3D INDRO FORGE
DESIGN - PROTOTYPES - PRODUCTION

BAYVIEW YARDS PROTOTYPING LAB

CAPABILITIES CHART

ADDITIVE

OUTCOME	MACHINE & USAGE	EXAMPLE APPLICATIONS	SCALE / SIZE	FIDELITY	LAYER HEIGHT	MATERIAL	DURABILITY	KEY ADVANTAGES
Production ready heavy duty pieces that need the stronger material properties of metal. These pieces will likely have a unique geometry, perhaps combining multiple pieces in an assembly into a single 3D printed piece. The resulting piece is solid metal and ready to be further machined or installed.	Markforged Metal X	Sacrificial tooling, End-use parts, engineering pieces, industrial effectors, defense pieces, manufacturing jigs and effectors, aerospace pieces, automotive pieces, robotics pieces, more	30 x 22 x 18 cm	HIGH	.05-.125mm (Post-Sinter)	17-4 PH Stainless Steel A2 & D2 Tool Steel Inconel 625 Copper H13 Tool Steel	5 / 5 stars 4.5/5 4.5/5 3/5 4.5/5	End use metal printing Fast and reliable (high resolution) Wide range of metals
These pieces rival the aesthetic quality of injection moulded pieces. Can be used in final production designs. Fine details and excellent surface finish are apparent in these pieces. Material options can increase durability where needed. Dissolvable support material means no noticeable areas of where the supports were. Small-batch manufacturing can be used for pieces. The Fortus produces pieces that are the gold standard.	Fortus	End-use parts, engineering pieces, industrial effectors, defense pieces, manufacturing jigs and effectors, aerospace pieces, automotive pieces, robotics pieces.	40.6 x 35.5 x 40.6 cm or (16 x 14 x 16 in)	HIGH	.127 -.330 mm	ASA PC ABS-M30i ABS-M30 ULTEM 9085/1010 ANTERO	3.5/5 stars 4/5 3.5/5 3.5/5 4.5/5 4/5	High resolution with highly resistant materials - Diverse application scenario - Wide range of materials available - Perfect for engineering, functional or end-use product - Reliable - Bigger print size
Large prints that can be used in installations. Given the massive scale, pieces are suitable in a MVP. With further post-processing, pieces could be used in a final installation. Great option for developing positives for further use in vacuum-forming. While the printer is not as fast, it can be used for small-batch manufacturing given the large build platform size. Experimental multi-material (2) prints is also possible, allowing for pieces that combine rigid and flexible.	BigRep	Full scale prototypes, base tool, molds, end-use products, consumer product representation, mock-ups, more	105 x 105 x 105 cm	MEDIUM	0.2 - 1.2 mm	PLA TPU More coming soon!	3.5 / 5 stars 3.5 / 5 stars Coming soon!	HUGE printing size - Inexpensive
High quality pieces that can be installed into a final design. Variety of materials that can give high strength, high temperature, flexibility, and more. Surface finish requires post-processing due to supports. Offers great tolerances with repeatable results. Widest selection of bio-compatible materials.	Formlabs Form2	Engineering pieces, functional prototypes, enclosures, mechanisms, healthcare pieces, detailed visual concepts, end-use parts, artistic, sales models, jewelry.	14.5 × 14.5 × 18.5 cm or (5.7 × 5.7 × 7.3 in)	VERY HIGH	.025 – .3 mm	STANDARD TOUGH & DURABLE FLEXIBLE & ELASTIC RIGID & STRUCTURAL CASTABLE	2.5/5 stars 4/5 2.5/5 3/5 1/5	High resolution with highly resistant materials - Diverse application scenario - Fairly inexpensive - Wide range of resins available - Engineering and aesthetic use
High quality pieces that can be installed into a final design. Variety of materials that can give high strength, high temperature, flexibility, and more. Less post-processing needed on the Form3 from supports. Small-batch manufacturing is possible on this larger build platform, however the cost should be considered. Offers great tolerances with repeatable results. Widest selection of bio-compatible materials.	Formlabs Form3	Engineering pieces, functional prototypes, enclosures, mechanisms, healthcare pieces, detailed visual concepts, end-use parts, artistic, sales models, jewelry.	14.5 × 14.5 × 18.5 cm or (5.7 × 5.7 × 7.3 in)	VERY HIGH	.026 – .3 mm	STANDARD TOUGH & DURABLE FLEXIBLE & ELASTIC RIGID & STRUCTURAL CASTABLE	2.5/5 stars 4/5 2.5/5 3/5 1/6	Very high resolution with highly resistant materials - - Diverse application scenario - Fairly inexpensive - Wide range of resins available - Engineering and aesthetic use
Extremely durable pieces to be used in final designs where there is high stress or high impact scenarios. These pieces will stand the test of time. Can be further enforced with rings of carbon fibre or kevlar that is inlayed. Excellent for pieces that have a unique geometry while still needing to be light weight and durable.	Markforged Mark2	End-use parts, engineering pieces, industrial effectors, defense pieces, manufacturing jigs and effectors, aerospace pieces, automotive pieces, robotics pieces.	32.0 x 13.2 x 15.4cm	MEDIUM	.1-.2 mm	ONYX with CARBON FIBER INLAY GLASS FIBER INLAY KEVLAR INLAY	4/5 stars	Closed Cell Infill with Continuous Fiber - Reinforcement Continuous Fiber Reinforcement (CFR) - Perfect to replace steel jigs and fixtures - Highly resistant to stress and impact
Prints that are suitable for usage in a MVP to beta test with users or demonstrate to stakeholders. A fast and inexpensive way to rapidly iterate pieces, while having enhanced quality from the Tinkerines. Excellent for concept designs. Can also be used with experimental / exotic materials for a variety of properties such as conductivity, varying flexibility shore hardness, elements of materials such as glass, bronze, wood, and even more.	Prusa I3 Mk3	Functional test pieces, brackets, enclosures, test jigs, visual looks-like prototype, concept and artistic models, educational pieces, test pieces, form concepts.	25 x 21 x 21 cm or 9,84 x 8,3 x 8,3 in)	MEDIUM	0.05 – 0.35 mm	EXOTICS PETG ABS PLA ASA FLEX	N/A 3.5/5 2/5 3/5 stars 3.5/5 2.5/5	-Reliable -Fast iterations -Inexpensive -Wide colour array available -Easily recyclable prints
Detailed and fully coloured concept design. Excellent at illustrating concepts for stakeholders by giving a tangible piece and representing the scale. Not for use in MVPs or final production given its delicate material. Perfect option for conceptual designs.	Projet 660							
Draft prints that are suitable to show as a concept design. A fast and inexpensive way to rapidly iterate pieces for form, fit, and function. Use this option before moving onwards to a more expensive printer to finalize your design. Advantageous for small- batch manufacturing with multiple printers operating in parallel.	Tinkerine Ditto Pro	Visual looks-like prototype, concept and artistic models, educational pieces, electronics enclosures, test pieces, form concepts.	37 x 39 x 43.6 cm or (14.6 x 15.4 x 17.2 in)	LOW	0.2 - 0.3 mm	PLA	1. 2 / 5 stars	- Fast iterations - Inexpensive - Wide color array available - Easily recyclable prints

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ELECTRONICS

OUTCOME	MACHINE & USAGE	EXAMPLE USE CASE	TECH SPECS	KEY ADVANTAGES
Customized add-on boards to dev boards containing all the supportive circuitry needed for your prototype. This can be iterated quickly, receiving boards that afternoon. Two layer prototypes. Breakout boards for sensors to test, low volume duplicates of boards. Customized all-on-one circuit board. Basically if you want a connected device - whether it's wearable, robotic, or something else - this is the machine that would be used. Your IoT prototype can be made on this machine.	Bantam Tools Mill (Original)	Working to build a prototype with an existing dev board, and you need additional peripherals such as sensors, LEDs, and supporting circuitry for voltage regulation and the like. Note that this type of board is usually for the step prior to miniaturization.	Our design recommendations for stable results: 20 mil trace width / 10 mil spacing Smallest part size: 0603 (0402 possible) Smallest chip size: SOIC, QFP, QFN (TSSOP possible) Layers: 2 - vias are not plated through-hole, design & plan accordingly Material: FR1 Copper clad Size: 4" x 5" Copper cladding: 1 oz File input: Gerbers, Eagle .brd, .gcode and .svg	Make multiple prototypes in a single day. Reduce costs and lead times waiting for boards. Test everything needed on boards made by the Bantam Tools Mill, then after the functionality check, order boards from a professional board manufacturer. This machine is also perfect for small batch runs in low quantities. Portable machine, can be brought to different sites and used there.
Analyze up to 4 channels. Use the probes to monitor voltages like a classic oscilloscope. Use the probes to sniff the data on UART, I2C, and SPI lines to analyze your embedded communication busses. Compare RF to signals on the same screen. Additionally, be delighted at the new UI & UX experience that the large touch screen on the MSO44 brings! The future of electronics is here at the Prototyping Lab. By the way, this oscilloscope runs on Linux.	Tektronix MSO44 Oscilloscope	Inspect voltage levels. Check your board. Test it against certain edge cases. Analyze packets being sent on communication busses (UART, I2C, SPI). See RF spectrum view and run analysis. Display both RF and signals to correlate time view to debug even further.	4 channels, 200 MHz, 31.25M record length Arbitrary function generator Serial analysis (RS-232/422/485/UART) Embedded analysis (I2C, SPI) Spectrum View Basic --- Near-Field Probe Set General purpose TPP0250 probes (< 4pF input capacitance, 10x and 2x attenuation)	Compare RF and signals as time-correlated data. This helps tremendously when debugging, and inspecting your board for any extra emittance when sending data through a communications module. Record data to a USB stick, save settings, and save screenshots. This machine greatly helps for analysis at the early prototype stage and can give you a leg up on the next stage.
Monitor the current load of your device, or supply a stable voltage supply to your device. This is an excellent way to determine the power usage of your device, and thereby the battery life. The resolution of 10 nA allows for measuring small load currents, for ultra-low power devices such as wearables or sensor nodes.	Keithley 2280S Power Supply	Wearable prototype and need to determine the proper battery capacity to choose (important for size and weight constraints). Monitor the current over time, monitor the current in different modes (such as when your IoT device is transmitting or sleeping), and see the power usage. Alternatively, use the power supply functionality to supply voltage to your prototype. This can be helpful in debugging, when perhaps an unreliable power supply is causing brown-outs.	32V 6A programmable DC linear power supply Clean output power <1 mV noise 10 nA current measurement accuracy Capture load changes that occur at intervals as short as 140 us Supports automated control, monitoring, and data logging	Really versatile test equipment! This one is going to be used often. Decent current supply ability at 6A allows for powering small motors, and power-hungry prototypes. The 10 nA resolution for current monitoring is advantageous for power optimization for wearable devices. We can't wait to see how often this is used for client prototypes.
Primary use: Reflow circuit boards with solder paste and components already placed. Secondary use: Dynamically dispense solder paste onto board, dispense conductive ink onto FR-4 substrate.	Voltera V-One	Quick turn soldering and assembly - Mill a board on the Bantam Tools Mill, apply solder paste onto the board, place components onto the board, and run the Voltera reflow profile to heat the solder paste - thereby 'soldering' the components to the board.	Tin Lead (Sn63 Pb37) Profile Soak temp: 180 deg C Soak time: 45 s Peak temp: 220 deg C Peak time: 30 s Tin Bismuth Silver (Sn42 Bi57.6 Ag0.4) Profile Soak temp: 140 deg C Soak time: 45 s Peak temp: 190 deg C Peak time: 30 s Manual reflow capability as well	Uniform reflow instead of hand soldering
Anything you want, we got it, anything you need, we got it, anything at all (for your early electronics prototype that is), we got it! Metcal soldering station, hand-tools, digital and stereo microscope, wire, dev boards, hot-air reflow station, and more.	Electronics Bench Tools	Make your prototype work! Cut wires with the snippers, solder a wire to go from A to B, and then inspect your work under a microscope.	N/A	Everything within an arms reach!
Detect RF emissions from your board before advancing to the next stage. Precision digital multimeter to fine tune any adjustments. Stereo microscope to inspect your work.	Testing and Analysis	Microscope especially useful for inspection of correct soldering of components to the board. Test for RF emittance as you iterate your board - allowing you to make changes as you go, instead of receiving the test results and needing a large re-design. Analyze your design for changes, and inspect the results of the work to date.	N/A	As you build your board, you can step through the process and there is a machine / test equipment at each stage to help with more information, testing, and analysis.t

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ADVANCED

OUTCOME	MACHINE & USAGE	EXAMPLE APPLICATIONS	SCALE / SIZE	ACCURACY	MATERIAL	DURABILITY	KEY ADVANTAGES
Large and small 2D pieces ready to be installed into a large prototype. Heavy-duty materials such as aluminum, steel, and wood can be cut with ease and precision. No distortion from the cutting process. Perfect for building large prototypes, or small prototypes involving thicker pieces. Possibilities for angular cuts. Can cut almost anything.	OMAX CNC Waterjet	1. Cutting of 2d or bent, components or brackets. 2. Cutting of	120in x 60 in or 3048mm x 1524mm	+/- 0.005in - 0.010in or +/- 0.125mm - 0.250mm	1. Aluminum 2. Steel 3. Stainless Steel 4. Wood 5. Glass 6. Stone 7. Foam/Rubbers		Large bed size Ability to cut almost anything
Precision 3D pieces fabricated out of metal. Perfect for heavy-duty pieces under loads and need to stand the test of time. For use in a final design.	HAAS CNC Mill	1. Complex custom components. 2. Finish machining or cleanup of 3d printed parts.	20in x 16in x 20 in or 508mm x 406mm x 508 mm	+/- 0.001in - 0.003in or +/- 0.025mm - 0.075mm	1. Aluminum 2. Steel 3. Stainless Steel 4. Cast Iron 5. Plastics		Create percise, high strength 3d shapes quickly
Intricate and detailed 2D pieces for enclosures or interlocking designs. Excellent to be used in a MVP for beta testing or demonstrations. Given the speed of the laser cutter, can be used in small-batch manufacturing as well. Great for customization of pieces using the engraving functionality. Metal can be engraved using the fibre laser option. A variety of materials can be cut with the CO2 laser option provided they are safe.	Epilog Fusion Dual Laser Cutter	1. Etched metal signage 2. Cutting gaskets form foam/rubber	40in x 28in or 1016 x 711 mm	+/- 0.010IN OR +/- 0.250MM	1. Aluminum 2. Steel 3. Stainless Steel 4. Wood 5. Cardboard 6. Paper 7. Foam/Rubbers	1. 1 / 5 stars	
Large and small 2.5D pieces. Cut interlocking pieces to make a larger prototype. Create beautiful engravings in wood for use in signs or forms. With post-processing, can be used in a final production design.	AXYZ CNC Router	1.Cutting or shaping of large wooden panels 2. Precise cutting of 2D plastics components 3. Engraving	120in x 60 in or 3048mm x 1524mm	+/- 0.005IN - 0.010IN OR +/- 0.125MM - 0.250MM	1. Wood 2. Plastics 3. Aluminum		Large bed size