ENGINEERING INNOVATION CHALLENGE 2021
AUGUST WORKSHOP

Product Development and Prototyping

A WORKSHOP BY

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JOINTLY ORGANISED BY:

NUS National University of Singapore | Singapore Nuclear Research & Safety Initiative | Science Centre Singapore | The Institution of Engineers Singapore

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PARTNERS:

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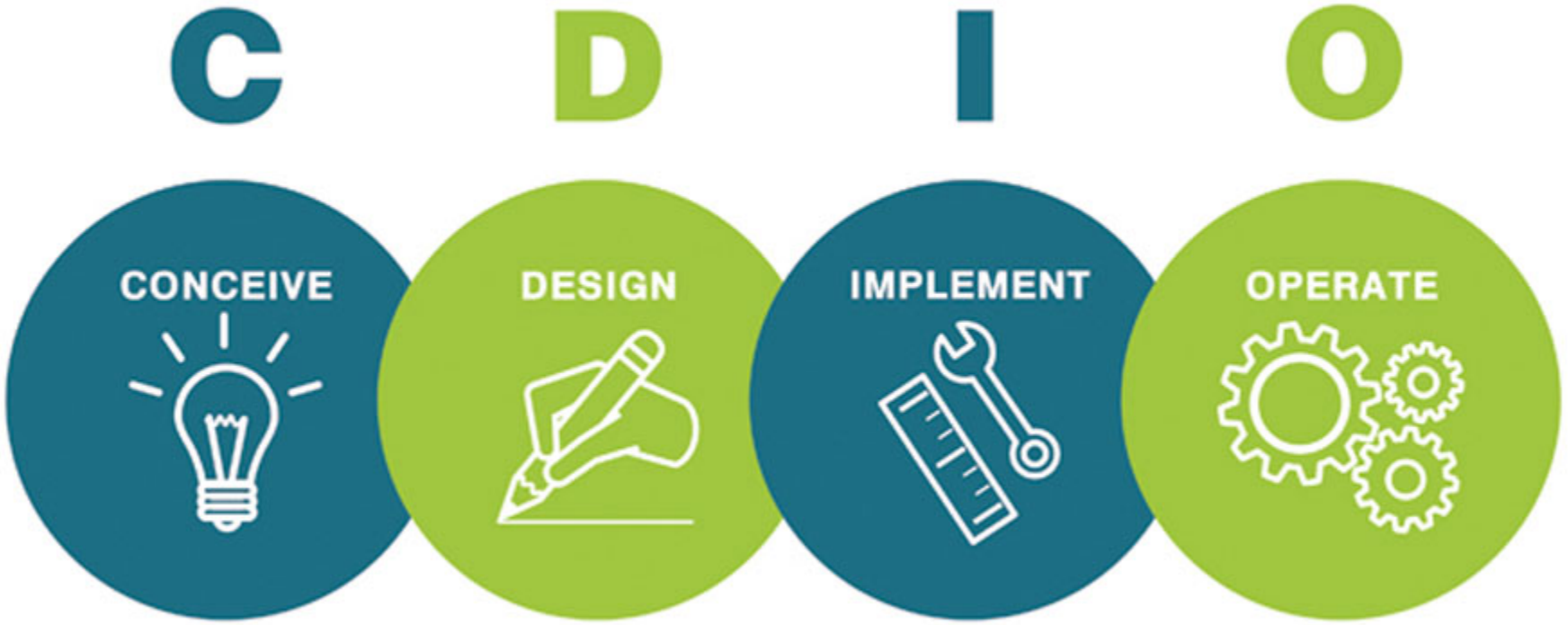
Product Development & Prototyping

Rodney Dorville

Fablab Singapore Polytechnic

CDIO Process



Prototyping

- A **prototype** is an early sample, model, or release of a product built to test a concept or process
- A chance to validate whether your idea matches users' thoughts.

Ref: Wikipedia

Ref: Stanford Social Innovation Review

Pros & Cons

Advantages

- Get a quick view (overview)
- Can try different ideas
- Find mistakes early
- Switch tracks easily
- Develop into a more refined product

Disadvantages

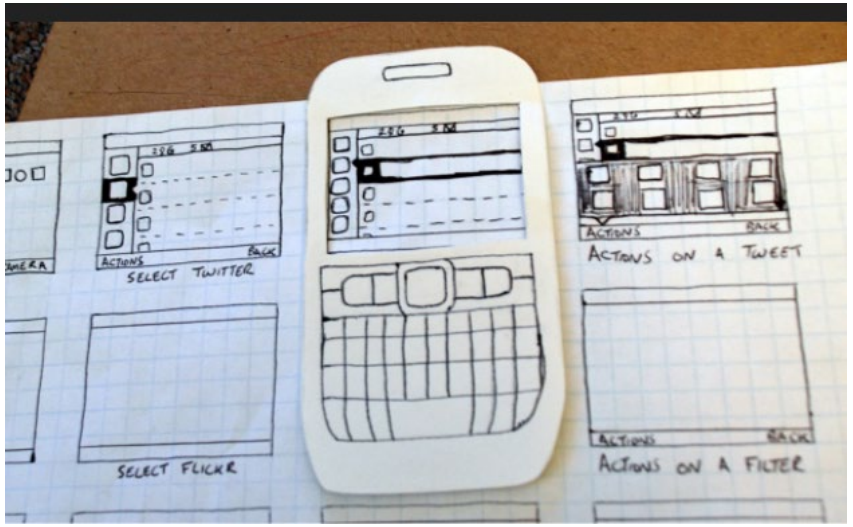
- Time – needs proper planning
- Cost
- Resource intensive
- Heartache

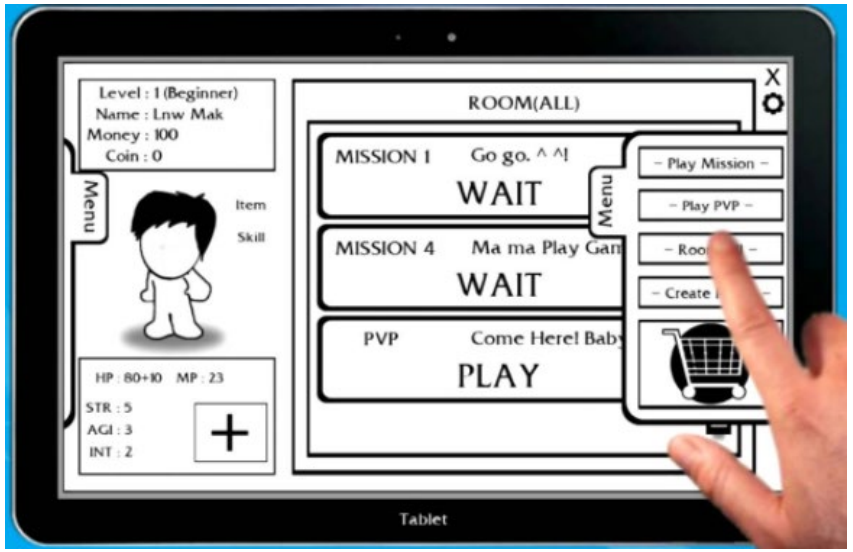
Prototyping

Quirky: How to make a cardboard prototype (2 min)

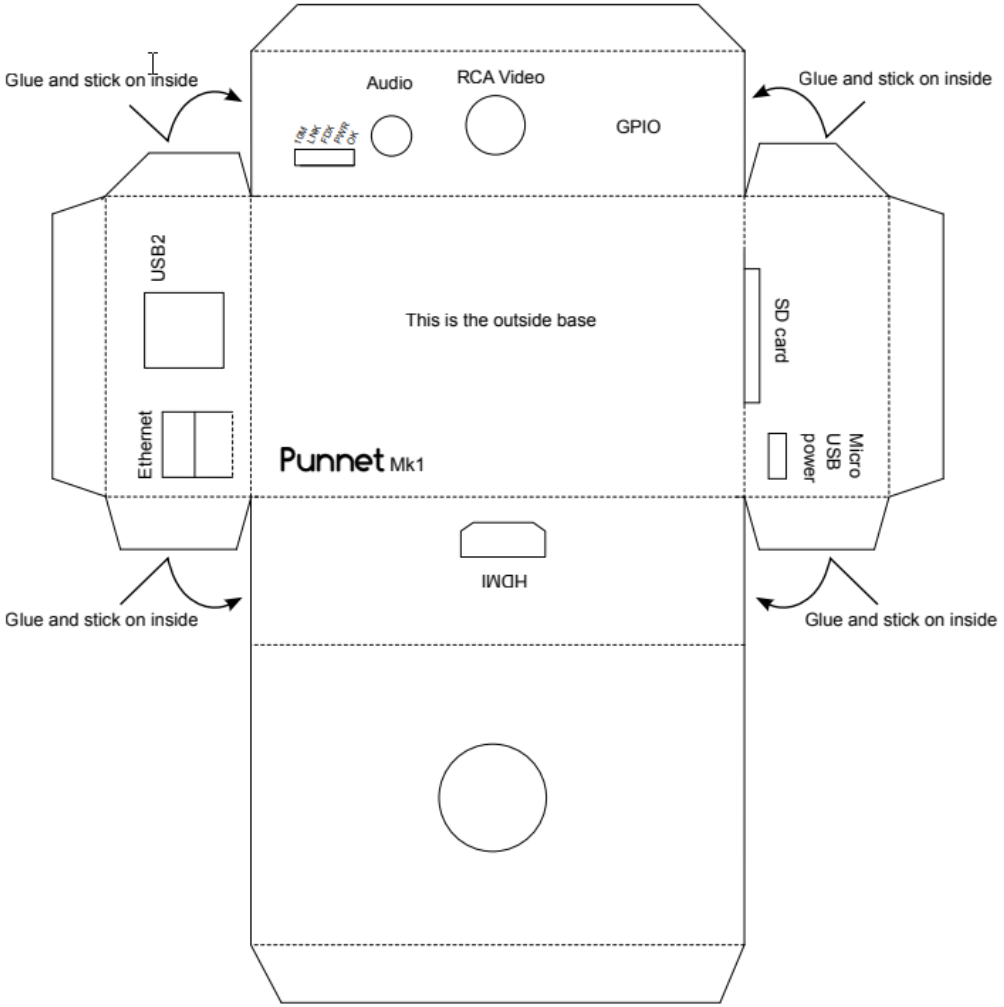
Paper prototyping

- The simplest method.
- Easy, quick, cheap, available everywhere, recyclable.
- Great for a first effort.
- However,
  - Not robust
  - Limited shapes for easy creation





Print & Cut



[The Punnet – card case for RPI]

- Some designs are available on the Internet
- Complex designs may need skills and planning
- Consider origami methods

Cardboard Prototyping

- Simple & easy mock-ups
- 100% recyclable
- Can be done with a knife and ruler
- Digital design
  - 2D drawing or 3D CAD design
  - Flatbed cutter
- Re-sizeable

Corrugated Cardboard

- Easy to manipulate
- Sturdy
- Easy to obtain
- Recyclable
  - Almost free
  - Cheap

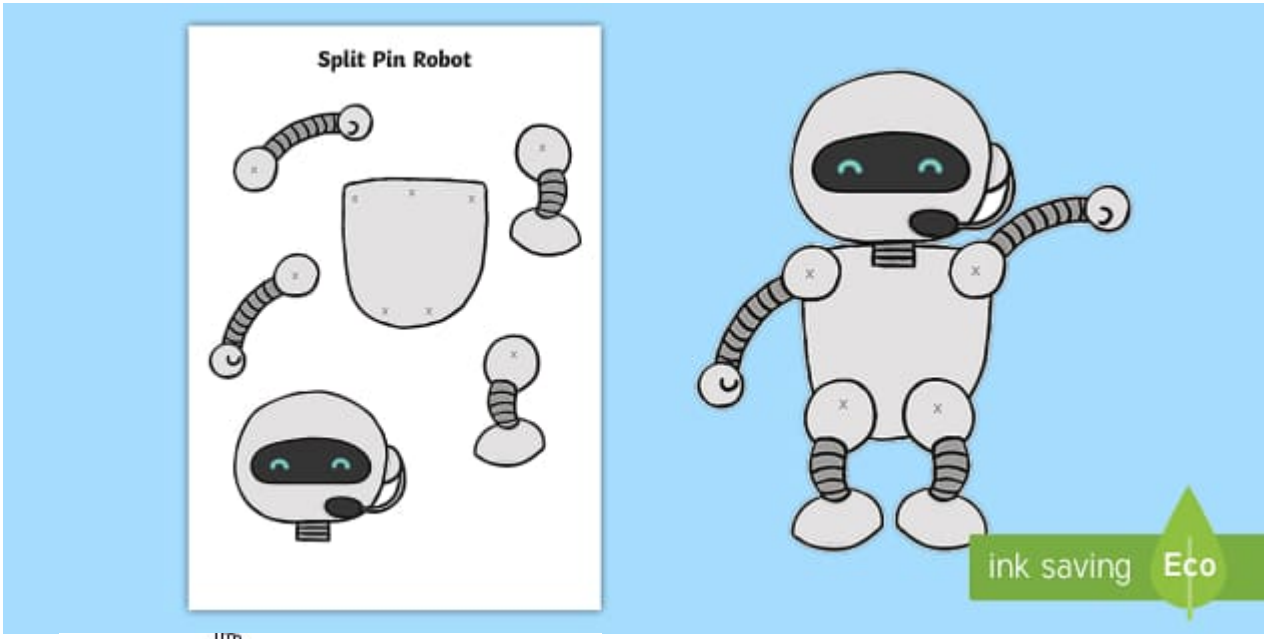
Tools Required

- Cutting Mat
- Box Cutter
- Metal rulers
- Sturdy shears / scissors
- Hot Glue Gun & glue sticks
- Markers, pens, pencils
- Masking tape
- Machinist square 90°
- Circular cutters

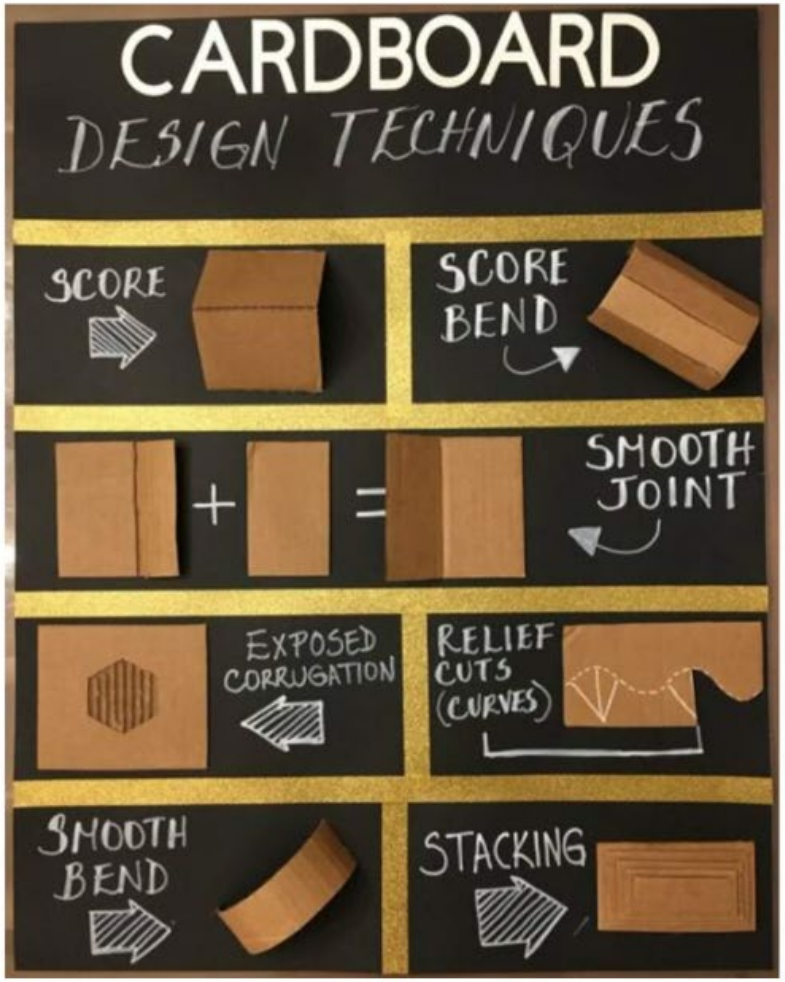
Adafruit: [Cutting Tools and Techniques]

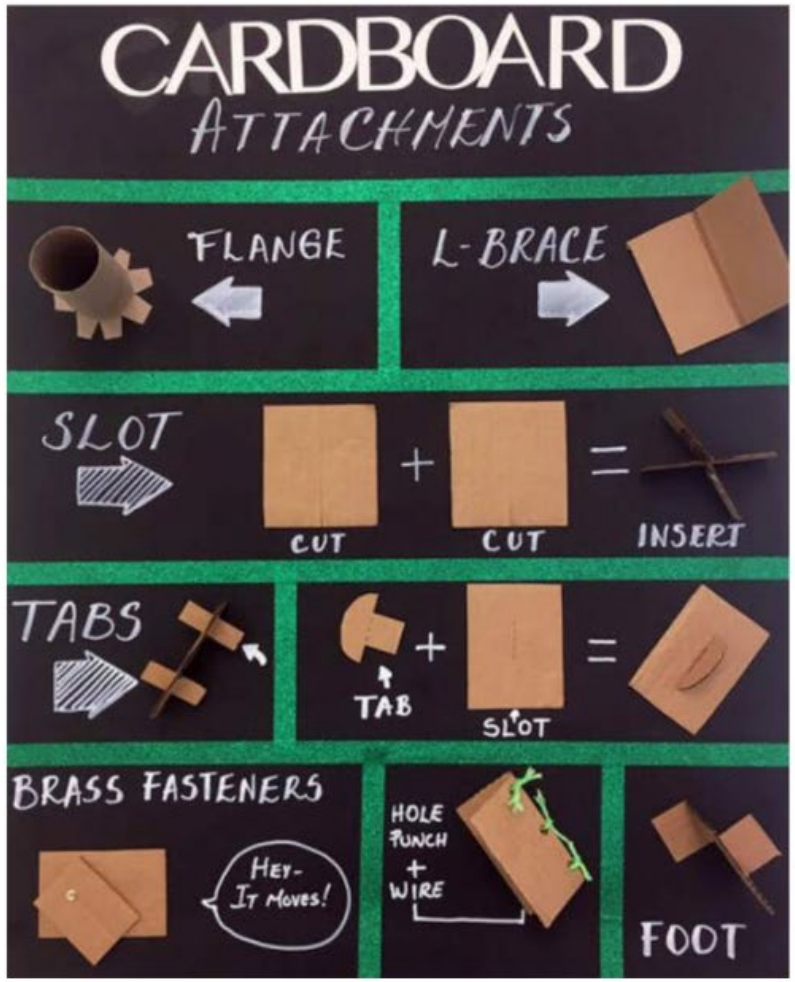
Techniques - Fasteners

- Fixtures
  - Masking Tape
  - Double-side Tape
  - White/Paper glue, UHU
  - Hot-melt glue
- Movement
  - Cable Ties
- Joints
  - Split-pin tacks
  - Rivets



Techniques





Ref: [Bay Area Educators Night]

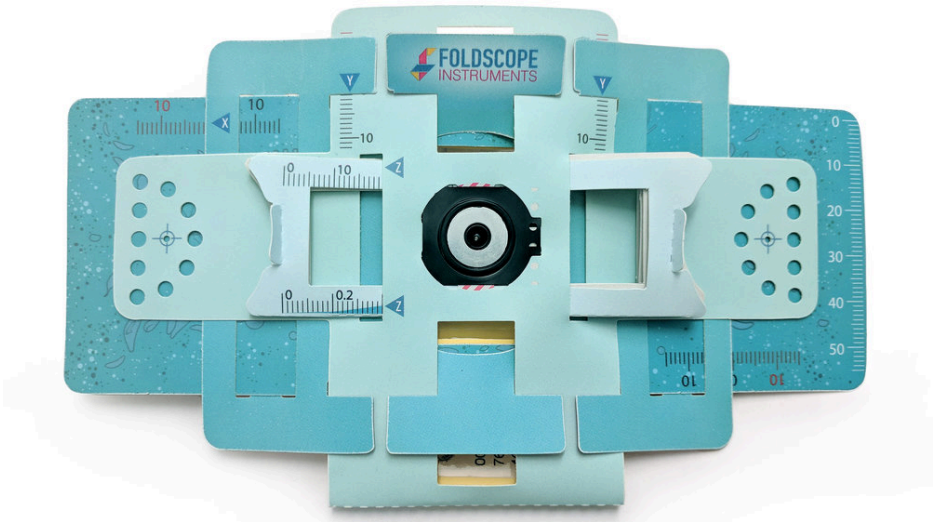
Construction Techniques

[Arianne Schnalzer – Cardboard Construction](#) (6 min)

Cardboard Prototypes

Kiosks

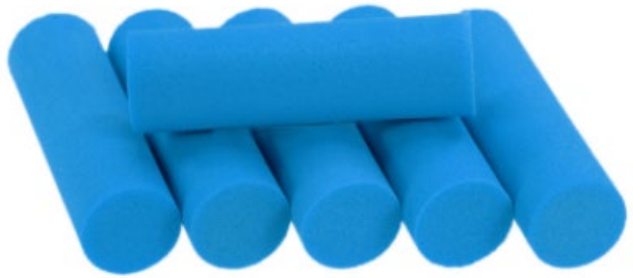
UV Sanitizer



[Manu Prakash: Frugal Foldscope]

Blue Foam

- XPS (Extruded PolyStyrene) foam
- Available in blocks or sheets
- Good for
  - Solid modelling
  - Authentic look and feel
  - Large models and prototypes
- Handling
  - Manual techniques
  - Digital Fabrication Machining

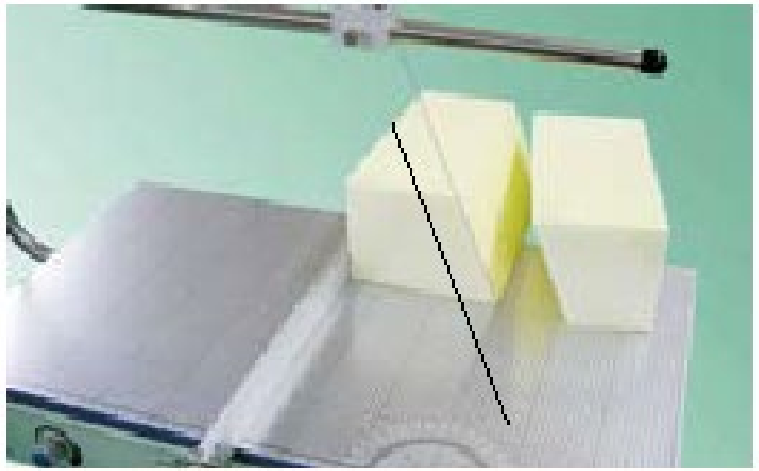


Cutting Blue Foam – Hot Wire

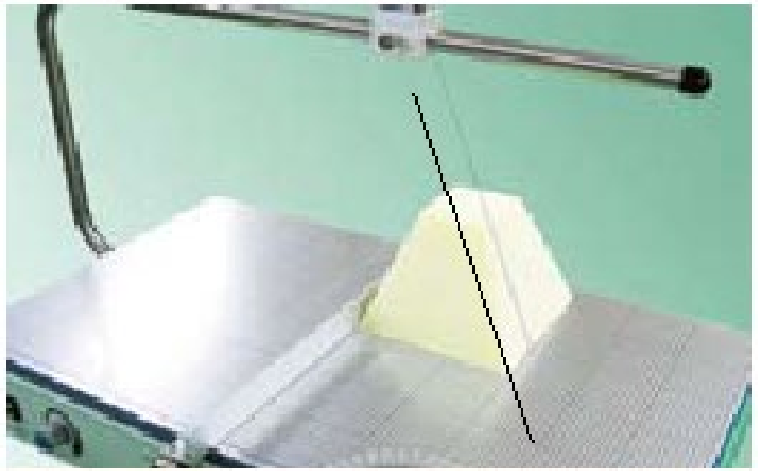
Handheld foam cutters

Table top foam cutters

Cutting Foam Shapes



Inclined cutting by adjusting the angle of the hot wire



Cutting a quadrangular pyramid through an inclined cutting work

Straight line cutting of a thick material using a angle square

AlfonsoTheTraitor: Cutting circles with a hot wire foam cutter
Quassi's Bell Tower: How to Make a Circle Jig for your Proxxon Thermcut

Foam Prototypes

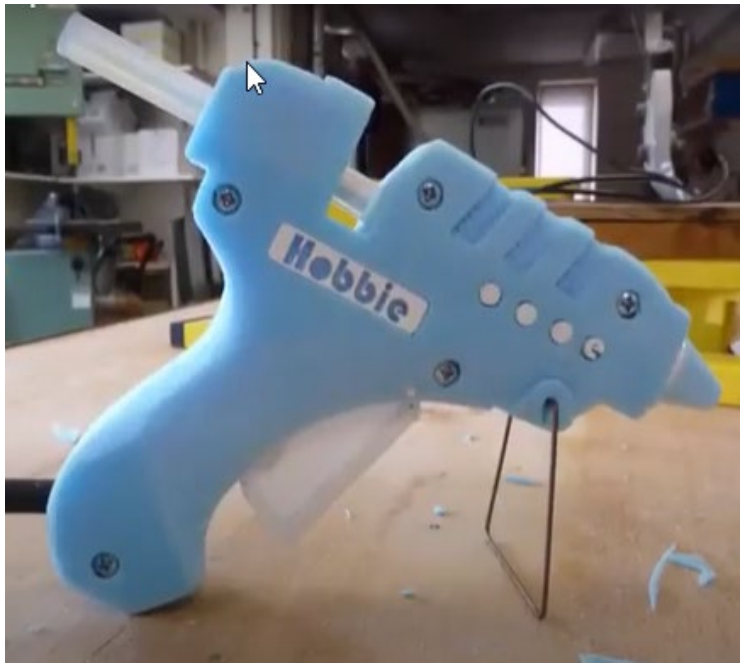
Shaping Tools:

- Carving knife
- Hot Wire
- Sandpaper
- Rasp & Assorted Files
- Heat Gun

Rian Touag: Foam Modelling - How To Make Rapid Prototypes (2 min)

Blue Foam Prototypes

Radio



Hot Glue Gun

Mouse

Foam prototypes add a SOLID touch/feel

Design Sojourn: [Re-thinking the hair dryer]

Guides:

- Cardboard
  - Adafruit: Cardboard Fundamentals - John Park
    - Remember to also check out the links at the end of the article
  - Making Society: Cardbord Shaping Techniques

- Foam
  - Juan Noguera - Blue Foam - Basic Model Making Techniques
  - Icarus Games - An Introduction to Working With Blue Foam (Styrofoam)XPS
  - Make: Skill Builder: Styrofoam Sculpting, Surfacing, and Sugru Skinning
  - CARVING FOAM: How To Carve Polystyrene Projects

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