

Cost Estimation

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Why cost matters?

Anything you want to sell...

...must be bought by someone

A certain **quantity** of products, at a certain **quality**, at a certain **cost**

Engineering

Common definition

- Technical solutions to solve problems

More realistic definition

- Solve problems with **limited resources**

Product Design

- Cost is part of design constraints
- Product design is optimizing a set of functions with limited resources
- This is engineering as well!

What is Quality?

- How well the functions are achieved
- Quality often increases complexity

Complexity

- Number of parts
- Number of functions on a part
- Diversity of parts
- Time is Money
- Complexity is Time
- Complexity is Money

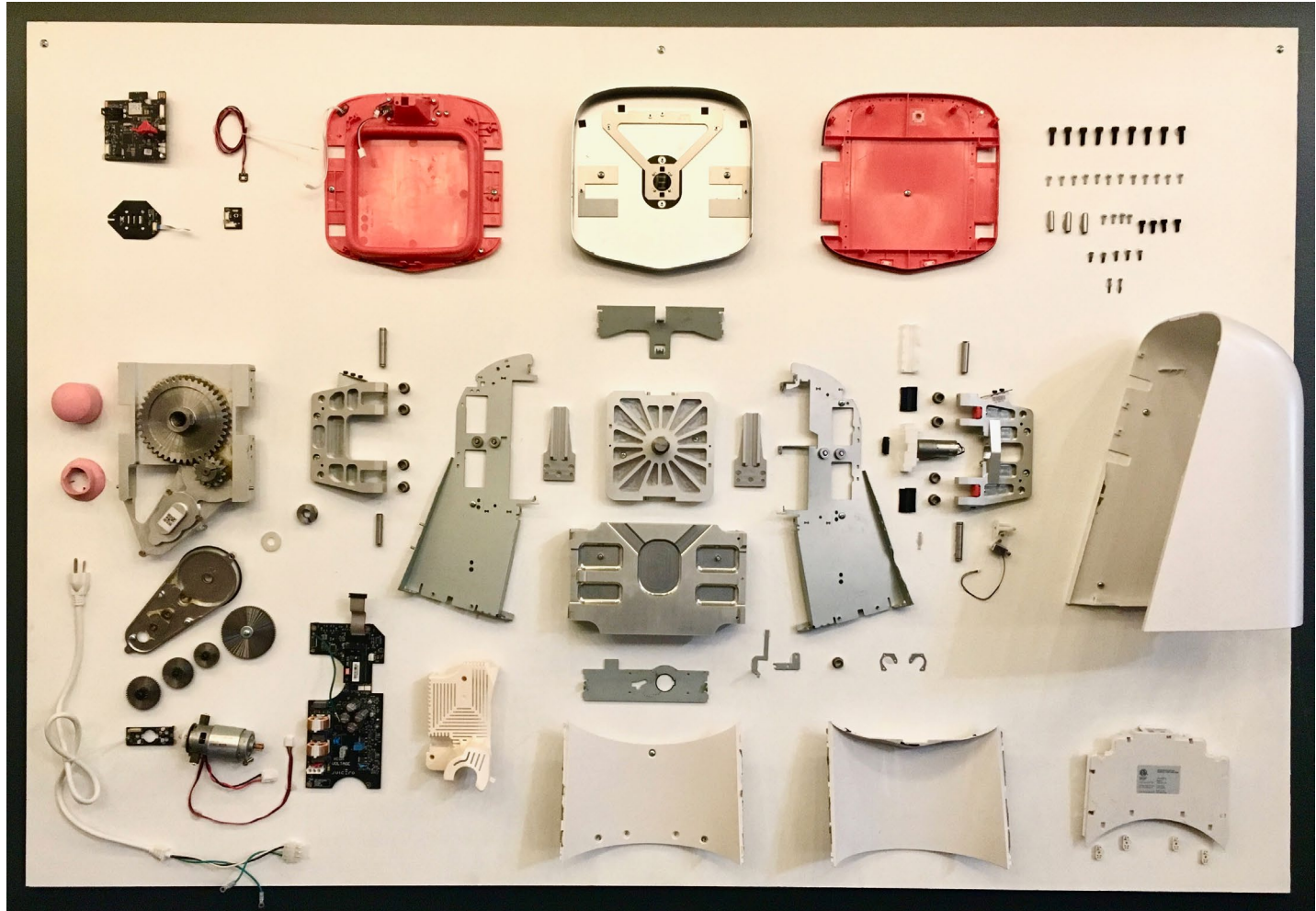
Overengineering

- Product more expensive than the minimum to fulfill specifications

Concept



Juicero



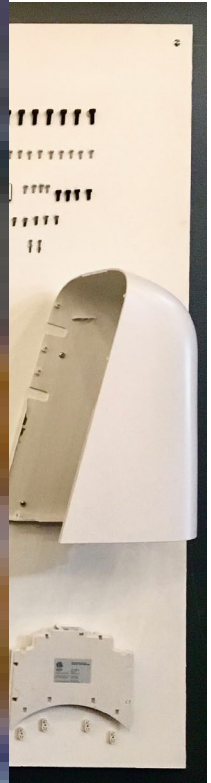
Overengineering

- Product

Concept



Juicero



Overengineering

- Product more expensive than the minimum to fulfill specifications

Technical Solution



Tissot Skeleton
2000.- CHF



Casio F-91W
20.- CHF

What about quantity?

- Prototype
 - Design cost is a large part
 - Fast manufacturing is preferred
- Small batch production
- Mass production
 - Design cost is negligible
 - Dedicated large scale manufacturing required

Quantity defines manufacturing

Prototyping



Break pedals
(3D printing, Titanium)
Scuderia Ferrari, Formula 1

Small batch production



Part
(CNC machined, Steel)

Mass manufacturing



Engine casing
(Injection molding, Aluminum)
Volkswagen Passat

Quantity defines cost

Formula 1



>10mio \$

<10 cars

Tesla Roadster 1



120k\$

2680 cars

Tesla Model 3



40k\$

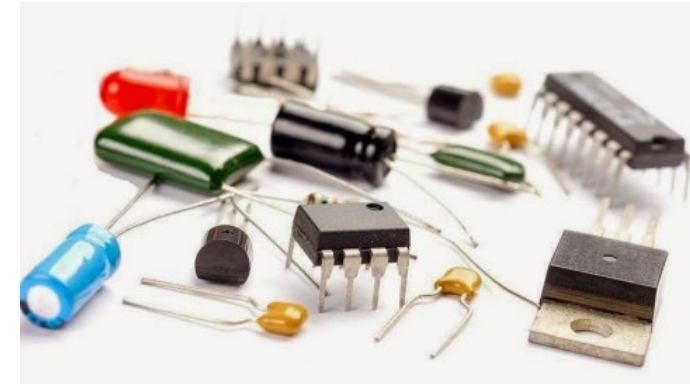
10mio cars

Cost vs Price

- Price = Overall Cost + Margin (usually 40-50%)
 - Production cost
 - Marketing
 - Sales
 - R&D (includes design, industrialization, etc)
 - Overhead
 - Profit

Production cost

- Components
 - Subcontractors
 - Material
 - Investments
 - Workforce
- Assembly
- Logistics (storage, transport)



Production cost

- Material (Aluminum: 3.-/kg)
- Investments (Injection Machine: 1-10mio)
- Workforce (Worker: 60.-/h)

→ (3 + 2.-/kg)



+



=



Production cost

- Material (Titanium: 30.-/kg)
- Investments (500kCHF-)
- Workforce (80.-/h)



Production cost

Production cost = Investment/#parts + Workforce + Material

	Injection Molding	3D Printing
1 part	$3'000'000/1 + 60/60 + 3.- =$ 3'000'004.-	$500'000/1 + 80*3 + 30.- =$ 500'270.-
1'000 parts	$3'000'000/1000 + 60/60 + 3.- =$ 3'004.-	$500'000/1000 + 80*3 + 30.- =$ 770.-
1mio parts	$3'000'000/1\text{mio} + 60/60 + 3.- =$ 7.-	

Production cost

$$\text{Production cost} = \text{Investment}/\#\text{parts} + \text{Workforce} + \text{Material}$$

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8.6 years

1.56 years

$$240 \text{ working days / years} * 8 \text{ hours} = 1920\text{h/y/machine}$$

Case Study: Presentation Clicker

- Quantity: large
- Price range: cheap



Case Study: Presentation Clicker

- Components
 - Electronics
 - Bluetooth
 - Trackpad
 - Processing
 - Bundle
 - Batteries
- Subcontractors
 - Plastic injection molding
 - Buttons
 - PCB (w/ components)
- Material
 - None
- Investments
 - None or Assembly
- Workforce
 - Assembly
- Logistics (storage, transport)



Case Study: Presentation Clicker

- Components
 - Electronics
 - Bluetooth (3.-)
 - Trackpad (2.-)
 - Processing (4.-)
 - Bundle (2.-)
 - Batteries (1.-)
- Subcontractors
 - Plastic injection molding (3.-)
 - Buttons (2.-)
 - PCB (w/ components) (3.-)
- Material
 - None
- Investments
 - None or Assembly
- Workforce
 - Assembly (3.-)
- Logistics (storage, transport)

Total Cost = 23.- CHF



Case Study: Presentation Clicker

- Total Cost : 23.-
- R&D : 6.-
- Marketing : 6.-
- Sales : 6.-
- Overhead : 6.-
- Profit : 6.-
- Total Price : 53.-



Actual Price = 59.- CHF

Conclusion

- The best product is never the best possible technical system
- It's very tricky to approximate a price precisely
- Be objective, don't start with presuppositions
- Compare with what exists already
- Cost is one of your concerns