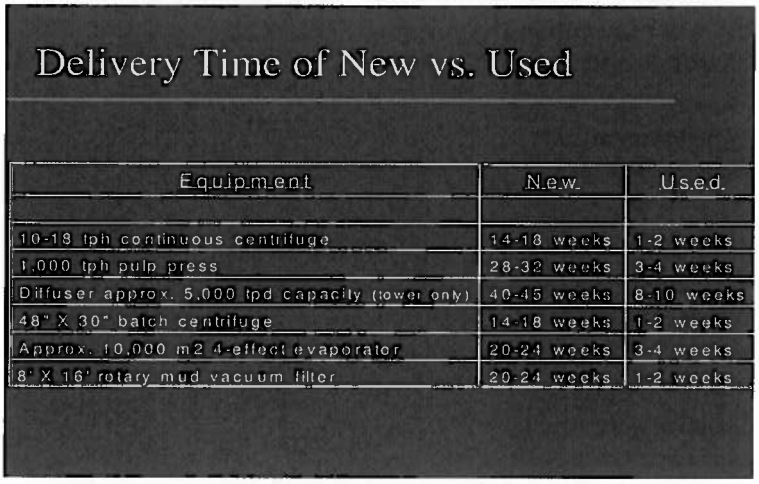
Equipment	New	Used
10-18 tph continuous centrifuge	$ 90,000	$ 20,000
1,000 tph pulp press	$ 580,000	$ 200,000
Diffuser approx. 5,000 tpd capacity (tower only)	$2,500,000	$ 500,000
48" X 30" batch centrifuge	$ 125,000	$ 35,000
Approx. 10,000 m² 4-effect evaporator	$ 750,000	$ 100,000
8' X 16' rotary mud vacuum filter	$ 300,000	$ 50,000

The decision to buy used equipment for some or all of the equipment needed for a project involves many factors. Used equipment by its very nature is not designed to the specification of the re-user. There is nothing the finance department can suggest unless there is suitable used equipment available. It is common that some suitable used equipment is available, but not enough for all the purposes of the manufacturer. In this situation, it may be possible to incorporate the available used equipment into a production line containing new equipment as well. The example used later in this paper is a form of mix and match hybrid.

Used equipment incorporated into an existing plant rarely comes with a performance warranty. It was not designed for the use for which it will be incorporated. When purchasing an entire line or factory, even if a performance warranty is not available, there is often available a recent operating history which may indicate if the equipment can produce as required. In some circumstances this operating history provides an advantage over new engineering - - the prior user has paid for both engineering and the cost of adjustments after use. This "engineering premium" of a line that was previously engineered is another cost saving in the comparison with new unless the purchaser is paying for the engineering of all the equipment, new and used.

Refurbished used equipment may come with a mechanical warranty. The seller warrants that the equipment sold is operational, but does not warranty production capacity is the purchaser's manufacturing environment.

Delivery timing also figures into the comparison. In many situations, an additional major benefit of used equipment is time saved to get up and running. That also figures into ROI. Assume that a sugar manufacturer purchases land with some buildings and infrastructure. It makes a down payment on equipment, hires people, not to run the factory, but for security, maintenance etc. It also incurs cost for the people who analyzed the project, lawyers for permits and other soft costs. These costs are paid at a time when there is no income on the project. Some of these are one time costs, and some (like security and power plant or whatever) continue. Of course they figure into overall project costs for which there
must be a return. However, if a used plant can be gotten up and running faster than new, the return starts earlier, and the overall ROI increases. Consider the advantage of purchasing a complete used sugar mill that can be installed and operating one full campaign earlier than a whole newly constructed mill. There will be a full year's additional operating income. That can be considered as a further cost saving or figured into the discounted returns on the investment.



Delivery Time of New vs. Used

Equipment	New	Used
10-18 tph continuous centrifuge	14-18 weeks	1-2 weeks
1,000 tph pulp press	28-32 weeks	3-4 weeks
Diffuser approx. 5,000 tpd capacity (tower only)	40-45 weeks	8-10 weeks
48" X 30" batch centrifuge	14-18 weeks	1-2 weeks
Approx. 10,000 m2 4-effect evaporator	20-24 weeks	3-4 weeks
8' X 16' rotary mud vacuum filter	20-24 weeks	1-2 weeks

Other financial factors figure into the decision to buy new or used. The more expensive the project, the greater the use of limited borrowing power or capital. Interest costs accrue during the construction phase, and the longer the construction phase, the higher the interest costs. To the extent lenders require a capital investment as a percentage of the loan, the greater the cost, the greater the capital needs of the manufacturer. If the equipment is sourced in a different currency than the country of manufacture, currency conversion restrictions and costs including currency hedging costs are all part of the finance decision. Some of these factors are too variable to work into the hypothetical illustration, but should be considered when making actual decisions.

The purchase of new equipment is more comfortable for every person involved in the decision. There is usually one general contractor or engineering firm to take responsibility. Subject to the usual installation and start up problems, the equipment is expected to work. It is engineered for specific product and conditions. There are warranties. It looks pretty. It is the safe decision. It may not be the best decision.

Case History and Hypothetical.

This paper will discuss a "hypothetical" project, based on a real project completed by the authors' company, Perry Videx, in cooperation with Sakhavtomat, based in the Ukraine. The actual project was to build a section of a proposed ethanol plant from beet reception through diffusion. This paper will simplify the hypothetical project as the initial stages of a 3000 t/p/d beet sugar plant. As we will see,

this simplification will help us allocate plant costs to determine ROI. In this hypothetical, a South Asian company, "Sugarco", wants to reduce the cost of a new sugar factory by using used equipment for beet reception through diffusion equipment. We'll refer to the beet reception through diffusion section as the "Juice Section", the balance of the plant as the "Refinery Section," and the entire project simply as the "Project". As mentioned previously, this kind of hybrid of new and used equipment is not unusual. Used equipment by its very nature can not be manufactured to specification. One can buy only what is available. Sometimes an entire line is available with only one or two items missing, in which case the line can be filled in with new.

In this hypothetical, we'll assume Sugarco has in place all the infrastructure and civil engineering in place required for the Project. Although the infrastructure and civil engineering will be the same whether the process equipment required for the Refinery Section is new or used, not taking into account a cost of the infrastructure will increase the ROI for used over new because assuming the same numerator, the relative increase in the cost (the denominator) will be greater with used.

The Juice Section consists of appropriately sized beet pilers and unloading station, beet sampling and analysis laboratory, stone catchers, leaf trash catchers, washers, beet slicers, and a DDS type diffuser.

It includes spare parts for the equipment and new sharpening equipment for the beet slicers. All of the equipment is supplied cleaned and painted. The diffuser will be supplied completely refurbished, including anti corrosive coating. The pilers also will be supplied refurbished. All of the equipment was manufactured in Ukraine about 30 years previously.

The ex works price for the refurbished equipment and spare parts, all inclusive, is €2,300,000. Shipping costs to site are €400,000. Installation supervision is €300,000 for a total cost of €3,000,000 for the Juice Section.

We will assume that the ex works price of the same equipment if purchased new in Ukraine would be €7,500,000. Similar European built equipment would be considerably more, maybe even double. This paper will assume that Sugarco is satisfied with equipment manufactured in Ukraine and compare new Ukrainian with used rather comparing with European sourced equipment. As all equipment is Ukrainian sourced, shipping will likely be the same €400,000. Based on these assumptions, a Juice Section, built new in Ukraine, delivered and installed will cost €8,200,000 plus the cost of engineering.

Engineering is done for the entire site. It is the same whether new or used equipment is purchased for the Juice Section. Installation supervision is an additional cost, but this supervision will be the same for used or new equipment.

Used equipment often comes without warranty. In the actual sale on which this hypothetical is based, seller offered a mechanical warranty but not a performance guarantee. An engineering firm was engaged by Sugarco for the design of the entire mill. A performance guarantee was provided for both the new and used sections. This is not always the case with incorporated used equipment. The entire cost of engineering in this hypothetical is €2,000,000. It will be allocated between the Juice Section and the Refinery Section based on their relative costs. This is a bit arbitrary, but will serve the purpose to illustrate the methodology of ROI analysis.

Dismantling and refurbishing of the used equipment for the Juice Section will take about 90 days. Arranging for the design and fabrication of new equipment for the Juice Section will take a year. Once

the refurbishment or fabrication is complete, the remaining time to ship and install would be substantially the same. There were several financial advantages to the use of used equipment discussed above. The most important was that the rapid deployment of used equipment can allow a manufacture to earn profits much sooner. That will not be the case in a hypothetical such as ours, because the Juice Section by itself does not have an end product. We'll assume that the timing of the Juice Section is coordinated with the construction of the balance of the Project. However, even without the value of an extra cycle of profits, there are other financial repercussions o f using used or new equipment. There are the factors of higher borrowing, increased interest, currency considerations and investment requirements.

The period of time between order and delivery for the Juice Section in this hypothetical is roughly 6 months for used, and 15 months for new. Even assuming that the supplier does not require full payment and that the new supplier will accept progress payments, the length of the loan is greater for new than for used. Borrowing costs are volatile. Purchasing in euros or other foreign currency adds another level of cost and complexity. For the purposes of this article, it will be assumed that Sugarco can borrow 10% and that the entire cost of the equipment will be financed. It is assumed that the supplier of equipment will accept 50% of the cost of the equipment at time of order, a progress payment 6 months before delivery, and the balance upon shipment. With the used equipment, time of order and 6 months before delivery are the same time, so 75% of the cost is incurred on order.

Maintenance and depreciation of used equipment will be somewhat higher than new. In this hypothetical, the main pieces of equipment were fully refurbished. New or used equipment require the annual replacement of knives and other annual maintenance costs after each campaign. The hypothetical assumes annual maintenance costs are the same, but to take into account the age of the used equipment, a sinking fund of 2% of the cost of the used equipment will be added after the 15th year of a 25 year useful life.

In other respects, the annual cost of used and new equipment in the Juice Section will be the same. Energy efficiency can be important in some sections of a sugar mill, but the Juice Section is not a heavy user of energy, and we will assume the refurbished equipment is similar to comparable new equipment in energy costs. Operating personnel will be the same.

Sugarco's factory has a capacity of 3,000 tons per day. The cost of the Refinery Section is €50,000,000 plus engineering. When completed and operational, each year's campaign will process beets for 200 days a year because Sugarco is located in India and it is possible to process two crops. If the extraction ratio is 14%, the amount of sugar produced will be 42,000 tons. The sugar will be sold for an average of €225 per ton. Sugar revenues would be €18,900,000 annually. Revenues and expenses for other byproducts such as animal feed will not be considered in this simplified hypothetical.

Sugarco can obtain beets for €23 per ton. Operational expenses attributable to sugar production will be approximately €30 per ton. Operational profits after allowance for a start up period, and unadjusted for inflation, each year will be

Tons per Day Produced		3,000
Production Days		200
Total Beet Processed		600,000
Extraction Ratio		14%
Annual Production (in Tons)		84,000
Revenue per Ton of Sugar	€	225
Cost of Beets per Ton	€	23
Operational Costs per Ton Produced	€	30
Total Revenues	€	18,900,000
Cost of Beets	€	13,500,000
Operational Costs	€	2,520,000
Operational Profit	€	2,880,000
Operational Profit Percentage		15.24%

Operating profit does not include general and administrative costs. In this instance, it also does not include depreciation on the equipment, as that will vary between new and used.

The next assumption is certainly simplified: If the cost of Refinery Section is €50,000,000, and plant engineering is €2,000,000 the operational profits can be allocated between the Juice Section and the

Refinery Section as follows:

	Used	New
Cost of Juice Section		
Equipment Cost	2,300,000	7,500,000
Shipping	400,000	400,000
Installation Supervision	300,000	300,000
Subtotal before Engineering	3,000,000	8,200,000
Interest Rate	10%	10%
Downpayment %	75%	50%
Downpayment	1,725,000	3,750,000
Months of Loan	6	15
Interest Cost	86,250	468,750
Lost Operational Profit	0	0
Subtotal - Financial Cost	86,250	468,750
Total Cost of Juice Section	3,086,250	8,668,750
Cost of Refinery Section	50,000,000	50,000,000
Engineering	2,000,000	2,000,000
Total Cost of Plant	55,086,250	60,668,750
Allocation to Juice Section	5.60%	14.29%

The relative cost of the Juice Section if all of the factory were built with new equipment would be 14.29%. As a simplified assumption, this paper will allocate 14.29% of all operating revenues to the Juice Section. This is true for both the use of new and used equipment in the Juice Section. The refurbished used equipment will produce the same amount of end product as using new.

Calculation of ROI

At this point, we can calculate a simplified ROI. This is simplified because it assumes that the annual operating costs of using new or used equipment in the Juice Section will be the same. We will consider some of the complexities after looking at the simplified calculation.

We have seen that the anticipated operating profit of Sugarco's new mill will be €2,880,000. Of this, we have determined that 14.29% should be allocated to the Juice Section. To determine the simplified ROI on the Juice Section investment, we simply take a fraction, the numerator of which is the annual allocated profit of €411,513 and the denominator of which is the cost of the Juice Section. If used equipment is installed, the denominator is €3,086,250, and the ROI is 13.33%. If new equipment is installed, the denominator is €8,668,750, and the ROI is only 4.75%.

This is nice to know, but all it proves is that if you can get the same net income from a lower investment, your returns expressed as a percentage of the investment will be higher. This may often be the case with used equipment. The remaining life of a used stainless steel tank may exceed the useful life of the rest of a new installation, so of course it is better to buy the used tank. With mechanical equipment, an older item, even if refurbished, may require more maintenance or be less energy efficient in a process than new. That would become an annual cost in determining operating costs allocated to used equipment, just as increased depreciation and interest costs would be used in the determination of the annual cost of new equipment. For the hypothetical Juice Section, the refurbished equipment will require the same annual upkeep as new equipment, and the difference in energy consumption or required labor is not significant. However, it is used equipment, and as it gets further from the date of the refurbishment, it may require more maintenance than the new equipment. Let's give a simplified example, which will allow us to look at internal rate of return percentage as a better guide to ROI than the simple fraction above.

Earlier in this paper, in setting out the hypothetical facts, we assumed that the used equipment would begin to required additional maintenance after 15 years of use equal to 2% of the initial cost. We were looking at a project with 25 years total expected useful life. The assumption is that there is annual maintenance for all equipment, new or used, but that the annual maintenance for the used equipment would be higher than the new equipment by €61,725 per year which is 2% of the original cost of the used equipment.

This does not change the simple calculation for ROI for new equipment, as this extra expense does not apply to new. It does change the calculation for the used equipment. The return on the used equipment must take into account a return that is not the same every year. No simple fraction can compute the return.

The answer is another financial calculation - - internal rate of return, or IRR. We know the amount of the investment, which is €3,086,250. We know that in years 1 through 15 the investment will return €322,846, the same as if new equipment. We know that in years 16 through 25 it will return only €261,123 because of the extra maintenance charge of €61,725. The IRR is approximate 8.9%. Put another way, if an investor paid €3,086,250 for an annuity contract that paid a combination of interest and principal of €411,513 for 15 years and then received €349,788 for 10 years and no further payments, the returns to the investor would be equivalent to interest of 12.37% plus his principal. The calculation of IRR is complex, but financial calculators and spreadsheets such as Microsoft Excel have built in calculation functions to solve IRR for any series of uneven cash flows against an investment.

Here's what the IRR calculation, looks like on an annual basis. As simple as it is, note that it computes a simple percentage for calculation even though the net return is not the same for all years. We only make one major change in return in this analysis, but the methodology applies even if there are adjustments in every year.

Year	Juice Section Operational Profit	Reserve for Extra Maintenance	Annual Net (Used)
Investment			-3086250
1	411,513		411,513
2	411,513		411,513
3	411,513		411,513
4	411,513		411,513
5	411,513		411,513
6	411,513		411,513
7	411,513		411,513
8	411,513		411,513
9	411,513		411,513
10	411,513		411,513
11	411,513		411,513
12	411,513		411,513
13	411,513		411,513
14	411,513		411,513
15	411,513		411,513
16	411,513	61,725	349,788
17	411,513	61,725	349,788
18	411,513	61,725	349,788
19	411,513	61,725	349,788
20	411,513	61,725	349,788
21	411,513	61,725	349,788
22	411,513	61,725	349,788
23	411,513	61,725	349,788
24	411,513	61,725	349,788
25	411,513	61,725	349,788
IRR	on Total Project Investment and Return		12.37%

In analyzing the installation of used equipment at Sugarco, the IRR and the ROI are equal concepts. On the basis of the assumptions in this article, the ROI for using new equipment for the Juice Section at Sugarco is 4.75%. As our assumption has no change in the annual net for new equipment, the ROI and IRR are the same. The ROI for used equipment is 12.37% after taking into account the extra costs in the last 10 years. The used investment returns more than two and a half times as much as using new equipment.

The assumptions used for this hypothetical are just that - - a hypothetical. Many have been simplified to make the explanations easier. Nevertheless, the methodology will apply to more complex factual situations. Determine the amount of the investment, new against used. Project a net return after all costs for the useful life of the project. The annual net return will most likely vary from year to year, but IRR will take this into account. Calculating the annual returns over time against the investment for new equipment versus used equipment will yield a simple return percentage for comparison and aid in the decision whether to purchase new equipment, used equipment, or a combination of both.