Everything You Always Wanted To Know About Product Cost but Were Afraid to Ask ............
General rule of thumb you have locked in 70 – 95 % of your product cost after you have completed 5% of the product design
In product costing no one cares what your prototype cost. Unless you spent more than your allotted $6500 dollars.

They want to know what your product costs in production AND how much profit you plan to make.
But first...

how does the cost of building your alpha prototype relate to the product’s manufacturing cost?
Product Cost

Product Cost Equals =

Material Cost + Assembly Labor + Profit

Material cost = parts, scrap, maybe amortized tooling to make parts.

Assembly labor = All labor to get it out the door to the customer manufacturing, assembly, testing, packaging,

Profit = $$$ left over after you pay all the bills
Product Cost

All the Bills include:

- Salary for your team about $100,000/ engineer including benefits
- Rental Space for offices, lab areas
- Manufacturing areas, tools assembly fixtures ........
- Equipment office, computers, Xerox machines ........
- Heat, lights ..... If not included in rent
- Inventory of raw and finished materials
- Phones, internet,
- Marketing
- Product Liability insurance

But to name a few
Typical Product Cost Breakdown

- Part Costs: 72%
- Overhead: 24%
- Labor: 4%

Source: The True Cost of Oversea Manufacturing June 2004 N. Dewhurst & D. Meeker
Costs and Expenses

Examples

Cost
materials, labor, overhead 69.7%

Expense SG&A
sales general and administrative 24.3%

Expense
R&D, interest, taxes 3.6%

Profit
NEAT: net earnings or profit after taxes 2.4%
Useful Sources for all kinds of information

Metals Sources

•LME
  http://www.lme.com/

•Kitco Metals
  http://www.kitcometals.com/

•Metal – Pages
  http://www.metal-pages.com/

•Metal Prices
  http://www.metalprices.com/

•Metals About
  http://metals.about.com/cs/utilities/l/blprices.htm

•PLATTS
  http://www.platts.com/CommodityHome.aspx?
  Commodity=Metals
Useful Sources for all kinds of information

Metals continued
• http://crugroup.com/Pages/default.aspx (Critical Intelligence)

Plastics
• http://www.chemicaldata.com/ (plastics and feedstocks)
• http://www.ptonline.com/ (plastic technology magazine)

Energy
• http://www.eia.doe.gov/ (U.S. Energy Information Administration)
Define Levels of Cost Analysis

**Level 1** - A first impression by knowledgeable engineers of what a part, assembly or system would cost based on prior experience. (parametric)

**Level 2** - An estimation based on prior experience with similar products, budgetary estimates, vendor quotes and expert opinion and experience. (analogy)

**Level 3** - Detailed costing of every part accomplished by using material cost estimation data bases, and time/motion studies. A high degree of accuracy is achieved by comparisons to industry standards and vendor quotes. (analytical)
Product Cost

**Level 1** - A first impression by knowledgeable engineers of what a part, assembly or system would cost based on prior experience. (parametric)

<table>
<thead>
<tr>
<th></th>
<th>Pro-Lite Spine Board</th>
<th>Aquaboard</th>
<th>SKED Rapid Deployment</th>
<th>Flotation Assist Device</th>
<th>Our Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>$250</td>
<td>$600</td>
<td>$1,164</td>
<td>$300 (add-on)</td>
<td>Goal: $600</td>
</tr>
</tbody>
</table>

Quick and dirty way to look at cost is try to figure out markup for the industry or the company.

<table>
<thead>
<tr>
<th>Markup</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td>$208.</td>
</tr>
<tr>
<td>2.0</td>
<td>$125.</td>
</tr>
<tr>
<td>3.0</td>
<td>$83.</td>
</tr>
<tr>
<td>4.0</td>
<td>$62.5</td>
</tr>
<tr>
<td>5.0</td>
<td>$50.</td>
</tr>
</tbody>
</table>
Product Cost

**Level 2** - An estimation based on prior experience with similar products, budgetary estimates, vendor quotes and expert opinion and experience. (analogy)

Might look at the major subassemblies, what they are made of, look at a trend line or a benchmark rule of thumb.

General rules of thumb:

- Printed circuit Boards 4 cents per square inch per layer
- Power supplies PC 10 cents per watt
- Large enclosures (servers) 1 cent per cubic inch
- Heatsinks Alum. Extrusions 50 -100 K volume no finish 3.0 times cost per pound ([LME London Metals Exchange](http://www.lme.co.uk/))
Trend Line Analysis

Tractor example

$/$HP 42 & 48 inch cut lawn tractors

\[
y = 2.4787x + 43.107 \\
R^2 = 0.9997
\]

\[
y = 2.78x + 29.84 \\
R^2 = 0.9876
\]
Product Cost

*Level 3* - Detailed costing of every part accomplished by using material cost estimation data bases, and time/motion studies. A high degree of accuracy is achieved by comparisons to industry standards and vendor quotes. (analytical)
Creating A Product Cost

When you are off buying material for your product. Remember to get quotes for larger quantities than you are buying.

Ideally several quantities which include your highest volume.

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Price $</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>$9.98</td>
</tr>
<tr>
<td>1K</td>
<td>$5.08</td>
</tr>
<tr>
<td>20K</td>
<td>$3.66</td>
</tr>
<tr>
<td>50K</td>
<td>$3.25</td>
</tr>
<tr>
<td>100K</td>
<td>$3.09</td>
</tr>
</tbody>
</table>

40mm x 20mm 12 volt 10.8 cfm fan
Creating A Product Cost

First
You need a bill of material BOM
This is a listing of all the materials, and parts it takes to making your product. The BOM should have a part name, description, quantity used in the product, dimensions and weights, and the material it is made of.

Ideally the BOM should be indented starting with the finished product.
Next all the subassemblies should be under it, and the parts and subassemblies that go into those listed under them respectively.

Second
You need to know the Volume of units you plan to produce. You want to cost your product at the max volume you plan to make for the year.
Volumes can increase over time if you believe your sales of units will increase.
Creating A Product Cost

Labor Cost:

Can be calculated by using Boothroyd and Dewhurst Design for Manufacturing and Assembly.

The Software estimates time to assemble various parts and subassemblies into a product.
Creating A Product Cost

Software That Helps You Estimate part cost

Boothroyd and Dewhurst DFM Concurrent Costing Version 2.3 Can estimate cost on the following processes and materials.
Costing Case Study

Aluminum Tubing

There are several ways to make Aluminum tubing. The most common way is by extrusion.
Extrusions

Most of you have some experience in extrusions from your childhood

Traditional Play Dough

1 cup flour
1 cup warm water
2 teaspoons cream of tartar
1 teaspoon oil
1/4 cup salt
food coloring

Mix all ingredients, adding food coloring last. Stir over medium heat until smooth. Remove from pan and knead until blended smooth. Place in plastic bag or airtight container when cooled. Will last for a long time.
Flitter / Fortrus
McMaster-Carr does not offer Volume discounts on Alum. tubing. Their price on a per inch basis is pretty linear.

Most of you bought your tubing from McMaster-Carr

<table>
<thead>
<tr>
<th>Tube Type</th>
<th>Round</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finish/Coating</td>
<td>Unpolished (MILL)</td>
</tr>
<tr>
<td>Round Tube Type</td>
<td>Single-Wall</td>
</tr>
<tr>
<td>Tolerance</td>
<td>Standard</td>
</tr>
<tr>
<td>Wall Thickness</td>
<td>.005&quot;</td>
</tr>
<tr>
<td>Inside Diameter</td>
<td>870&quot;</td>
</tr>
<tr>
<td>Outside Diameter</td>
<td>1&quot;</td>
</tr>
<tr>
<td>System of Measurement</td>
<td>Inch</td>
</tr>
<tr>
<td>Test Report</td>
<td>Without Test Report</td>
</tr>
<tr>
<td>Hardness</td>
<td>95 Brinell</td>
</tr>
<tr>
<td>Application</td>
<td>Structural Tubes</td>
</tr>
<tr>
<td>Specifications Met</td>
<td>American Society for Testing and Materials (ASTM)</td>
</tr>
<tr>
<td>ASTM Specification</td>
<td>ASTM D241</td>
</tr>
</tbody>
</table>

Length
12" | 36" | 6"

These 3 products match your selections

<table>
<thead>
<tr>
<th>Length</th>
<th>Each</th>
</tr>
</thead>
<tbody>
<tr>
<td>12&quot;</td>
<td>9066K753</td>
</tr>
<tr>
<td>36&quot;</td>
<td>9066K752</td>
</tr>
<tr>
<td>6'</td>
<td>9066K751</td>
</tr>
</tbody>
</table>
2.009 Product Engineering Processes

Quote from and Extrusion Company SAPA
AL-6061-T6 1" OD 0.065" Wall

5k, 10k (feet)
$0.4136/FT

50k, 100k (feet)
$0.3929/FT

Links to design guide and power point on extrusions

Typically the Tooling cost which are dies are relatively inexpensive ie; a few thousand dollars. In this case it is a standard die size no cost.
Recap

• No one cares what your prototype cost

• Product Cost = Material Cost + Assembly labor cost + profit

To Get Started

• Bill of Material (BOM)
• Product volume first year
Costing Tutorials

http://www.dfma.com/support/tutorials.htm

Learn the basics of the DFM Concurrent Costing Software – [10:45 runtime]
Learn the Basics of the Design for Assembly Software – [7:46 runtime]
Import a Bill of Material (BOM) into DFA – [3:18 runtime]
Import a CAD model into DFM Concurrent Costing – [2:28 runtime]
Learn how to use DFA to redesign my product – [5:45 runtime]
Share the results of my DFMA Analyses with others – [3:12 runtime]
Analyze an Injection Molded Part – [7:19 runtime]
Analyze a Sheet Metal Part – [4:09 runtime]
Analyze a Machined Part – [7:05 runtime]
Analyze a Machined Part using the Quick Estimator – [5:15 runtime]
Conduct an environmental assessment of my product – [7:09 runtime]
Add a Machine to the Machine Library in DFM – [2:56 runtime]
Add a Material to the Material Library in DFM – [3:27 runtime]
WHERE possible and as you are buying things now, ask for quotes in quantities you need to build at least your first year volume.
I Keep Six Honest Serving Men

I KEEP six honest serving-men
(They taught me all I knew);
Their names are What and Why and When
And How and Where and Who.

I send them over land and sea,
    I send them east and west;
But after they have worked for me,
    I give them all a rest.

I let them rest from nine till five,
    For I am busy then,
As well as breakfast, lunch, and tea,
    For they are hungry men.
But different folk have different views;
    I know a person small—
She keeps ten million serving-men,
    Who get no rest at all!

She sends'em abroad on her own affairs,
    From the second she opens her eyes—
One million Hows, two million Wheres,
    and seven million Whys!

Rudyard Kipling

Questions

http://www.youtube.com/watch?v=WIn5CQ_XH1Q