Product Design
Session 4 - Cost, Channel, and Unit Economics

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Value-Creating Innovation: The Three Key Questions

✓ 1. Is the need real?

✓ 2. Does the solution meet the need?

? 3. Is the user/customer willing to pay more for the solution than it costs you to deliver it?

Financial Sustainability – making and selling something

$$Q\,(p - c) > F$$

where

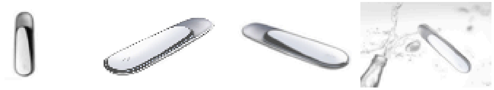
Q	**quantity** sold per unit time (e.g., 30,000 openers/year)
p	**price** per unit (e.g., 25.00 USD/opener)
c	**cost** per unit (e.g., 13.44 USD/opener)
F	**fixed costs** to operate the business per unit time (e.g., 300,000 USD/year) rent, advertising, salaries, etc.

Of course we can integrate these variables over time, discount cash flows, and so forth, to capture time value of money and total project value.

See Ulrich and Eppinger Chapter "Product Development Economics" for details.

Target Costing - Key Idea

1. Set price based on market logic.
2. Work backwards from price to set cost target.
3. Check your *cost of goods* against the cost target.



Bottle Opener

$50.00

Quantity:

1 Order

The Belle-V Bottle Opener adds style to any bar. The "business end" of the opener features a self-centering lip to make removing bottle caps a cinch. The curved upper surface feels great against your palm and elevates the opener above your bar, table or counter to make it easier to pick up. The product is made from stainless steel for strength and durability and is finished and polished by hand.

Bottles have needed openers ever since William Painter invented the first pleated metal bottle cap in 1892. Typically stamped metal, utilitarian bottle openers have functioned adequately but are so visually uninteresting that users are barely aware of them during use. They are usually uncomfortable and not ergonomic in their design.

The Belle-V Bottle Opener's beautiful design instantly forges an emotional connection with the user, who can quickly, easily and comfortably remove a bottle cap. Investment-cast stainless steel provides corrosion resistance and the thick walled durable construction imbues the bottle opener with an heirloom quality.

BELLE-V
KITCHEN

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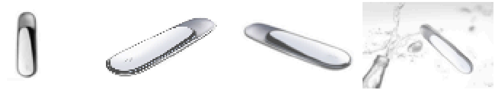

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Pricing

- What are prices of competitive alternatives?
- What is the relative advantage of the product?
- Look and feel of the number itself (e.g., 88.88 or 28.50 or 1.99).
- For B2B, what is "value in use" (i.e., cost savings).

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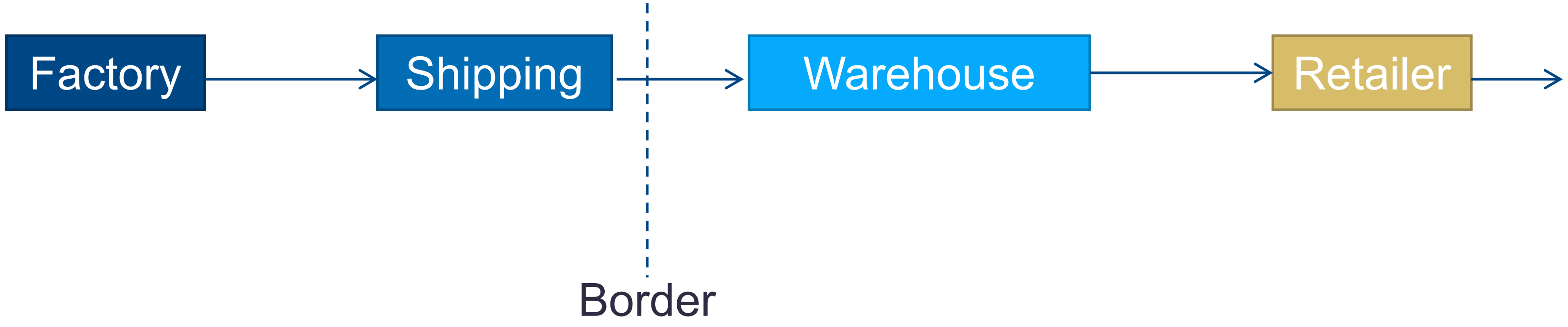
Supply Chain

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Example Target Cost Calculation for a Physical Good Sold Through Retailer

50 USD retail price (the price the end consumer pays)

50% retailer gross margin
Implies…
25 USD wholesale price (the price the retailer pays you, the *brand owner*)

40% brand owner gross margin
Implies…
15 USD (maximum) cost of goods (COGS)

$$50 \times (1 - 0.50) \times (1 - 0.40) = 15$$

Gross Margin (Retailer Example)

Gross Margin is $$\frac{\text{Price - Cost}}{\text{Price}}$$

That is, $$\frac{\text{Price to Consumer – Price Retailer Pays You}}{\text{Price to Consumer}}$$

For example, $$\frac{50 - 28}{50} = 44\ \%$$

"Mark Up" is Defined Differently

Mark Up is $\dfrac{\text{Price}}{\text{Cost}} - 1$

For example, $\dfrac{50}{28} - 1 = 0.79 = 79\%$

Mark up and Gross Margin are related as follows:

$$\text{Mark Up} = \frac{\text{Gross Margin}}{1 - \text{Gross Margin}}$$

For example, $\dfrac{0.44}{1 - 0.44} = 0.79 = 79\%$

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Typical Gross Margins for Retailers

What determines margin?

- Volume (higher volume ➔ lower margin)
- Price point (higher price ➔ lower margin)
- Differentiation (less differentiation ➔ lower margin)
- Retailer’s costs: seasonality, lifecycle, returns, sales effort
- E.g., construction materials vs. luxury cosmetics

Typical ranges

- Fashion apparel 60%
- Building materials 20%
- Typical consumer goods 35 – 50%

Typical Gross Margins for “Manufacturers” (i.e., “Brand Owners”)

What determines margin?

- Volume (higher volume ➔ lower margin)
- Price point (higher price ➔ lower margin)
- Differentiation (less differentiation ➔ lower margin)
- Manufacturer’s SG&A and R&D costs: Software vs. Cleaning Supplies

Representative values

- Luxury Cosmetics 75%
- Apparel 50%
- Automobiles 20%
- Typical consumer goods 30 – 50%

Note: You can find average values in your industry by studying financials of public companies.

“Rule” of 4

- In many retail settings, retailer margin requirement is ~50%.
- In such settings, manufacturer (i.e., “brand owner”) also seeks ~50% gross margin.
- These 50% values are often called *keystone* margins (no idea why…)

- Thus, **c** = **p**(1-.50)(1-.50), **p/c** = 4

- Useful quick check, but of course some categories will be p/c>10 (e.g., cosmetics) and some will be p/c<1.5 (e.g., autos).

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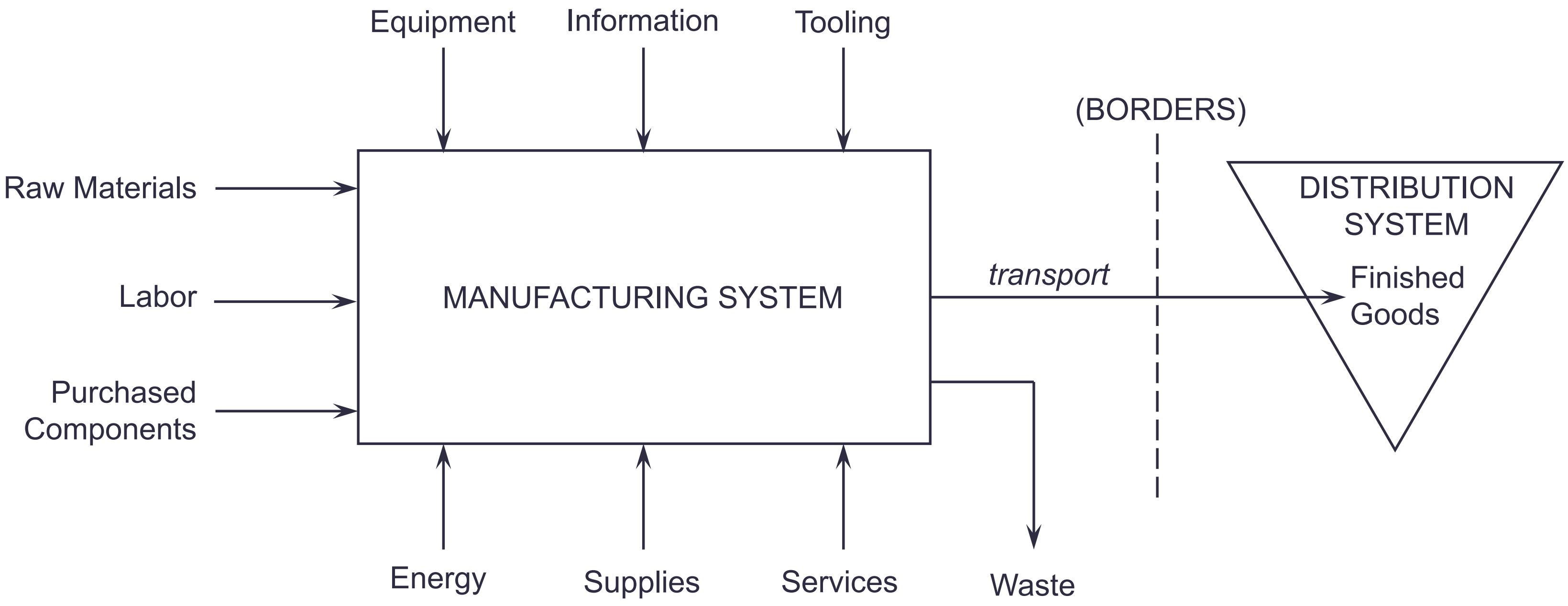
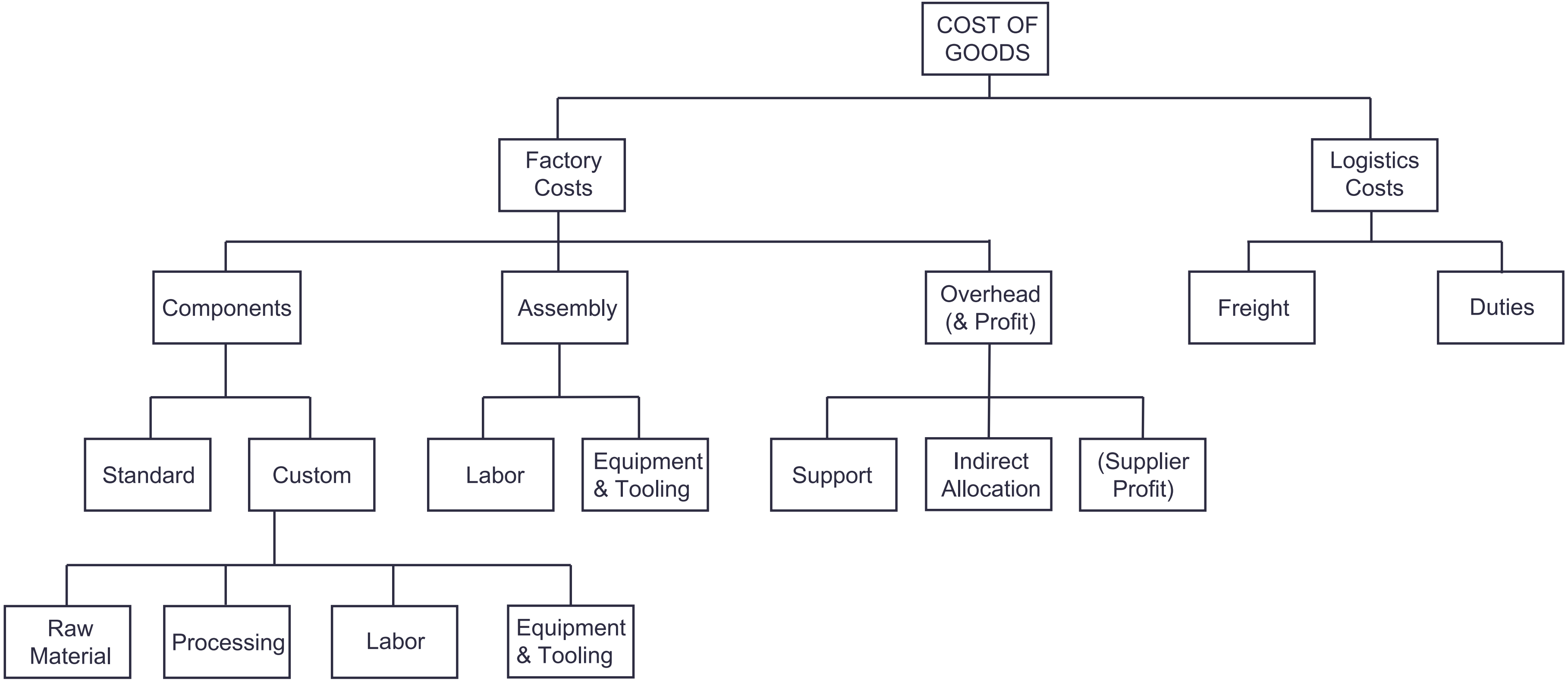
Manufacturing and Supply Chain



Cost of Goods ("COGS")



Excludes warranty, scrap, shrinkage, and outbound freight, which may be included in COGS depending on context.

Duties (or *Tariffs*)

Duties may be levied on imports when they pass through customs.

(But, most goods come into US duty free.)

Duties depend on the class of goods – very specific (and sometimes apparently arbitrary)

Based on Harmonized Tariff Schedule (HTS Code)

Duties sometimes vary by the country from which the goods are exported
(e.g., NAFTA vs. China)

Look up the duty rate according to HTS Code.

https://hts.usitc.gov/ (for imports to U.S.)

Freight Costs

Shipping containers are 40 ft x 8 ft x 8 ft (about 70 m^3).
Max weight of contents about 26,500 kg -- volume usually is constraint, except for very dense goods.
$3k - $6k per container from Asia to US depending on route, season, size of account, etc.
(Much cheaper from U.S. to Asia.)

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Example Custom Part Costs – Injection Molded Chair

https://www.youtube.com/watch?v=b1U9W4iNDiQ (animation of injection molding process)

https://www.youtube.com/watch?v=xim1m2Bhvzc (chair example)

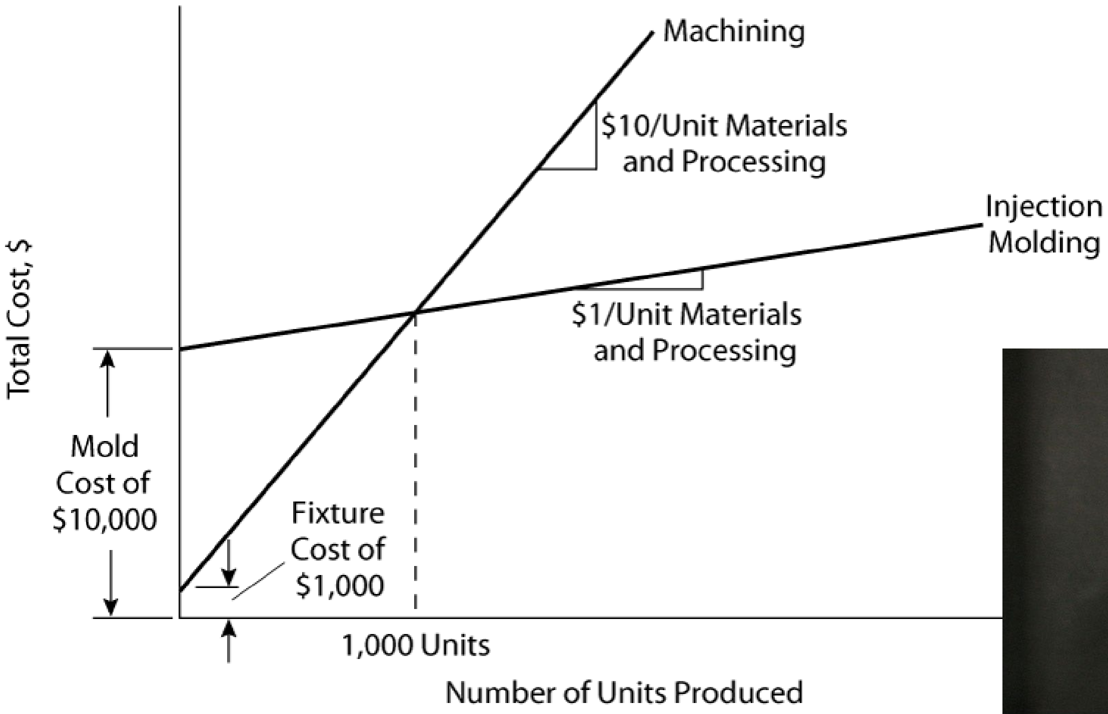
M (kg/unit) Mass of plastic pellets used, net of scrap and regrind (depends on design)
b (usd/kg) Cost of bulk raw materials (depends on polymer of course)

R (units/hr) Rate of production of machine (depends on number of cavities, thickness of part)
K (usd/hr) Cost of machine and operator time (depends on size of machine and level of automation)
T (usd) Cost of tooling/mold (depends on size and complexity of mold)
L (units) Mold/tool life

Direct Unit Cost =	e.g., for chair…	
M x **b** +	2 kg x 2 USD/kg +	4 +
K/R +	100 USD/hr / 60 units/hr +	1.67 +
T/L	250,000 USD / 1,000,000 units	0.25
		= 5.92 USD/unit

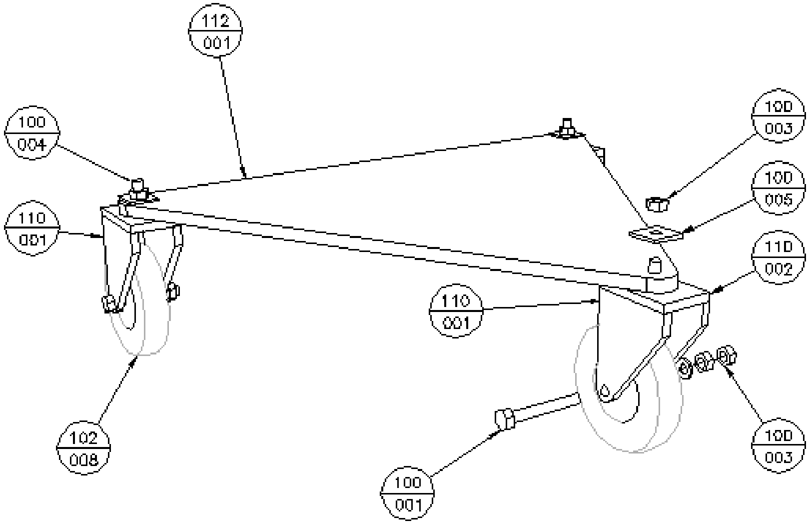
Does not include any overhead or profit.

Process Selection – Trading off Fixed and Variable Costs



Similar for 3D Printing vs. Molding

Bill of Materials (BOM, pronounced “bomb”)



Sample trolley with bill of materials

Bill of Materials - Multi Level

Bill of materials part No: 120-001 QTY: 1 Find Print List...

Total cost 1: $2
Total weight: 0.

Level	Part No.	Description	QTY	Unit	Unit Cost
1	120-001	Trolley, 3 wheeled	1.0000	EA	
2	110-001	Wheel Housing	3.0000	EA	
3	100-001	MS Bolt, M10x70, Galv	1.0000	EA	5.30
3	100-002	M10, washer, Galv	2.0000	EA	2.20
3	100-003	M10, Nut, Galv	3.0000	EA	1.50
3	100-004	MS Bolt, M10x30, Galv	1.0000	EA	4.00
3	100-005	M10 Square Nut	1.0000	EA	1.90
3	102-108	Wheel, with tyre, 100mm	1.0000	EA	15.00
3	110-002	Top Piece	1.0000	EA	
4	105-001	MS Flat 80x8	0.0500	LG	10.00
4	111-001	Galvanising	0.0010	KG	60.00
4	130-001	Labor	0.5000	HR	45.00
3	110-003	Side Piece	2.0000	EA	
4	105-001	MS Flat 80x8	0.1000	LG	10.00
4	111-001	Galvanising	0.0010	KG	60.00
4	130-001	Labor	0.1000	HR	45.00
2	112-001	Plywood Platform	1.0000	EA	
3	106-001	Plywood,12mm,2400x1200	0.1250	SH	75.00
3	111-006	Varnish, Semi Gloss	0.0500	l	10.00
3	130-001	Labor	0.6500	HR	45.00

Source: http://www.billofmaterials.net/

ROBO Bill of Materials Advanced - 30 Day Trial Version

File Inventory Bill of Materials View Reports Import/Export Data Settings Statistics User Interface Purchase Help

Add Part to Inventory | Edit Inventory | Delete from Inventory | Add/Edit Bill of Materials | Setup Reports | Settings | Print List | Buy Software | Help | Statistics

Allocated Shortages | Orphaned Parts | Stock Below Min. Level | Accounts | Customers | Vendors

Inventory | Search Inventory | BOM - Multi Level | BOM - Top Level | BOM - Single Level | Find Where Part Used | Purchase Orders | Works Orders | Quotes and Customer Orders

Bill of Materials - Multi Level

Bill of materials part No: 120-001 QTY: 1 Find Print List...

Total cost 1: $246.97 **Total cost 2:** $297.59 **Total cost 3:** $343.91
Total weight: 0.00Kg

Level	Part No.	Description	QTY	Unit	Unit Cost 1	Wastage %	Ext. QTY	Ext. Cost 1	Ext. Cost 2	Ext. Cost 3	Category
1	120-001	Trolley, 3 wheeled	1.0000	EA							ASY
2	110-001	Wheel Housing	3.0000	EA							ASY
3	100-001	MS Bolt, M10x70, Galv	1.0000	EA	5.30	0.000	3.0000	15.90	19.20	22.50	FS
3	100-002	M10, washer, Galv	2.0000	EA	2.20	0.000	6.0000	13.20	19.20	25.20	FS
3	100-003	M10, Nut, Galv	3.0000	EA	1.50	0.000	9.0000	13.50	16.20	17.55	FS
3	100-004	MS Bolt, M10x30, Galv	1.0000	EA	4.00	0.000	3.0000	12.00	13.50	15.00	FS
3	100-005	M10 Square Nut	1.0000	EA	1.90	0.000	3.0000	5.70	6.30	6.90	FS
3	102-108	Wheel, with tyre, 100mm	1.0000	EA	15.00	0.000	3.0000	45.00	51.00	54.00	ASY
3	110-002	Top Piece	1.0000	EA							ASY
4	105-001	MS Flat 80x8	0.0500	LG	10.00	0.000	0.1500	1.50	1.80	2.10	RM
4	111-001	Galvanising	0.0010	KG	60.00	0.000	0.0030	0.18	0.20	0.21	PR
4	130-001	Labor	0.5000	HR	45.00	0.000	1.5000	67.50	82.50	97.50	PR
3	110-003	Side Piece	2.0000	EA							ASY
4	105-001	MS Flat 80x8	0.1000	LG	10.00	0.000	0.6000	6.00	7.20	8.40	RM
4	111-001	Galvanising	0.0010	KG	60.00	0.000	0.0060	0.36	0.39	0.42	PR
4	130-001	Labor	0.1000	HR	45.00	0.000	0.6000	27.00	33.00	39.00	PR
2	112-001	Plywood Platform	1.0000	EA							ASY
3	106-001	Plywood,12mm,2400x1200	0.1250	SH	75.00	0.000	0.1250	9.38	10.75	12.13	RM
3	111-006	Varnish, Semi Gloss	0.0500	l	10.00	0.000	0.0500	0.50	0.60	0.75	RM
3	130-001	Labor	0.6500	HR	45.00	0.000	0.6500	29.25	35.75	42.25	PR

Code: RBOMA Version: 2.2.1.0 Please note all costs, except where stated exclude GST(Goods and Services Tax)

10:44 a.m.
3/07/2013

Cost of Goods

Factory Price (price you pay factory)		10.00
Duties	3.4%	0.34
Inbound Freight		0.90
Landed Cost		**11.24**
Warranty, Scrap, Shrinkage	1%	0.11
Fulfillment and Outbound Freight		2.20
Cost of Goods		**13.44**

Illustrative only – your values will be different

Class Cost Model

XPULT Example

You set the retail price, and we assume a retail margin of 30%, so you get revenue of 70% of retail price.

Catalog Components
- used *exactly* as purchased
- assume 33% of single-unit retail price
- e.g., AA battery, M5x10 screw

Custom Components
- anything you design
- materials cost x 2.2

Assembly Cost
- USD 0.005 per part

Overhead Cost
- USD 0.05 per unique custom part
- USD 0.01 per unique catalog part

Freight Cost
- assuming 40’ shipping container @ USD 8000 per container

Services or Recurring Purchases → Use "Lifetime Value" or "LTV"

99cheeses.com

- Cheese subscription delivery
- 1 shipment of 4 cheeses per month
- $34 per month subscription fee
- Free shipping
  (shipping and packaging costs $8 per shipment)
- Cost of cheese is $8 per shipment.
- Average customer retention is 20 months

$$\begin{aligned} LTV &= 20 \times (34 - 8 - 8) \\ &= 20 \times 18 \\ &= \$360 \end{aligned}$$

Illustrative only

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