Project Management and Cost Estimation

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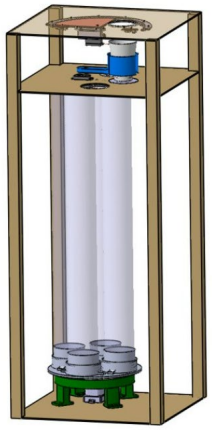
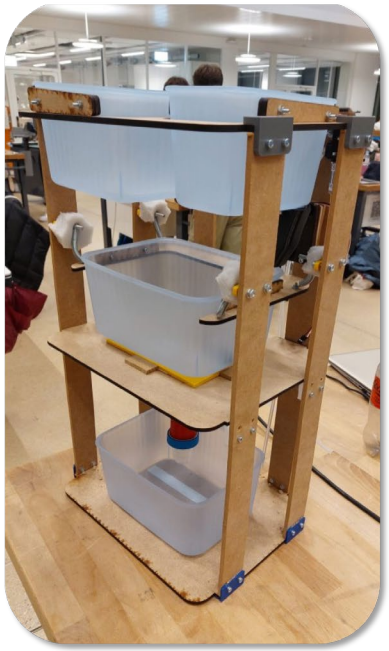
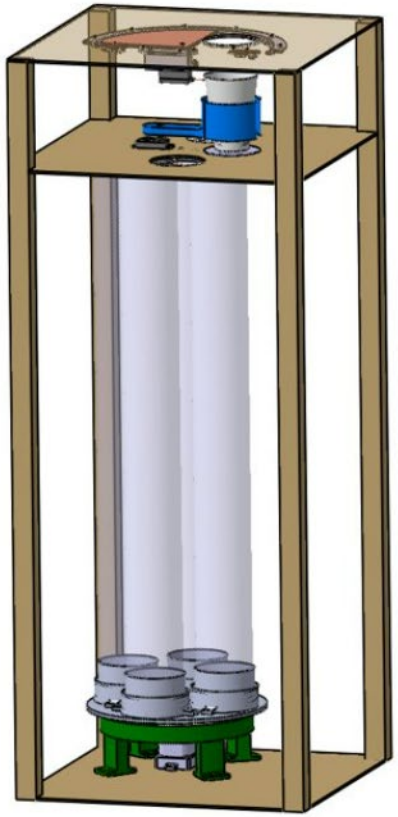
Example Projects

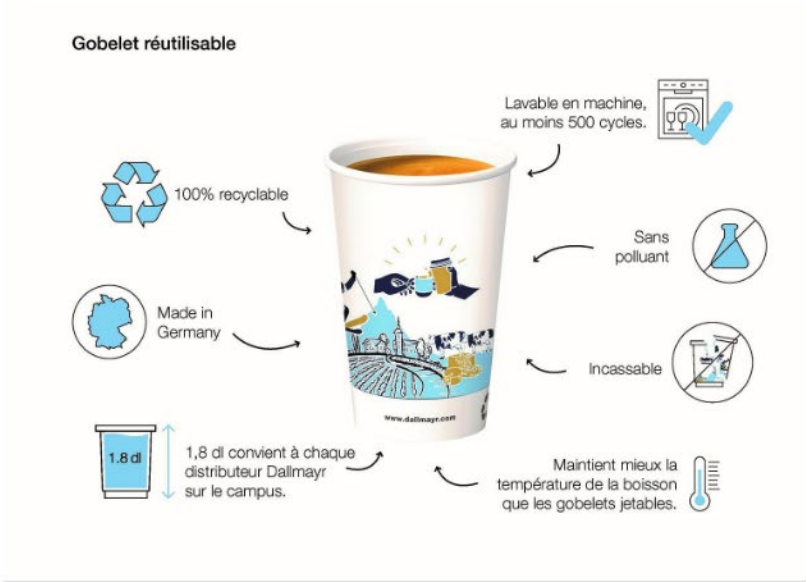




2024 Class

Cup & Go





- A system to support EPFL's "Reuse your cup" initiative by offering a collection solution.
- The machine collects only cups, rejecting others, and stores up to 80 cups

Adaptative and Regenerative Bike Braking Module

- By using an e-bike motor as a generator, the system captures and converts braking energy into electricity.
- With this system, they aimed to make cycling even more sustainable by maximizing energy efficiency.

SunChase

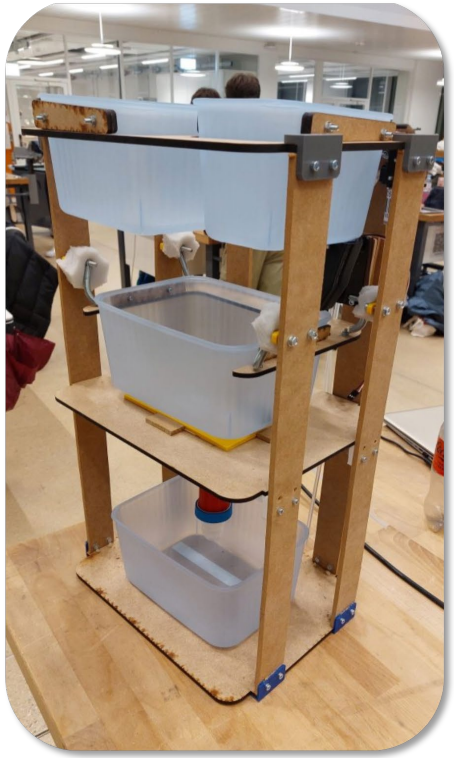
- By dynamically aligning itself with the sun’s position, this system ensures consistent shading while maximizing solar energy capture compared to static designs.

Light Redirection Device: GlowGrow

- This project introduces a device that tracks plant position and sun position to redirect sunlight from outside your window to your houseplant.

- As the sun moves, the device automatically adjusts to redirect light onto the plant, increasing the plant's light exposure. GlowGrow keeps indoor plants well-lit, even in spaces with limited natural sunlight.

VibraClean



- This device is designed to make food preparation easy while conserving water.
- After washing, the water is filtered, making it safe for reuse in cooking or other applications.

How Sustainability Links to Cost

- **Material Choice** Affects Both Price and Impact
  - Recycled or biodegradable materials may cost more upfront but reduce environmental cost and potential regulatory fines.
- **Energy Efficiency** Saves Money Over Time
  - More efficient robots cost less to run over time (electricity, cooling, wear-and-tear).
- Design for **Repairability** and Reuse Lowers Lifecycle Costs
  - If parts are easy to swap out, you avoid replacing the whole robot when something breaks.
- **Manufacturing Process** Impacts Carbon and Capital Cost
  - Sustainable methods can reduce raw material use and disposal costs.
- Sustainable Designs Can Attract **More Support**
  - Investors, grants, or customers may prefer green solutions—even if they cost a bit more up front.

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

In a sustainable design, cost must balance function, impact, and feasibility.

Sustainable robotics isn't just about reducing emissions. It's about making smart design choices that reduce waste, energy, and total lifecycle 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

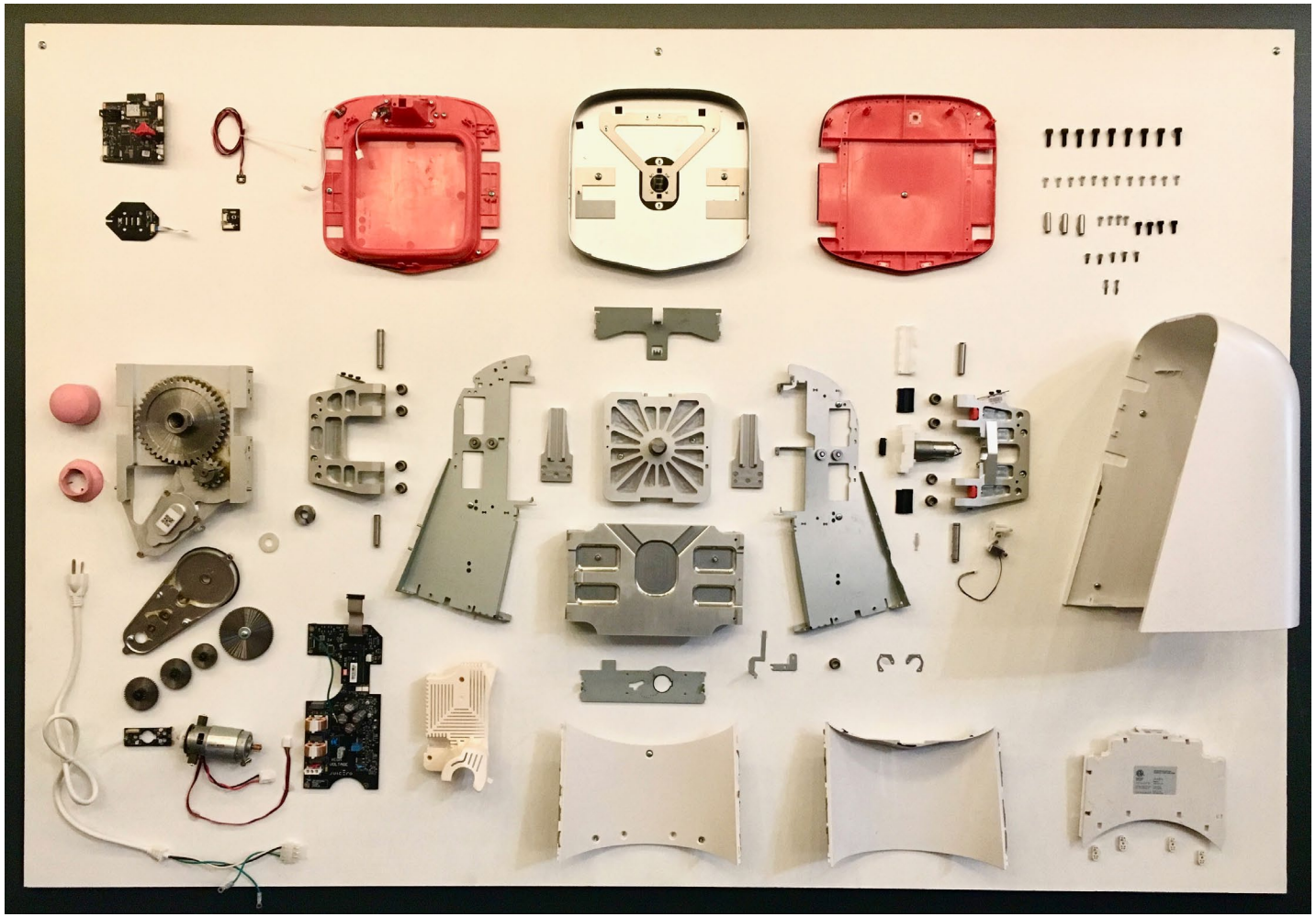
Complexity = more materials, more energy
Overengineering = excess weight, harder repairs, material waste

Overengineering

- Product more expensive than the minimum to fulfill specifications

Concept

Juicero



Overengineering

- Product more expensive than the minimum to fulfill specifications

Concept

Juicero

Overengineering

- Overengineering = sustainability risk: More cost, more waste, harder to repair.
- 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

High quantity can make greener materials more affordable.

Prototyping

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

Small batch production

Part
(CNC machined, Steel)

Mass manufacturing

Engine casing
(Injection molding, Aluminum)
Volkswagen Passat

With scale, sustainability becomes accessible

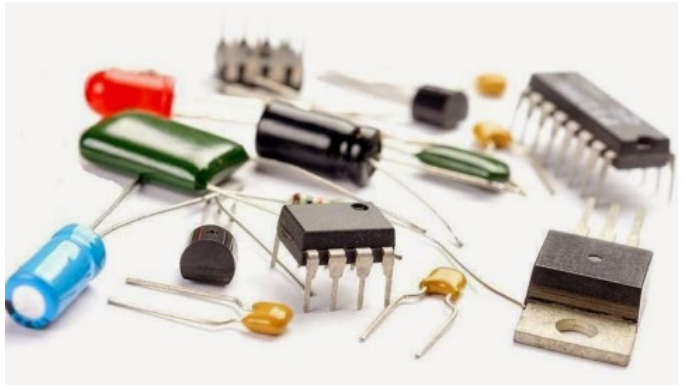
Formula 1	Tesla Roadster 1	Tesla Model 3
		
>10mio $	120k$	40k$
<10 cars	2680 cars	10mio cars

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)



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 lowest-cost solution today isn’t always the most sustainable, or the best long-term investment.
- Designing sustainable robots means estimating both money and environmental impact together.