Everything You Always Wanted To know About Product Cost but Were Afraid to Ask
Some Facts About Product Cost

General rule of thumb you have locked in 70 – 95 % of your product cost after you have completed 5% of the product design

Source: Ford Motor Company
In product costing no one cares what your prototype cost. Unless you spent more than your allotted $6000 dollars.

They want to know what your product costs in production AND how much profit you plan to make.
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
Product Cost  mini quiz

What do Materials Cost?

• Copper $/lb
• Aluminum $/lb.
• Magnesium $/lb
• Nickel $/lb
• Tin $/lb
• Zinc $/lb
• Steel hot dipped galvanized $/ton
• Oil $/barrel
• Natural Gas $/MMbtu
• Kraft $/ton
• ABS plastics $/lb
• Nylon 66 plastic $/lb
• Polystrene plastic $/lb
• LCP plastic $/lb
Product Cost

www.bls.gov/

Bureau of Labor Statistics

1 Trade-weighted average
2 The Asian NIEs are Hong Kong SAR, Republic of Korea, Singapore, and Taiwan.
Hourly compensation costs measure the cost to employers to hire one hour of labor in manufacturing. They include payments made directly to workers, as well as employer expenditures on social insurance. In some countries, taxes and subsidies related to employment also are included. For this measure, hourly compensation costs in national currencies have been converted to U.S. dollars using market exchange rates.

Manufacturing hourly compensation costs were highest in Norway, at 1.8 times the U.S. level. Australia, Canada, and 10 of the 12 European countries had higher hourly compensation costs than the United States; Spain and Portugal were the only two European countries that had lower hourly compensation costs than the United States. Hourly compensation costs were under $11 in Mexico, Taiwan, and Portugal.

http://www.bls.gov/fls/chartbook/section3.htm#chart3.1
Product Cost

What do Materials Cost?

- Copper $/lb 3.94
- Aluminum $/lb. 1.11
- Magnesium $/lb 2.35
- Nickel $/lb 11.09
- Tin $/lb 11.97
- Zinc $/lb 1.14
- Steel hot dipped galvanized $/ton 780
- Oil $/barrel 86.60
- Natural Gas $/MMbtu 4.05
- Kraft #42 $/ton 690
- ABS plastics $/lb 1.17 – 1.18
- Nylon 66 plastic $/lb 1.83 – 1.94
- Polystyrene plastic $/lb 1.02 – 1.04
- LCP plastic $/lb 6.10 – 9.80

www.lme.co.uk--

http://www.plasticsnews.com/resin-pricing/all-resins.html
Product Cost
All materials are Commodities

Price of raw material is effected by:
• Supply and Demand
• Global Distribution
• Institutional Investors

Chuquicanita open pit mine in Chile
London Metals Exchange (LME) 1 year supply / cost curves

- Aluminium Alloy
- Aluminium
- Copper
- Lead
- Nickel
- Tin
- Zinc
- Nasaac
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 databases, 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>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td>$208.</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>$125.</td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>$83.</td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>$62.5</td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>$50.</td>
<td></td>
</tr>
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</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 www.lme.co.uk/](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>
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<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

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.
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.
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
McMaster-Carr does not offer Volume discounts on Alum. tubing. Their price on a per inch basis is pretty linear.
2.009 Product Engineering Processes

Cost from Two Distribution houses that sell Aluminum Tubing 1"OD 0.065 Wall Thickness 6061 T6

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Metals Depot</th>
<th>TW Metals</th>
</tr>
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<tbody>
<tr>
<td>5000 ft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10,000 ft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50000 ft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100000 ft</td>
<td></td>
<td></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.
2.009 Product Engineering Processes

Costing Example:
Boothroyd and Dewhurst Plastic injection molded parts

http://www.protomold.com/SampleCube.aspx
### DFMA Example-Comparing Estimates Against Vendor Quotes

#### B&D Estimates Against Actual Quotes

<table>
<thead>
<tr>
<th>Item Description</th>
<th>QTY</th>
<th>Cost</th>
<th>B&amp;D Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOOR,</td>
<td>1</td>
<td>$22.34</td>
<td>$9.40</td>
</tr>
</tbody>
</table>

![Diagram of a component](image.png)
**DFMA  Example-Vendor Quote**

<table>
<thead>
<tr>
<th>Item Description</th>
<th>QTY</th>
<th>Cost</th>
<th>B&amp;D Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOOR,</td>
<td>250</td>
<td>$22.34</td>
<td>$9.40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FOUP Door</th>
<th>2,500</th>
<th>1,500</th>
<th>1,000</th>
<th>500</th>
<th>250</th>
</tr>
</thead>
<tbody>
<tr>
<td>$55,000.00</td>
<td>$14.17/ea.</td>
<td>$15.59/ea.</td>
<td>$17.30/ea.</td>
<td>$18.74/ea.</td>
<td>$22.34/ea.</td>
</tr>
</tbody>
</table>

Delivery: (8) weeks ARO

Resin: LNP DB 1004 EMMR, BK115

Tooling Description: Single cavity self-contained *pre-hardened steel mold*, tri-plate gating with (4) pinpoint gates, pin ejection, flat parting line, and bead blast cavity finish.

Notes:
- The molding material is a suggestion by our contact at LNP Corporation, based upon the need for optimum flatness. *(20% glass bead filled polycarbonate)*
- The flatness is difficult to predict. We are proposing a “tri-plate” gating design with (4) pin-point gates for help in improving flatness. A flatness specification of .010 cannot be guaranteed. We feel reasonably confident that we could mold between .012” and .020” flatness.
- “Sink” marks may be evident because of the intersecting wall section ratios. Any “sink” mark would not be part of the measured flatness.

148 Christian Street  
Oxford, CT 06478  
203-888-0585

PTA CORP  
www.ptacorp.com

7350 Dry Creek Parkway  
Longmont, CO 80503  
303-652-2500

Page 2 of 2
Questions were asked to gather further information

• Material parameters and material cost from vendor, tonnage machine, and process information. PTA $7.35/lb  GE $7.65/lb  PTA is passing their material cost saving.

• New Plastic Material database created

• The cost estimate was revised using the above information.

• New B&D estimate is $23.30  VS.  Vendor Quote $22.34
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