MACHINE HOUR RATES AND PROFIT PLANNING FUNDAMENTALS

The Insomniac Converter's Handbook

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guiding business toward excellence

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- What does it cost our company to produce a single job?
- Where should we set the quoted price so that we get the most potential profit without losing the order to the competition?

If we can successfully answer these two questions, there is nothing else standing between us and a satisfying, successful career in the converting industry.

The good news is, the answers are not all that difficult to find.

Since the selling price is often (but not always) set by the marketplace, it's critical to examine cost first, to create a yardstick by which we can evaluate what the market may offer.

The Direct Approach to Cost

Cost is primarily composed of two elements: hours required and dollars per hour. First, we must be able to determine the time a job will consume on each production center. Second, we must figure out what cost per hour to assign each of these machines. Our discussion will concern itself with the second element of cost: the machine hour rate.

A machine hour rate, or MHR, is the total of every cost incurred by a production center over an entire year, divided by the hours that production center is expected to need to produce jobs. Management must determine exactly what elements of cost need to be included in that annual budget. As we learn more about the nature of cost, we'll find that only the direct, or variable MHR is appropriate for determining cost.

Profit planning is the systematic evaluation of cost in order to identify and maximize profit opportunities. Its scope stretches from machine hour rate construction to machine productivity, contribution, variance and waste analysis, and salesperson, product line, and market evaluation. If we treat profit like any other budgeted expense, the schedules we prepare—and their resulting MHRs—will plan for the profit we want to achieve by year end.

Variable Cost accrues as a function of the job. Fixed Cost accrues as a function of time.

Using profit planning and variable MHRs, a boxmaker can quantify the profit potential of each order and with a small amount of management can substantially increase the bottom line.

Here are the basic Profit Planning formulas:

Contribution = Revenue – Variable Cost
Profit = Contribution – Fixed Cost
CF = Contribution ÷ Revenue

Variable cost accrues as a function of the job, or items that are directly identifiable with the manufacture of an order. Variable costs include direct labor (such as pressman and helpers), supplies (such as blankets, rollers, and glue), variable overhead (such as load movers and balers), and direct materials (such as paper, ink, and corrugated paper).

Variable cost does *not* include the salaries of management, the cost of depreciation and interest, the sales force, estimating, or the president of the company's salary. All these are fixed costs, or costs that accrue as a function of time, no matter how many jobs are run.

When we estimate a job, we need to lay the fixed costs aside temporarily and use variable MHRs to determine cost. Any time we try to apportion fixed costs to a machine, we need to use an allocation factor, say spreading rent by square feet. Any allocation factor will be wrong by its very nature because they're all arbitrary. Why bother trying to squeeze a round peg into a square hole? For example, it doesn't make sense to ask how much rent any job uses. But it's perfectly legitimate to ask how much we'll pay the pressmen to run this job. In addition to having to allocate the fixed costs by production center, we would have to guess how many hours to spread it over.

When considering new business, it's easier to find the most competitive price when we know where our out-of-pocket costs end and our fixed costs begin.

What about a new piece of business that will allow us to add another shift in printing? If the

MHR we use includes fixed costs, the rates will fluctuate depending on our planned hours and we will not be able to make an intelligent pricing decision. One of the major benefits of using variable cost MHRs is that they remain relatively stable, regardless of the accuracy of our volume estimates. It is true that as we add more shifts we increase labor cost if we have shift differentials, or that power cost per KWH is lower in off-peak hours. But these differences are inconsequential when looking at most pieces of business.

Contribution is what's left after we've covered all the variable costs. One dollar of contribution pays for an equal dollar of fixed cost. Because boxmakers need to take many orders during the year before the fixed "nut" is covered, we measure the amount of contribution on a job-by-job basis. Once the total contribution exceeds total fixed costs, we can truly say we are making money.

In addition to measuring the amount of contribution, we also measure the rate at which it accumulates. Contribution dollars divided into the sales revenue equals the contribution factor, or CF. An order that has a CF of .250 contributes 25 cents of each sales dollar toward fixed costs and profit.

Creating the Profit Plan: The Big Picture

We know the importance of determining variable cost when making pricing and manufacturing decisions. But before we can apply this knowledge, we must create a yardstick against which to judge the potential profitability of any one order.

The first step is to create a profit plan, or a snapshot of the company for the coming year, describing not only what costs it will incur but also how much money it hopes to make. It may help to think of the profit plan as a quotation for a single job the size of an entire year's volume. A simplified version for A Packaging Company appears in Exhibit 1. (Please note that for all of the following exercises, bookings are assumed to equal shipments.)

In Exhibit 1, the company expects to do $15,000,000 in sales. If our variable costs are $12,000,000, that will leave $3,000,000 of contribution to cover fixed costs of $2,250,000. If we've projected accurately, we'll have $750,000 left over, and therefore realize a profit of 5% on revenue. To achieve the profit plan goal, 20 cents of every sales

EXHIBIT 1: A Packaging Company 20xx Profit Plan

		TARGET		BREAKEVEN
SALES	15,000,000	100%	11,250,000	100%
Material	6,750,000	45%	5,062,500	45%
Direct Labor	3,000,000	20%	2,250,000	20%
Other Variable	2,250,000	15%	1,687,500	15%
TOTAL VARIABLE COST	12,000,000	80%	9,000,000	80%
CONTRIBUTION	3,000,000	20%	2,250,000	20%
Fixed Cost	2,250,000	15%	2,250,000	20%
PROFIT	750,000	5%	0	0%

CALCULATION OF CONTRIBUTION FACTOR

	TARGET	BREAKEVEN
Contribution	= Fixed Cost + Profit	
	= 2,250,000 + 750,000	= 2,250,000 + 0
Contribution ÷ Sales	= Contribution Factor, or CF	
	= 3,000,000 ÷ 15,000,000	= 2,250,000 ÷ 15,000,000
	= .200	**= .150**

dollar must be contribution.

We've just described the contribution factor, possibly the most important piece of information we can determine about our business. The CF is the rate that contribution accumulates, and if we know it for each booked order, we can estimate the company's potential for profit for any period desired.

For example, suppose A Packaging Company books $1,100,000 in November at an average CF of .218. Is this good or bad news? Actually, it's a little of both. From the standpoint of revenue, it's 12% below the average monthly target of $1,250,000 (15mm ÷ 12). The CF, however, is 9% higher than that called for in the profit plan.

It's easy to discover if the company performed well against the profit plan for the month of November—here's how. First, we determine the average monthly booked contribution required to meet the plan. Since sales multiplied by CF is another way to define contribution, $1,250,000 x .200 = $250,000 of target booked contribution. To figure the actual booked contribution, we apply the same formula: $1,100,000 x .218 = $239,800. The higher CF has almost made up for the lower sales revenue, but not quite.

It is also useful, especially in tight markets, to know the breakeven CF. This is the rate of contribution that will cover all our costs, both variable and fixed, but will leave nothing for profit. Breakeven CF is a benchmark which tells us the minimum amount of contribution necessary to tread water.

To calculate breakeven CF, we divide the company's fixed costs by its target sales. The resulting CF is .150. To prove that we need 15¢ of contribution from every sales dollar to make a profit of $0, multiply .150 times the sales of $15,000,000. This equals $2,250,000, or the exact amount of our fixed costs and therefore, no profit. Note that this scenario assumes the company will maintain its level of sales. Another way of looking at a breakeven scenario is that fixed costs remain constant but revenue falls. In this case, the breakeven CF would remain at .200 (2250m / 11250mm).

Exhibit 1 also assumes that the ratio of out-of-pocket costs to sales remains the same as volume decreases. It is true, however, that as sales drop, cost has a nasty tendency to transform itself from variable to fixed.

For example, we are not always free to reduce direct labor by the same proportion as a large drop in sales would demand. If this happens, both fixed and variable costs will rise as a percentage of revenue and sales will fail to cover costs. This loss will be equal to the portion of the variable cost that became fixed. For example, if direct labor in Exhibit 1 remained at $3,000,000 if volume fell to $11,250,000, the company would not break even, but would suffer a loss of $750,000.

Profit plans, as you can imagine, are imperfect at best. But they do provide an easy way to analyze trends as soon as they are perceived. For example, suppose bookings fall short of the plan's projection. After six months, only $7,000,000 has been booked at a compound CF of .210. The resulting contribution of $1,470,000 is $30,000 short of the target for the period, and will be $60,000 short if the trend continues to year-end. The company must either reduce spending by $60,000 or increase sales by some amount in the remaining six months.

Assuming the budget has been cut to the bone, how much incremental business is needed to make up this shortfall?

First, let's assume the rest of the year's sales will also be booked at a CF of .210. We know we are $60,000 short in planned contribution. By applying the formula: Sales = C ÷ CF, we divide 60,000 by .210 and discover that if we can generate an additional $286,000 in the last half of the year, we will achieve the profit plan goal.

Reacting to quarterly changes in the profit plan is all well and good, but too often it's a case of too little, too late.

The Contribution Log

In this section, we'll look at the tools used to analyze contribution and potential profitability on every order the moment it is booked.

We've put together a basic profit plan for A Packaging Company. Sales were pegged at $15,000,000 with out-of-pocket costs budgeted at $12,000,000. With fixed expenses at $2,250,000, if all goes well we'll be left with $750,000 in profit. Our breakeven and target contribution factors are .150

EXHIBIT 2: **A Packaging Company Contribution Log for the Period ending _____ , 20XX**

	Job	Booked Sales	Direct Cost	Contrib.	CF	Target Sales	Target Contrib.	Target CF	Target Var.
1	6361A	1,563	1,271	292	.187	1,589	318	.200	–26
2	6741B	7,800	5,717	2,083	.267	7,146	1,429	.200	654
3	6741C	21,714	18,012	3,702	.170	22,515	4,503	.200	–801
4	6774A	1,492	1,111	380	.255	1,389	278	.200	103
5	6840	6,075	4,726	1,349	.222	5,908	1,182	.200	167
6	6860	9,515	6,615	2,900	.305	8,269	1,654	.200	1,246
–	–	–	–	–	–	–	–	–	–
25	–	–	–	–	–	–	–	–	–
TOTAL:		**1,167,230**	**912,590**	**254,640**	**.218**	**1,140,738**	**228,148**	**.200**	**26,492**

and .200 respectively (CF = contribution/sales).

Fine so far, but how, during the course of the coming year, can we tell if we're booking enough contribution to meet the requirements of the plan?

The first step is to realize that **sales do not mean profit.** In fact, sales can put a company out of business.

Here's an example of how the philosophy of "we'll be fine if we just keep the machines running full tilt" can ruin a converter.

A plant operating at 70% capacity goes after a contract for 20 million cartons of a prestigious national account. Unfortunately, they estimate the job using "full" cost machine hour rates, which tells them that in order to realize their normal markup they should quote $60.00 per thousand. Fierce competition, however, forces them down to $48.50. They decide to take the contract at that price because, after all, it is almost a million dollars in sales. But if they'd known their out-of-pocket costs were $49.25, they could have saved themselves the privilege of throwing away $15,000 for an order that consumed precious machine time while contributing less than nothing to the bottom line.

Sales containing adequate contribution is the only way to insure that the business we accept will result in healthy profits. That's why, instead of talking about a booked orders report, we prefer analyzing the contribution log. To achieve a particular return, a sufficient combination of sales and CF must be attained. Revenue of $100,000 with a CF of .205 will yield the same contribution as sales of $50,000 with a CF of .410 (i.e., $20,500).

For an example of a simplified contribution log, see Exhibit 2. In this example, the last line reflects the entire period's bookings for A Packaging Company. From our profit plan, we know that to earn $750,000 at year-end for each of 13 periods, we need an average of $1,154,000 in sales and $231,000 in contribution. In both categories we are enjoying positive variances for the period.

EXERCISE 1: calculate the year's profit potential if sales averaged the same for 13 periods and the annual CF averaged .218.

Let's look at order number six. Booked sales of $9,515 less direct cost of $6,615 yield a contribution of $2,900. 2900/9515 is the calculation for CF, or .305.

EXERCISE 2: if the average CF for the period was as high as the booked CF for order number 6, find the total booked contribution.

Finally, for those converters who insist on allocating fixed costs into their estimating rates, we recommend adding the following column to the booked orders report. Multiply the fixed portion of each machine hour rate by the hours for each job booked and cumulate them here. At the end of each

period you, too, will be able to compare your actual fixed expenses with the amount absorbed in bookings. If the booked amount is greater, the balance will be profit.

Estimating the Target Selling Price

Now let's turn to a discussion of the different ways to mark up estimated direct costs. Machine hour rates (MHRs) are the per-job reflection of the annual budgeting process. And to be successful, this process must include eliminating any padding from the estimates. We will then be able to determine where the hard deck of direct cost really lies. When we do this for the first time, there's often a great deal of confusion regarding the purpose of a machine hour rate.

Do we look at the rates from the bottom up (from the standpoint of covering our budgeted costs) or from the top down (from the perspective of surviving in the marketplace)? There's no need to get caught between this philosophical rock and a hard place. The fact is that no one MHR can be all things to all people. When estimating, each rate can only be either a cost or a target. Once we understand this, not only will any confusion evaporate, but we'll also be left with much better tools for evaluating and guiding the company's progress.

After we've translated the profit plan into direct cost MHRs, how do we add enough of a markup to ensure we cover fixed costs plus planned profit? We're almost ready to answer that question, but first we must ask ourselves another: which direction are we facing?

"Do we look at the rates from the bottom up (from the standpoint of covering our budgeted costs) or from the top down (from the perspective of surviving in the marketplace)?"

Think of yourself standing outside your plant. If your primary concern is making sure you've accounted for all your budgeted costs, including planned profit, you'll construct rates that will have you facing inwards, your back to the outside world. The resulting estimates will suggest target prices that reflect little market intelligence, perhaps none at all. We'll call this the *internal pricing strategy.*

On the other hand, if your orientation is more toward surviving in that jungle out there, the rates you develop will turn you around to face the outside, your back to the factory. You'll ignore, to some degree, your internal needs in favor of rates that will help get the company more and better business. Let's refer to this philosophy as the *external pricing strategy.*

Which strategy is more desirable? We can almost hear the financial people clamoring for rates that turn us in toward the plant. And equally vociferous are the salespeople, struggling to get us to face the marketplace. Of course, it's never black or white, and this dilemma is no exception: neither method is sufficient on its own.

Target rates that only pay attention to the profit plan may easily price us out of desirable business, or have us booking orders below the maximum available levels. The internal pricing strategy would have us operating in a vacuum, as if we were the only carton company on the planet. We know what happens when we try to breathe in a vacuum.

And target MHRs that ignore the realities of our financial statements may generate large volumes of business that contribute so little that we fail to make any profit at all. The external pricing strategy refuses to look at the company's unique mixture of equipment, costs,

Answers

Exercise 1. Profit = $1,057,930. Annual Sales = 13 x 1,167,230. Contribution = .218 x 15,173,990; Profit = Contribution - Fixed Cost, or 3,307,930 - 2,250,000.
Exercise 2. CF = .305. CF x Sales = Contribution, .305 x $1,167,230 = $356,005.

and capabilities. It's operating in another kind of vacuum, but the results will be just as inevitable.

In order to be successful, a carton company must employ both strategies when creating target MHRs. For the next few pages, however, we'll only be employing the internal pricing strategy. That is, we're going to turn our backs on the marketplace and concentrate on building target rates that satisfy the goals set out in the profit plan. We have to recognize what the profit plan requires before we can decide how to use the market intelligence we gather later on. This is an instance of having to know the rules before we can break them. Eventually, we will combine these two philosophies into a strategy that considers both the needs of the profit plan and the realities of the marketplace.

The internal pricing strategy would have us operating in a vacuum, as if we were the only carton company on the planet. The external pricing strategy refuses to look at the company's unique mixture of equipment, costs, and capabilities.

Now that we know the direction we'll be facing, we're ready to tackle the two basic methods of marking up direct cost MHRs using the internal pricing strategy: the level markup and the differential markup.

Level Markup Machine Hour Rates

At this point, we're going to calculate target MHRs. They will absorb not only all our out-of-pocket expenses but also account for fixed costs and the most important line item on the budget: profit.

The process of calculating target MHRs is just like baking a cake. Think of the total variable cost ($12,000,000) as the flour, butter, and eggs. While cake is nice, in our opinion, it's not worth the calories without a rich, thick, butter-cream frosting, preferably double Dutch chocolate! Target contribution (the sum of fixed costs plus planned profit) is the frosting on the cake. To see how this icing is applied to our direct cost MHRs, let's look at Exhibit 3.

There are two places on an estimate where markups are normally applied: conversion and/or materials. In our example, we are only going to look for a ten percent markup on materials. The bulk of the contribution necessary for A Packaging Company to meet the goals of its profit plan will come from conversion. For the time being, here is a brief justification of this practice.

As converters, we are not in the business of selling materials. Rather, we sell machine time, our most valuable resource. It is therefore logical that most of the return on our investment ought to come from the cost of converting raw materials and not from the substrate itself.

Back to the exhibit. The first element of the frosting is fixed cost. To avoid double dipping, we

EXHIBIT 3: **A Packaging Company Level Markup Factor**

TARGET CONVERSION CONTRIBUTION	
Fixed Costs minus	2,250,000
Material Contribution @ 10%	– 675,000
= Breakeven Conversion Contrib.	1,575,000
plus Planned Profit	+ 750,000
= Target Conversion Contribution	2,325,000
TARGET LEVEL MARKUP FACTOR	
Conversion Cost plus	3,000,000
Target Conversion Contribution	+ 2,325,000
=	5,325,000
divided by Conversion Cost =	1.7750

subtract the contribution we expect from materials, leaving $1,575,000 of contribution which must be generated by conversion. If we covered the cake of the direct cost MHRs with only this $2,250,000 of contribution, we'd absorb all our costs, fixed and direct, but wouldn't make any profit. This is why we call this first step in the calculation breakeven conversion contribution. When we add planned profit, we find we need conversion "icing" totaling $2,325,000. This is our target conversion contribution.

Conversion cost is $3,000,000. By adding target conversion contribution and dividing the sum by the conversion cost, we get the factor to apply to each direct cost MHR. That's why we call this the *level markup method*. We are frosting the cake evenly on all sides. Each production center, whether it be a six-color offset press or a cylinder diecutter, will be marked up 1.775 to arrive at its target MHR.

If we've budgeted our hours for each production center correctly—and our booked orders average the targets (the "frosted" MHRs suggested on each estimate)—by year's end we will have accumulated enough contribution to earn the profit budgeted in the profit plan.

To test the validity of the 1.775 factor, we need to examine A Packaging Company's production centers and budgeted hours. Exhibit 4 lists their equipment. The direct cost MHRs only contain expenses directly identifiable with either the running of a press or an order. Profit, and all costs that accrue as a function of time such as rent, depreciation, and executive salaries, are not included in these rates.

Fixed costs and profit are accounted for in the estimate by the target MHR which, in this case, is constructed using a level markup on direct cost. Remember, this is an *internal pricing strategy*, one that looks at the company's needs but ignores the marketplace.

No matter what a machine costs to purchase—or how much it costs to operate—when level markups are applied, each receives the same relative amount of contribution as every other production center. To prove this, divide a target MHR by its corresponding direct cost MHR, and the result in this example will always be the same: 1.7750.

If it's not clear why we create two rates—that is, why we bother to calculate the direct cost MHR at all—consider the following example.

Suppose we quote a job and the customer says we can have it if we lower our price by five percent. An estimate employing only the target MHR lacks a systematic approach for evaluating price. We'd have no tool other than our gut feeling to guide us. But with the addition of direct cost, we can calculate the available contribution, compare it to the profit plan, and make an informed decision on whether or not to book the order.

Back to level markups. How do we know these rates will make money for A Packaging Company? By multiplying the target MHRs by each production center's budgeted hours, we arrive at the number to the far right of the exhibit. For example, if we sell 15,318 hours on the gluers, they will generate almost two million dollars of revenue. $1,104,000 will cover

EXHIBIT 4: **A Packaging Company Machine Hour Rate Summary**

PRODUCTION CENTER	BUDGETED HOURS	DIRECT COST MHR	LEVEL MARKUP FACTOR	LEVEL MARKUP MHR	EXTENSION (LEVEL MHRs x HOURS)
Diemaking	7,650	27.60	1.7750	48.99	374,774
Offset Printing	8,509	91.75	1.7750	162.86	1,385,813
Platen Cutting	11,004	44.16	1.7750	78.38	862,537
Stripping	24,509	17.07	1.7750	30.30	742.604
Gluing	15,318	72.06	1.7750	127.91	1,959,272
Totals:	**66,990**				**5,325,000**

the out-of-pocket expense of running those jobs (72.06 x 15,318). The balance, $855,000, is this department's contribution toward fixed cost and profit.

If we glance back at the profit plan in Exhibit 1, we are reminded that we need to capture $3,000,000 of conversion cost—plus $2,325,000 of conversion contribution—in order to yield a profit of $750,000. The sum of the extension on Exhibit 4 equals the necessary $5,325,000, so we're sure that as long as we've budgeted correctly, we'll generate the necessary contribution.

However, an error in budgeted hours will have a drastic affect on accumulated contribution. Any *target* MHR, because it includes allocations of fixed cost, is vulnerable to changes in hours. $200,000 in rent, for example, when spread over 67,000 budgeted hours, is $2.99 per hour. But if actual hours only reach 57,000, rent will be under-absorbed at $29,900 (2.99 x 10,000). For this reason, we cannot emphasize strongly enough the need for variance reporting.

Another reason direct cost MHRs are so valuable is that they are practically immune to discrepancies in actual versus budgeted hours. Since they primarily contain costs that vary with volume, an error in budgeted hours will have only a minimal effect. Whether we run the gluers for 15,000 hours or 10,000 hours, it will still cost A Packaging Company about $108 per hour for the labor, power, etc., to run those machines.

We've established level markups and the resulting target MHRs. In the next section, we'll look at another method of marking up: direct cost. But bear in mind, no matter which markup method we use, we will always build up to the target rate from the concrete floor of direct cost. In any profit plan, *direct cost MHRs do not alter*. Target rates are subject to the vagaries of poorly budgeted hours; direct cost rates are not.

Differential Markups

As mentioned, it helps to think of direct, or variable cost, as the cake in the profit plan and contribution as the frosting. So far, using level markups, we've frosted the cake evenly on all sides. The level markup factor on each machine hour rate was 1.775. Now it's time to get more creative.

A couple of reminders. Direct cost rates are pretty much carved in stone: the hourly cost of a pressman does not fluctuate with the number of hours he works. But the amount of contribution spread on top of direct cost rates to arrive at target rates is infinitely flexible. And since we're working with an *internal pricing strategy*, total contribution in this exercise takes no account of what the market will bear. We're only concerned (so far) with satisfying the goals set forth in the profit plan.

You may not like the fact that with level

EXHIBIT 5: **A Packaging Company: Calculation of Differential Markup MHRs**
**From the Profit Plan: Annual Conversion Contribution = $2,325,000*

COLUMN	1	2	3	4	5	6	7
PRD CENTER	BUDGETED HOURS (in Ms)	Rplcmnt Value Rplcmnt	Rplcmnt Value X Hours	FACTOR 2,325,000* ÷ 36,241,440 = 0.06415308 TARGET CPM	DIRECT COST MHR	DIFF. TARGET MHR	EXT. TARGET MHR'S X HOURS
Diemaking	7,650	50	382,500	3.21	27.60	**30.81**	235,679
Printing	8,509	1,750	14,891,494	112.27	91.75	**204.02**	1,736,075
Cutting	11,004	975	10,728,890	62.55	44.16	**106.71**	1,174,228
Stripping	24,509	24	588,216	1.54	17.07	**18.61**	456,104
Gluing	15,318	630	9,650,340	40.42	72.06	**112.48**	1,722,914
TOTALS:	**66,990**	**3,429**	36,241,440	2,325,000	3,000,000		5,325,000

markups, your stripping department receives the same relative rate of return as your offset presses. For example, you may want the replacement value of each production center to be reflected in the estimating target rate for each machine. If so, consider differential markups.

Exhibit 5 shows the equipment for A Packaging Company. Column 1 lists the budgeted hours (i.e., makeready and run) that each production center is expected to incur in the coming year. Column 2 cites the cost of replacing the entire department's equipment in its present condition.

Column 3 is the product of columns 1 and 2. We do this to assign a temporary, weighted value to each production center. If we used replacement value (column 2) to represent conversion contribution per hour, we'd collect over $36 million! But the profit plan tells us that this amount need only be $2,325,000. At the top of column 4 we calculate the factor that will scale down that $36 million. The factor of roughly 6.4% is applied to each production center's replacement value in column 2.

That's how, for example, diemaking is reduced from 50 to $3.21. Now, if we multiply this target contribution per hour with each operation's hours, we arrive at the $2.325 million required for conversion contribution. Add column 4 to column 5 to get the new differential target MHRs in column 6. Column 7 proves that these rates will cover the direct cost of conversion, plus the contribution the profit plan calls for them to supply.

Exhibit 6 compares the level markup rates to the differential rates. Notice how much higher printing and cutting have become with differential MHRs. Providing we've budgeted correctly, though, either set of rates will provide the same overall contribution at year's end.

Comparing Markup Methods

We have been searching for the perfect estimate, one that not only calculates direct cost but also presents a competitive yet profitable target selling price. The next step in achieving this Holy Grail of Profit Planning is to compare the two sets of target machine hour rates we've developed.

Exhibit 7 summarizes an estimate for 200,000 reverse tucks, five colors plus varnish, running twelve up on a 33 x 48 inch sheet of .018 SBS. Other details not printed in the summary are 1200 startup sheets, 6% waste, and a board price of $25.73 per MSF.

The out-of-pocket, or direct cost MHRs, when multiplied by the makeready and run hours, yields the total out-of-pocket cost in the far right column. The level target MHRs reflect the same markup factor on each production center, regardless of any other consideration. The differential MHRs are weighted by replacement value to reflect a desire for a higher return on the plant's more valuable production centers.

The two pricing methods are summarized in Exhibit 8. Notice that OOP cost and marked-up materials do not change. The only difference between the two methods is the amount of contribution required from each production center. Remember that if we've budgeted hours and costs

EXHIBIT 6: **A Packaging Company: Machine Hour Rate Summary**

PRODUCTION CENTER	BUDGETED HOURS	DIRECT COST MHR	LEVEL MARKUP MHR	LEVEL MARKUP FACTOR	DIFF. MARKUP MHR	DIFF. MARKUP FACTOR
Diemaking	7,650	27.60	48.99	1.7750	30.81	1.1162
Offset Printing	8,509	91.75	162.86	1.7750	204.02	2.2236
Platen Cutting	11,004	44.16	78.38	1.7750	106.71	2.4164
Stripping	24,509	17.07	30.30	1.7750	18.61	1.0902
Gluing	15,318	72.06	127.91	1.7750	112.48	1.5609

EXHIBIT 7: **A Packaging Company: Estimate Conversion Summary**

Speeds		MR Hours	Run Hours	OOP MHR	LEVEL MHR	DIFF. MHR	TOTAL OOP Cost
	Diemaking	32.0		27.60	48.99	30.81	883
5500	Offset	5.5	3.4	91.75	162.86	204.02	820
3200	Platen Cutting	6.0	5.5	44.16	78.38	106.71	510
850	Stripping		22.3	17.07	30.30	18.61	380
39000	Gluing	1.5	5.1	72.06	127.91	112.48	478

TOTAL CONVERSION COST: $3,071
TOTAL MATERIAL COST: $5,840

EXHIBIT 8: **A Packaging Company: Level v. Differential Target Pricing**

LEVEL TARGET PRICING	
TOTAL OOP COST	$8,911
MATERIALS + 10%	$6,424
MARKED UP CONVERSION	**$5,451**
LEVEL TARGET SP	$11,875
DIRECT COST/M	$44.56
LEVEL SELLING PRICE/M	$59.38
TGT CONTRIBUTION FACTOR	**.250**

DIFFERENTIAL TARGET PRICING	
TOTAL OOP COST	$8,911
MATERIALS + 10%	$6,424
MARKED UP CONVERSION	**$5,202**
DIFFERENTIAL TARGET SP	$11,626
DIRECT COST/M	$44.56
LEVEL SELLING PRICE/M	$58.13
TGT CONTRIBUTION FACTOR	**.234**

correctly, both techniques will, over the course of the year, accumulate the same total conversion contribution required by the company's profit plan.

In this example, the level MHRs have developed a higher target than the differential MHRs. But at this point, it's impossible to tell which price more accurately reflects the market. Both of these techniques employ an internal pricing strategy, which means they ignore the marketplace entirely. They will only generate enough contribution to cover the company's fixed expenses plus a percentage for profit.

For the company to employ a truly external pricing strategy, target rates for each machine would be based on management's assessment of what constitutes a successful selling rate in the marketplace. The rates would not be derived from any calculation. Hopefully, when the direct cost MHRs are compared to these external target MHRs, they would generate at least as much contribution as target rates based on the profit plan.

Of course, our customers couldn't care less whether we use level or differential markups. All they expect is the best price, quality, delivery, and service. So the direct cost of an hour of machine time has little to do with what we want to sell that hour for, and even less to do with what the customer is willing to pay for that time. Rather, differential markups will generate a variety of target prices, depending on the choice of equipment flow through the plant. Here's an example.

Suppose you had two six-color printers, more or less identical, except that one was five years older than the other. The newer machine's replacement value is significantly higher than the old, thereby generating a much higher differential target rate.

The newer press's rates are:

OOP: $100
Level: $200
Differential: $350

The older machine carries:

OOP: $100
Level: $200
Differential: $225.

If the company decides to use level target rates when estimating, no discernible difference will be seen between the two estimates whose only difference is the choice between these two presses. This will not be true if the company opts for differential MHRs. The older press's smaller replacement value will demand a lower target. The direct cost of both estimates will be the same, but the target contribution—and therefore the target selling price on the newer press—will be higher.

Material Markups: Less is More

Unlike death and taxes, we can't always depend on the presence of historical pricing data. Sooner or later, we're going to have to rely on the estimate to help us arrive at intelligent target selling prices. Here's how the majority of the converting industry does it.

The cost of an order is determined and a flat markup is applied to the result. Unfortunately, this technique paints each of the three components of an estimate—conversion, materials, and variable order costs—with the identical brush stroke. It abandons a valuable opportunity for the estimate to create a bit of its own market intelligence.

Let's take a look at Exhibit 9, a full cost estimate summary for two quantities of the same item. Regardless of quantity, the fifteen percent markup is applied to all cost components. This ignores the fact that the marketplace is willing to pay more for "value added" or, in this case, a smaller order size.

By contrast, compare Exhibit 9 to the method of pricing in Exhibit 10. First, the direct cost of $5,281 is established. Then materials are increased by a modest ten percent while conversion is marked up a whopping 225 percent. To arrive at the final target price, the variable order costs of freight and commission are added with no markup at all.

The underlying philosophy at work here is this: converters are in the business of selling machine time, not paperboard (or any other substrate). Almost all our capital is tied up in equipment, and we

EXHIBIT 9: **Full Cost Estimate Summary**

	100,000 Qty	25,000 Qty
MATERIALS	$3,105	$1,054
FULL CONVERSION COST	$2,162	$1,508
FREIGHT & COMMISSION	$554	$237
OVERHEAD	$873	$420
TOTAL FULL COST	**$6,694**	**$3,219**
15% MARKUP	$1,004	$483
TARGET SELLING PRICE	**$7,698**	**$3,702**
TARGET SP/M	**$76.98**	**$148.08**

EXHIBIT 10: **Direct Cost Estimate Summary**

	100,000 Qty	25,000 Qty
MATERIALS	$3,105	$1,054
DIRECT COST CONVERSION	$1,622	$1,131
FREIGHT & COMMISSION	$554	$237
OVERHEAD	$554	$237
TOTAL DIRECT COST	**$5,281**	**$2,422**
MATERIALS + 10%	$3,416	$1,159
MARKED UP CONVERSION (2.254)	$3,657	$2,550
VARIABLE ORDER COST	$554	$237
TARGET SELLING PRICE	**$7,627**	**$3,946**
TARGET SP/M	**$76.27**	**$157.84**
TGT CONTRIBUTION FACTOR	**.308**	**.386**

have the legitimate expectation that the bulk of our return on that capital should come from converting paperboard into packaging.

Now the beauty of this philosophy is that the marketplace agrees with it! Isn't it easier to command a higher quality price from a cosmetic or pharmaceutical carton than from a plain sealed-end shell? And don't we usually find that short runs are more profitable than long runs? The method of pricing in Exhibit 10 automatically takes this into account.

Level markups ask for equal rates of return regardless of a machine's book or replacement value.

Differential markups might have us running round the clock on a new press, but never estimating on it.

If we compare the 100,000 quantities, there's less than a dollar difference between the two pricing techniques. But there's a six and a half percent swing between the shorter run targets. The traditional pricing method calls for a flat markup in all situations. But Exhibit 10 operates on the following principle: the degree of order contribution is directly proportional to the ratio of conversion to total direct cost.

Notice the two contribution factors on Exhibit 10. As makeready is spread over smaller run and material costs, conversion rises as a percent of the total. The estimate therefore suggests a 25% increase in the *quality* of the target price (.386 divided by .308).

If this concept is acceptable, why then, do we mark up materials at all? The most aggressive pricing strategy would indeed pass along this component at cost. We, however, suggest a minimal markup of five to fifteen percent to cover the risk of damage and the cost of carrying the raw material inventory.

The Last Word

There are two fundamental ways to arrive at a target MHR once the direct cost MHR has been calculated: the level markup and the differential markup. We have illustrated how each is constructed but the question remains: which is the superior technique for establishing a target price on the estimate? Let's take a look at the pros and cons.

First, to recap the definitions. A level markup MHR takes the total conversion contribution required by the profit plan and spreads it evenly over the direct cost MHRs of each production center. The markup factor (conversion contribution plus direct conversion cost divided by direct conversion cost) will be identical for each machine. The differential markup starts with the same total conversion contribution but piles more of it on some machines than on others. These weighted markup factors often are based on the replacement value of the equipment.

Both markup methods employ an internal pricing strategy, which is both a plus and a minus. On the negative side, either technique will have little or no market intelligence. On the other hand, both will generate enough contribution to cover the company's fixed costs and planned profit. A particular production center's level target rate might vary substantially from its differential target. However, when all the level target rates are multiplied by their corresponding budgeted hours, the total will be identical to the same calculation done with differential targets.

To visualize the major disadvantage of using level markups, suppose we've just spent two million dollars on a new offset press. If we want a higher return on investment on the machine responsible for all that additional interest and depreciation, then level markups are not for us because level markups ignore the investment in equipment and ask for equal rates of return, regardless of a machine's book or replacement value.

However, differential markups may actually

steer business away from the very machines on which we want to make the biggest return. Suppose we've got two platen cutters whose direct cost MHRs are almost identical and whose production standards are fairly close. But one is five years older and its replacement value is half that of the new press. In this case, the target pricing rate of the newer machine will be substantially higher.

Two negatives may result—we run a greater risk of pricing ourselves out of the business on the new press and equally bad, there will be a strong tendency for the estimating department to ignore the new press altogether. After all, when the sales manager is breathing down our necks, there's a strong incentive to submit the price that uses the lower target.

We could find ourselves running the new press around the clock but never estimating on it. And since our selling prices would be lowered as a result of the older press's smaller markup, we'd be losing the contribution the profit plan has demanded of the new machine. This is not a mathematical exercise; it will translate into a real and tangible loss.

So what's it to be then—level or differential targets? The answer has to be the method that most accurately and consistently reflects the conditions in the marketplace while at the same time maximizing booked contribution.

To find out what's right for your company, here's what to do: create two sets of target MHRs, both level and differential markups. Then go back and review a healthy chunk of your mix, at least one third of your annual volume. Re-estimate each order using both markup methods and compare the resulting target to the actual booked selling price.

It may be necessary to pare a little target contribution from one production center and add it to another, but eventually you'll arrive at a set of target rates you can trust to deliver a market-intelligent price, even when no other information is available.

Having said this, regardless of the markup method, any set of target rates constructed with the company's profit plan in mind will implement an internal pricing strategy. And since this strategy is only concerned with accumulating enough contribution to meet the needs of the company's budget, it cannot possibly have as much market intelligence as historical data.

Since a large percentage of most converters' mix is repeat business, there's usually ample market intelligence from past pricing. So if we've run the job before, here's the best way to set price: ignore the target suggested by the estimate and instead, mark up the new direct cost by the last booked CF.

Example: new direct cost equals $52.81/M. The last booked CF was .307. Use the formula price = direct cost divided by 1 minus the desired CF. Therefore, $52.81 divided by .693 equals a target selling price of $76.20. Proof: $76.20 times .307 equals $23.39. $76.20 less $23.39 of contribution brings us back to the direct cost of $52.81.

If you agree that the rerun should earn a contribution factor at least as high as the previous order, this CF will set the minimum acceptable price for the job. After all, the customer has already agreed to pay this level of pricing quality.

Assume your company's target CF from the profit plan is .297. Using a flat markup on total direct cost would only yield a price of $75.12. ($52.81 divided by .703.) The price would look fine from the standpoint of our internal goal, but, in fact, it would leave $1.08/M on the table, almost 5% of the available contribution ($1.08 divided by $23.39).

Of course, not every order can be a repeat order so we do need target MHRs. Even though, in many instances, the market determines the selling price, a well-crafted internal pricing strategy is still an invaluable tool.

So what's it to be then—level or differential targets? The answer has to be the method that most accurately reflects the conditions in the marketplace while at the same time maximizing booked contribution.

The key to success is a two-pronged approach. When the market is calling the tune, knowing our direct costs allows us to evaluate the available contribution. And when we're creating a new niche or developing a proprietary technology—or when price isn't the only consideration (it does happen now and then)—thoughtful target rates that maximize the return on our own investment will, by definition, have a more positive effect on the market.

You'd think that when historical data and target MHRs are both available, we should opt for the former. Unfortunately, it's not that simple.

Let's add another factor into the equation, one that is often ignored when basing quotations on historical pricing.

Suppose the last order quantity from our earlier example was 100,000. Due to an economic slump, the customer has reduced the reorder to 25,000. Smaller orders command higher quality pricing because the ratio of conversion to materials is higher. The marketplace understands this and expects to pay a premium for shorter runs. So pricing based on historical data is only useful when the order quantities are the same.

If we netted a CF of .307 for 100,000 cartons, shouldn't we earn an even higher price for an order one quarter the size? And if we use the last booked CF of .307, won't we be giving up contribution we deserve and, more importantly, contribution the market is willing to give us?

The solution to this problem can be found by turning once again to target MHRs. By requiring the bulk of the profit plan's target contribution to come from conversion and only a small amount from materials, we can build this additional market intelligence into our estimating system. The result will yield an estimate that changes the quality of the target price depending on the amount of value added, the order quantity, and the ratio of materials to the total cost of the order.

Not only will this make more sense when we quote on a job, it's also a logical expression of why we're in business.

We call ourselves converters because we take someone else's raw material and, with huge quantities of capital and talent, turn it into packaging. Machine time is the only thing we have to sell. It's those valuable production centers, then, that ought to bear the burden of generating most of the return on the company's total capital employed.