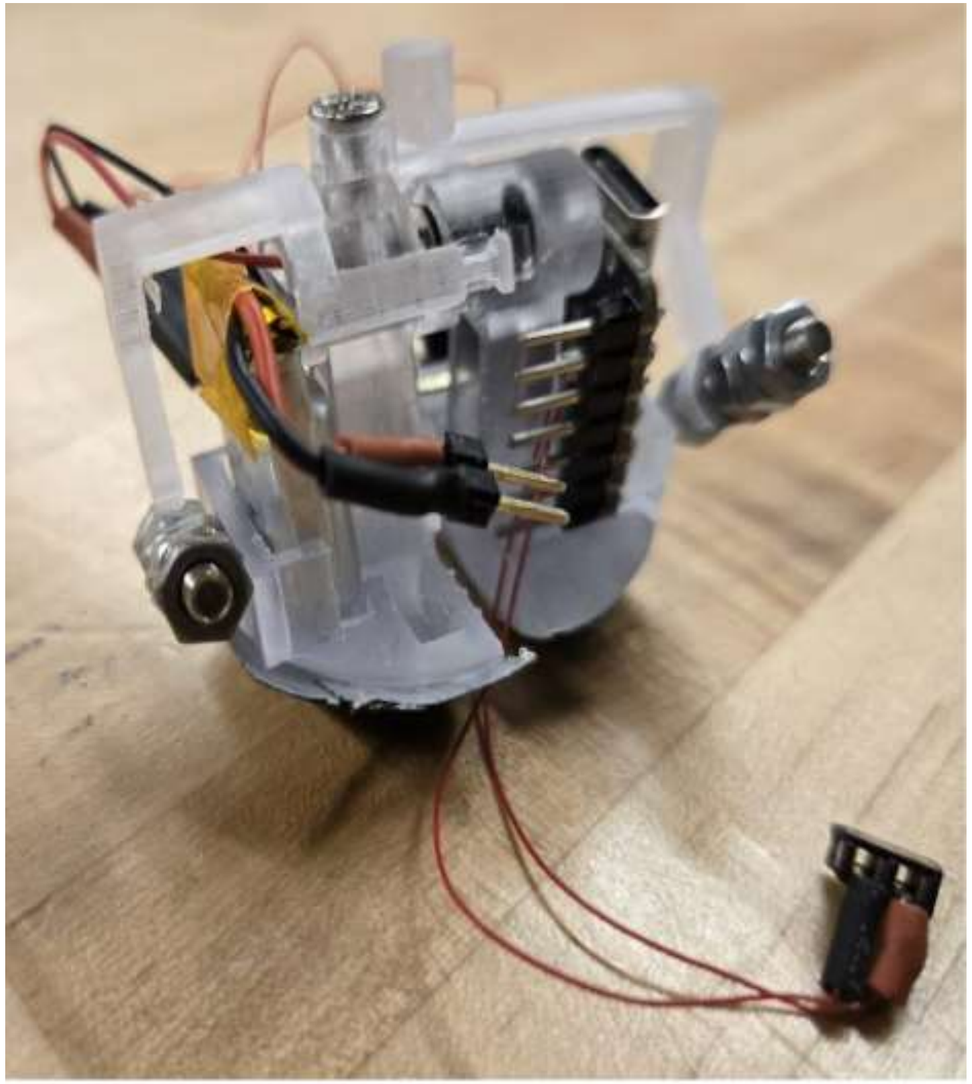
ZIPPY - STEM TOY ROBOT

19670 - Quantitative Entrepreneurship

Chenhao Tan
Sneha Hassan
Medha Reddy
Medhavi Goyal
Carlos Valverde

Zippy - Introduction



Zippy, one of its kind, is the **smallest customizable** bipedal STEM toy robot, with a height of **3 cm**.

It is equipped with a coreless DC motor, LiPo battery, and a microcontroller that allows users to **modify its walking pattern** by adjusting parameters like voltage, delay, and balance through software.

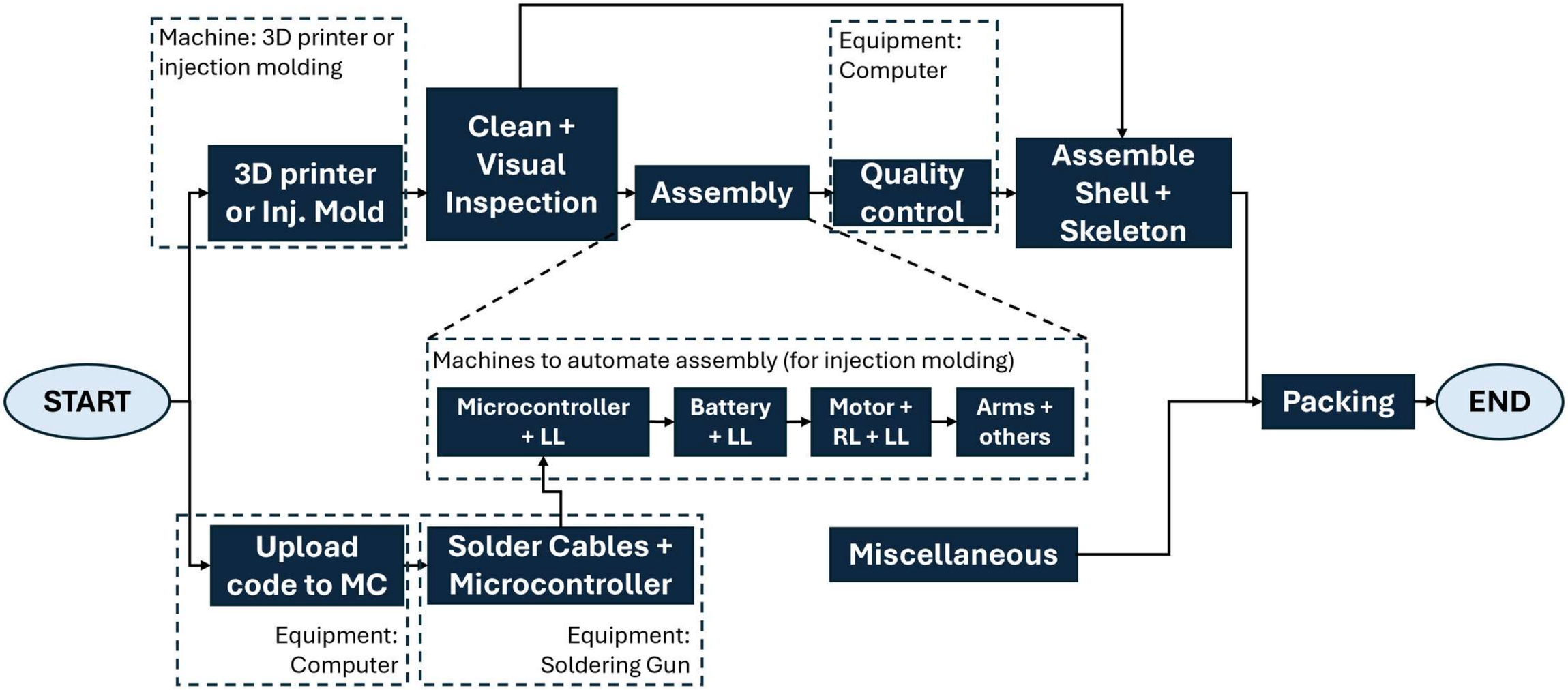
Video of Zippy

Key Findings

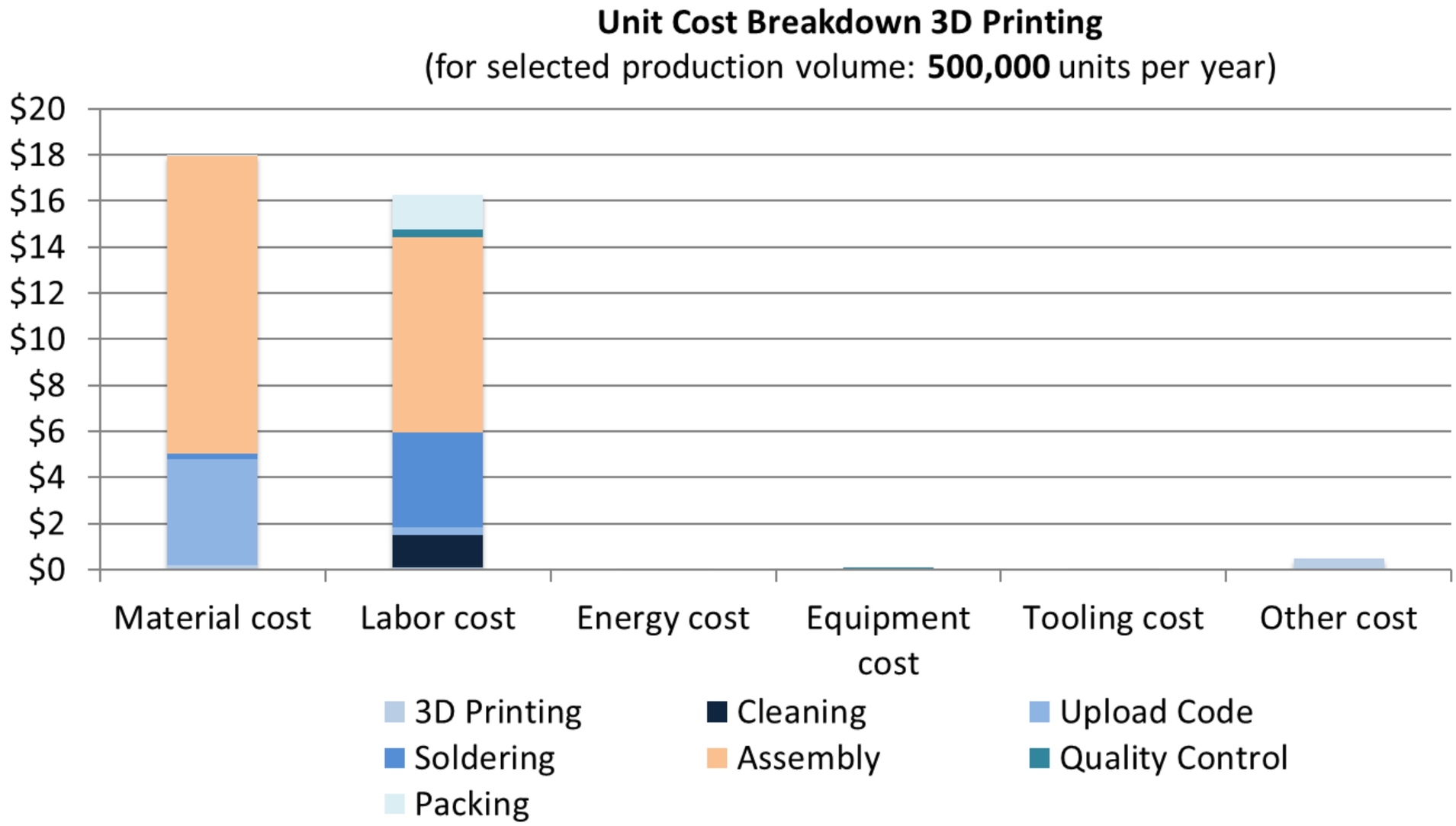
- **Cost Efficiency**: Injection molding is more cost-effective above 31,000 units.

- **Max Profit Volume**: ~280K units for 3D printing, ~320K for injection molding.

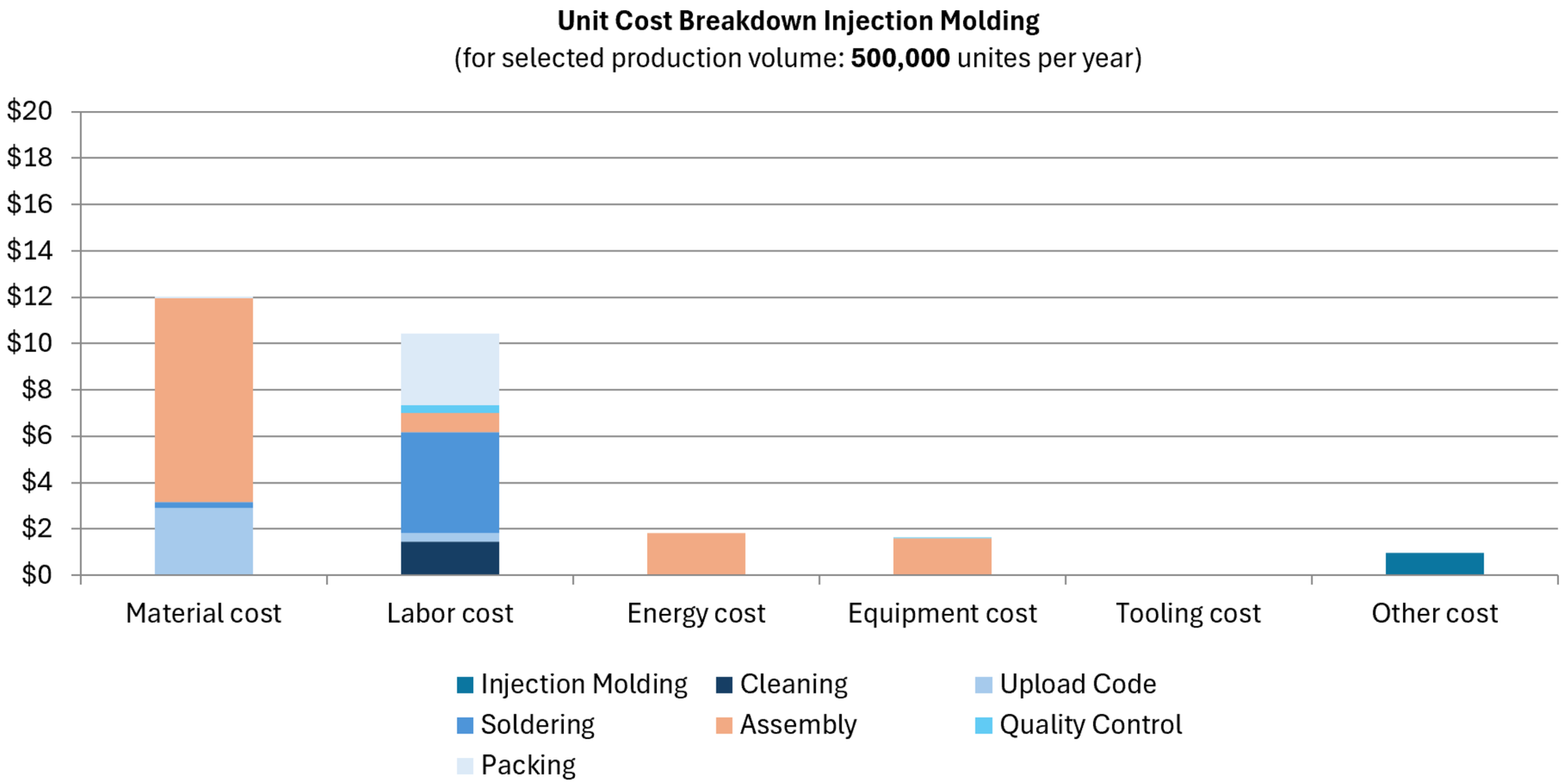
Process Flow Diagram - Manufacturing



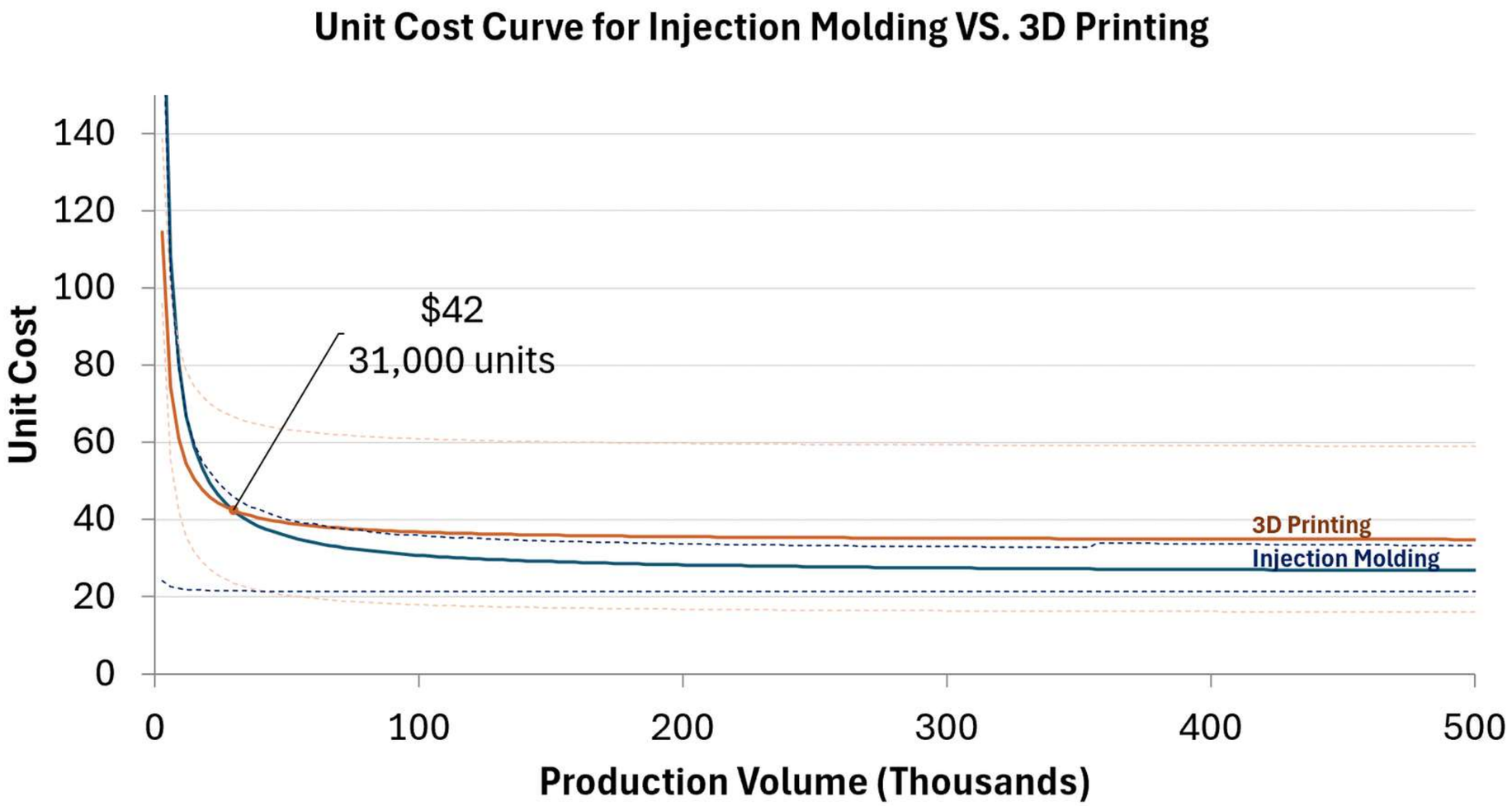
Main Cost Drivers for 3D Printing: Material & Labor



Main Cost Drivers for Injection Molding: Material & Labor



Injection molding is more viable for bigger production volumes



Survey Screenshot

Suppose the following three options are available for purchase. Each is a STEM toy in the form of a customizable bipedal walking robot. Which would you prefer for Sarah?

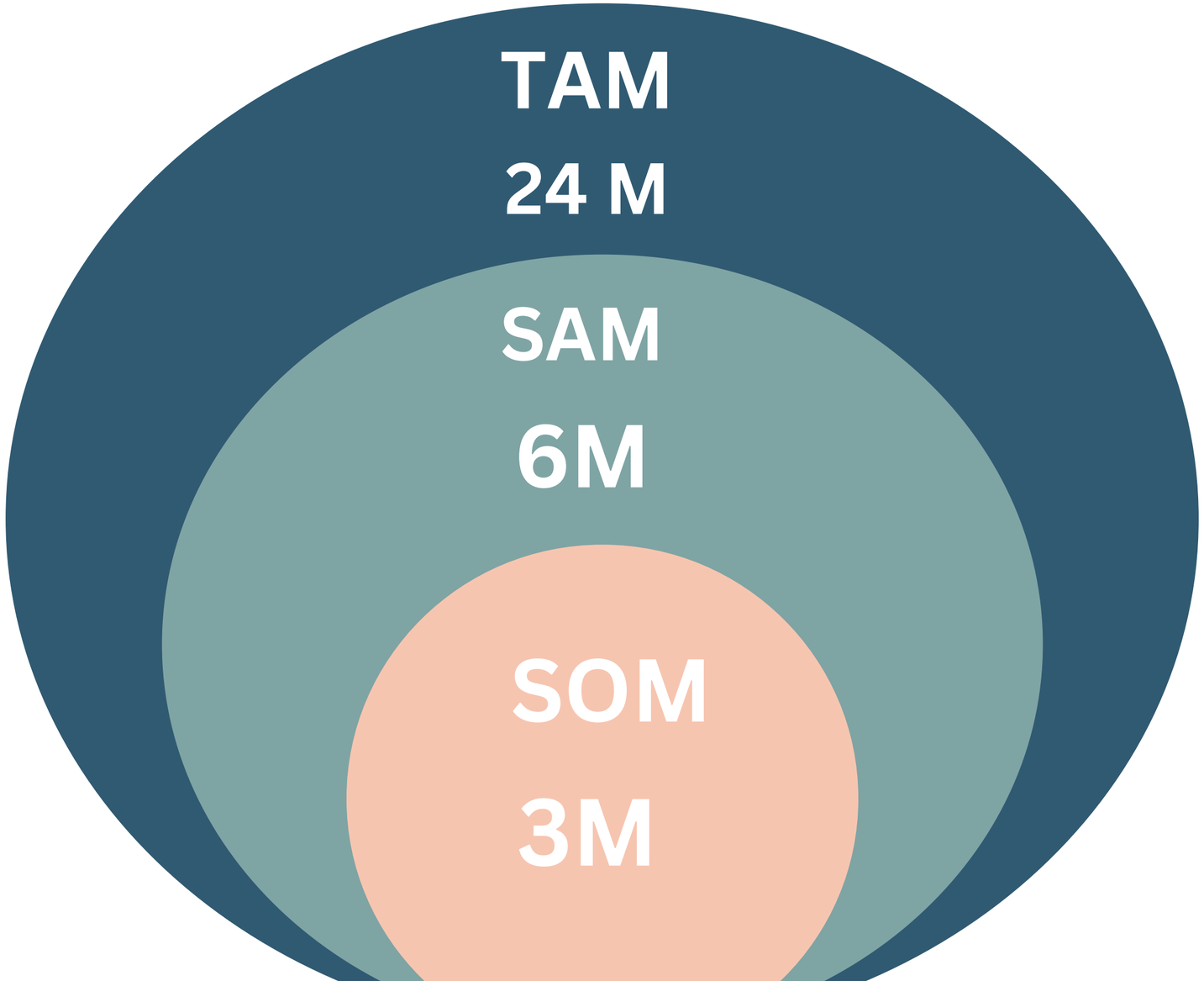
TASK 1/9

Price	$100	$70	$130
Battery life	1 hrs	2 hrs	3 hrs
Assembly Preference	Pre-assembled	Semi-assembled	Pre-assembled
Programming	Basic coding via app or software	Advanced AI learning and coding	Pre-programmed actions
	Select	Select	Select

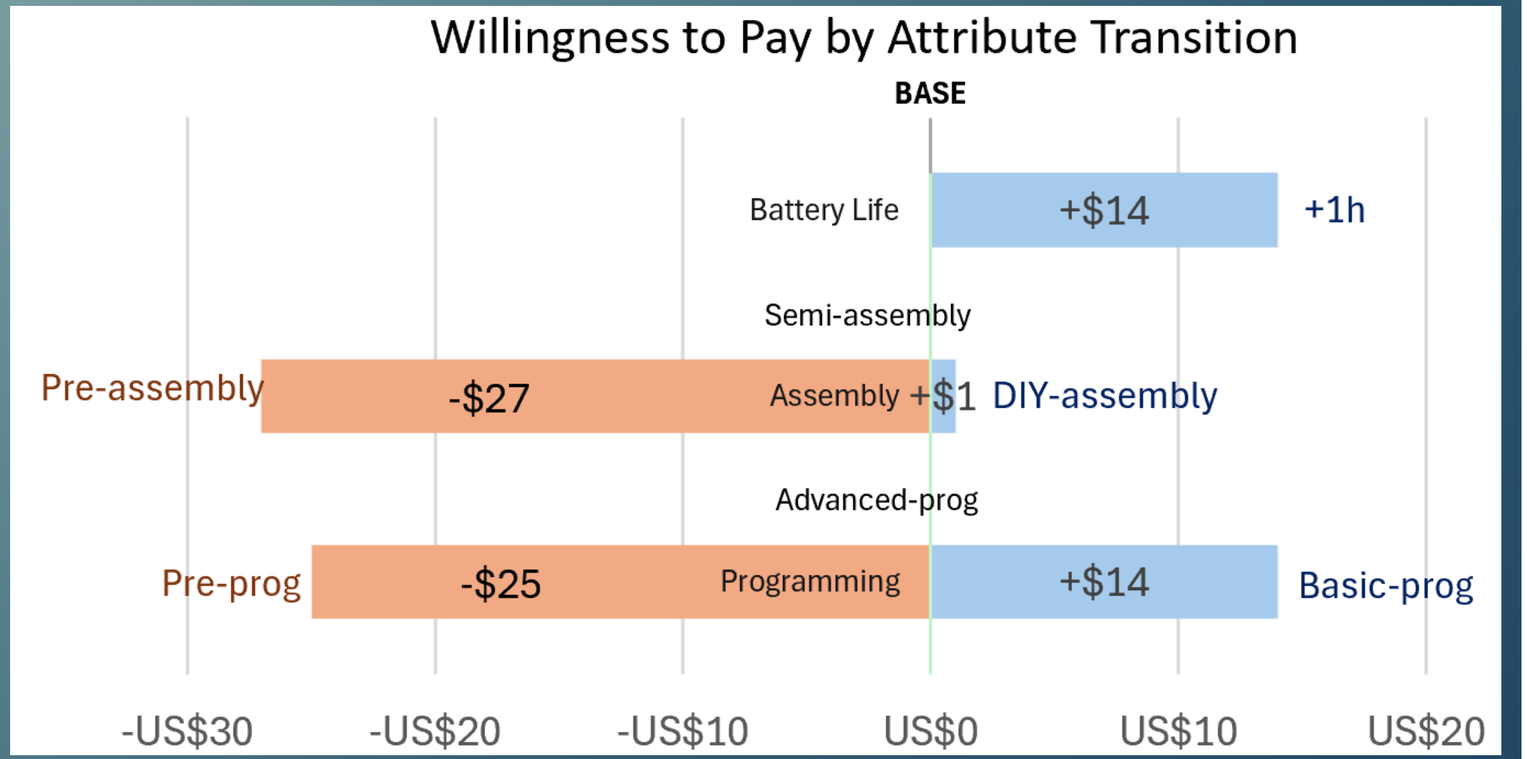
None, I wouldn't choose any of these.

Select

Our Market



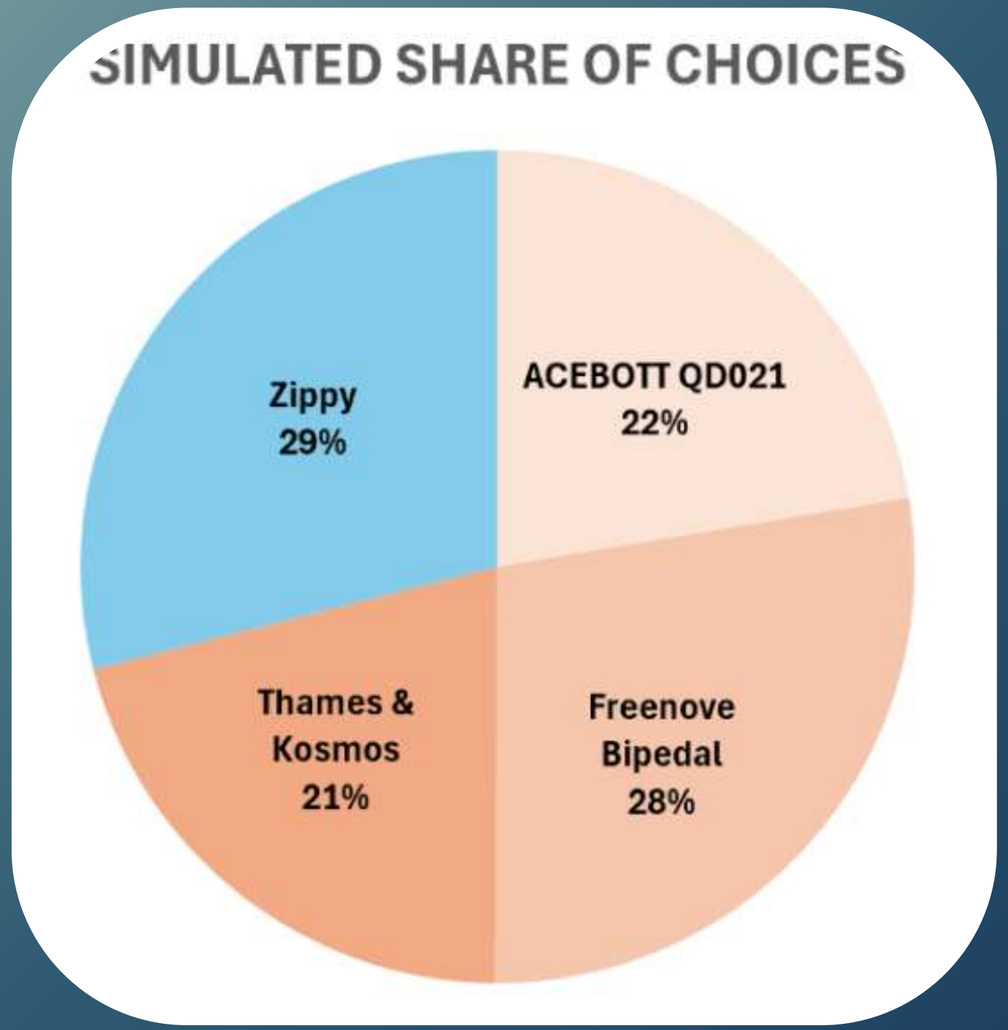
Key Product Attributes: Programming>Battery Life > Assembly



Note: Orange and blue bars represent deviations from the base case.
Base case: Basic programming, semi-assembled, 2-hour battery life, $80 price
Blue bars indicate attribute levels more preferred than the base (positive impact on share)
Orange bars indicate attribute levels less preferred than the base (negative impact on share)

Levels of attributes

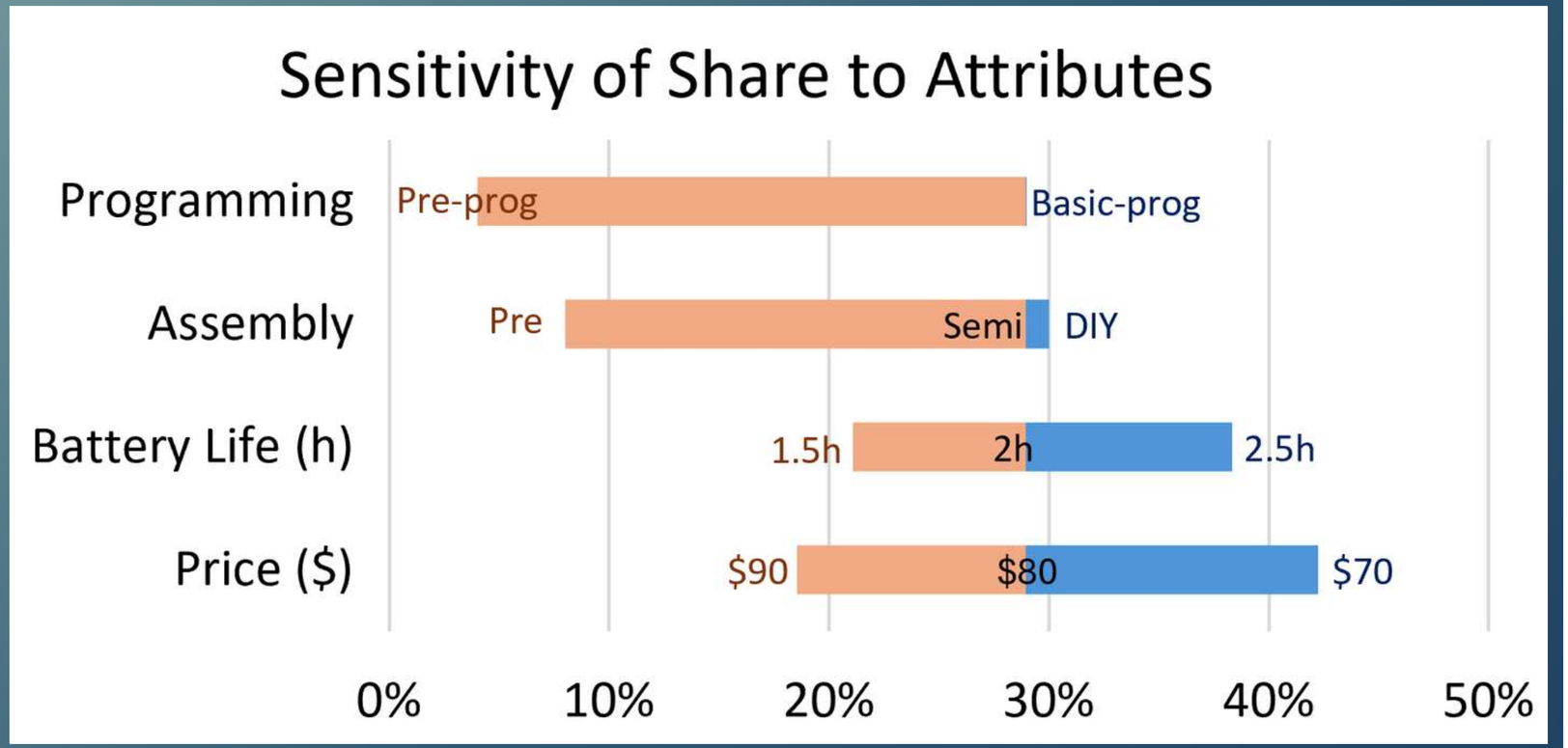
1. **Programming**: Basic Programming, Pre programmed, Advanced coding
2. **Assembly**: DIY, Pre-assembled, Semi-assembled
3. **Price**: $70, $100, $130
4. **Battery life**: 1 hour, 2 hours, 3 hours



Zippy has the highest simulated market share

1. **Balanced Product Features**
2. **Competitive Pricing:** Priced at $80
3. **Superior Battery Life:** Offers 120 minutes of runtime
4. **Accessibility for Broader Audience:** Easier entry compared to Freenove, whose advanced programming intimidates less tech-savvy users.
5. **Stronger Market Fit Compared to Competitors:** Unlike Thames & Kosmos(which is fully pre-assembled and pre-programmed), Zippy provides meaningful interaction without complexity.

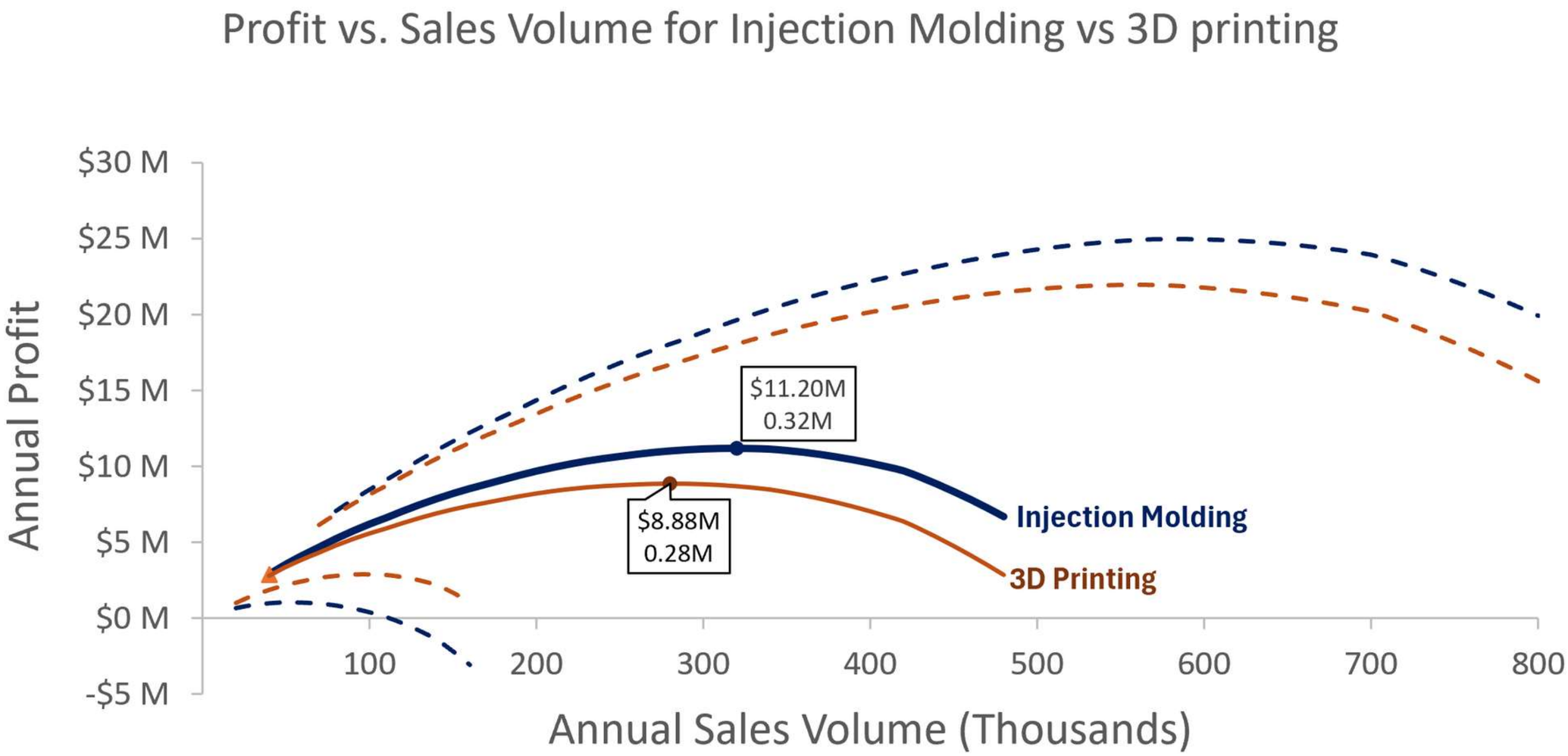
Willingness to Pay



- **+$14**: Basic programming, +1h battery life
- **+$1**: DIY assembly
- –$25 to –$27: Pre-programmed & Pre-assembled

Customization > Convenience

Compare profit



Recommendation

- **Focus on Semi-Assembly + Basic Programming**
  → Highest value-add features (+$14 WTP each) preferred by kids and parents.
- **Ensure 2+ Hour Battery Life**
  → Sustains user engagement and improves product appeal.
- **Use 3D Printing for production volume of upto 31,000 and injection molding above that upto a volume of 1 Million.**
  → Optimizes costs and margins across production scale.
- **Bundle Zippy with App or Curriculum**
  → Enhances educational value, ideal for school adoption.
- **Target Parents (25-50) of kids aged 8-15**
  → Most optimum market with most disposable income
- **We recommend selling Zippy in the price range of $60-80$ for 3D printing**
  → For injection molding - $55 - $70

Conclusions

- **Injection molding** becomes **cheaper** than 3D printing beyond 31,000 units.
- Max Profit Volume: **~280K** units for **3D printing**, **~320K** for **injection molding**.
- SOM estimated at **$580M** for customizable bipedal STEM toy robots.
- **Willingness to Pay**: Users value basic programming, DIY, and longer battery life.
- **Labor and material costs** are the biggest cost drivers.

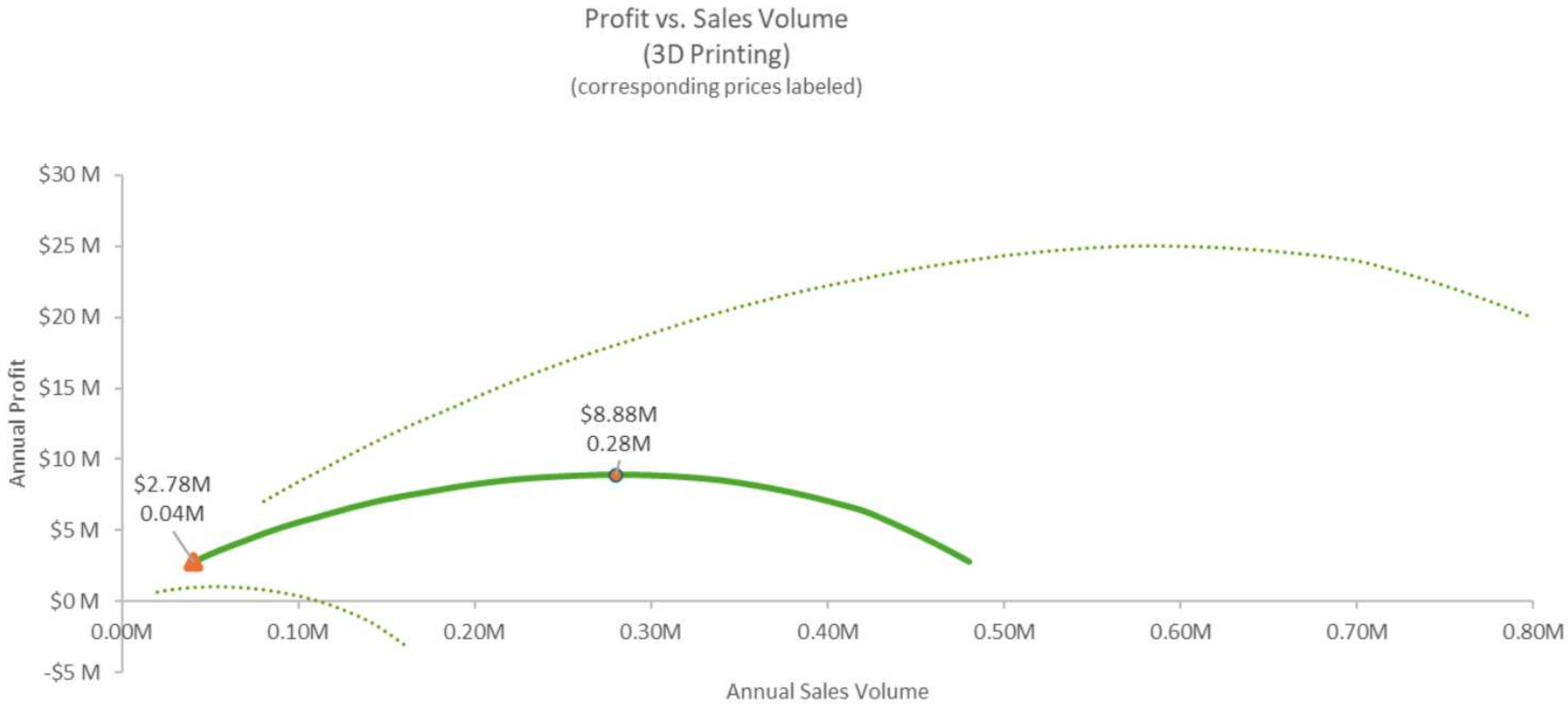
Limitations and Out of Scope

- **Tariffs**: Cost impact from future trade policies not included.
- **Logistics**: Shipping & distribution costs excluded.
- **Labor Costs**: Costs vary by skill level and region, impacting total cost.
- **Partial Automation**: Only assembly step automated in model.
- **Shell Omitted**: No cost or materials or design modeled for aesthetic outer toy covering.
- **Component Costs**: Based on early estimates, not final supplier quotes.

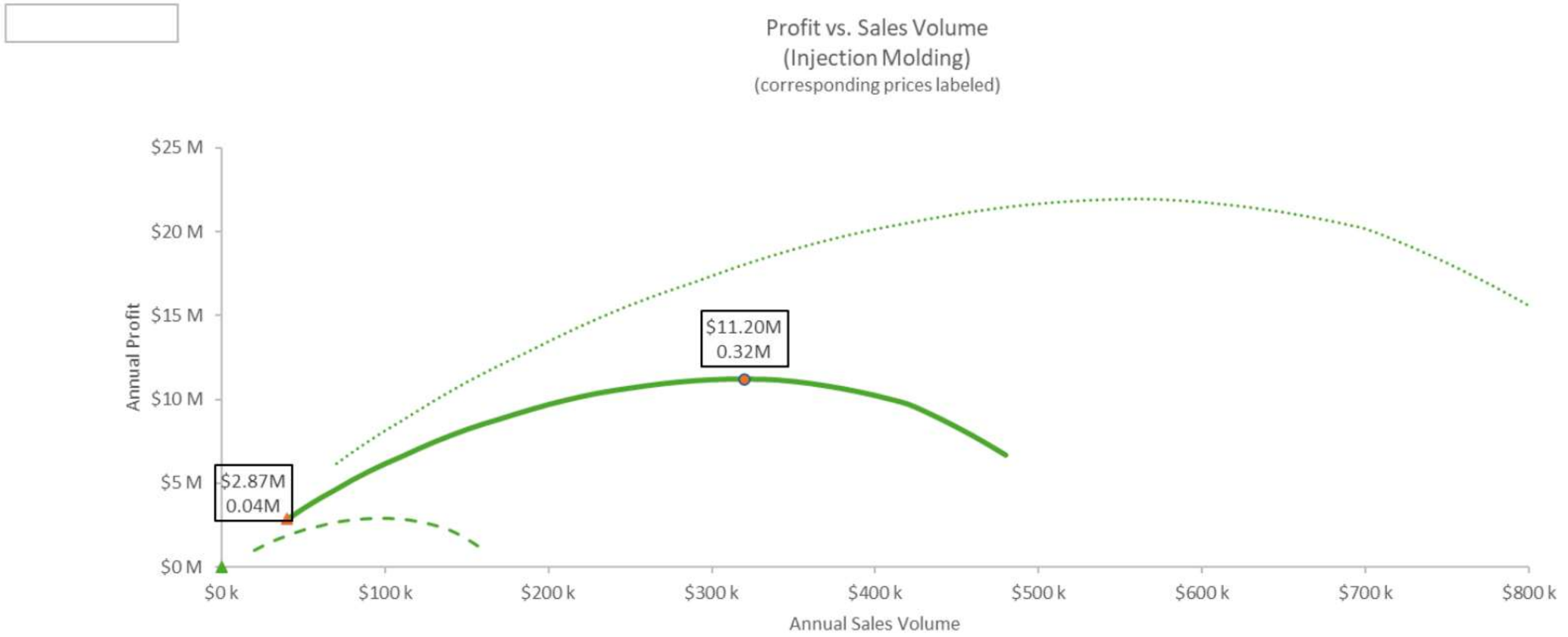
THANK YOU

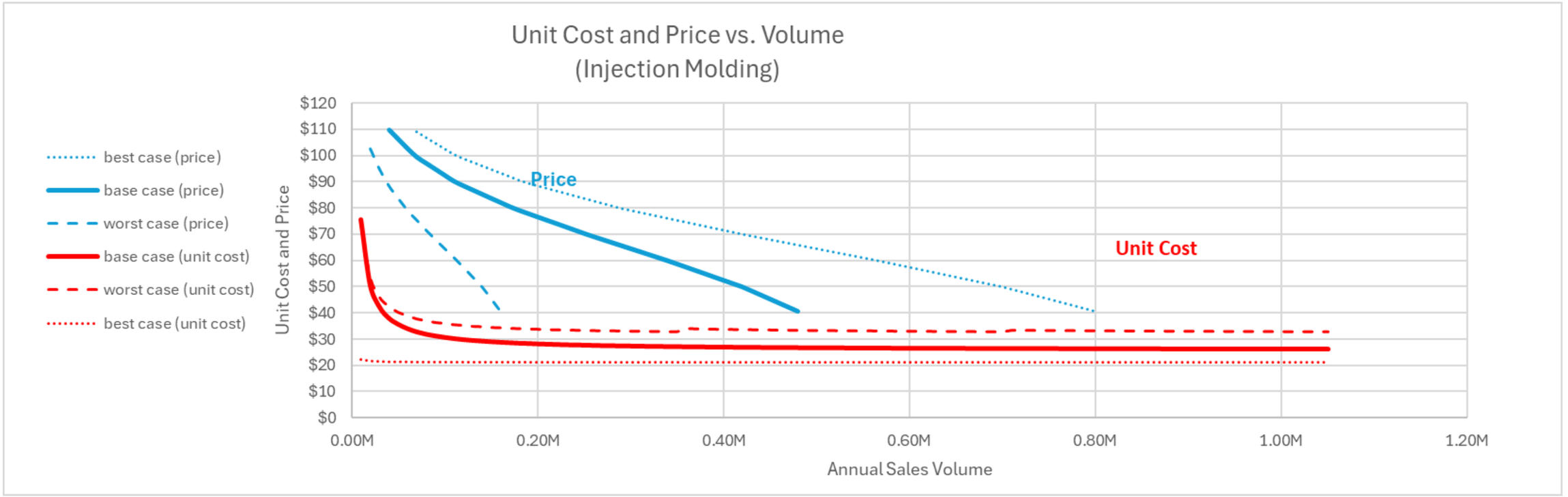
APPENDIX

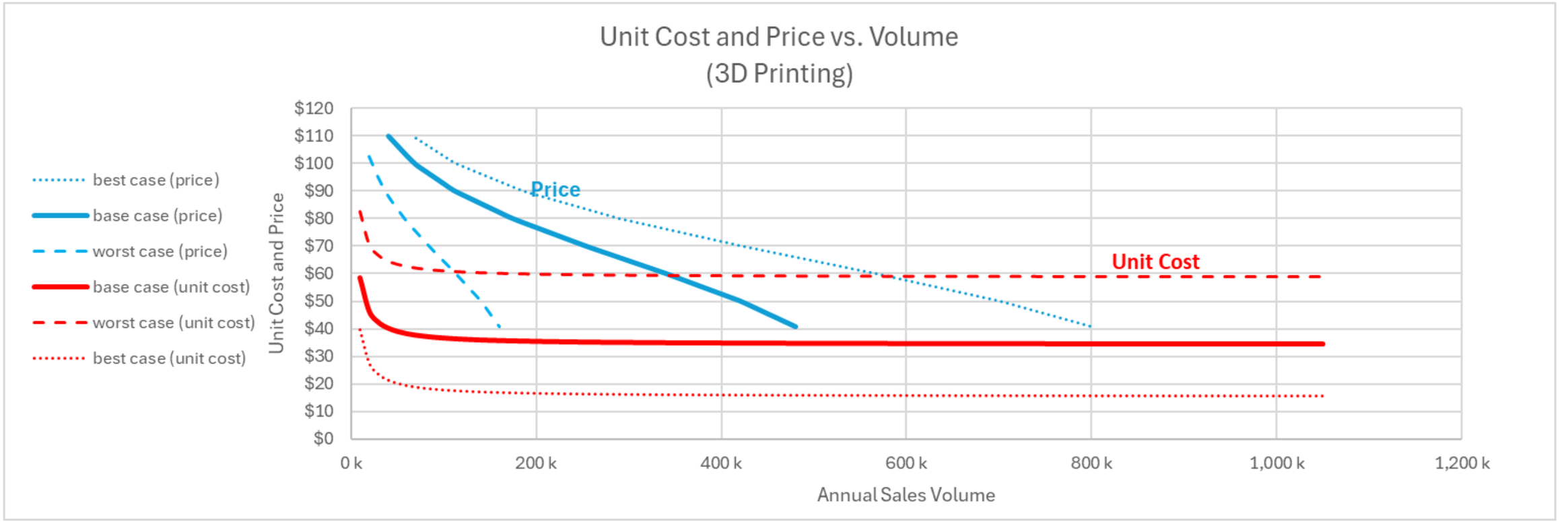
Zippy is economically viable

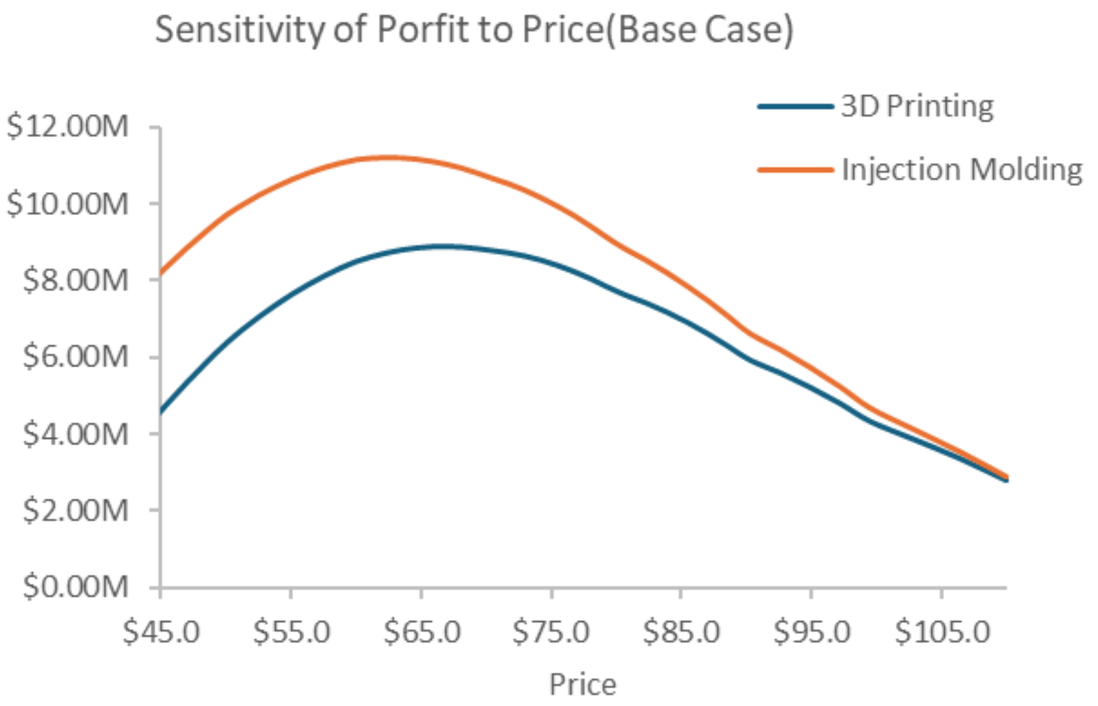


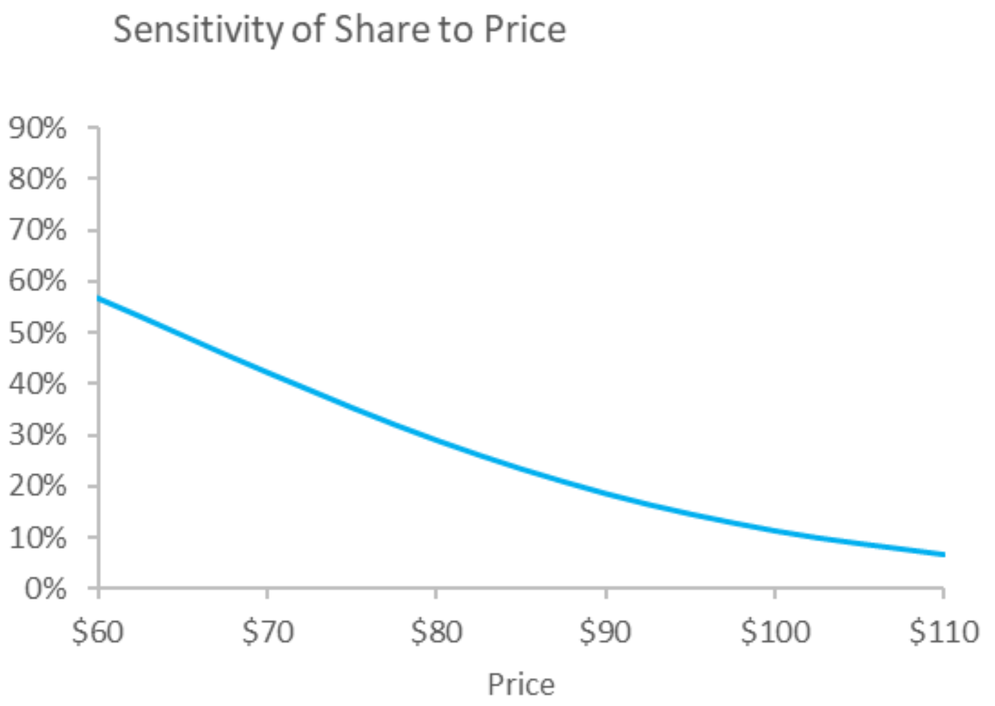
Profitability of $11 Million at a production volume of 300,000 units




Unit Cost and Price vs. Volume
(Injection Molding)
best case (price)
base case (price)
worst case (price)
base case (unit cost)
worst case (unit cost)
best case (unit cost)
Unit Cost and Price
$120
$110
$100
$90
$80
$70
$60
$50
$40
$30
$20
$10
$0
Price
Unit Cost
0.00M
0.20M
0.40M
0.60M
0.80M
1.00M
1.20M
Annual Sales Volume


Unit Cost and Price vs. Volume
(3D Printing)
best case (price)
base case (price)
worst case (price)
base case (unit cost)
worst case (unit cost)
best case (unit cost)
Unit Cost and Price
$120
$110
$100
$90
$80
$70
$60
$50
$40
$30
$20
$10
$0
Price
Unit Cost
0 k
200 k
400 k
600 k
800 k
1,000 k
1,200 k
Annual Sales Volume


Sensitivity of Porfit to Price(Base Case)
3D Printing
Injection Molding
$12.00M
$10.00M
$8.00M
$6.00M
$4.00M
$2.00M
$0.00M
$45.0
$55.0
$65.0
$75.0
$85.0
$95.0
$105.0
Price


Sensitivity of Share to Price
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
$60
$70
$80
$90
$100
$110
Price