



## 3D Design and 3D Printing – Session B

TechResort Innovators Sessions #2107B

Skills involved:	3D Design using Microsoft 3D Builder	✓
	Using a 3D Printer	✓
	Creativity and Imagination!	✓
Suitable for ages:	10+	

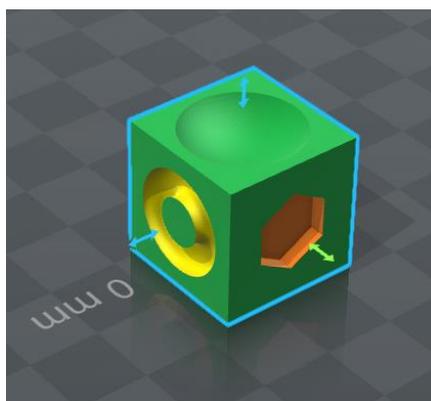
In these sessions we're going to investigate 3D printing. In order to make the most of 3D printing we'd like to be able to design the objects we make ourselves: this is much more useful and rewarding than just downloading stuff off of the internet.

In this session we'll explore how to use one of our 3D printers to print a small object during the session.

### Challenge 1: Design a small object

3D prints can take ages to print (your badges, for example took about hour to complete) but it's great to see the printer in action so we'll learn how to set up and use one of TechResort's printers and print a very small object so that we can give everyone a chance to print their own object some time during the second or third session.

- Use 3D building to create a small object – maybe something like this:



It's a small cube with other simple shapes subtracted.

- The rules of your small object should be:
  - No more than 20mm in any direction (but we'll print it smaller than that)

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- The bottom should be flat
- Make sure that the upper bits of the object are no wider than the lower bits so that it's simple to print.
- When you've completed your object save the model file to a USB stick. Save both a 3MF file copy and an OBJ copy.  
**Make sure your file name starts with your NAME**
- If one of the printers is available go and see one of the printing Elves to help you complete the next bit of the challenge. Take your USB stick with you.
- If no printer is currently available go onto the **session C** notes. Be ready to break off if you're called to use a printer.

### Printing your object using a CEL Robox 3D Printer

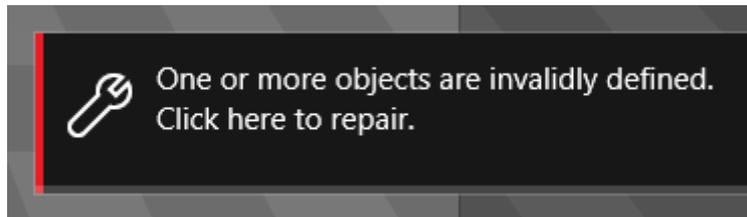
These instructions will get you printing using a Robox printer which is a very simple to use machine for the beginner. If you're going to use the Ultimaker, follow the Ultimaker instructions below instead.

### Checking Your Model

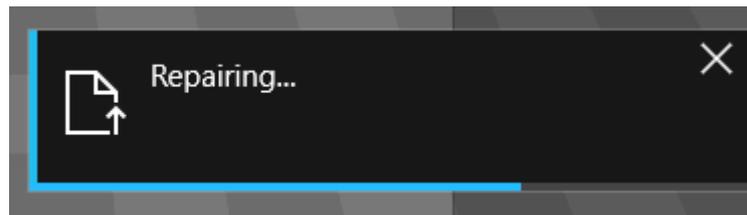
Firstly we need to check that your model file is correctly defined. There may be parts of it that won't print correctly.

Start up 3D Builder again and load in the OBJ file (note NOT the 3MF file) that you saved of your design.

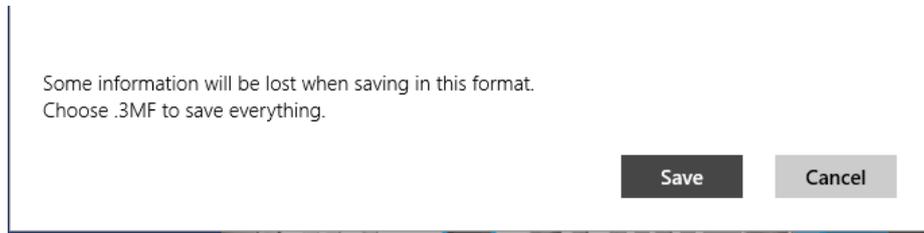
When it's loaded you may see the following message in the bottom right corner of the window:



If you do, then click where it says 'Click here' and the following message should appear:

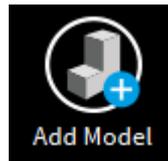


When that message has disappeared, your model should be OK so you need to save it in OBJ format again. Overwrite the original file. You'll see the following message which you should ignore by clicking on [Save]:

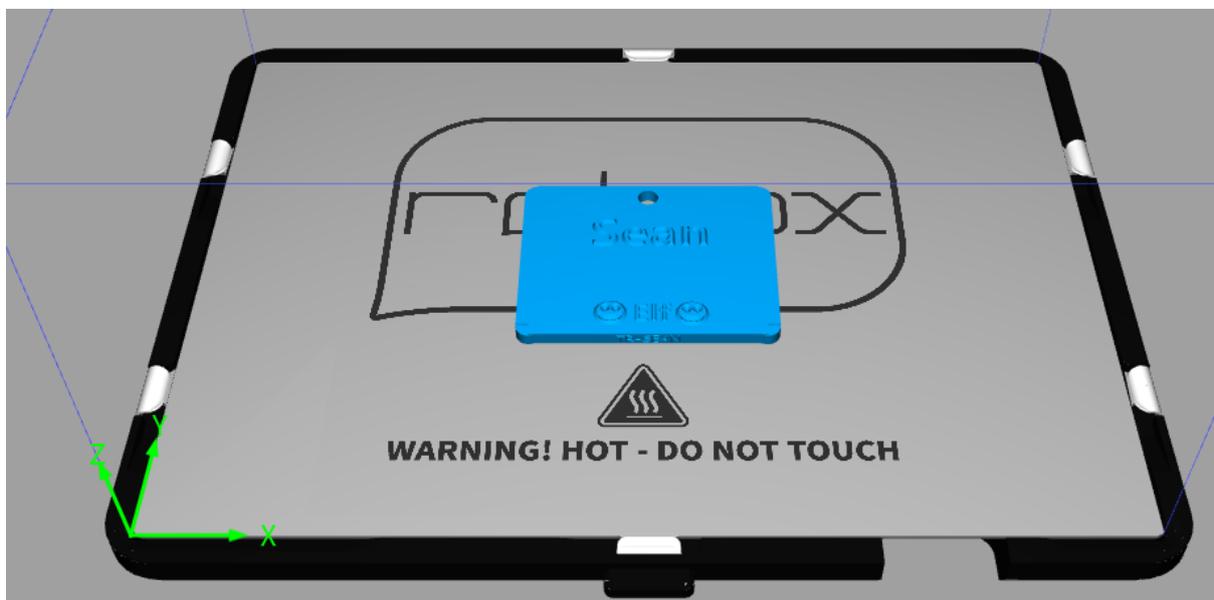


## Automaker

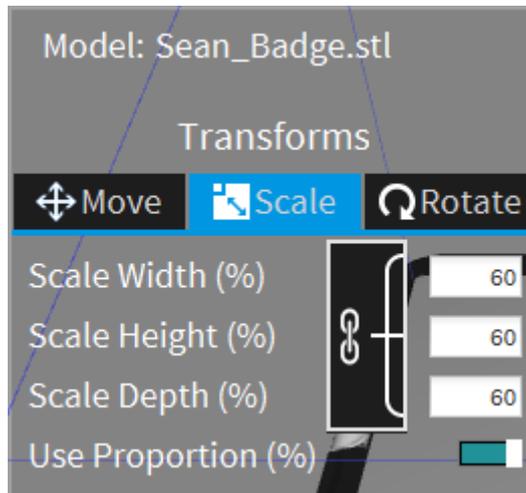
We use a program called 'Automaker' to control our 3D printer. This should be running on the PC connected to the printer.



We'll click on the 'Add Model' button at the bottom of the Layout screen to put add our design. Navigate to your small object (not your name badge – that's on the picture just for illustration) design on your memory stick and add it to the virtual printer bed



If we now click on our model, another box will appear that allows us to move, rotate and re-size our model in a similar way to 3D Builder:

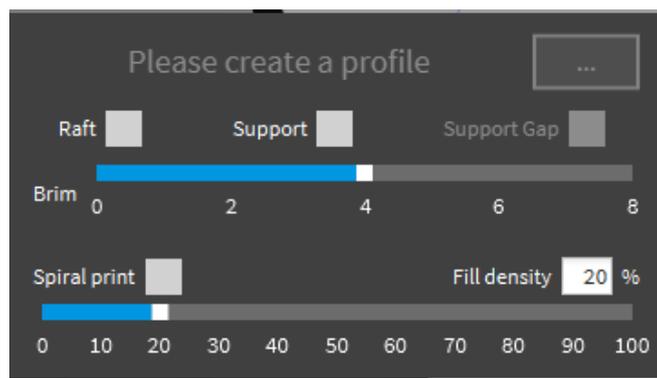


We'll use this tool to re-size our badge to 50% of its original size.



After we've decided where and how big to print our model, we need to click on [To Settings](#) to tell the printer about some of the important things we need to do to print our model.

The box below shows the basic settings we need to specify:



**Raft:** Checking this box prints a platform under your model before it prints the model itself. Select this if the model only has a very small base or if you have trouble with it sticking to the print bed.

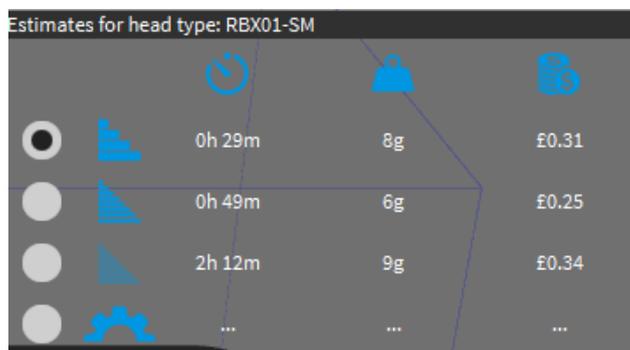
**Support:** This prints scaffolding under areas of the print which would otherwise be hanging in the air. In theory, this scaffolding is easy to remove when the print is complete but, if your model is delicate, this may not be the case. Also note that the print material is sticky so you can print overhangs which slope up gently without scaffolding (albeit with some loss of quality). If you've designed your small model according to the rules then you won't need support for this model.

**Brim:** This prints an extra ribbon of material around the bottom edge of your print. It should help your print stick to the print bed and stop it curling up at the edges. We almost always use a brim as prints tend to be better with them. The brim is much easier to remove than a raft when the print is complete.

**Fill density:** This controls how much the inside of the model is filled up with material. Selecting a lower density will help it print quicker but will make the model lighter and potentially more delicate.

The box below shows the quality set to 'Draft' which is the fastest way to make our print. The other options are 'Fine' and 'Medium' which will be slower but better quality (ignore the bottom one for now). Select 'Draft' here to print your badge. When you've chosen your other settings, the printer will estimate the print time, weight and cost and show them in this box.

**Important note:** If the print time is more than 13 minutes don't start the print but go back and reduce the dimensions of your object so that it will print in 13 minutes.



Quality	Print Time	Weight	Cost
Draft	0h 29m	8g	£0.31
Fine	0h 49m	6g	£0.25
Medium	2h 12m	9g	£0.34
...	...	...	...

For your object, we'll use the following settings:

- Medium resolution
- No Raft
- No Support
- 4mm Brim
- 30% Fill Density



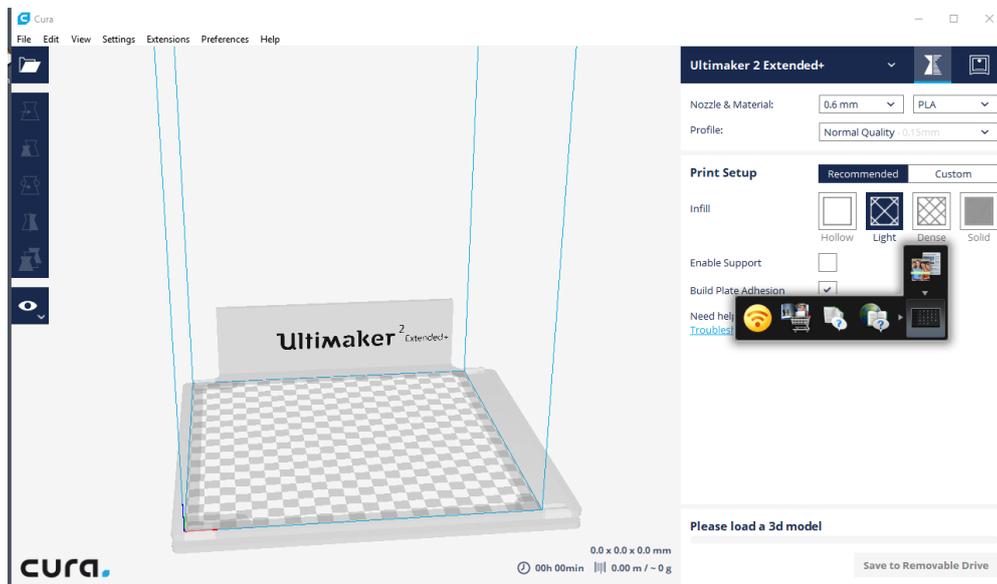
Having chosen the required settings, all that's needed to do is click on . The PC will prepare and download the necessary files and download them to the printer. No further intervention should be necessary and the PC can be disconnected from the printer once the files have been successfully downloaded (it's suggested the Automaker software is shut down first).

Your print shouldn't take very long (maybe 15 minutes) so you can either watch it being made or carry on with the Session C work. We like to watch prints for a while to make sure everything's going ok...and anyway, it's fun.

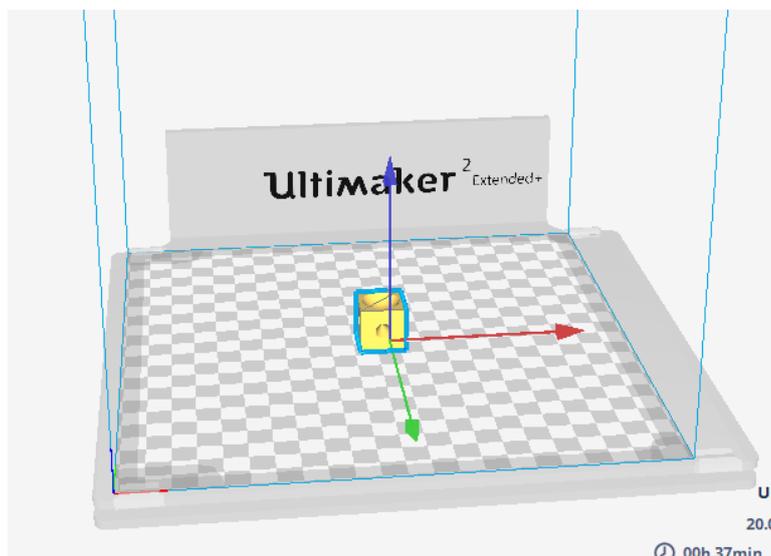
### Printing your object with the Ultimaker 2+ Printer

These instructions will get you printing using an Ultimaker. If you're going to use the Cel Robox machine, follow the Robox printer instructions above instead.

- Open Cura.  
Cura is the software that takes your 3D design and turns it into code that the Ultimaker Printer understands. This is called "GCode". It tells the printer how to build your object layer, by layer.
- When you open Cura it should look something like this:



- First, open your 3MF file (don't use open project) that you saved to your USB stick and make sure it's in the chequerboard area that represents the bed of the 3D printer



If the model appears outside the chequerboard area you'll see a warning on the screen. Click and drag your model to approximately the middle of the print bed.

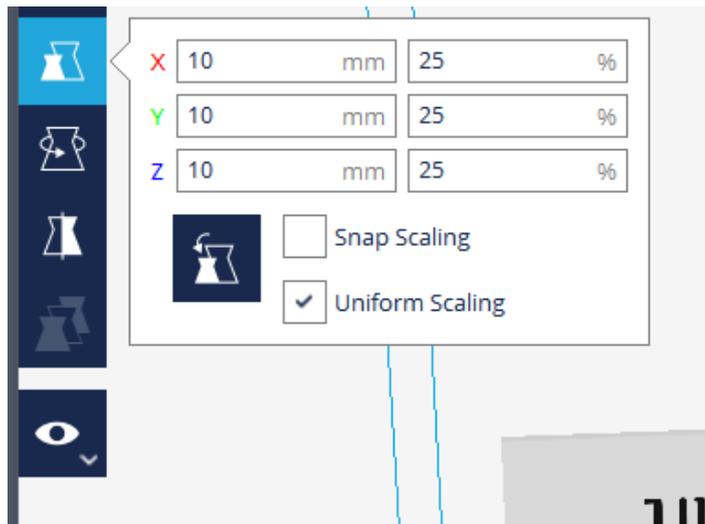
- When you designed your model in 3D builder – you set the maximum size in any direction to 2cm (20mm). But this would still take a long time to print so we'll tell Cura to print the object at 50% size.



- Click the scale button on the left

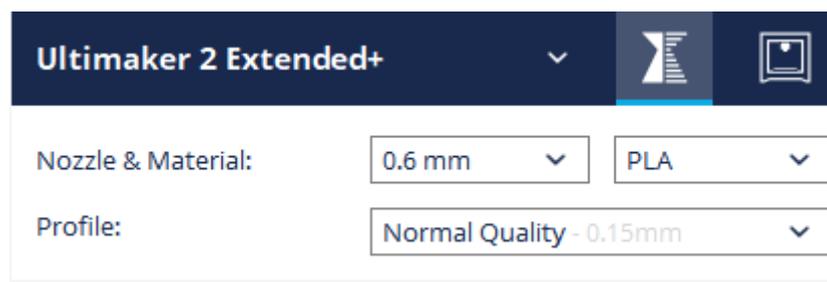
In the resulting box that is displayed make sure that the "Uniform scaling box" is checked. Now change the measurement for the biggest number in X Y or Z to 10mm. When you change one, all

the others will change in proportion.



- The next thing to check is the material that we're using in the printer. Your model will be using PLA material and a 0.6mm nozzle.

On the right hand side of the screen, near the top you'll see these settings:



change them if you need to.

- Now check the printing information at the bottom of the screen. It should tell you how big the object will be printed, how long it will take and how much printer filament it will use. It should look something like this:



- As long as the print time is less than 12mins you can go ahead. If it's longer than 12mins, change the dimensions again until it's small enough to print in 12minutes.
- Now you need to save the gcode file to the SD card which we'll use in the printer. Insert the SD card into the reader on your laptop and at the bottom of the screen you should see the following:

## Ready to Save to Removable Drive

Save to Removable Drive



Click on “Save to Removable Drive” and your gcode file will automatically be saved to the SD card.

- Remove the SD card and put it in the Ultimaker.
- Use the wheel on the front of the Ultimaker and navigate to “Print” and then select your model. An elf will help you with this as it’s a little bit fiddly.
- We usually spray a little bit of adhesive on the bed to help the model stick well and print properly. We’ll have already done this by the time you use the printer but if it hadn’t been used for a while, this is something you’d need to do.
- Once you’ve selected your model select print and watch the print happen.
- It’s important not to touch the print head or print bed whilst printing – they’re both very hot.