APPENDIX 2. CALCULATION OF PRODUCTION METHOD.

The following lists some of the limitations that were considered when selecting the appropriate manufacturing process.

Product quality matter	**Economics**	**Productivity**
Shape	Relative Tooling cost	Relative production rate
Material	Economical production quantity	
Mass range	Material cost	
Section thickness	Labour cost	
Surface roughness		
Tolerance		

For the base box:

1. Shape: Disked sheet

   (Rotational Moulding, Thermoforming)
2. Material: Polyethylene (PE)
3. Mass range: Volume*Density of material

   = $4.2541x10^{-4}$*0.94 - $4.2541x10^{-4}$*0.96

   = 0.3999–0.4084 kg
4. Section thickness: 0.005m

   (Thermoforming)
5. Surface roughness: Very smooth
6. Tolerance: <1 mm
7. Relative tooling cost: Low
8. Economical production quantity: 10-1,000
9. Material cost: Price*Mass

   =$1.85*0.3999kg - $2.04*0.4084

   = $0.7398 -0.8331
10. Relative production rate: Medium

Selected manufacturing processes: *Thermoforming*

For the fence:

1. Shape: Circular prismatic
   (Injection Moulding, Extrusion, Resin Casting, Reaction Injection Moulding)
2. Material: Polyethylene (PE)
   (Extrusion, Injection Moulding)
3. Mass range:$6.9116 \times 10^{-4} * 0.94 - 6.9116 \times 10^{-4} * 0.96$
   $= 0.06497 – 0.06635$ kg
4. Section thickness: 0.005m – 0.0055m
   (Injection Moulding)
5. Surface roughness: Very smooth
6. Tolerance:< 2mm
7. Relative tooling cost: High
8. Economical production quantity: 10,000-1,000,000
9. Material cost:$0.06497 * \$1.85 – 0.06635 * 2.04$
   $= \$ 0.120 – 0.1354$
10. Relative production rate: High

Selected manufacturing processes: *Injection Moulding*

For the bouncing film:

1. Shape: Flat Sheet
   (Extrusion, Blow Moulding)
2. Material: Soft Polyvinyl chloride (PVC)
3. Mass range: $1.9258 \times 10^{-4} * 0.94 - 1.9258 \times 10^{-4} * 0.96$
   $= 0.1810 – 0.1849$ kg
   (Blow Moulding)
4. Section thickness: ~0.005 m
5. Surface roughness: Very smooth
6. Tolerance:< 1mm
7. Relative tooling cost: Medium
8. Economical production quantity: 5,000 – 5,000,000
9. Material cost:$1.8103 * \$1.85 – 1.8488 * \$2.04$
   $= \$ 0.3349–0.3772$
10. Relative production rate: High

Selected manufacturing processes: *Blow Moulding*

For the balls:

1. Shape: Hollow 3D
2. Material: Polypropylene (PP)

3. Mass range:$1.8106 \times 10^{-6} * 0.89$ - $1.8106 * 0.91$

   = 0.001612 –0.001648 kg
4. Section thickness: 1 mm
5. Surface roughness: Very smooth
6. Tolerance:< 1mm
7. Tooling cost: Medium
8. Economical production quantity: 5,000 – 5,000,000
9. Material cost: 0.001612 kg*$2.14 - 0.001648 kg*$2.35

   = $0.003450 – 0.003873
10. Production rate: High

Selected manufacturing processes: *Blow Moulding*

For the spoons:

1. Shape: Solid 3D

   (Injection Moulding, Compression Moulding, Resin Casting, Reaction Injection Moulding)
2. Material: Polyethylene (PE)
3. Mass range:0.045068*0.94 –0.045068*0.96

   = 0.042364 – 0.043265 kg
4. Section thickness: ~ 1 mm
5. Surface roughness: Very smooth
6. Tolerance:< 1mm
7. Tooling cost: High
8. Economical production quantity: 10,000 – 1,000,000
9. Material cost:0.042364 kg*$1.85 - 0.043265 kg*$2.04

   = $ 0.078373 - $ 0.088261
10. Production rate: High

Selected manufacturing processes: *Injection Moulding*