[dstl] The Science Inside

Development of an additively manufactured thermal technique to access and vapourise a liquid payload within a munition

Harriet Hoskyns

In collaboration with Cranfield University at Shrivenham Defence Academy

Ministry of Defence

Introduction and Overview

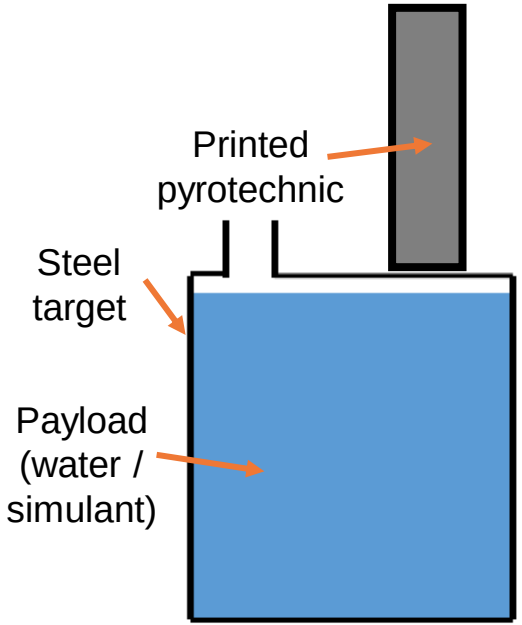
- The placement: Cranfield University
- Introduction to the project
- The printer
- Work process
- Results
- Future work

STEM FUTURES

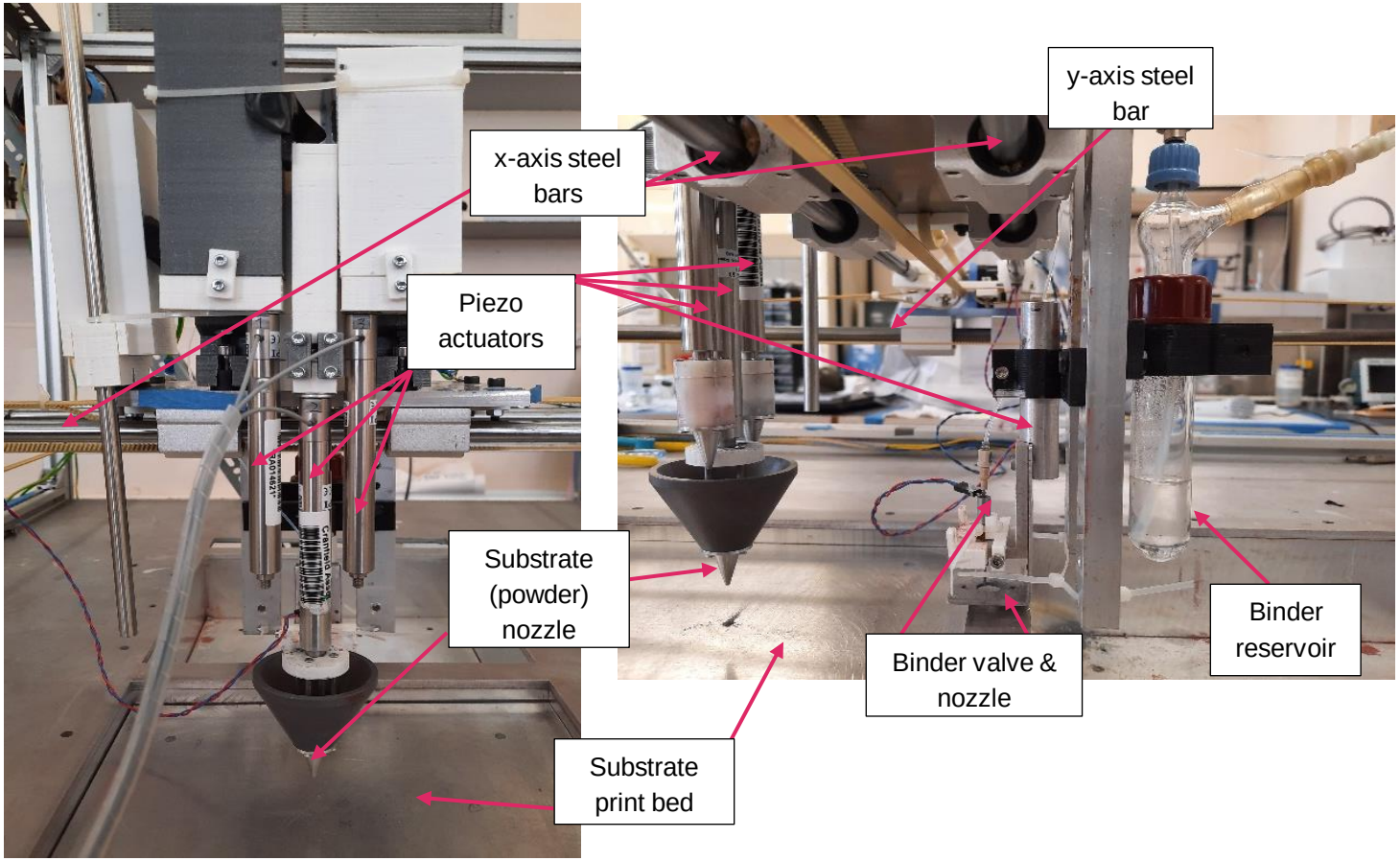
Introduction to the project

Aims

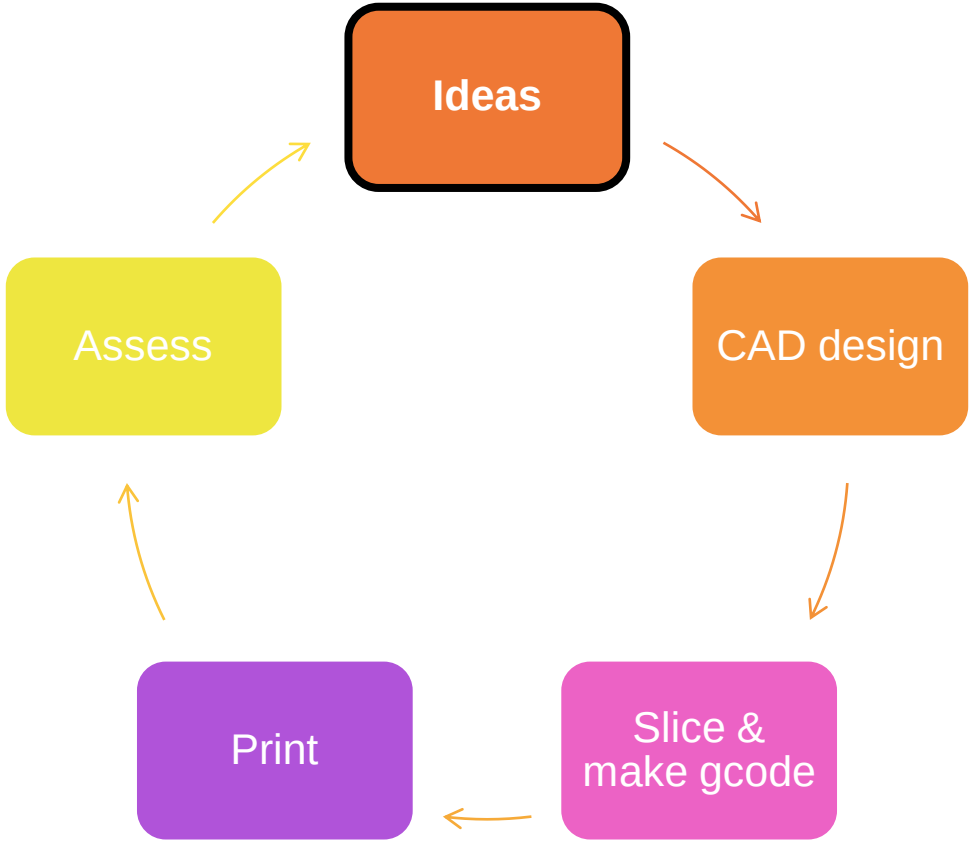
- Develop an additive manufacturing technique for 3D printing energetic material
- Design a 3D printed device that can penetrate through 10mm steel (shell)
- And eliminate the liquid payload within the munition
- Decide on a suitable composition for the energetic device



The Printer



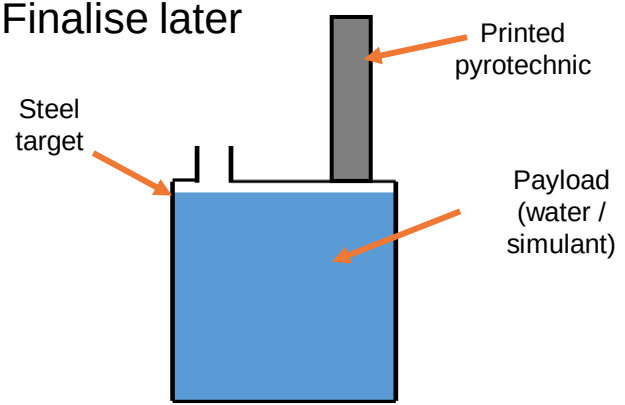
Work process



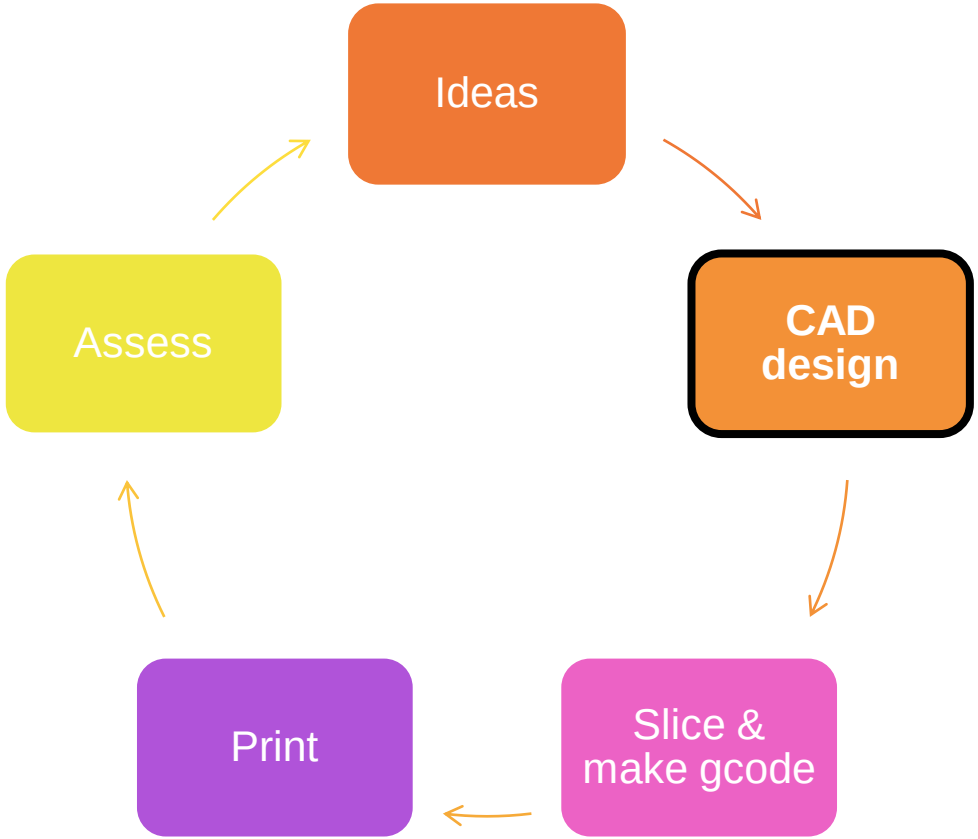
Ideas

Start with the brief:

- Burn through the target casing (without detonation)
- Print a device that works (burns)
- Finalise later



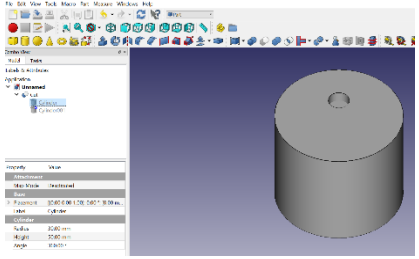
Work process

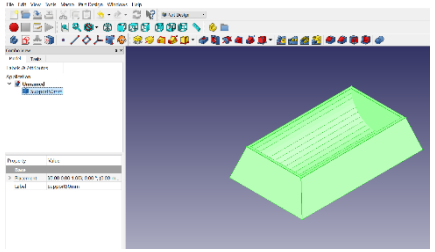


CAD design

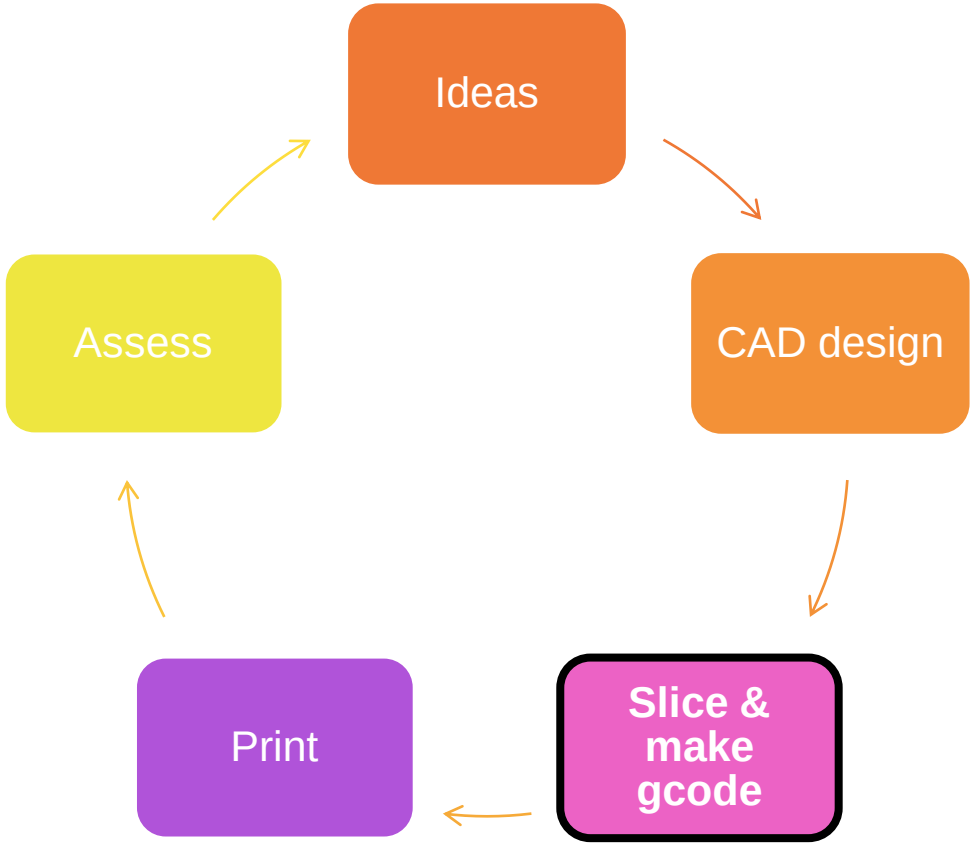
We use CAD software (FreeCAD) to:

- Created new design ideas
- Make exact designs on request





Work process



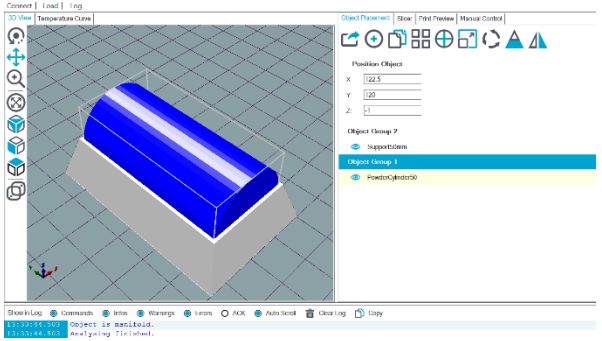
Slice & make gcode

Slicing (Slic3r):

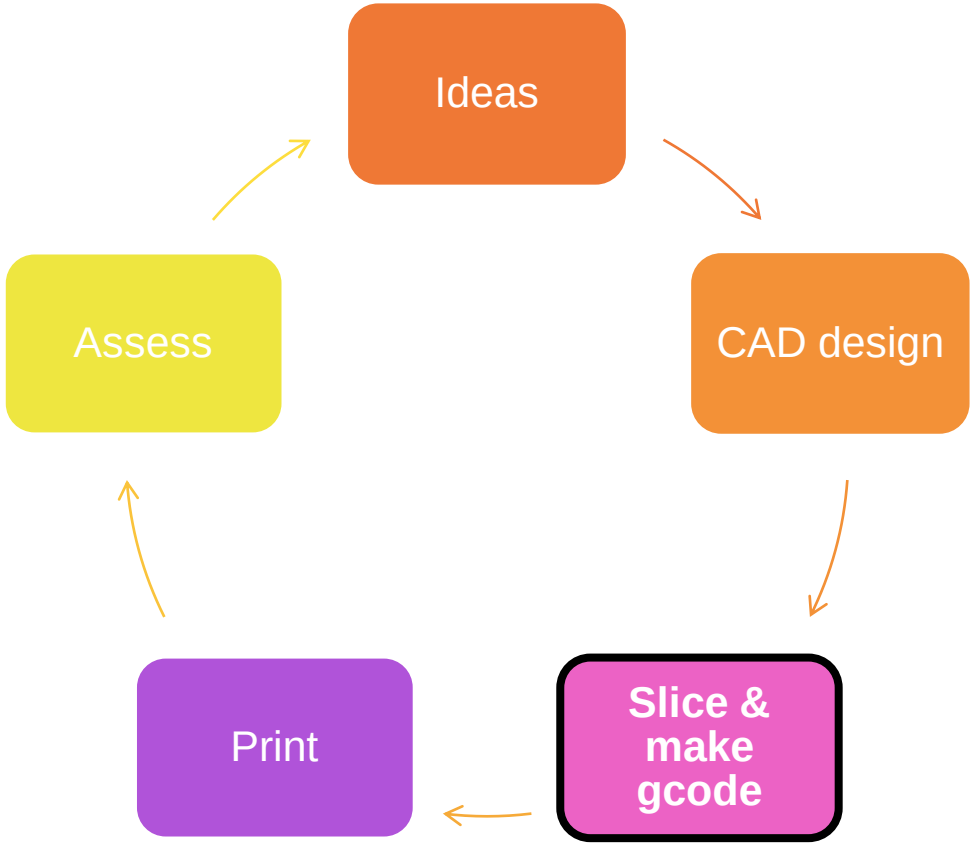
- turning your design into printable layers

Gcode (Slic3r, NotePad++):

- Turning layers into printer language



Work process



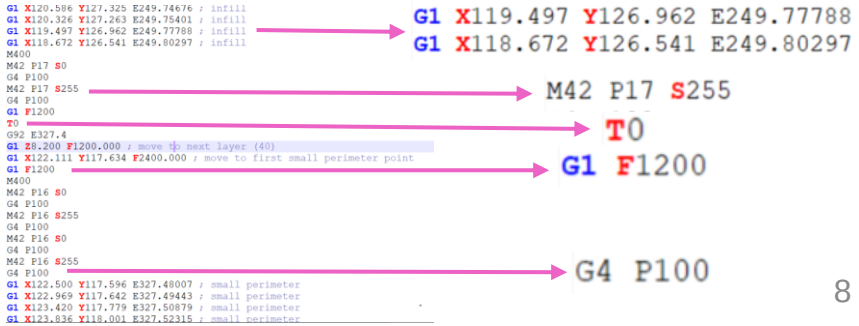
Slice & make gcode

Slicing (Slic3r):

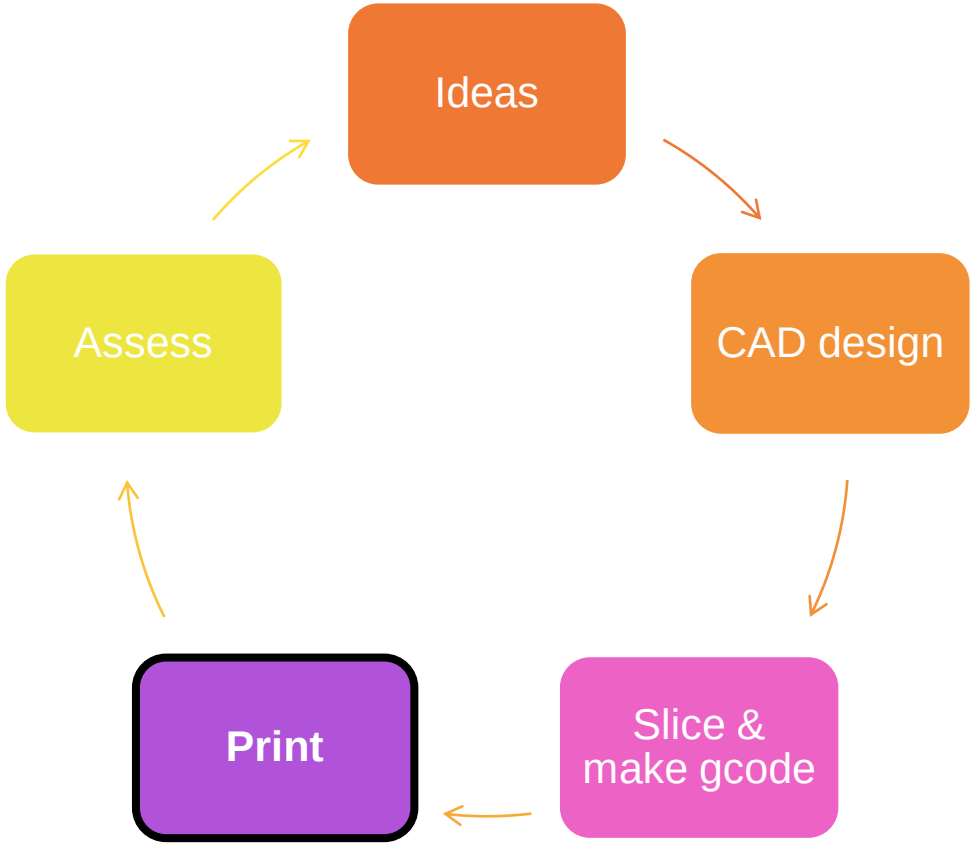
- turning your design into printable layers

Gcode (Slic3r, NotePad++):

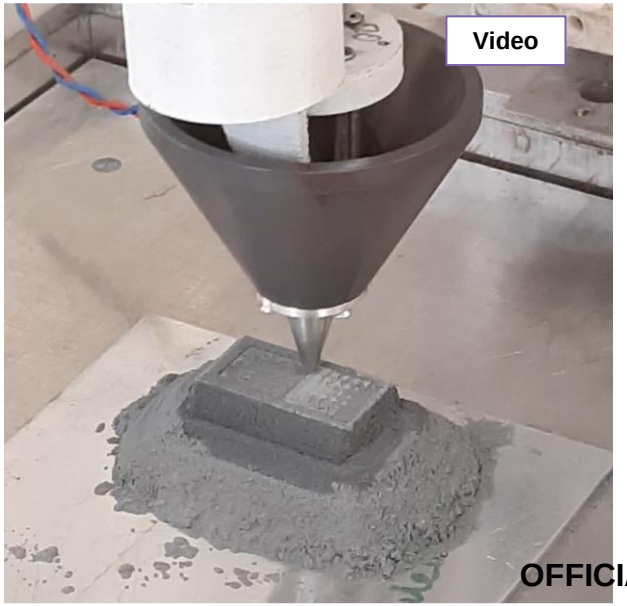
- Turning layers into printer language



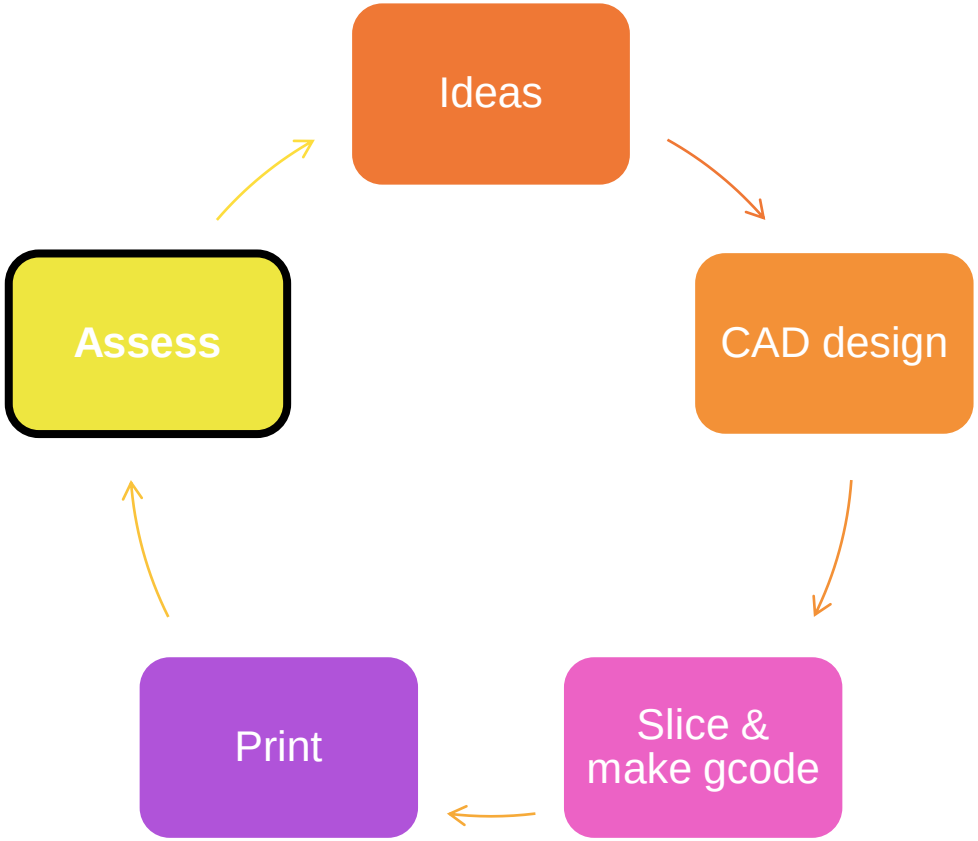
Work process



Print



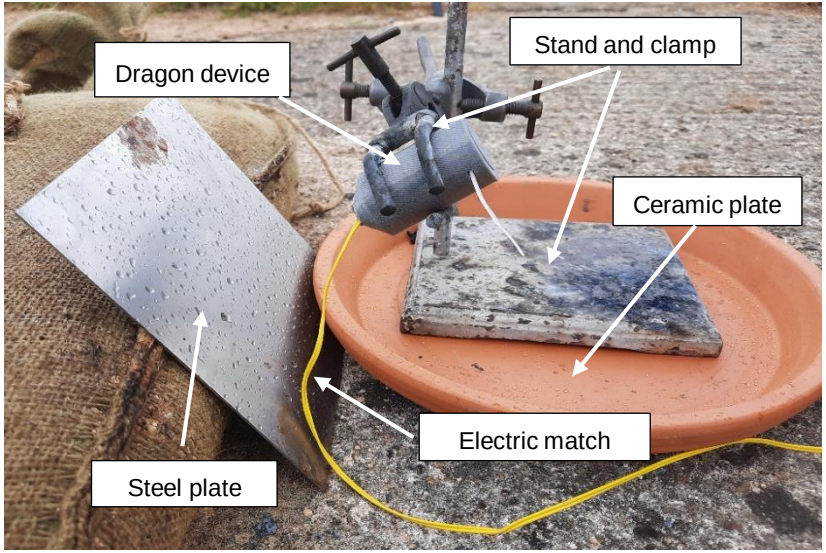
Work process



Assess

Work process

Assess



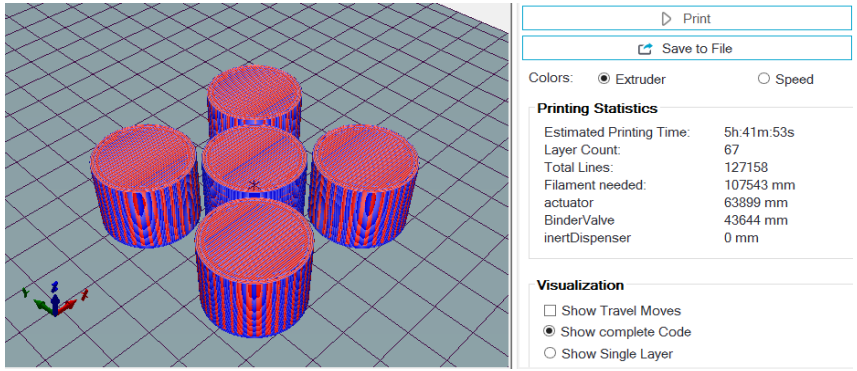
Results

Assess

Results

Assess

Larger scale



Printing:

- Multiple prints in one go
- Light thermite and dark thermite

Device

- Large rod-like structure
- Set up like a firework

Final set-up

Results

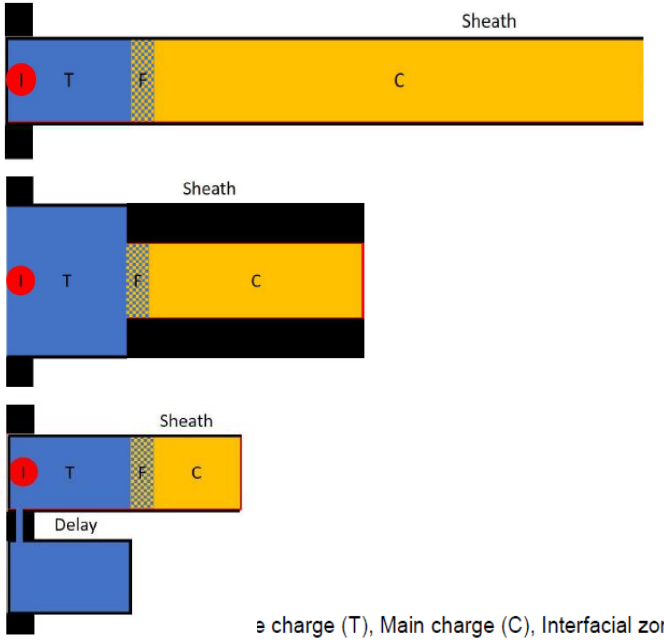
Pros:
- Ignition successful
- Mechanism worked

Cons:
- Confinement issues affected burn rate
- Breach unsuccessful
- Failed propagation

Future Work

Future work:

- Funding has continued but I am no longer on the project
- Target confinement issues
- Look at potential new designs (right)
- Assess propagation issues
- Collect more data
  - Pressure
  - Temperature
  - Water vaporisation



e charge (T), Main charge (C), Interfacial zone (F), Sheath Surround, Plastic containment sheath (P), and Spring.

[dstl] The Science Inside

Discover more

Thank you

A special thanks to:

Cranfield university
- Ranko Vrcelj
- Christine McGee
- Jacopo Bonifacio

Dstl
- STEM Futures Scheme

Any Questions?

hhoskyns@dstl.gov.uk