3D Printing for the Next Generation
Lessons Learned from a Rookie and a Geek

Lawrence Bergie, Chief Information Officer
Britta McKenna, Chief Innovation Officer
Welcome!

Introductions

Goals for this hour
3D scan project

- Introduce Zach
  (Head of Maker Squad)
- A few words about Maker Squad
- Need a volunteer to scan…
The maker movement is the name given to the increasing number of people employing do-it-yourself and do-it-with-others techniques and processes to develop unique technology and/or products.

Most of the products created in the maker movement are open source and incorporate creations that never existed before. Most were developed by individuals in whatever space they could find with little or no manufacturing capabilities.
where is IMSA in this movement?

- IMSA Students have been building robots competitively since 2008
- We have a fabrication lab to build robots including a CNC machine and power tools
- We have a maker space, managed by a student Maker Squad, that includes 3D technology
- IMSA engineering team operates a commercial grade 3D printer in support of classroom engineering projects
the story of this room...

1.0 Since all IMSA students have a laptop, this computer lab was repurposed into the IMSA Energy Center

2.0 Launch of IN2 Innovation Hub heightened interest in Maker Movement now (IN2 to open fall 2016)

3.0 With considerable student support and involvement, our Maker space was conceived and created within the Energy Center

4.0 The creation of IMSA’s Maker Squad has increased use and interest in the space for class and personal projects
space modification

3 Reasons to Convert Your Computer Lab to a Maker Space

A computer lab is ideal for the following reasons:

1. 1:1 laptop/student ratio is making computer labs obsolete
2. Computer labs have plenty of electrical outlets, tables and chairs
3. The size of a computer lab is ample to get started
fieldtrips

Chicago Public Library
more fieldtrips

MIT Media Lab
more fieldtrips

IIT Idea Shop
more fieldtrips

Harvard Innovation Lab

Artists’ Asylum
other ideas...

3-D printer on wheels

rapid prototyping cart
birds eye view above the hub

(IMSA front door is on bottom right)
inside 500 sf maker space with storage/overflow
work and staging area
Our Maker Space has the following tools for rapid prototyping:

- 2 Da Vinci XYZ 3D printers
- 1 Makerbot Replicator 2X two color 3D printer
- 1 3D scanner
- 3 YaYa 3D pens
- 3 3Doodler 3D pens

3D printing specs are generally defined by: build volume, filament diameter, nozzle diameter, layer resolution and positioning precision.

3D scanning specs are generally defined by: scan volume, operating range, spatial resolution and depth resolution.
### Types of 3D Printing Technology

<table>
<thead>
<tr>
<th>Type</th>
<th>Technologies</th>
<th>Materials</th>
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<tbody>
<tr>
<td>Extrusion</td>
<td>Fused deposition modeling (FDM)</td>
<td>Thermoplastics (e.g. PLA, ABS), HDPE, eutectic metals, edible materials, Rubber (Sugru), Modeling clay, Plasticine, RTV silicone, Porcelain, Metal clay (including Precious Metal Clay)</td>
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<td></td>
<td>Robocasting</td>
<td>Ceramic materials, Metal alloy, cermet, metal matrix composite, ceramic matrix composite</td>
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<tr>
<td>Wire</td>
<td>Electron Beam Freeform Fabrication (EBF³)</td>
<td>Almost any metal alloy</td>
</tr>
<tr>
<td>Granular</td>
<td>Direct metal laser sintering (DMLS)</td>
<td>Almost any metal alloy</td>
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<tr>
<td></td>
<td>Electron-beam melting (EBM)</td>
<td>Almost any metal alloy including Titanium alloys</td>
</tr>
<tr>
<td></td>
<td>Selective laser melting (SLM)</td>
<td>Titanium alloys, Cobalt Chrome alloys, Stainless Steel, Aluminium</td>
</tr>
<tr>
<td></td>
<td>Selective heat sintering (SHS) [30]</td>
<td>Thermoplastic powder</td>
</tr>
<tr>
<td></td>
<td>Selective laser sintering (SLS)</td>
<td>Thermoplastics, metal powders, ceramic powders</td>
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<tr>
<td>Powder bed and inkjet head 3D printing</td>
<td>Plaster-based 3D printing (PP)</td>
<td>Plaster</td>
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<tr>
<td>Laminated</td>
<td>Laminated object manufacturing (LOM)</td>
<td>Paper, metal foil, plastic film</td>
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<tr>
<td>Light polymerised</td>
<td>Stereolithography (SLA)</td>
<td>photopolymer</td>
</tr>
<tr>
<td></td>
<td>Digital Light Processing (DLP)</td>
<td>photopolymer</td>
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</tbody>
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In order to create a 3D output you need an application that can produce or convert to an .STL format. Many free and for purchase applications exist

1. Autodesk  http://www.autodesk.com/
2. Solidworks  http://www.solidworks.com/
5. Tinkercad  https://www.tinkercad.com/
6. FreeCad  http://www.freecadweb.org/
7. Sketchup  http://www.sketchup.com/
8. Slic3r  http://slic3r.org/
safety

3D Printers:
1. Use in a well ventilated room
2. Do not drink or eat from 3D printed objects.
3. Wear goggles when you clean the nozzle.
4. Supervise printing whenever possible.
5. Clean nozzles regularly (weekly at least) to avoid major clogging.
6. Keep door shut while printing.
7. Don’t touch platform or extruder (nozzle).

3D pens:
1. Do not touch nozzle during use – it’s hot!
2. Extrude filament all the way through before unplugging or after each use.
3. Don’t press both buttons at once.
how much does it cost?

$$

XYZ printer = $499
MakerBot Replicator 2X = $2,500
Cube Scanner = $599
3D pens = $89-$129
1.75 mm ABS plastic filament = $28.00
Tablet (1-2)
Flash drives (3)
Other supplies you should purchase:
screwdrivers, spatulas, scissors, paper and pencil, etc.
top 10 lessons learned

1. Start small and roll out slowly
2. Open your doors when students have time to explore (beyond regular class time)
3. Reach out to early adopter faculty to have them use the space or make it an option for class projects
4. New technology is imperfect; plan for it to work 50% of the time
5. Train student helpers, who will train other students
6. Keep a scrap book (physical or virtual) of projects
7. Plan to recycle scrap plastic
8. Order 3D pens that use the same filament as your printers
9. Don’t be afraid to hack solutions
10. Track use and types of projects
10 tips to get you started

1. Identify resources (space, people and budget)
2. Create a plan with at least a few months lead time
3. Get your students involved to create your own Maker Squad (include faculty and staff to supervise)
4. Learn alongside or from the students
5. Design space, order equipment
6. Unpack and play until it breaks, then fix it
7. Establish hours for open lab
8. Create a “do-ocracy” culture
9. Reach out to invite key faculty and student leaders
10. Make stuff and see what happens…
Join IN2 on social media...

IN2IMSA

IN2 (Group page)

IN2 (group)

imsa.edu/in2
Questions?
Thank you!

- Britta Wilk McKenna
  bmckenna@imsa.edu

- Bud Bergie
  lbergie@imsa.edu