KANSAS STATE UNIVERSITY | Technology Development Institute

Product Development Process

Technology Development Institute
510 McCall Road
Manhattan, Kansas 66502
www.ksu.edu/tdi

Background…

- Unit in the K-State College of Engineering
- Established in 1985
- Since 1995 Over 2,500 development projects with over 600 clients
- Off campus 22,000 sq. ft. facility
  - Half office & half prototyping shop facility
- 10+ full-time staff members
- Primary focus is to provide technical support in an effort to develop new technologies, grow companies and communities

The Product Development Process …

- **Where do you start?**
  - Consumer Research
    - Is there a problem?
    - How are they solving it today?
    - What does that cost them and is it painful?
    - Where do people shop for these products?
    - How much are they paying to address the issue?
    - Conducting surveys are a good way to gather information
      - Make sure the questions are structured properly to gather information and not just confirm opinions
      - How much would you pay vs. what would you expect the price to be
    - Products must have market demand to be successful

The Product Development Process …

- **Where do you start?**
  - Competitive Product Research
    - It's not just does this exists – what else solves this problem?
    - Just because your idea is different doesn't make it better
    - Where do people shop for these types of products?
      - Websites, Amazon, WalMart, Target, etc …
    - Internet searches – there is lots of stuff out there!!

The Product Development Process …

- Intellectual Property Research
  - Trademarks
    - www.uspto.gov
    - Pay attention to Classification Codes
      - Raven Example
  - Patents
    - Google Patents https://patents.google.com/
    - Enter search terms as you would normally search the web
    - Patent Searches
    - Patent Citations
    - Cited By
    - Similar Documents
    - Claims – Infringement vs. patentability

The Product Development Process …

- Document everything you have found in a written document that you can pull out later if needed.
  - What was the customer feedback
  - What were the competitive products, where were they sold, price points
  - Patents, Applications, Issued, Expired
- All of this information should be used to develop a product specification that is the guide for concept development.

Engineering Design Process

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Engineering Design Process

1 Project Scope

- Identify the problem/need
- What are the constraints?
- What is the timeline and budget?

2 Research

- What is needed to complete the project?
- What has already been developed?

3 Concept Generation

- Brainstorm lots of basic ideas
- Test/evaluate general concepts
- Select one or two concepts to move forward with

4 Design and Detail

- Generate detailed models and plans
- Complete various calculations and further research to prove out design

5 Build and Test

- Build first prototype(s)
- Test for functionality and other metrics

6 Iterate

- Improve design based on testing and other feedback

Engineering Design Process

1

Project Scope

Hunting Product – Remote Scent Dispenser

- **Identify the problem/need**
- What are the constraints?
- What is the timeline and budget?

Engineering Design Process

1

Project Scope

- Identify the problem/need
- **What are the constraints?**
- What is the timeline and budget?

Hunting Product – Remote Scent Dispenser

- Remotely triggered and/or on a timer
- Works with current scent packaging
- Battery powered

Engineering Design Process

1

Project Scope

- Identify the problem/need
- What are the constraints?
- **What is the timeline and budget?**

Hunting Product – Remote Scent Dispenser

- Remotely triggered and/or on a timer
- Works with current scent packaging
- Battery powered
- Low cost of goods for production design
- Production ready design in 9 months

Engineering Design Process

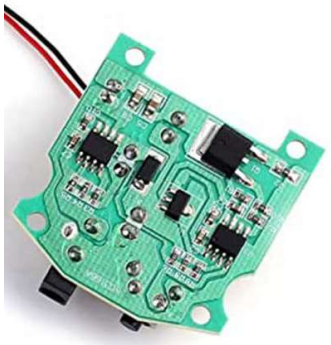
2

Research

- **What is needed to complete the project?**
- What has already been developed?

Parts needed to function

- Plastic injection molded housing
- Actuator for dispensing scent
- IC board for remote and/or timer



Engineering Design Process

2

Research

- What is needed to complete the project?
- **What has already been developed?**

What else dispenses scent?

- Household air fresheners
  - Sprays
  - Diffusers
  - Heated oil/wax

Engineering Design Process

2

Research

- What is needed to complete the project?
- **What has already been developed?**

What else dispenses scent?

- Household air fresheners
  - Sprays
  - Diffusers
  - Heated oil/wax
- Hunting scent dispensers

Engineering Design Process

3

Concept Generation

- **Brainstorm lots of basic ideas**
- Test/evaluate general concepts
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Engineering Design Process

3

Concept Generation

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Engineering Design Process

3

Concept Generation

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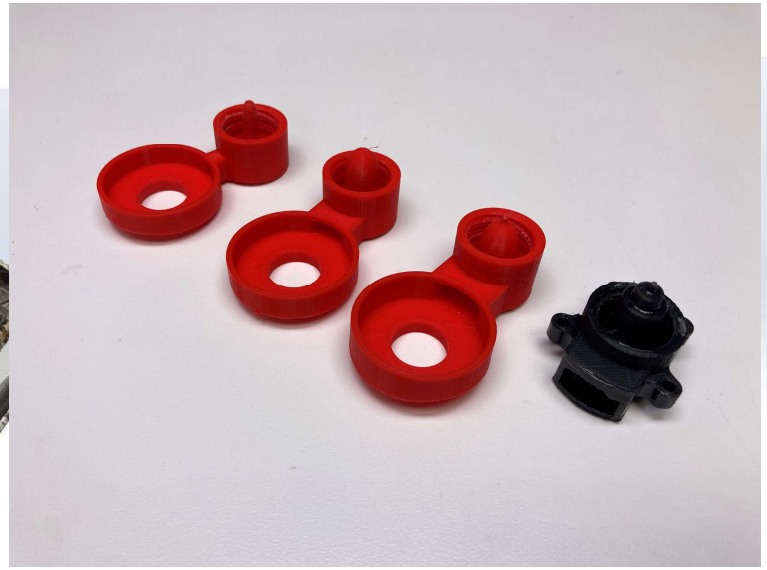


Engineering Design Process

3

Concept Generation

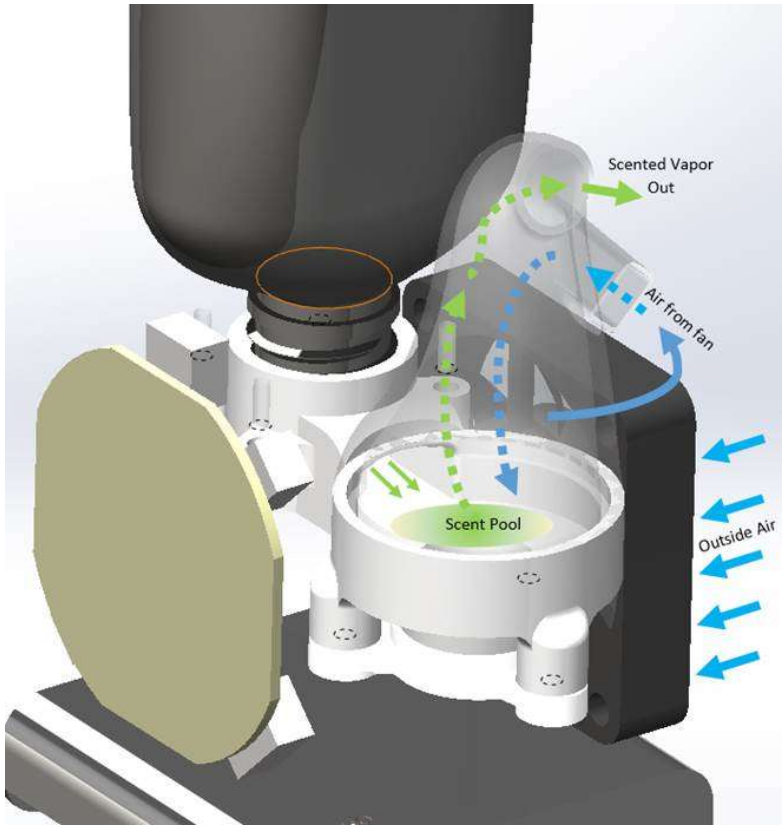
- Brainstorm lots of basic ideas
- Test/evaluate general concepts
- **Select one or two concepts to move forward with**

Engineering Design Process

4

Design and Detail

- **Generate detailed models and plans**
- Complete various calculations and further research to prove out design



Engineering Design Process

4

Design and Detail

- Generate detailed models and plans
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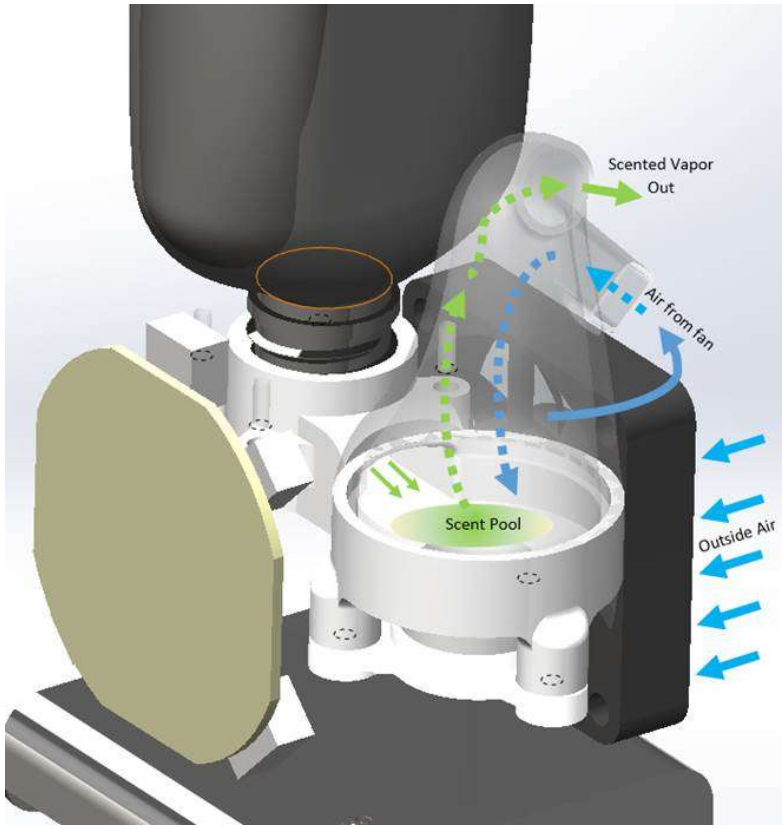


Engineering Design Process

5

Build and Test

- **Build first prototype(s)**
- Test for functionality and other metrics

Engineering Design Process

5

Build and Test

- Build first prototype(s)
- **Test for functionality and other metrics**

Engineering Design Process

6

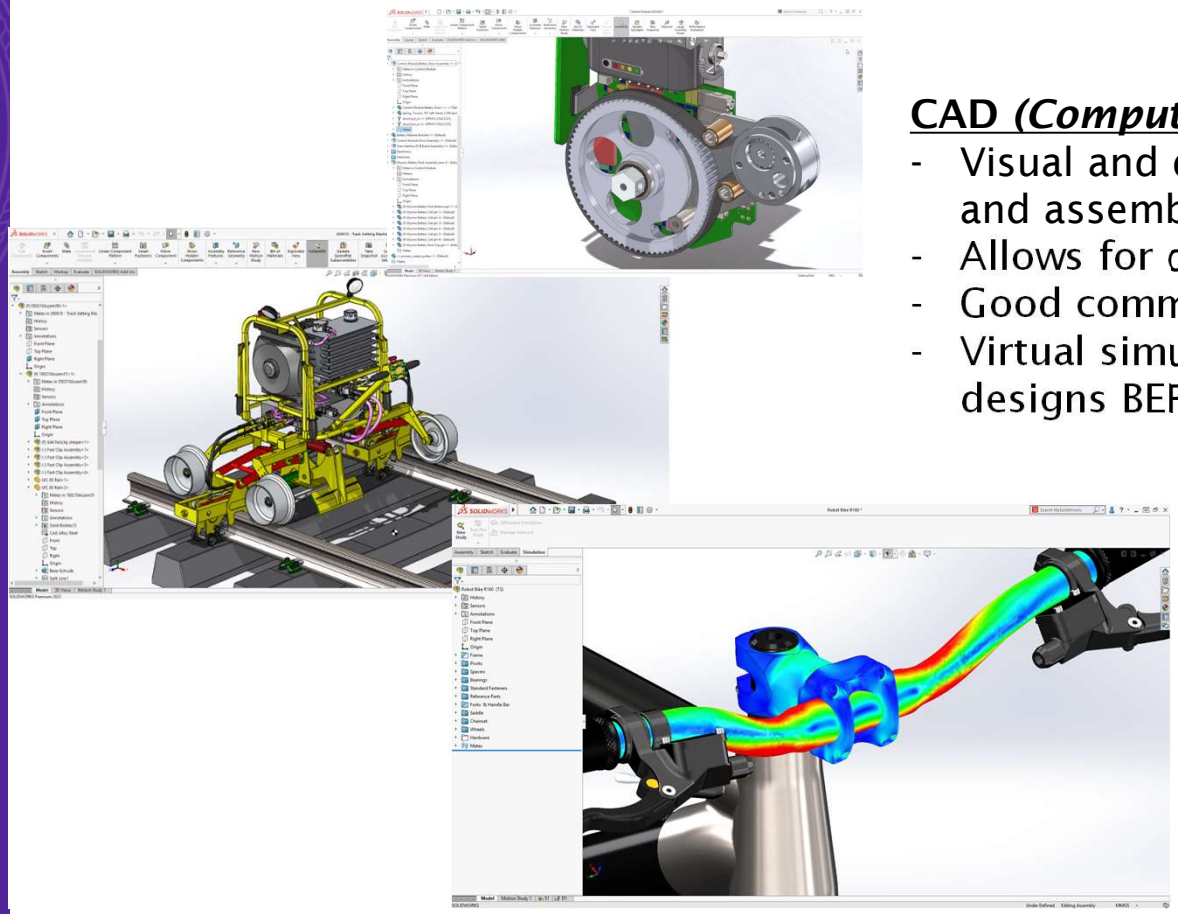
Iterate

- **Improve design based on testing and other feedback**

vs.

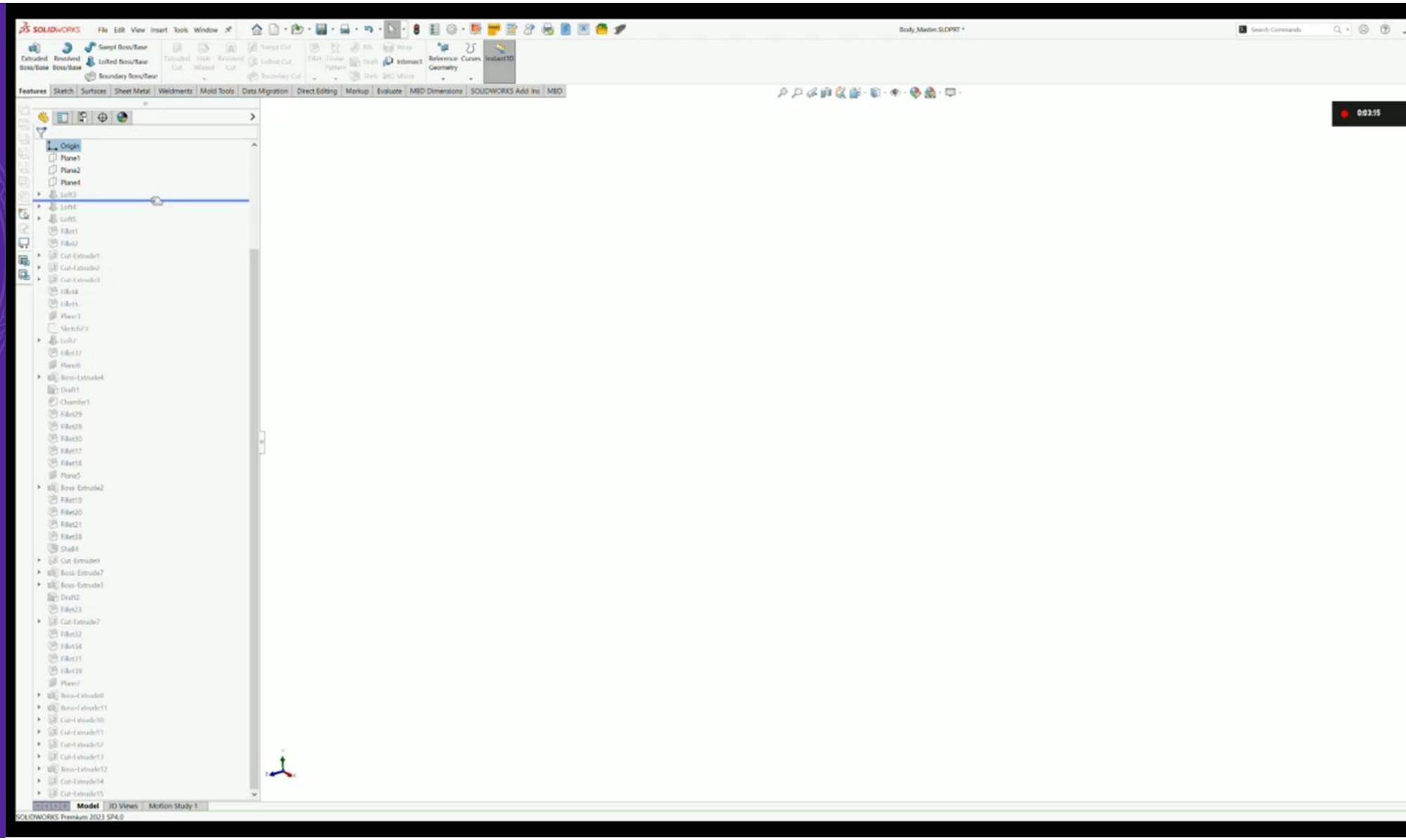
CAD Modeling

CAD Modeling



CAD *(Computer Aided Design)*

- Visual and dimensional representation of parts and assemblies
- Allows for quick changes
- Good communication tool between groups
- Virtual simulations and calculations can validate designs BEFORE physical testing.


SOLIDWORKS
File Edit View Insert Tools Window
Body_Master.SLDPRT *
Search Commands
Extruded Boss/Base
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Curves
Instant3D
Features Sketch Surfaces Sheet Metal Weldments Mold Tools Data Migration Direct Editing Markup Evaluate MBD Dimensions SOLIDWORKS Add-Ins MBD
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Origin
Plane1
Plane2
Plane4
Model
3D Views
Motion Study 1
SOLIDWORKS Premium 2023 SP4.0

Now that we have a product…

- What's Next?
  - Licensing vs. Manufacturing
- Licensing requires creation of some form of Intellectual Property
  - This is usually in the form of a utility patent, but may be design patent, copyright, trademark or even a trade secret
  - Conceptual model to export drawings from is enough to file a patent
  - Prior art becomes very important here ….
  - Difficult to accomplish
- Manufacturing does not require IP, but does require a business plan, marketing and sales plan, detailed engineering drawings, part specifications, BOM and people
  - Expensive
  - Time consuming
  - Much higher returns

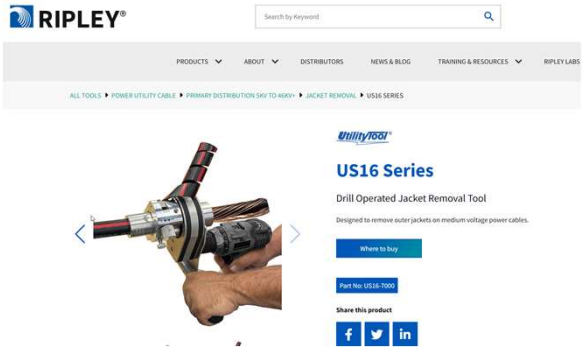
Licensing

- The goal behind licensing is to create IP and then offer that to a manufacturer under a license agreement where they pay a royalty on the sale of each unit

- Draft a disclosure, create patent drawings & find a good attorney to draft the claims and file the patent
  - Provisional Patent, Utility Patent, Design Patent

- Terms of the license very widely
  - Exclusive vs. Non
  - Field of Use
  - Signing Fee
  - Patent Costs
  - Minimums
  - Royalty Rates – typically range 3-8% (revenue) depending on industry

- Difficult to accomplish
  - Right company, Right time, Right dollar amount
  - 9 out of 10 licensing deals fail to find a home



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Licensing

How do you go about licensing?

- Identify target companies with distribution channels needed to sell the product
- Conduct market research to determine the size and potential of the market
- Generate a “Technology Licensing Profile”
  - One pager that explains the product, the market, the benefits and that you are seeking to license
- Valuation Model – Spreadsheet used to determine how much the IP is worth
- Term Sheet – what are you asking for?

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Business Planning

- Manufacturing is expensive and typically requires capital to be raised
- If you need to raise capital – a business plan is going to be required to illustrate to investors how you plan to manufacture product, sell and generate revenue
- Financials are also needed to show how much investment is required
- Determine exit strategy for investors
- Kansas Small Business Development Centers provide assistance in drafting the business plans

Marketing and Sales

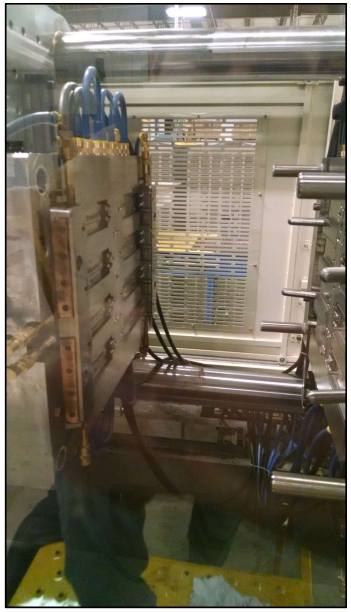
- This is the single most important aspect of planning and something that you cannot control
- "Selling it on my website" is not a sales and marketing plan
  - How are you driving traffic to the website? How much does that cost?
- Distributors vs. direct sales?
- Pricing
- Sales projections and cash flow

Manufacturing

- It really has to work – and be able to be produced!
- Design for manufacturability comes into play
- Tooling – what is required to put the project into production
- Machines – In-house vs. toll processing
- Supply chain development
  - Landing correct materials at the correct time
  - Outbound shipping to customers
- Do you produce in the US or overseas?
- Once everything is lined up, time to Launch

Product Scale-Up

- EXPENSIVE!
- Tooling cost for injection molding can easily cost $50k - $100k
- Packaging tooling costs
- Labor
- Facilities
- Inventory costs



Other Resources in Kansas

- KDOC – Proof of Concept Grant
  - Up to $25k to design and prototype a new idea
- TDI – Innovation Funds provided through K-State 105 funding
  - 50/50 matching grant up to $25k to help offset the cost of development for a new product or technology for Kansas based businesses
- KDOC – Small Business R&D Acceleration Grants
  - 50/50 matching grant to cover costs of doing research with higher education institutions up to $25k
- KDOC – Angel Investor Tax Credits
  - Obtain Kansas tax credits to assist in raising capital from angel investors
- Network Kansas – GrowKS Program
  - GrowKS loan and equity program - $69 million
- Numerous other local programs designed to support the development of new products & technologies
  - Talk with local economical development representatives

Questions &
Thank You!!

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Manhattan, Kansas 66502-5034
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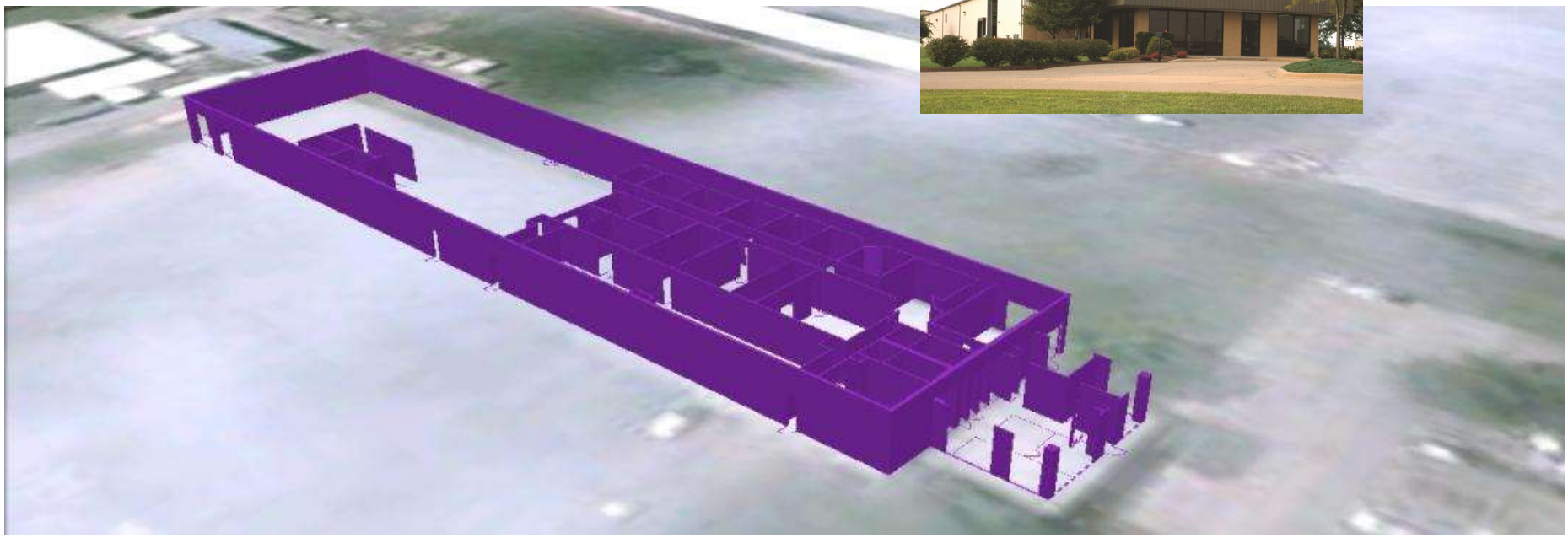
Phone: 785-532-7044

TDI Development Facilities

- *22,000 sq. ft. Off-Campus Facility*
- *11,000 sq. ft. Project Offices/Meeting Space*
- *11,000 sq. ft. Prototyping Shop*



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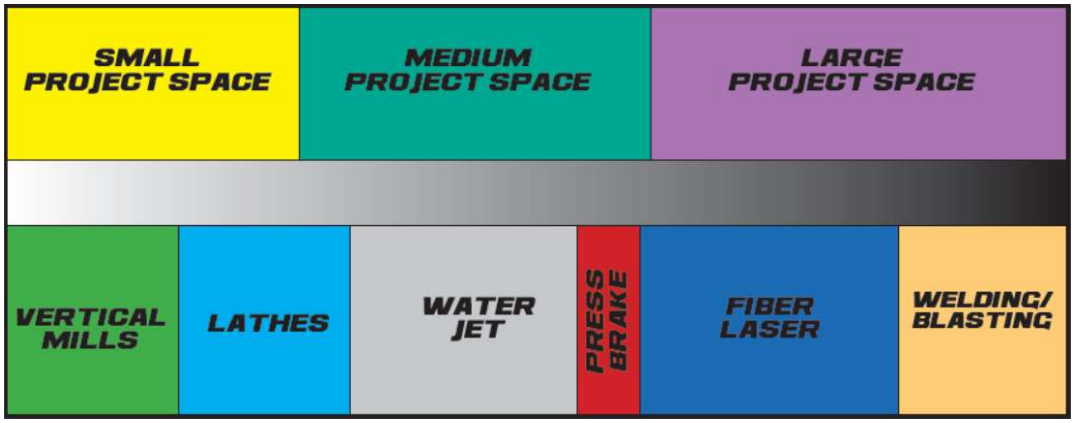
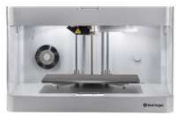
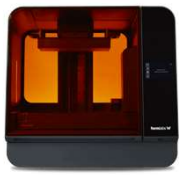


Plastic 3D Printing

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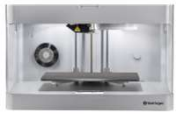
Plastic 3D Printing

FDM *(Fused Deposition Modeling)*

- Pushes melted plastic through a nozzle
- Material comes on a spool
- Easy to use and cheap



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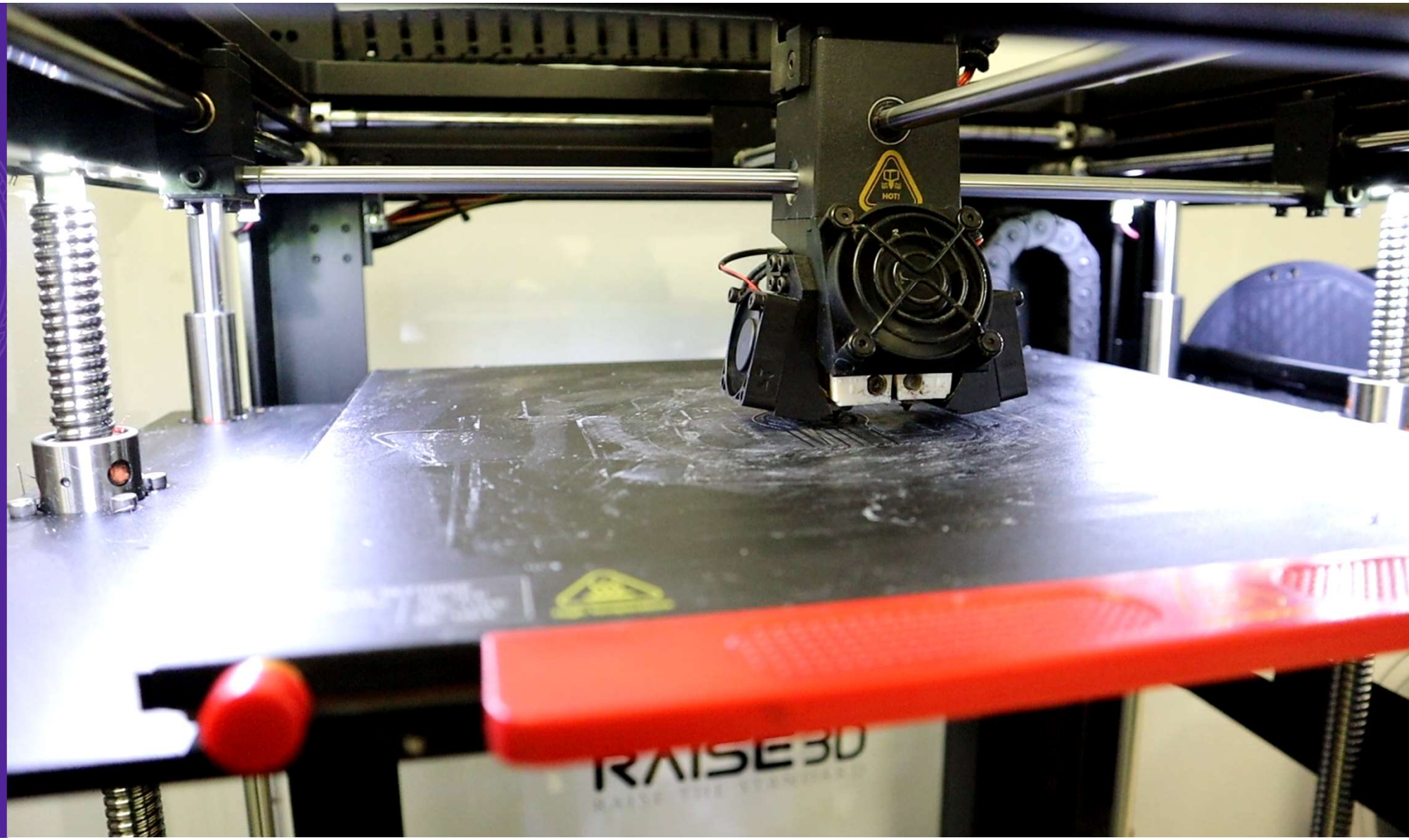
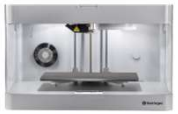

HOT!
RAISE3D

Plastic 3D Printing

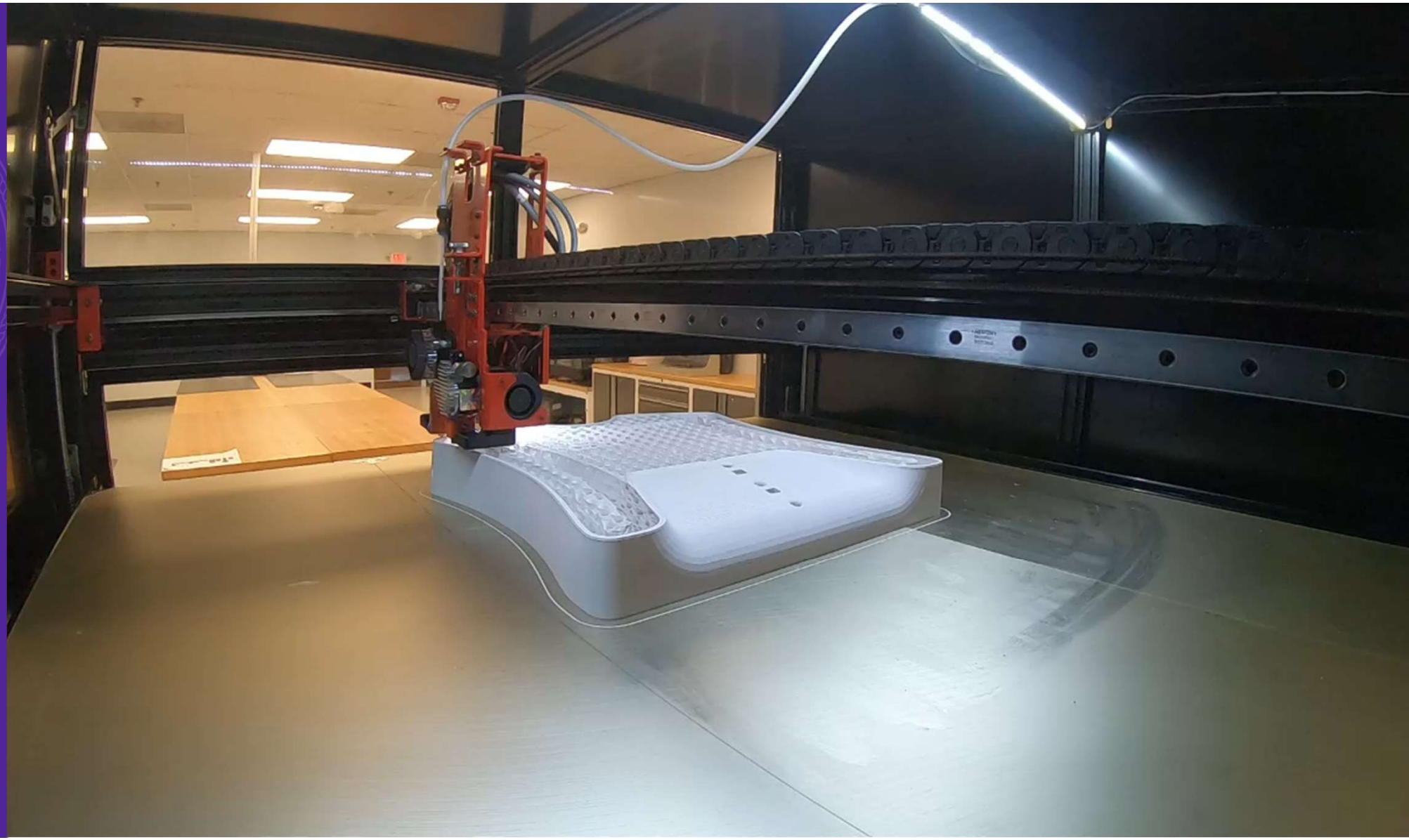
Large Format FDM

- Works the same as smaller machines

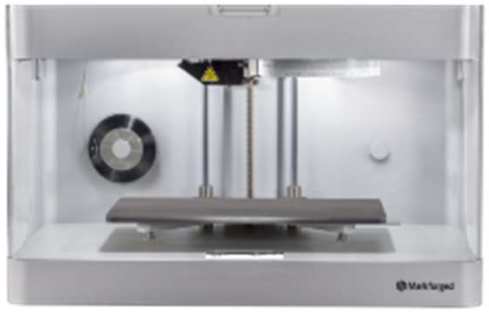








Plastic 3D Printing



Continuous Carbon Fiber

- Very similar to FDM printing
- Additional nozzle “irons” down a continuous fiber within each layer
- Can make parts that are as strong as aluminum







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3150SS 139

Plastic 3D Printing

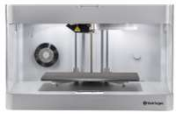
SLS *(Selective Laser Sintering)*

- Melts part profiles on a flat layer of fine plastic powder and repeats with a new layer of powder
- No supports required to hold up part while printing
- Medium to high detail with good performance
- Post processing requires powder recovery station









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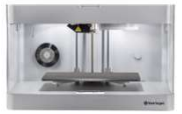
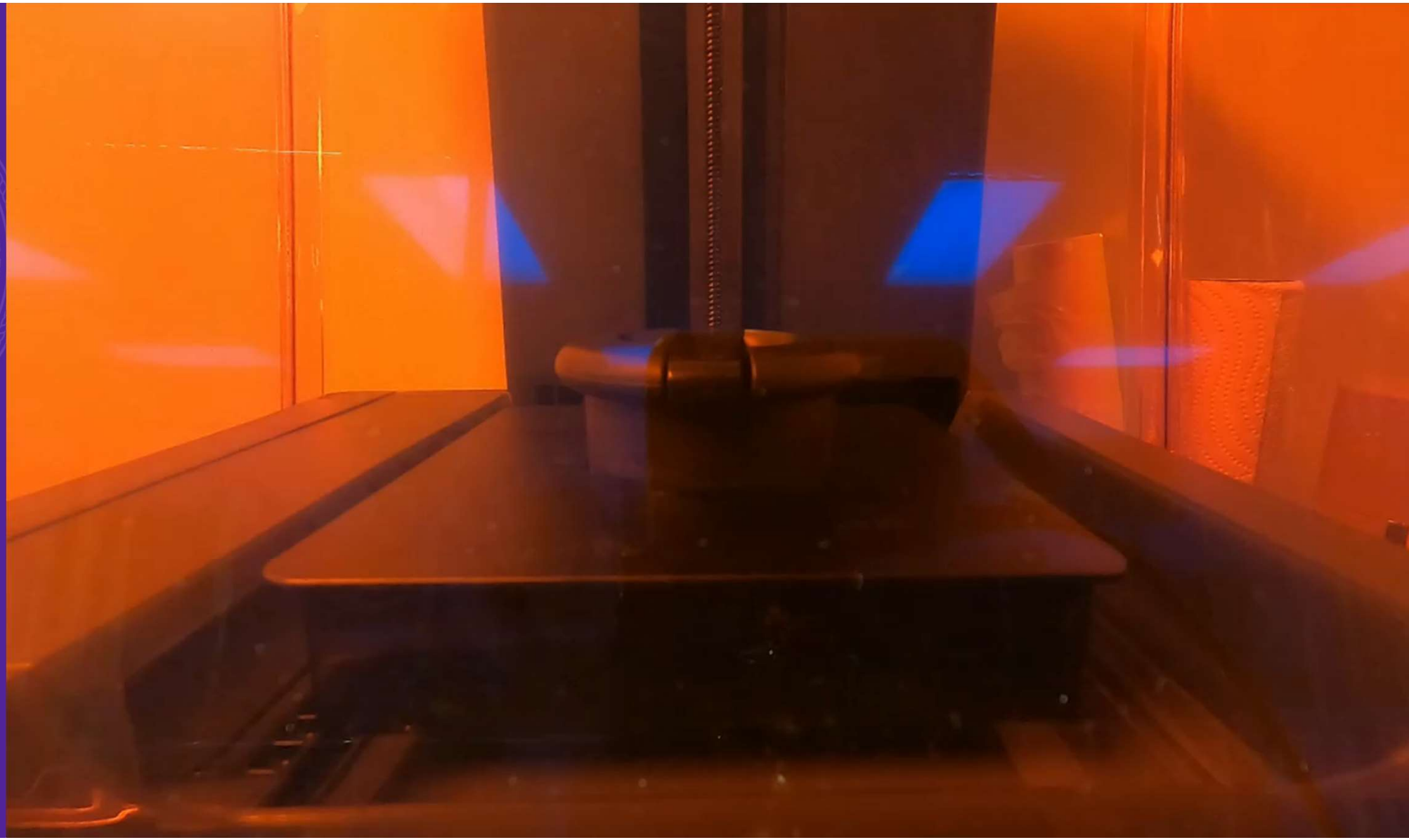
Plastic 3D Printing

SLA *(Stereolithography)*

- Liquid resin is in a vat on the bottom and is cured layer by layer using a UV laser
- High detail and functional parts
- More expensive than FDM



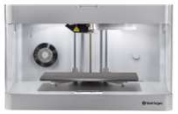


Plastic 3D Printing

Polyjet

- Deposits liquid resin from a print head and uses UV light to cure each layer
- Can print multiple materials and colors all at once
- High Detail and smooth finish
- Expensive material and operating costs

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Plastic 3D Printing Comparison

	FDM	CCF	SLA	SLS	Polyjet
Print Speed					
Cost	$	$$$	$$	$$$	$$$$
Part Size					
Surface Finish	★	★★	★★★	★★	★★★
Functional, End use parts	★★	★★★	★★★	★★★	★
Flexible Material Option	✓	✗	✓	✗	✓
Multi-material/color print	✗	✗	✗	✗	✓
					

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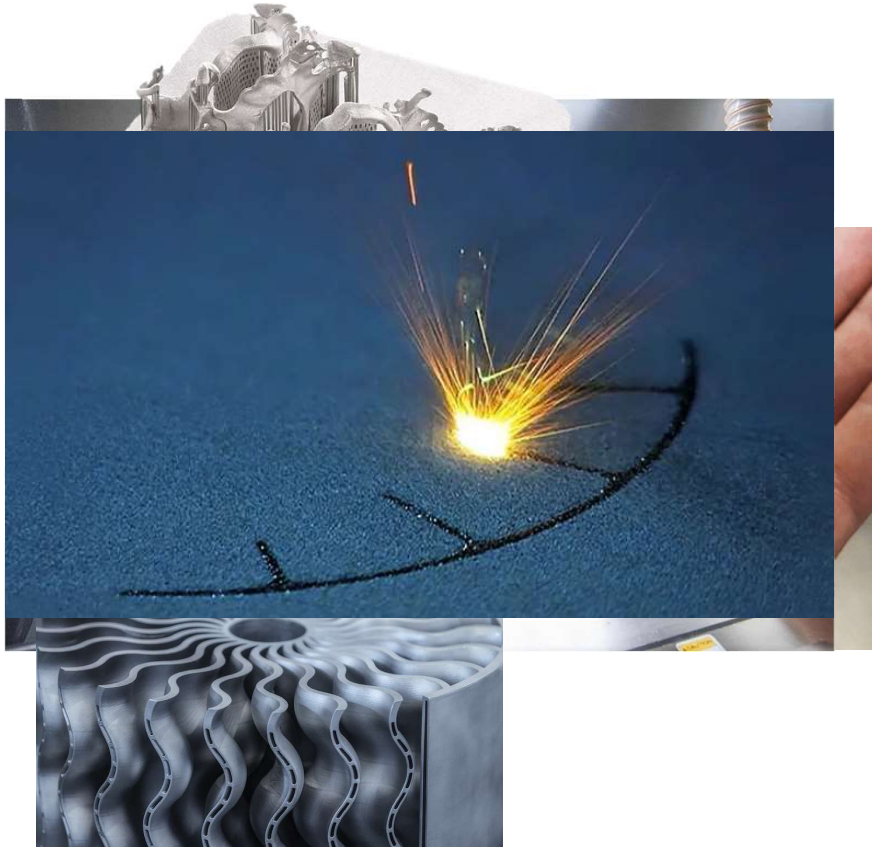
Metal 3D Printing



Laser Powder Bed Fusion (LPBF)

- Uses a high powered laser to melt together metal powder layer by layer
- Unused powder is cleaned off of parts and reused
- Allows for complex shapes and internal structures not possible using traditional manufacturing

Metal 3D Printing

Direct Energy Deposition (DED)

- Uses lasers an/or electricity to heat metal material depositing it in a bead (similar to welding)
- Can be mounted on a robot, CNC machine, or other frames
- Useful for making large parts

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Metal Fabrication





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Metal Fabrication

Fiber Laser

- Uses a high powered laser and assist gas to cut sheet metal
- Cuts plain steel, stainless steel, and aluminum sheets
- High precision and fast cutting
- Tube function cuts high precision profiles in tube stock

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CAUTION
LASER
IN USE

Metal Fabrication

Waterjet

- Uses high pressure water and garnet to cut various materials.
- Cuts steels, aluminum, plastic, rubber, stone, etc.
- Slower than a laser, but more precise than using a jigsaw or other hand tools





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OMAX
OMAX 60120
IN REAL TIME

Metal Fabrication

Press Brake

- Bends sheet metal at precise lengths and angles
- Various supports and stops on the machine help position the part for bending

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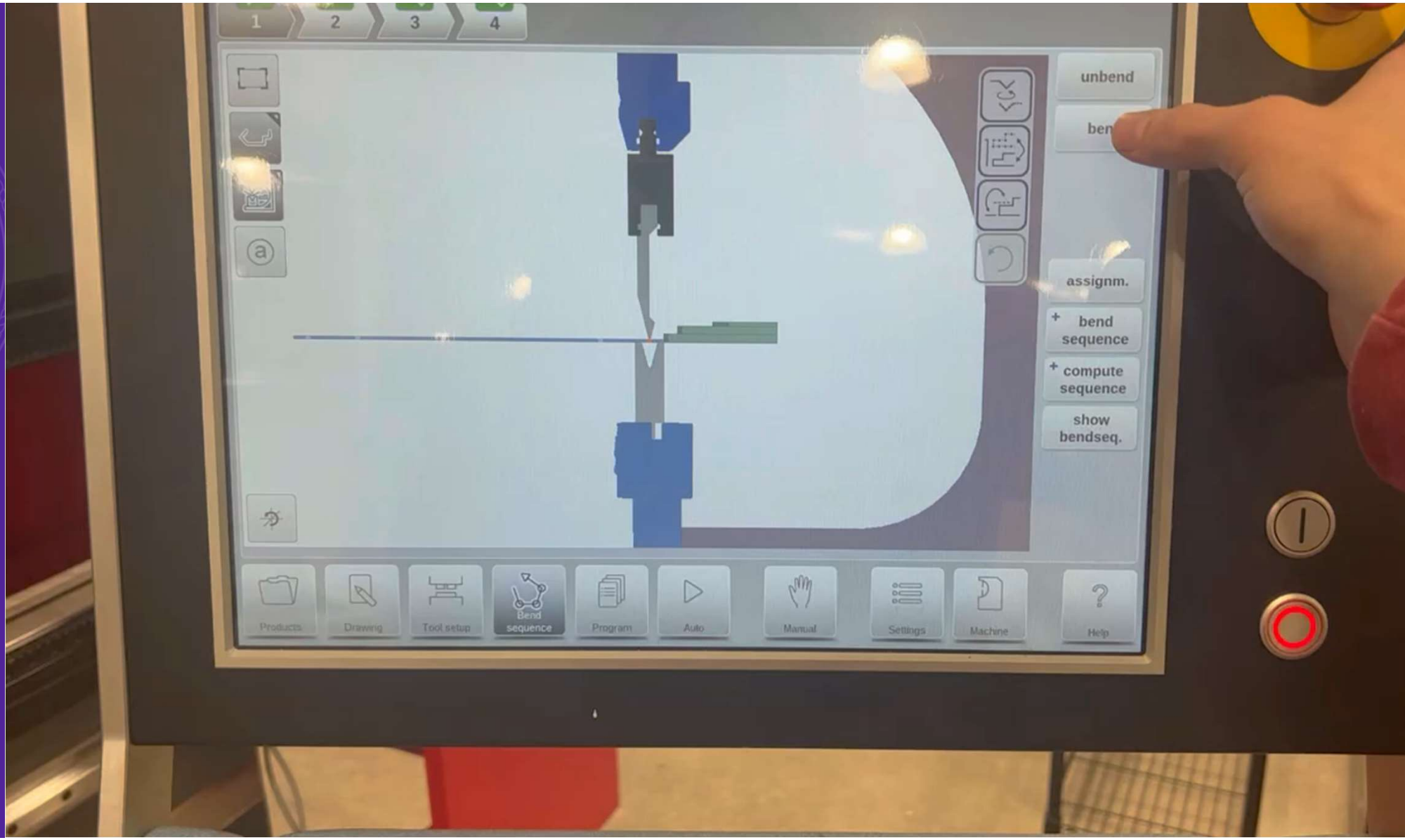
1
2
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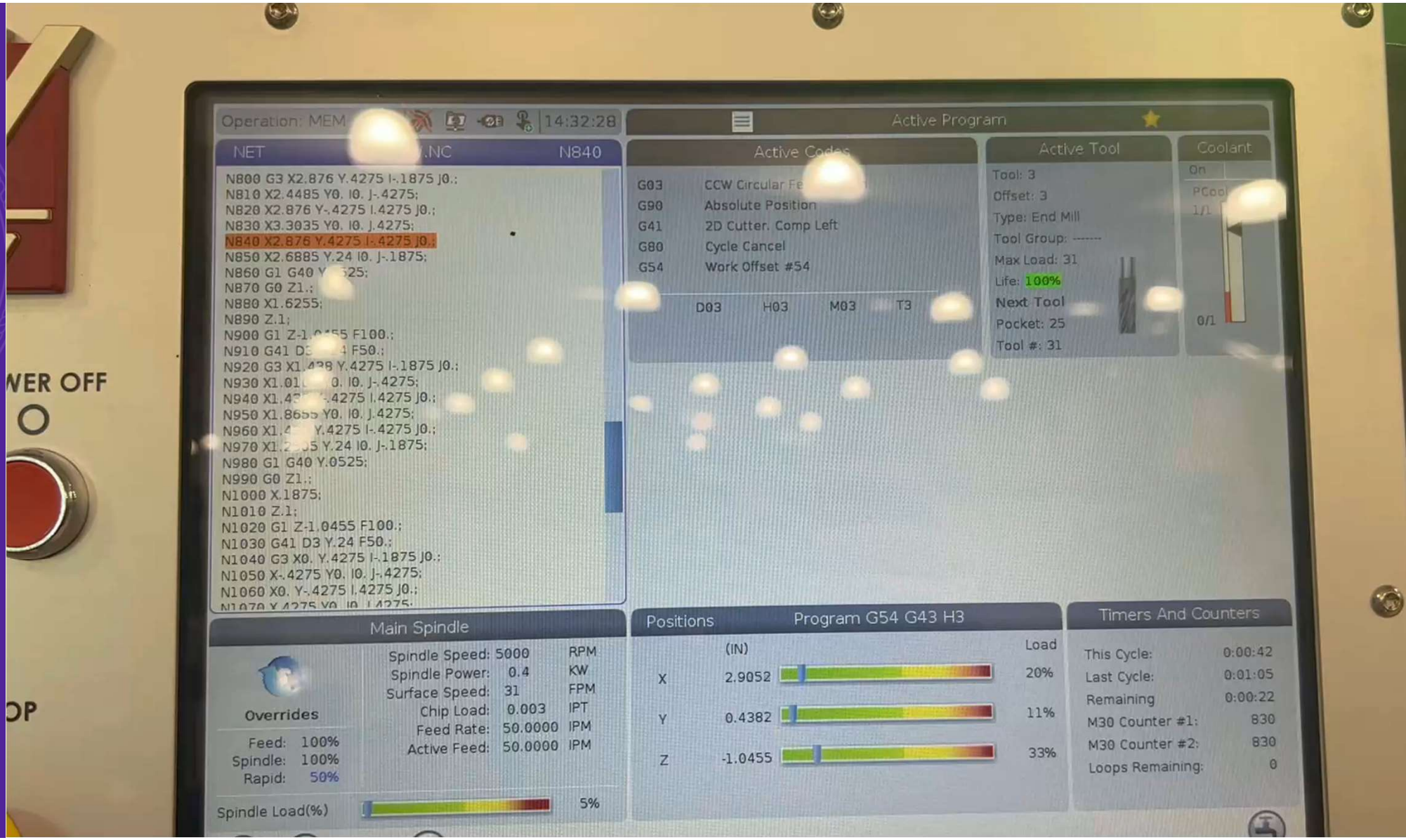
Products
Drawing
Tool setup
Bend sequence
Program
Auto
Manual
Settings
Machine
Help

Metal Fabrication

CNC Machines

- Parts are positioned in machine workspace and cut using various bits and tools
- Vertical mill, 5-axis mill, and a lathe are common machine types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Active Program
NET .NC N840
N800 G3 X2.876 Y.4275 I-.1875 J0.;
N810 X2.4485 Y0. I0. J-.4275;
N820 X2.876 Y-.4275 I.4275 J0.;
N830 X3.3035 Y0. I0. J.4275;
N840 X2.876 Y.4275 I-.4275 J0.;
N850 X2.6885 Y.24 I0. J-.1875;
N860 G1 G40 Y.0525;
N870 G0 Z1.;
N880 X1.6255;
N890 Z.1;
N900 G1 Z-1.0455 F100.;
N910 G41 D3 Y.24 F50.;
N920 G3 X1.438 Y.4275 I-.1875 J0.;
N930 X1.01 0. I0. J-.4275;
N940 X1.4 .4275 I.4275 J0.;
N950 X1.8655 Y0. I0. J.4275;
N960 X1.4 Y.4275 I-.4275 J0.;
N970 X1.2 5 Y.24 I0. J-.1875;
N980 G1 G40 Y.0525;
N990 G0 Z1.;
N1000 X.1875;
N1010 Z.1;
N1020 G1 Z-1.0455 F100.;
N1030 G41 D3 Y.24 F50.;
N1040 G3 X0. Y.4275 I-.1875 J0.;
N1050 X-.4275 Y0. I0. J-.4275;
N1060 X0. Y-.4275 I.4275 J0.;
Active Codes
G03 CCW Circular Fe
G90 Absolute Position
G41 2D Cutter. Comp Left
G80 Cycle Cancel
G54 Work Offset #54
D03 H03 M03 T3
Active Tool
Tool: 3
Offset: 3
Type: End Mill
Tool Group: -------
Max Load: 31
Life: 100%
Next Tool
Pocket: 25
Tool #: 31
Coolant
On
PCool
1/1
0/1
Main Spindle
Overrides
Feed: 100%
Spindle: 100%
Rapid: 50%
Spindle Speed: 5000 RPM
Spindle Power: 0.4 KW
Surface Speed: 31 FPM
Chip Load: 0.003 IPT
Feed Rate: 50.0000 IPM
Active Feed: 50.0000 IPM
Spindle Load(%) 5%
Positions
Program G54 G43 H3
(IN)
Load
X 2.9052 20%
Y 0.4382 11%
Z -1.0455 33%
Timers And Counters
This Cycle: 0:00:42
Last Cycle: 0:01:05
Remaining 0:00:22
M30 Counter #1: 830
M30 Counter #2: 830
Loops Remaining: 0

3D Scanning

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3D Scanning

CMM Arm and Laser Scanner

- Use probe or laser to measure and inspect parts
- Laser is useful for complex or organic geometry
- Useful for scanning all sizes of parts


EXIT
HEXAGON
HEXAGON

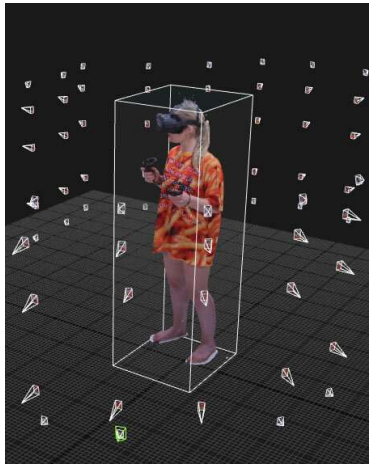
3D Scanning

Wide Area Scanner

- Gathers point cloud and picture data all at once (similar to a Google car)
- Useful for capturing layouts of large objects, buildings, and outdoor areas


NAVVIS

3D Scanning



Other technologies

- Handheld scanners
- Desktop setups
- Terrestrial Lasers
- Photogrammetry*

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