Cost, Price and Staying Alive[1]

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Conventional business wisdom holds that the price of a manufactured product is independent of its cost; Price is what the market will bear, and Cost is what it costs to make it. Companies whose prices exceed their costs sometimes succeed, and companies whose don't, certainly fail.

This is always true for mature companies in mature markets. Mature markets are "efficient:" buyers and sellers are in constant contact, prices are well-known and are driven by supply and demand, and volumes are highly "price-elastic," in that a small price reduction by one supplier quickly lures orders away from its competitors, and a price reduction by all suppliers increases everybody's volume. Companies in mature markets compete by advertising, distribution efficiencies and product features; they work hard and spend a lot of money to differentiate themselves from their competitors.

In contrast, early-stage companies usually offer products or services that are highly innovative and which have few or no competitors. The sheer cost of entering mature markets effectively closes those markets to new companies, and differentiation is easy by definition: the new company's problem is not to seem *different*, but to seem *similar* enough to be credible in an environment where one's product, and even one's company, is strongly different from established companies in the same market segment.

The first entrants in a new niche market are in a particularly difficult position. Because there is no established market for their products, there is no competitive information upon which to set prices for their products. There are also no competitors to help the new company advertise: it must use its own resources to make its potential customers aware that its product exists. In addition, since the product or service is unique, its cost in large quantities is unknown and must be estimated accurately or the venture will fail.

This essay attempts to provide a rational method of estimating costs and setting prices for companies in this predicament, and avoiding bankruptcy in the process. It is based on a manufacturing-company model, because that is more complicated than a service company, but the strategies and models presented here work well in the service milieu.

Since many readers of this essay are not accounting experts, the essay is also a tutorial. As you read this, you'll notice that I've used first-letter capitalization with wild abandon. This is because I have taken the time to define a number of generally-used terms, buzzwords and jargon. These terms are Capitalized when they are used, to emphasize that they have a specific, defined meaning.

Cost

Accountants call a product's cost its "Shop Cost" or "Cost of Sales," or "Cost of Goods Sold." This is the variable (meaning "related to sales volume") cost of producing the product. It includes purchased materials; royalties; "Direct Labor," the pay earned by the people who actually touch the product while it is being made; and "Burden" which is a surcharge, explained below, added to labor and sometimes to materials.

Burden includes employment taxes, health insurance and other benefits; rent, utilities and other costs of the factory itself; and the salaries and expenses of all of the people in the Manufacturing Function who don't touch the product: foremen, purchasing people, the Quality Function, and the Manufacturing boss himself. Accountants then divide this entire amount by the number of dollars paid directly to the Direct Labor people, and apply it as a percentage to each dollar earned by a direct laborer. Burden rates in mature manufacturers are often 200% or more. In electronic manufacturers, they are a lot higher.

An accountant will object that Depreciation, which is the cost of the manufacturing and test equipment you've already bought, spread across the life of the equipment, should also be in Burden. I've left it out of Burden and will tell you why later.

Although Generally Accepted Accounting Practice ("GAAP" for short) insists that shop cost be calculated and reported this way, it obviously makes no sense at all for a young company. The underlying assumption that hiring one more assembler or test technician means that one ten-thousandth of a Vice-President of Manufacturing must also be hired may make sense for Boeing, but it clearly isn't the way to manage and forecast a company with 50 employees. It's possible, however, to create cost projections in a way which both satisfy investors' needs for GAAP reporting and still allow rational management of a new company.

Standard Cost and Variances

The concept of Standard Cost is central to GAAP, and can be a very useful tool in projecting a new company's performance. Standard Cost is the estimated cost to make or provide a single unit of a product in a mature company. It assumes that the product's design is stable, that the workforce is well-trained and has had two or three years' experience building or providing the same product, and that the rate at which the product is being sold is not growing or shrinking radically.

As it happens, Standard Cost is easy to estimate, even for a product that's never been manufactured. To do this, one must find an experienced manufacturing person who has managed the Manufacturing Function in a company or division making products of similar complexity at annual unit volumes *at least as high as the highest expected annual unit volume of the new company. It is very important that this person has had direct experience at the target volume level or higher.* People who have managed plants at a certain unit volume level have internal conceptions and biases that are appropriate to that volume level. It is very difficult for someone who has managed a plant that builds, say,

1000 units per year, to estimate accurately at higher volumes, because he or she does not think in terms of the processes and procedures used at, say, the 100,000 level. Such people invariably overestimate the cost of building products at significantly higher volumes. They can estimate accurately only at volume levels they have already experienced, or at lower levels. Costs of providing a service can be estimated similarly. Being conservative here is not a good idea, because it will lead to overpricing. The dire consequences of over- or underpricing are discussed below in the section headed Price.

To estimate the high-volume cost, our expert gets quotations for material in the quantities expected to be made in the product's fourth year; he or she estimates the labor hours that will be required to assemble and test the product, the amount of capital equipment needed to build and test it, the supervisory and support structure needed, and the degree of integration. He or she then estimates a Burden rate. The Materials estimate plus the Burdened Labor (Labor plus Burden) estimate becomes the Standard Cost per unit. In established companies, differences between the Standard Cost and the actual cost of building a product (arising, for example, from a change in the cost of one of the product's components) are treated as "Variances," and used to reconcile the company's books at the end of each reporting period. In our case, Variances are there mostly because we don't know how to build it yet, and we make mistakes. Because we use Variances, the Standard Cost itself is re-estimated infrequently, usually once a year.

Changes of Cost with Volume

Everybody knows that the cost of a product is less when it's made in higher volume. Until recently, however, it wasn't recognized that this cost-volume dependence is a rather simple relationship, changing in a simple way. Figure 1, on the next page, was developed by James R. Stuart, an expert in, among other things, high-volume satellite manufacture[2]. Surprisingly, the *cost per pound* of sophisticated electronic goods is reasonably close to a straight line on log-log paper over a range of seven orders of magnitude! (The correspondence is almost exact for volumes between 100 units per year and 1,000,000 units per year. Dr. Stuart and I believe that the cost of the two lower-volume products on the curve in Figure 1 is about twice as high as normal because they are made from Space-Qualified components and are themselves Space-Qualified. This usually doubles or triples the price of an otherwise identical product, as discussed below. The costs at volumes of 10 million or more are also higher than a straight line would predict because the sheer volume of materials needed is high enough to trigger shortages of basic materials and supplies.) As far as Dr. Stuart or I know, no one has done an adequate analysis of the roots of this correlation, but it holds for a wide variety of goods.

It is very important to remember that in every case, *the cost to produce a product in a particular factory, on a specific set of tools, is not strongly dependent on volume*, assuming that capital equipment is bought only as needed. The cost doesn't automatically go down when you make more products: *the cost to produce a product depends on the volume assumption that was made when the factory and tooling were built*. It is a serious mistake to assume that costs will automatically go up or down with

2. Presented at the 7th AIAA/USU Conference on Small Satellites, 1993.

volume in accordance with Dr. Stuart's curve unless the designs, processes and management structure of the factory itself are changed.

If one has a good Standard Cost estimate for a product at a high volume, one can then estimate the cost of that product when made *in the same factory, with the same tools,* at lower volumes. Material prices are obtained at the lower volume levels, Depreciation charges are calculated for the capital equipment actually needed, and Burdened Labor content is adjusted to allow for the lower level of automation in assembly and test equipment, and the fact that the cost of supervisors and other "Indirect" people is spread over fewer Direct Labor workers. A rule of thumb that has worked reasonably well for the author is to assume that, for a company which will reach its target volume in its fourth year of production, there will be Variances of 20% of Standard Cost in the first year, 10% in the second, and 5% in the third. These Variances cover not only labor inefficiencies and learning curves, but design flaws and their resulting scrap and rework.

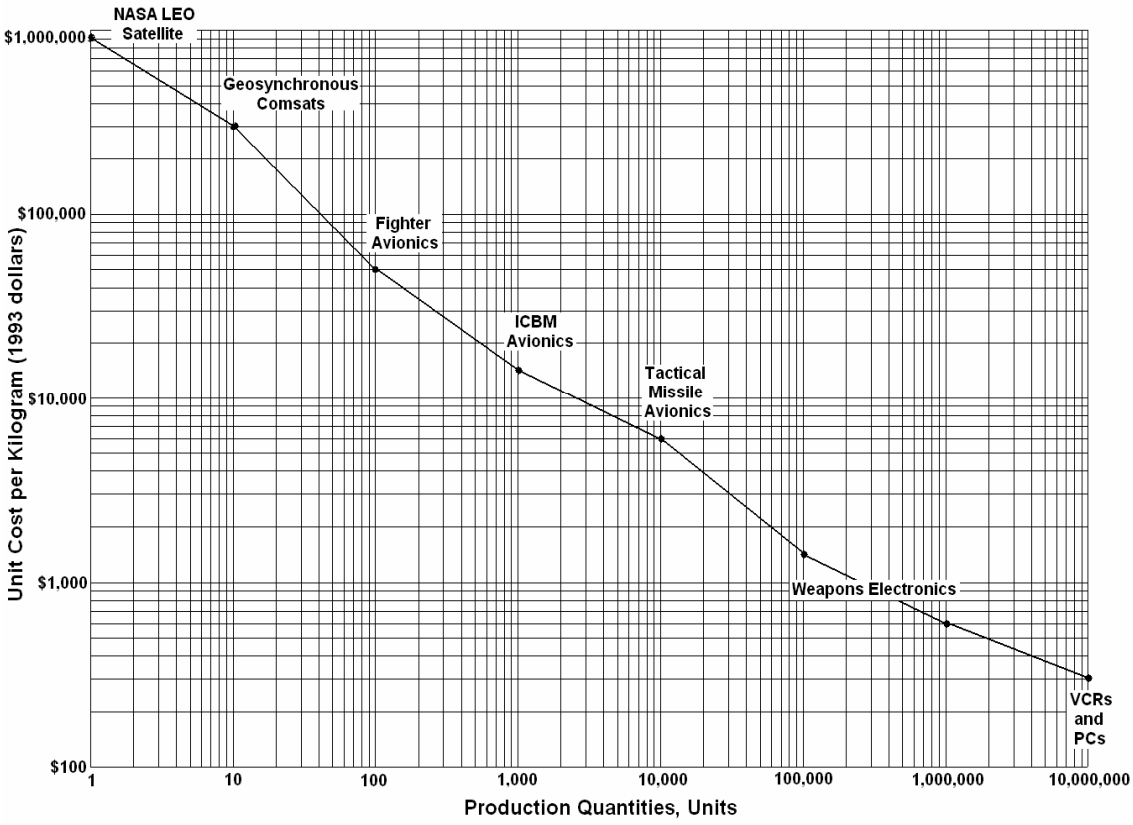

Figure 1: Cost vs. Volume for Manufacturing Plants of Various Capacities

So here is the way to manage your factory:

1. Design the product at the outset for manufacturing processes appropriate to the highest imaginable volume the product might enjoy,
2. Design the factory, tooling, processes, etc. *for that volume*,
3. Have the product cost estimated *at that volume* by someone who is experienced in manufacturing similar equipment *at the same or higher volume*,
4. Recalculate cost at lower volumes using the suggestions above, or apply the 20-10-5 Variance rule above.

Standard Margins

Gross Margin is defined as the difference between the selling price of a product and its Shop Cost plus Variances, and is the money available to pay everybody else in the company, and if anything's left, to make a profit. Since we now have an estimate of the cost of making our product, we are ready to find out whether we have a business, by calculating the minimum Standard Margin (selling price minus Standard Cost) we can tolerate and still survive. This sets a lower bound on the prices we can charge.

A new company in general is short of cash. It therefore can tolerate losses only for a short time. In addition to surviving, which implies cash breakeven, the company must generate enough cash, through profits, to finance at least part of its growth. This is a matter of life and death, and is addressed in the next section.

Staying Alive: *Your* Cash Needs

Receivables

Most capital-goods manufacturers sell their products to domestic customers on "Net 30" terms, "FOB." Taken together, these terms mean that title to the goods passes to the purchaser when a "clean" Bill of Lading is received from the freight carrier who transports the product, and that the purchaser agrees to pay for the goods within 30 days of shipment. In practice, payments are received in 45 to 60 days from customers of good credit; and retailers and the U.S. Government are famous for taking much longer. Small companies rarely extend credit to foreign customers; they insist that such customers pay by "Letter of Credit," which in theory results in immediate payment when a clean bill of lading is presented to the bank providing the Letter of Credit. In practice, payment on Letters of Credit is usually received in 15 to 30 days.

If the average payment interval is, say, 45 days, our company has paid the cost of manufacturing its goods, but won't get paid for them for 45 days. This means that, for an instantaneous manufacturing rate of, say, 100 units per week, the company's customers owe the company for about 600 units. This debt appears in the company's Balance Sheet and is called "Accounts Receivable," or just "Receivables." In very young companies, growth is fast: it is not unusual for unit volumes to triple in a year's time. When this happens, Accounts Receivable also grow rapidly. In a year's time, our hypothetical company has an instantaneous manufacturing rate of 300 units per week and may be owed for 1800 units. This is serious money, and it has to be found or the company will fail.

A company which has been selling acceptable product to customers of good credit for a few months *and is profitable* can usually borrow 70% or 80% of the value of its Receivables from a bank. The loan is secured by the Receivables themselves and by some or all of the company's other assets, and in new companies, sometimes by personal guarantees from its founders.. Banks usually will not lend on Receivables which are over 60 days old, and often will not lend on US Government or foreign receivables at all: the Government is notoriously slow to pay, and there is no sure way to collect foreign debts. Interest rates are high on Receivables loans to small companies. Companies selling to retailers often are not able to borrow from a bank ("Bankable"), but must use a Factor who buys Receivables at a steep discount and takes the risk that they may not be collected.

Note that a Receivable isn't necessarily something you can book immediately in certain industries. Retailers are especially prone to return unsold product, even after several months. A decision on whether a particular Sale can actually be "recognized" is a subject for discussion between a company's management and its Auditors.

Inventory

The company must buy parts to make its products. These are called "Raw Material." Partially assembled product is called "Work in Process," and product that is ready to ship is called "Finished Goods." These last two categories include Raw Material, along with the Direct Labor and Burden that has been expended to make it into a product. The total of Raw Materials, Work in Process and Finished Goods is called "Inventory" on the company's Balance Sheet. Except for any Depreciation contained in Burden, these are cash numbers: they represent money the company owes or has already paid for the Material, Labor and Burden. This money must be spent or committed before the product can be sold, and in companies that use materials that must be ordered far in advance ("long-lead-time materials"), or materials such as semiconductor wafers, which must be bought in batches, there may be several months' supply on hand.

For planning purposes, Inventory levels are estimated in "Turns," which is the Cost of Sales to build a year's supply of product at the current, instantaneous volume ("Run Rate"), divided by the amount of Inventory actually on hand. Inventory Turns for a company running at a steady volume are usually five times or better; Inventory Turns for a rapidly-growing company are usually much lower, often fewer than two times.

Like Receivables, Inventory appears in the Current Assets section of the company's Balance Sheet. Small companies normally cannot use their Inventory as security for loans, because the bank wouldn't be able to assemble the Inventory into products and sell them if the company defaults.

Vendor Payables: A Source of Cash

Vendor credit is a source of cash. If the company buys parts and doesn't pay for them for 45 days, they are in effect borrowing money from their vendors. This debt is shown on the Balance Sheet as "Accounts Payable," or "Payables." If the company is growing rapidly, the Payables account will increase, since the company is buying for higher volumes than it is currently making. This increase in Payables represents a source of cash for the company, and is a significant amount of money. Large companies sometimes have a person called Cash Manager: his or her job is to pay bills as late as possible while collecting Receivables as early as possible.

How Much Cash do *We* Need?

Besides paying its Cost of Sales, a company also needs to generate enough cash to cover its Period Costs (Marketing, Engineering, and General and Administration salaries, mostly), pay for its increases in Inventory, and, say, 30% to 100% of its increase in Receivables (the difference is bank debt, if any). It also has to pay the interest on its Receivables loan. Some of this cash need is offset by increases in Payables.

A typical small high-growth company spends about 15% to 20% of its sales on its Marketing Function, 15% to 20% on the Engineering Function, and 5% on General and Administrative expenses ("G & A"). If it is growing rapidly, it will have Inventories of about 6 months' Cost of Sales (a "two-times turn"), and the absolute value of this inventory will grow at the same rate as Sales. Its Receivables will also grow in proportion to Sales, and will be equal to around two months' annualized sales. If the product contains, say, 80% purchased material, the increase in Payables will free enough cash to offset two months' Inventory increase. The interest rate of the Receivables loan will be well over prime, say 8%to 10%.

We can easily cook up an equation to express our monthly cash status:

$$S - C_S + \left[C_S * V\right] + \left[S*(E_M + E_E + E_{G\&A})\right] + \left[\frac{C_S * R_G}{T_I}\right] + \left[S*\frac{A_R}{365}*R_G\right] - \left[S*\frac{A_R}{365}*R_G*L_{MAX}\right] - \left[C_S * M_{\%}*\frac{A_P}{365}*R_G\right] + \left[S*\frac{A_R}{365}*R_I*\mathrm{L}_{\max}\right] = 0$$

Sales	Cost of Sales	Variances	Period Costs	Increase in Inventory	Increase in Receivables	Increase in Receivables Loan	Increase in Payables	Interest

Where:

A_P = Average Age of Payables, Days
A_R = Average Age of Receivables, Days
C_S = **Monthly** Cost of Sales
E_E = Engineering Expense as a percent of Sales
$E_{G\&A}$ = General and Administrative Expense as a percent of Sales
E_M = Marketing Expense as a percent of Sales
V = Variances as a percent of Standard Cost of Sales
L_{MAX} = Borrowable Percent of Receivables
$M_{\%}$ = Material content of Standard Cost, as a percentage
R_G = Annual Rate of Growth
R_I = Interest Rate of Receivables Loan
S = **Monthly** Sales
T_I = Annual Inventory Turns

If the company pays income taxes, that's a cash item, too, but if it's breaking even or has been losing money, it doesn't have to pay those taxes.

The Price you charge your customers is the most important decision you have to make. To make an informed decision, we need to solve the cash equation above for our minimum Gross Margin, so we can derive the minimum price of our products. Since:

Gross Margin = Sales - Standard Cost of Sales - Variances

We can in principle solve the big equation above for Gross Margin, but because the solution is highly recursive, it turns into a big, meaningless mess. The lazy man's way of doing that is to set up a little Excel spreadsheet and do it by trial and error. The template for this spreadsheet is in a separate file, **`analysis.xls`**. You can download it from the website on which you found this essay, and put it to work. You can enter your own Cost,

sales volume and Price numbers and calculate your own cash needs and profits for any set of assumptions. The boxes outlined in a heavy black line are calculated, so they can't be changed, but you can change the numbers in the dotted column and see the result, in both percentages and money. The next page contains a snapshot of this spreadsheet for a particular set of circumstances.

It's worth warning you that there are some approximations in my assumptions that make the spreadsheet less than a perfect accounting tool. But it'll come close enough for planning purposes. Note that is is only for planning, and is not a substitute for competent accounting help. Note also that I've violated GAAP by not including Depreciation in Burden, but stating it separately. This is because we're managing for cash, and Depreciation doesn't affect cash flow (you already spent the money when you bought the assets). It does, however, affect profits, so you have to add it back in. I've done that.

analysis.xls 12-Jun-05 EFT | **ONE-MONTH ANALYSIS SPREADSHEET** | Template Copyright 2005, Edward F. Tuck

NOTE: This template is not a subsitute for competent accounting. It is approximate, and there are no guantees of its accuracy.

Please enter **numbers** in the following **seven** lines-->	**Enter Here:**	**Comments**
P = Price per unit	$150.00	You get to choose this. It is the price at which you will offer your product for sale..
C_u = **Standard** Cost per unit without depreciation	$48.60	This is the Standard Cost you have estimated for each product you make, **not including depreciation**.
N_m = **Monthly** unit volume	1000	This is the number of products you expect to sell **this month**
PP&E = Capital Equipment	$500,000	This is the price you paid for everything the company owns except its inventory.
T_I = Inventory Turns, **Times per Year**	2	This is almost always poor (that is, low) for a new company. Use your judgment here.
A_R = Average Receivables Age, **Days**	45	You have to be aggressive about collections to hit 45 days.
A_P = Average Payable Age, **Days**	45	For a small company, vendors will not tolerate payment delays. 45 days is max.
Please enter the following **nine** numbers as **percentages**-->		
R_G = Assumed **Annual** Growth Rate, %	100.0%	As you change this number, you will see why your Gross Margin has to be high.
L_{MAX} = Borrowable % of Receivables	70.0%	You get this number from your bank. Note that your bank may not lend without personal guarantees.
R_I = **Annual** Interest Rate of Receivables Loan	8.0%	Get this from your banker, if he'll lend to you at all.
R_T = Combined State & Federal Income Tax Rate **% of Pretax**	40.0%	This is the total of State and Federal corporate income tax rates. They are based on pretax profit.
$M_{\%}$ = Material, Percent of **Standard Unit Cost**	80.0%	This comes from your bill of materials and labor and burden estimates.
V = Variances, percent of **Standard Unit Cost**	20.0%	I use 20% for a product's first year, 10% for its second year, 5% for its third year and zero thereafter.
E_M = Marketing Expense, Percent of **Sales**	15.0%	15% to 20% is about right for a technology company
E_E = Engineering Expense, Percent of **Sales**	15.0%	15% to 20% is about right for a technology company
$E_{G\&A}$ = General and Admistrative Exp., Percent of **Sales**	5.0%	4% to 5%, depending on how good a manager you are. It includes executives, legal fees and similar stuff (everything else).

The template calculates the following percentages and numbers from the numbers and percentages you entered above:

RESULTS: CASH FLOW	**% of Sales**	**Dollars**	
Cash Received from Operations			
S =**Monthly** Sales, Defined as 100%	**100%**	**$150,000**	This is the amount of money you billed for your goods. It is fixed at 100%, and the other percentages refer to this.
Less: (Increase in Receivables = $S*(A_R/365)*R_G$)	**12.3%**	**$18,493**	You haven't been paid yet for the stuff you shipped this month, so this deducts what you haven't been paid.
Receipts from Operations	**87.7%**	**$131,507**	This is the cash you received from selling your goods.
Payments from Operations			
C_S = **Monthly** Cost of Sales at Standard = C_u*N_m	**32.4%**	**$48,600**	This is calculated from the cost and volume numbers you entered above.
Variances = $V*C_S$	**6.5%**	**$9,720**	This is calculated from your Variance number above, times your cost of Sales at Standard as a percentage of sales.
Period Costs = $E_M+E_E+E_{G\&A}$	**35.0%**	**$52,500**	This is the total of the Marketing, Engineering and G&A expenses you entered above
Increase in Inventory = $(C_S/T_I)*R_G$	**16.2%**	**$24,300**	This is the extra money you have tied up in inventory because you're growing.
(Increase in Payables) = $(C_S*M_{\%}*(A_P/365)*R_G$	**-3.2%**	**($4,793)**	The good news is, you haven't paid for the increase in inventory yet, so you get to keep this much cash.
Taxes Payable	**8.2%**	**$12,289**	This is the tax bill for this month's income. If you've had losses, it may be less or zero.
Payments from Operations	**95.1%**	**$142,616**	This is the money you paid out during the month.
Cash Flow from Operations	**-7.4%**	**($11,109)**	What you got, less what you paid.
Other Cash Flow Items			
(Increase in Receivables Loan) =-(Incr. in Rec.)*L_{MAX}	**8.6%**	**$12,945**	This is the extra money you're able to borrow because your receivables are higher.
Less: (**Monthly** Interest on Loan=$(S*A_R/365)*R_I/12$)	**0.1%**	**$123**	This is what the bank soaks you for your loan. Note that this is this month's portion, not the year's, and is a % of sales.
Net Other Cash	**8.5%**	**$12,822**	In this case, increase in the Receivables loan less the monthly interest
Cash Generated or (Needed) = Cash from Ops. + Other	**1.1%**	**$1,713**	This is how much cash you created, or how much you need. Note that you can lose cash while making a profit.

RESULTS: PROFIT OR LOSS	**% of Sales**	**Dollars**	
Sales	**100.0%**	**150,000**	Again, Sales is the reference, and is 100%. The dollar Sales number is copied from above.
Less: Cost of Sales at Standard = C_s	**32.4%**	**48,600**	The total of this and the next line is what it cost to make this month's products.
Less: Variances	**6.5%**	**9,720**	Copied from above.
GM = Gross Margin = S - C_s	**61.1%**	**91,680**	This is simply the amount you billed for goods minus the standard cost of the goods you sold.
Less			
Period Costs	**35.0%**	**52,500**	Copied from above.
Interest	**0.1%**	**123**	Copied from above.
D = **Monthly** Depreciation, % of Sales	**5.6%**	**8,333**	This assumes your capital equipment has an average life of five years, and is linear. It affects only profit, not cash.
Pretax Profit	**20.5%**	**30,723**	This is your investors' second most-important figure. The most important is cash flow (it's their money, after all).
Income Taxes = Rt*(Pretax Profit)	**8.2%**	**12,289**	These income taxes are subject to complicated rules, and are lower or zero in a new company.
NIAT = Net Income After Taxes = Pretax Profit - Income Taxes	**12.3%**	**18,434**	This is the money you have available to fund new growth, or to buy necessary equipment.

It turns out that our hypothetical company, using the assumptions about percentages above and doubling in size every year, needs about 60% Gross Margin to break even (on cash, not profit, requiring a selling price of $146) but only 52.7% Gross Margin to make a profit of 10% after taxes (selling price $138). This is because growing at 100% per year soaks up an enormous amount of working capital. In another typical case, a

company in its second year of operation, fully-taxed, tripling its size (200% growth), needs 70.8% Gross Margin (price = $200) to break even on cash. If it weren't growing, it'd need only 38.6% Gross Margin (price = $95) for cash breakeven, but would still need 57.7% (price = $138) Gross Margin to make 10% after taxes. Growing companies need lots of margin.

How to Manage a New Company

That's easy: You *manage for cash*, not profit, and if you're able, make enough profit to cover your capital purchases and keep your banker and investors happy. You use your margins to increase engineering and marketing, to drive growth and increase or maintain market share. That way, you don't go broke, and you may be able to grow fast enough to hold 50% market share or better.

Sometimes, companies considering a sale or a public offering abruptly raise prices. This soon slows their growth, but in the short term raises their profits and generates cash like crazy. This maneuver is not well-regarded, and is known in the trade as, "Dressing Up the Stiff." In more complicated forms, it leads to jail.

Why Make a Profit?

Aside from the fact that investors won't invest in an unprofitable company, any new capital equipment a company needs must be bought with after-tax dollars. This means that a break-even company can't grow: not only can't it raise money, but it can't buy new equipment that costs more than its yearly Depreciation allowance, because that's all the free cash it has. This means that it will slowly fade away. And the founders can't sell their stock, because no one will buy it. It follows that the more profit a company makes, the more money it can get for a share of stock, so fast growth can be funded with outside capital, causing little dilution for insiders. A respectable *pre-tax* profit level for a growing company is 20% of sales.

If our little company makes too much profit (unless it has an unusually strong patent position, or unless, like Microsoft, it controls its market in other ways), it will attract very serious competition from companies that have a lot of money to spend. The small company will not win this battle. So a reasonable maximum profit level is one that will not make it worthwhile for a potential competitor to dump enormous resources into destroying the company. This level is open to debate, but is probably no more than 20% of sales, *after full taxes*. Our hypothetical company would have to have margins of 72.4% (price = $211) to make that kind of money.

Tempting as it seems, keeping profits low by raising the officers' salaries and buying a fancy office building doesn't work. Competitors aren't that dumb.

Pricing

Now we're there. We know our costs, we know the minimum price we must charge for each unit to survive, and the higher price we must charge in order to grow, and a maximum we can charge without turning into a shooting star. We need a pricing strategy that will let us make the best company we can out of our startup.

Pricing for Market Share

Market Share is the portion of a market segment a single company serves. If a company serves 50% or more of a segment, it's in a dominant position. Unless it is badly managed, the volume of a company with 50% market share makes it the low-cost supplier. This is true not only because its products cost less to make, but because its distribution channels are better-used, its brand name is better-recognized (thus reducing advertising costs) and it has an easier time attracting good people. This gives it some control of prices, since a competitor cannot lower prices as far as the dominant supplier, if he starts a price war. Smart competitors don't try, and dumb ones don't last long. New companies in new markets normally start out with the whole market (100% share), but lose share to competition over months to a few years. Serving more than 50% of a market for more than a few years can lead to antitrust problems.

If a company serves less than 30% of a market that is reaching maturity, it really has very little control of its prices. It can do well by being an excellent supplier (like Southwest Airlines), but cannot gain market dominance except through gross stupidity on its competitors' part. A 30% player can usually maintain its share and possibly even displace the leader. A good example of these dynamics is the Compaq-Dell-Gateway story, in which the smallest player did well in good times, but was the first to suffer in bad times, and in which a stumble by the leader, in this case Compaq, was instantly exploited by #2.

One major goal of pricing strategy is therefore to generate several small competitors while maintaining an approximate 50% share.

Preemptive Pricing

Many new companies with a unique product decide to price their product very high in the beginning, intending to reduce prices as competition appears. Their aim is to reduce the company's early cash needs, avoid selling more stock (which dilutes the founders' ownership), and let their customers finance the company's growth. If the company is absolutely sure that it understands its product's potential customers fully, and is sure that demand for its product is limited, this policy makes sense; however, it's unlikely that a product addressing such a limited market would have received venture capital funding. In general, this all-the-market-will-bear strategy is unwise, for these reasons:

1. By adopting this strategy, the company defines itself as a low-volume supplier. A new competitor can easily walk away with the entire market by assuming a higher

volume level, tooling accordingly, and dramatically undercutting the first entrant's prices. The first entrant, even if it is a large company, then finds it impossible to retool and regain market share before running out of money or patience. An excellent example of this, discussed below, is Litton's overnight loss of dominance in the commercial Global Positioning System (GPS) market when startup companies realized that there might be a consumer market for the devices.

2. At an appropriate price level, the product might be an enabler for a volume application that wouldn't exist if the price were higher. A current example of this is consumer- and small-business-oriented satellite systems. The capital cost to build, launch and commission the necessary satellite constellation is upwards of $1 billion. In order to break even, each constellation must serve 2 million or more customers, each of whom must have a user terminal. The cost of an installed user terminal is about $100 for labor, plus the cost of the terminal. At reasonable margins, the satellite service provider has to pay about $1000 for a user terminal, making the installed cost $1100. The consumer will not pay more than $300. The satellite service provider must therefore subsidize the user equipment to the tune of $800 per customer, making the user equipment segment of the satellite system cost considerably more than the constellation itself. The mere existence of a component that will reduce the price of a user terminal by, say, $150, may make the difference between a constellation that gets launched and one that doesn't. This is an extreme example of price elasticity, discussed below.

Price Elasticity

Companies in mature markets use the concept of Price Elasticity as an important planning tool. Conceptually, Price Elasticity is actually “volume elasticity,” because it is a measure of the change in sales volume of a product as price is varied. Oddly, Price Elasticity can be either positive or negative, as the following example will show:

In 1986, the least expensive commercial GPS receiver on the market was Litton’s, at $12,000. It was intended to be used in large private jets and commercial aircraft. Magellan was formed in 1986 to make GPS receivers for the consumer market, and believed that an appropriate price for a consumer GPS product, based on the price of high-end calculators and other battery-operated products of similar complexity, was about $300. An analysis of distribution costs led to a maximum unit cost of $160. To reach this cost goal, Magellan designed two specialized integrated circuits for its product (a gallium arsenide integrated circuit and a silicon “Swiss Army” chip that performed a variety of functions). This resulted in a Standard Cost of about $500, and it was clear that the $160 cost target could easily be reached with subsequent redesigns involving more integration.

Because the company had to make money, and knew its initial prices would have to be too high for the outdoor market for which the company was founded, Magellan decided to first offer its product to the marine market for $1000. There was little interest. The company ran focus groups of mariners to understand its market better, and found that

mariners, who trusted their lives to the product, did not believe a $1000 product could be reliable. The company then offered the same product for $4000 and began to sell them briskly. As the market matured and competitors appeared, prices began to drop and volumes increased, as new segments (casual military users, then boat owners, then pilots, and finally backpackers, hunters and fishermen) found that they could afford the products. The market for these products is now mature, and the retail price for an outdoorsman's product has settled between $350 for a very highly-featured unit, to less than $100 for a basic get-you-there product. Marine products, which are the same product in a different case and with a different database, now sell for about $1000, and aircraft products, still basically the same but with federal approval, sell for $3000 to $8,000, depending on features.

The textbook example of negative price elasticity involves Toni Home Permanents. In the 1930s, most women who could afford it went to a beauty shop once a month to get a "Permanent Wave." Toni invented a home permanent kit, which they sold for twenty-five cents (the then-equivalent of about $5.00). It worked fine, but women didn't buy the product, because they thought it couldn't be any good if they sold it that cheap. Toni raised the price to $1.00 ($20.00) and couldn't keep the product on the shelves. They learned two things: first, people who trust something of value (in this case, their hair) to a product need to believe the product is of high quality. There is a price below which a product is considered to be shoddy. Second, they learned that their customers would pay close to beauty-shop prices just to avoid going to the beauty shop. Convenience (and maybe freedom from gossip) is worth a lot. This and the previous story are examples of "Product Positioning," discussed below.

From the above, it's clear that Price Elasticity is nonlinear, and in capital-goods markets not really measurable except by trial and error. A few ways to minimize the error are discussed below, in "Zeroing in on a Price."

Product Positioning

The price a purchaser is willing to pay depends on his or her perception of the product's value. Sometimes this is a practical consideration ("Will that car hold my whole family?"), sometimes on the expected reaction of others ("Is this car too pretentious for me?"), and sometimes on the buyer's estimate of the cost of manufacture ("Rolls-Royces are hand-built."). Most important of all, a buyer won't pay significantly more for a product than for other, similar products, and is extremely reluctant to buy a product if he thinks its maker is making an excessive profit, even if he has the money ("I don't want to be cheated."). Each of these perceptions has an exact counterpart in the capital-goods business.

New companies entering new markets have a very interesting positioning problem to solve, especially if, as in the GPS case above, there are several segments in which customers gain greater or lesser benefits from the product. To pilots, for example, GPS is a great convenience but not a necessity (because there are other means of navigation available to them); however, to use this convenience legally for instrument flight, they

must have a product approved by their government's aviation regulatory bureau. Mariners in bad weather can find their lives completely dependent on the product, but there is more competition in the marine segment because there is no approval requirement. GPS brings outdoors people enormous freedom and safety, but those users aren't big spenders.

A new company can be much more successful if it's able to position slight variations of its first product in several segments, with different price points and different volume expectations for each segment. This requires that its customers believe that there are significant differences between the products offered in the different segments. For this to work in a product sold to other companies, the company must decide, early in its life, to be very secretive about information which can allow others to deduce its costs. A determined customer or competitor can eventually estimate cost closely by disassembling the product to considerable depth; however, if the product contains custom integrated circuits, for example, or a large amount of firmware, cost estimation is a big, time-consuming job, involving X-rays and extensive reverse engineering. It's a good idea to make the job as difficult as possible. Some people[3] have been known to add extra pins to a custom integrated circuit with the sole object of sowing confusion among competitors and customers.

Products intended for different segments must *look* different. Different finishes and colors are a must. A little gold plating goes a long way. Different physical shapes are important. If there are interface choices, use them.

Typically, the distinctions between segments for the same product are based on different applications, and those applications vary in volume. The trick is to charge high prices for the low-volume products with high-value end uses, and lower prices for the same product in high-volume, low-value applications. Products for segments requiring regulatory approval, Space Qualification, or other special tests should be priced very high. In each case, the price should be chosen to maximize total Gross Margin in the segment *over the product's expected life, not just in the short term.* This is easy to say, but very hard to do in a new market.

Zeroing in on a Price

The best way to generate price-volume curves ("Price Elasticity Curves") is to conduct focus groups. This works very well for consumer products, but obviously is impossible in capital-goods markets where there are only a few customers. The next best thing is to spend a lot of time talking with customers, find out what they're paying for various other products, and try to fit the product into that matrix. One must then apply that process that even lizards know how to use, "Making Decisions Based on Lousy Information." The following suggestions may help:

1. Most people have an internal conception about price and volume, arising from their life's experiences, that conform pretty well to Dr. Stuart's cost-volume

3. Gary Sutton, private communication.

curve. If, therefore, a company is offering a basic product in quantities of 50,000 for $250, a price of $82.59 for quantities of 500,000, $756 for quantities of 5000, $1640 for quantities of 1000, and $5000 for quantities of 100 *of seemingly different products* would not seem offensive or unreasonable.

2. Regulatory approvals take time and money, and Federal agencies such as the FCC and FAA are careful not to let applicants obtain approvals based on work their competitors have already done: they make them repeat the work, and do go to some lengths to keep details of the applicants' approval test methodologies confidential. Approvals take time, from two or three months to years. Regulatory approvals therefore present a formidable barrier to competitors, and that cost is recognized by customers. Customers will pay a hefty premium for regulatory approvals, albeit grudgingly. These premiums are of the order of 20%, in the case of a simple Federal Communications Commission Type Acceptance, to several times the unapproved price for FAA-approved aviation products containing software.

3. Space Qualification involves vacuum, radiation, heat, and combinations of those tests. It is done in dedicated facilities. It is breathtakingly expensive, and once obtained, can command a huge price premium. It is often possible to obtain Space Qualification through participation in a Government contract requiring it, at little cost to the manufacturer. Space Qualification thus obtained can be used on identical products sold thereafter at no additional charge to the manufacturer except for the rigorous testing each individual item must endure.

Predatory Procurement

New companies making components of larger systems can get into a lot of trouble when dealing with large Original Equipment Manufacturers ("OEMs") in which there is a close relationship between the Purchasing function and the engineering department. The OEM is a very attractive customer for the small company, because a relatively small order from the OEM's point of view can amount to half or more of the small company's business. If it can be filled profitably, it can literally assure the small company's success.

A new company occasionally has the misfortune to meet a predator. When this happens, things proceed as follows: once contact has been established and the OEM understands that the small company holds important intellectual property or is otherwise not vulnerable to competitive pricing, the OEM sets out to determine the small company's costs. Sometimes this is easy: the OEM demands details of the product's construction and cost breakdown, "To make sure you'll survive, and will be there when we need you." If the selling company is made up of engineers, they're eager to show off, and are often all too happy to oblige. Sometimes the OEM offers engineering money ("Non-Recurring Engineering," or "NRE") for specific features, but of course must have full details of the product, "To make sure the NRE is properly used." Sometimes they just disassemble samples. However he does it, the OEM soon knows exactly how much your product costs, unless you are careful.

If the order will make up most of your business, and the OEM knows you've planned on it, he will simply figure out the price that will bring you to cash break-even, and tell you that's what he'll pay. If you accept this price, your company will survive, but it will join the ranks of the "Living Dead," a class of companies that don't grow and eventually fail for lack of innovation. The OEM has, in effect, made your company a subsidiary of his company, without buying it; and by stopping his orders can dump it, any time he wants, for no cost. This is because you will have great difficulty charging the OEM's competitors a higher price than the OEM is paying, since even if they don't know your price (and they'd have to be pretty stupid not to be able to guess it), they can't stay in business if they pay more. You have effectively set the price of your product in all of the competing systems by setting your price too low.

If you put up a fight, the OEM will simply modify his specification, forcing you to spend engineering money. He will then order 100,000 units, take 10,000, and refuse to pay the 10,000-unit price. He will encourage another company to compete with you, and pay them to do it. He may even leak some of your Intellectual Property ("IP") to this "second source." He will then continue do this until you accept his price in desperation.

There is a variation on that theme in cases where small companies use offshore manufacturers. In this case, the OEM, or especially a large retail chain if you're making a consumer product, wants to know who your Chinese manufacturer is, "So we can be sure he's reliable." If you tell him, he'll go directly to your foreign manufacturer and place an order, and you're toast. There are two strategies to deal with this: first, don't tell him. This will annoy him, but at least he won't think you're stupid. The other, in the case of a complex product, is to use two or three different manufacturers to make different parts of the product. Have the parts containing the important intellectual property made domestically, or make them yourself. Do your own integration, final assembly and test.

The way to avoid these traps is to be tough. First, don't give the OEM information on your costs, even indirect information. Don't sell him samples. Lend them to him, and have your lawyer write an agreement, with teeth in it, that keeps the OEM from taking them apart. Don't take NRE unless you must, and if you do, do not give his engineers access to your plant. Place a fair price on your product, and stick to it. *You will have to walk away from the table more than once.* If the OEM violates your nondisclosure agreement or steals your private competitive information, sue him instantly. If your lawyer did a good job, you will have a case, and the OEM will fold. *But you have to learn to keep your mouth shut.*

Note that I didn't say, "Sue him for dishonest behavior, or restraint of trade." If you do this, you may eventually win, but in the meantime you've chosen a different kind of career for yourself: talking to lawyers. And your company will fail while you're doing it.

Is this going to make your customer mad? Not really. He knows he's playing a hard game. And his bosses tell him it's not really unethical, it's just, "Doing what everybody else does, because that's how we'll win[4]."

Just so he'll be sure they know what to do and how to do it, he sends his engineers and purchasing people off to seminars that teach them the details of these scams. And people who have consciences leave that company and go off and do something else, as you're thinking of doing.

Parting Thoughts

It's helpful to remember that:

- Pricing in new markets is an art, not a science, but good information helps.
- Traditional accounting practices applied to costing decisions in new companies can be misleading, and if followed slavishly, will do much more harm than good.
- Companies must always be planned for the maximum expected volume. A failure of nerve here means huge competitive problems later.
- Pricing decisions are not for the faint of heart, because they can be damaging or fatal. Boldness is important, as is the ability to say, "I was wrong," and do something else. In this context, it's helpful to be addressing a large market, since one can then alienate some of one's customers and still make a living off the rest.
- Not all customers are ethical, but they're all customers. Some of them are a joy, and will bring you not only business, but friendships that will long survive your business relationship. A useful rule is "tit for tat:" treat others, not like you'd like to be treated, but like they treat you. This strategy always wins in the long run[5].
- Greed is not good, because it makes enemies at a time when one needs friends.
- Anyone starting a company is in it for the long haul, whatever he or she thought or was told at the outset. Founders and investors are judged more by the quality of their companies than by their marginal financial performance, as recent business history has shown. Good reputations arise first from excellent results, and secondarily by the short-term accumulation of wealth. For all of those reasons, it is important in making pricing decisions to consider the best long-term outcome for the company, and not set prices for maximum short-term gains. In this way, one builds a stable, loyal customer base, a responsive list of suppliers, happy investors, and a dedicated, fulfilled staff of employees whose value far exceeds the Net Worth line on the company's Balance Sheet.

4. Take a Tum, and then read McLean, Bethany et al., *The Smartest Guys in the Room*, Portfolio (Penguin Group) New York, 2003.
5. Axelrod, Robert, *The Evolution of Cooperation*, Basic Books, New York, 1984.