xTool M1

The xTool M1 (FIG. 1), introduced in the spring of 2022, represents the first true desktop creative workstation, able to engrave and cut the widest selection of craft materials ever. The M1 is truly unique, with a dual cutting head that incorporates both a 10W laser module (also available as a 5W model) and a precision soft material cutting blade, both housed in a single precision laser head module.

FIG. 1. The xTool M1 creative workstation, along with the xTool Smoke Purifier, form an integrated system that streamlines the production workflow with automatic focusing, built-in workpiece settings, and much more. Credit: xTool

The M1 represents a new generation of laser engraver/cutter, one that is more focused on creative activities, as opposed to testing and experimentation. This new generation is cleaner, safer, more accessible, and ultimately, more productive.

The xTool M1, as well as the xTool D1, are 2022 recipients of the esteemed Red Dot Design awards (red-dot.org) in recognition of their world-class creative design features. The M1 is a sleek, modern self-contained unit touting a feature list heretofore unavailable.

The incorporation of a cutting blade greatly expands the range of materials that can be processed, adding vinyl. Vinyl cannot be cut with a laser due to the release of chlorine gas, which is toxic to humans, and harmful to machine parts. The addition of the cutting blade, similar in function to the Silhouette and Cricut blade-cutting machines, enables the user to produce signs, logos, t-shirts, and other products, all without odor or burnt edges.

The M1 is one of only a small number of self-contained laser engraver/cutters on the market; the first diode laser device of its kind; and the only hybrid machine available. The combination of its technical capabilities and price make it a truly unique machine, and a smart value. The benefit of an enclosure, to shield the user from the inevitable hazards of the strong laser light, and air-borne contaminants, is considerable. Entry-level open-frame laser engraver/cutters do not include an enclosure, the cost of which can approach the cost of the engraver/cutter itself!

The xTool M1 also has what is perhaps the most valuable, if not the most useful feature of any creative craft machine: availability of manufacturer testing results on a wide selection of materials. xTool has meticulously tested hundreds of materials, recording the results of their experimentation and releasing it to users (FIG. 2). In addition, the Materials Parameters for Reference sheet lists the actual power, speed, and pass settings for dozens of readily available materials (FIG. 3). Knowledge of the optimum machine settings for a laser engraver/cutter is akin to finding hidden treasure.

FIG. 2 This is one of the many material testing reports produced for the xTool M1.

xTool M1(10W) Materials parameters for reference

Material code	Material name	Machine	Processing mode	Power %	Speed mm/s	Processing times
AE001	Rubber mat for engraving	M1 10W	Laser vector engraving	70	50	1
AE001	Rubber mat for engraving	M1 10W	Laser bitmap engraving	100	40	2
AH001	PU Heat transfer film	M1 10W	Tool cutting	90	80	1
AH002	PET Heat transfer film	M1 10W	Tool cutting	105	80	1
AH003	PVC Heat transfer film	M1 10W	Tool cutting	60	80	1
AL001	PU artificial leather	M1 10W	Tool cutting			
AL006	Gray top-layer leather	M1 10W	Tool cutting			
AL016	PU artificial leather with knit fabric	M1 10W	Tool cutting	190	80	1
AP017	PVC self-adhesive lettering film	M1 10W	Tool cutting	75	80	1
AP024	Kraft paper 200g	M1 10W	Tool cutting	234	80	1
AP038	White self-adhesive material	M1 10W	Tool cutting	78	80	1
APL0010	Black acrylic 3.0mm	M1 10W	Tool cutting	100	4	2
APL0010	Black acrylic 3.0mm	M1 10W	Laser vector engraving	50	50	1
APL0010	Black acrylic 3.0mm	M1 10W	Laser bitmap engraving	100	60	1
APL054	PVC colored transparent sheet	M1 10W	Tool cutting	347	80	3
APL055	PVC frosted transparent sheet	M1 10W	Tool cutting	379	80	4
AW050	Basswood plywood 3mm (launched by xTool)	M1 10W	Tool cutting	100	4	1
AW050	Basswood plywood 3mm (launched by xTool)	M1 10W	Laser bitmap engraving	70	175	1
AW051	Black Walnut (launched by xTool)	M1 10W	Tool cutting	100	4	1
AW051	Black Walnut (launched by xTool)	M1 10W	Laser bitmap engraving	70	175	1
AW069	Materials library_Black Walnut plywood (30cm × 30cm) 2pcs	M1 10W	Tool cutting	100	4	1
AW069	Materials library_Black Walnut plywood (30cm × 30cm) 2pcs	M1 10W	Laser vector engraving	60	40	1
AW069	Materials library_Black Walnut plywood (30cm × 30cm) 2pcs	M1 10W	Laser bitmap engraving	70	70	1
AW070	Materials library_Pine plywood (30cm × 30cm) 2pcs	M1 10W	Tool cutting	100	4	1
AW070	Materials library_Pine plywood (30cm × 30cm) 2pcs	M1 10W	Laser vector engraving	90	40	1
AW070	Materials library_Pine plywood (30cm × 30cm) 2pcs	M1 10W	Laser bitmap engraving	80	60	1
AW072	Materials library_M... wood (30cm × 30...		...cutting	100		

FIG. 3. This list of dozens of materials, along with their M1 machine settings, ensures that users will be able to produce acceptable, repeatable, results, without the time-consuming testing requirements.

Safety.

The M1 has been designed to provide a safe working environment. The working heads are totally enclosed, shielding the operator from the intense light of the laser. The machine lid has been engineered with an auto-stop feature that ceases the operation of the machine when the lid is opened. If either the laser or the blade have been in operation, they stop immediately when the lid is lifted.

Despite the fact that all moving parts are contained in the M1 enclosure, and that opening the enclosure will halt operation, it is recommended that children, of any age, only use the device under the supervision of an adult. That being said, the M1, along with the optional xTool Smoke Purifier, makes it possible to bring laser engraving and cutting out of the basement, garage, and workshop, and into the home studio, without the need for external venting nor modification of a living space.*

As the machine is used, the built-in ventilation fan discharges odors and toxic gases into the optional xTool Smoke Purifier for treatment, leaving the work environment safe and virtually odor-free. As previously stated, the air purifier makes it possible to use the M1 inside a home, and has been certified by the Federal Communications Commission and Conformite Europeenne. Inside the M1, a fan above the laser head works to disperse work particles and smoke from the work surface, to protect the lens, and essentially serve as an air assist.

Assembly and Maintenance.

The xTool M1 is shipped assembled, except for the smoke exhaust pipe. Over time, the cutting blade will need replacement based on the amount of time it has been used, and the composition of the materials it has cut. Like any laser engraver, the laser head will be susceptible to errant smoke and air-borne contaminants, and will need to be cleaned routinely with a cotton swab dipped in alcohol. The chrome-plated optical shaft will need to be lubricated with grease (https://amzn.to/3yFIPM3) on a regular basis, anywhere from every 15 days to two months, depending on use, to prevent rust and ensure optimal performance.

Size & Weight.

The M1 is quite compact, fitting easily on a small table or counter. Its outside dimensions are 22" x 18" x 9", with an actual inside workspace of 15" x 12". The weight is 21.6 lbs.

Connectivity.

The xTool M1 can be controlled by a Mac or Windows computer using either a direct USB cable connection, or WiFi (FIG. 4).

Compatibility with LightBurn.

LightBurn software can be used with the M1 with some limitations. The software will only work with the laser-processing component of the device, not the blade-cutting functions, and requires that compatible files, or native G-code be imported to the M1 manually. No other software, other than the proprietary xTool Creative Space, provided by xTool, will work. According to xTool, the Creative Space software will add significant capabilities over time.

A small room may need the benefit of a window exhaust fan to remove any lingering odors. Some workpieces, dependent on their composition, may retain a lingering burnt smell after processing.

FIG. 4. Connecting the M1 to a computer is fast and easy. The inset in the lower right shows that the M1 is connected.

Focusing.

Proper focusing is always a critical step in the production workflow for any laser-processed workpiece. The M1 can automatically adjust the focus based on a ring code adhered to xTool-supplied materials (FIG. 5). If the material is user-supplied, the M1 uses AI to compute the thickness of the material, anywhere from 0 to 16mm, and automatically enter that value in the software to adjust the focus both for engraving and cutting (FIG. 6).

FIG. 5. A ring code is provided on all xTool-supplied materials to provide the M1 with relevant information regarding material characteristics and processing requirements.

FIG. 6. Here a flat rock has been placed on the workbed. The red spot that appears in the center of the rock is the laser that is determining its thickness by using the Auto-measure button in the Creative Space software (inset).

Accuracy and Strength.

The FAC lens configuration, which maintains high beam quality, generates a laser spot size of 0.08x0.08mm, producing an ultra-fine engraving precision of 0.01mm. The laser head incorporates dual laser technology, focusing two diode lasers into one spot, producing a laser intensity sufficiently strong to cut 8mm basswood in a single pass. The image resolution is an impressive 500 dpi.

Smart Camera.

The M1 is provided with a 16MP high-resolution camera to aid in visual processing. After loading a workpiece in the M1, the user can remain at their computer and see the processing stages as captured by the camera. This capability provides exceptional control over the placement of the image onto the work surface of the substrate, ensuring that the image size, angle, and orientation, are accurate.

Image Extraction.

The M1 is able to capture graphic designs, images, and drawings from any flat hand-drawn or printed surface and import them into the M1 software for modification or refinement. In lieu of a flat-bed scanner, the user can create hand-drawn artwork, or appropriate two-dimensional images from virtually any source that they are authorized to use, and place the material on the M1 work bed. The built-in high-resolution camera captures the images, displays them on the Creative Space canvas, and allows the user to edit, crop, resize, re-orient, and position the image onto a substrate for processing.

Batch Processing.

Based on the shape of multiple workpieces, the AI system can determine how to process defined functions for the entire batch, all at one time. The user simply defines the placement of an image on one of a number of like-sized shapes. Using the Smart fill button, the Creative Space software intelligently determines the location of each workpiece, and based on all necessary factors, places the same image on each one, properly sized and positioned.

Creative Space Software.

The xTool Creative Space interface, although basic, provides a good selection of options for imaginative expression. On start-up the user sees an image of the work area as captured by the built-in high-resolution camera and displayed on the on-screen canvas. The user places their workpiece onto the device working area. If the material is xTool-branded, the ring code on the material will automatically set the focus; if the material is user-supplied, the user sets the material in the work area and presses the Auto-measure button to set the focus (FIG. 7). With a minimum of effort, and the calculation of a few settings, the user can be producing their creations quickly and efficiently (FIG. 8).

FIG. 7. In the work area the user has placed a piece of aluminum foil, shiny side up, to prevent stray laser movement from hitting the laser bed and leaving an unwanted image. The text tool has been used to type the word "Creativity," with the user's choice of typeface. The user positions the word in the required position and selects the Engrave option.

FIG. 8. This stone was engraved without the use of any pre-treatment. After processing the user has the option of adding color to improve the contrast of the lettering.

The Creative Space interface consists mainly of two toolbars, one vertical and one horizontal, that are in proximity to the workspace canvas. The vertical toolbar deals mainly with the creation of elements that will ultimately be output. The tools include:

- The Import button, which leads to accessing one or more files for processing, and setting their properties.
- The Insert button that creates lines, rectangles, and circles.
- The Shape tool that provides a palette of dozens of unique shapes, such as stars, arrows, gears, and dozens of primitive forms that can be combined or modified using other Creative Space tools (FIG. 9).
- The Text tool that provides an input window, defaulting with the words "Your text here," in which text is entered, a typeface is selected, and optional intercharacter spacing can be applied. The handles that appear around the text can be used to condense, expand, enlarge, reduce, or rotate the text.
- The Vector tool that supports the drawing of a vector path. Any of the anchor points can be double-clicked once to convert them into a rounded corner with adjustable curvature, or double-clicked twice to convert them back to a sharp corner.
- The Extract tool that can acquire an image that has been captured by the M1's camera, edit that image with the Magic wand, Eraser, and Crop tools, and then use it for processing on a workpiece.

The Creative Space horizontal toolbar presents tools that interact with images that have been imported or created directly in the workspace. These include:

- Undo, which cancels the last action.
- Redo, which reinstates the last action.
- Outline, which traces the outline of an image including the inner and outer outline.
- Array, which creates a grid or circular duplication of an image.
- Smart fill, which is a "magical" feature that enables the user to duplicate a design they have created on a single material, automatically on a number of like materials laid out in a random fashion. The software makes the design conform in the proper size and orientation of the original.
- Align, which forces two or more elements to align or distribute to a prescribed position.
- Arrange, which changes the stacking order of two or more elements to the front or back, or forward or backward.
- Combine, which supports the use of two or more shapes to either unite, subtract, unite at overlap, or subtract at overlap, to produce a new shape composed of parts of the original shapes.
- Reflect, which will produce a duplicate of a selected element in a horizontal or vertical reflected duplicate.
- Position, which displays the x and y coordinates of a selected element, with 0,0 indicating the upper left corner. The user can enter new coordinates which will change the position of the element.
- Size, which shows the width and height of the selected element in the unit system defined by the user.
- Rotate, which shows the angle of rotation of the selected element.
- Zoom, which enlarges or decreases the view of the work area, with a minimum size of 25% and a maximum of 1000%.

The M1 has four main work modes, or processing types: Laser flat, Laser cylindrical, Open plane, and Blade cut (FIG. 10). The Laser flat mode is the typical workflow for most flat materials, and does not involve removing the floor plate on the bottom of the machine, which can lift off with the removal of three screws. The Laser cy-

FIG. 9. The variety of shapes available in the Shape tool ensures that the user can quickly construct or modify an outline suitable for a given task.
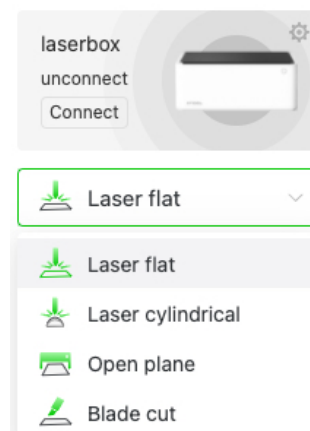

FIG. 10. The four main M1 machine modes.

lindrical workflow involves the use of the Rotary Attachment, and requires that the metal floor plate, or baseplate, be removed, and the entire machine be elevated using a set of risers. The Open plane workflow also requires the removal of the metal floor plate, and that the entire machine be positioned over a workpiece that is too large to fit inside the M1 enclosure. Finally, the Blade cut workflow involves the use of the cutting blade positioned over a cutting mat with the work material adhered to the mat surface.

Materials that are processed with the cutting blade are first adhered to a cutting mat, to hold them in place. There are two varieties of cutting mat; the red one which has a high-grip adhesive surface for fabric, and the blue one which has a low-grip adhesive surface for paper and vinyl (FIG. 11). Each mat is provided with two sheets of protective film, one on each side. Removing the front protective film reveals the adhesive surface. The protective film should be replaced after each use to maintain the strength of the adhesive layer.

FIG. 11. The adhesive surface on the cutting mat is covered with a sheet of protective film when not in use.

The selection of the material, specified in the Material window, will automatically determine the machine settings for laser-processing. If the material has been sourced from xTool, the software will automatically use the material's associated ring code settings for Power, Speed, and Pass. Should the user want to override the recommended settings they can enter their own by selecting the "User-defined parameters" option. If the material is actually User-defined, the operator must input the necessary settings manually, although they may be based on the settings suggested for a comparable xTool material.

The associated parameters for xTool sourced materials will change based on the ultimate type of processing to be performed, and the type of material to be used. Laser processing modes include: Score, Engrave, or Cut; Blade cut has the single option of Cut. The score setting produces an engraved outline of the object, the engrave setting produces a solid engraving of the object, and the cut setting, cuts out the object.

The M1 processes both bitmap (scan line-by-scan line) and vector (trajectory path) files. Bitmaps can be altered using the Grid filter, to alter its pixelization, and the blur and sharpening options to affect its appearance.

Laser cut materials can benefit from being lifted up slightly off the baseplate, in order to allow air to circulate below, and let smoke escape from the bottom of the material. This is typically the function of a honeycomb panel. The M1 solution, provided with the machine, is the use of ten triangular prisms, 12-inch aluminum rods that can be placed across the baseplate to raise the workpiece. The prisms have proven to reduce soot and smoke discoloration (FIG. 12).
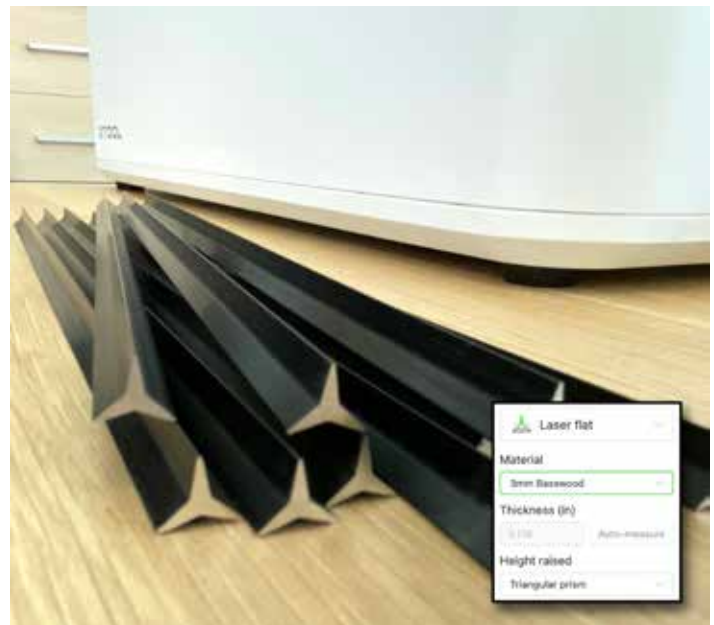

FIG.12. The set of triangular prisms provides an effective way to raise a workpiece off of the baseplate, enabling air circulation, and therefore removing smoke, and minimizing discoloration. The inset in the lower right corner shows that the height of the material has been raised to account for the use of the triangular prisms.

The materials listed for laser processing in the initial version of the software include: 3mm Basswood, 3.5mm Cardboard, Walnut Plywood, Black Acrylic, Stainless Steel Dog Tag, Metal Card, Laser engraved rubber mat, Mahogany Plywood, Rock Coaster, and Cherry Plywood. The materials listed for blade cutting include: PU Heat Transfer Vinyl, White Sticker Paper, PU Leather, Colored Glossy PVC Sheet, Transparent Frosted PVC, Kraft Paper, and Self-adhesive PVC Sheet. Any blade cutting operation requires the use of a vector file.

The session content can be imported from a file or image, can be lifted from a drawing or print placed inside the M1, or can be designed directly within the program. The tools provided to edit an imported image are limited to resizing, rotating, reflecting (horizontally or vertically), magic wand, eraser, and cropping. An original design can be created using a variety of shapes, text elements, and vector paths.

Elements that will be scored appear on-screen in an orange outline; elements that will be engraved appear in a solid orange; and elements that will be cut appear in a purple outline (FIG. 13).
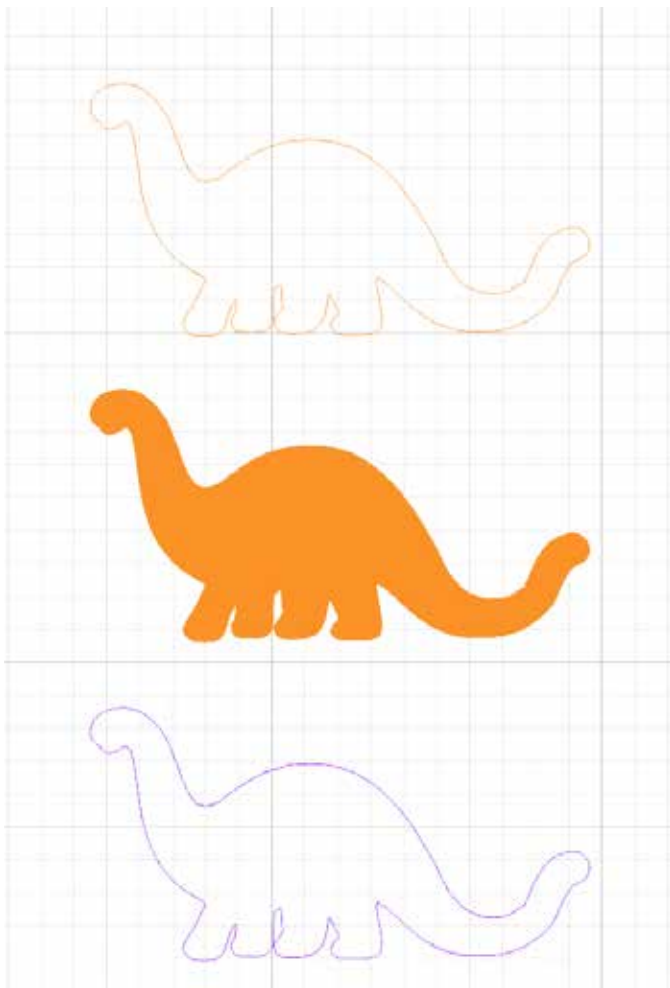
FIG. 13. *The laser processing status of an object is indicated by its color: orange outline for Score, orange solid for Engrave, and purple outline for Cut.*

After the material has been positioned, the elements and/or images have been set, the parameters have been entered, the actual processing is initiated by pressing the Start button. The Working window is presented with an estimate of the processing time, and options to preview the path of the imager and to show how the image will be framed. If the operator approves, the job is sent to the M1 using the Send button (FIG. 14). The job is not processed until the user physically goes to the M1 and presses the button in the front upper right corner of the machine. This final step is a precaution to remind the operator that there is always a fire risk, and that the machine must be monitored closely at all times when in operation (FIG. 15).
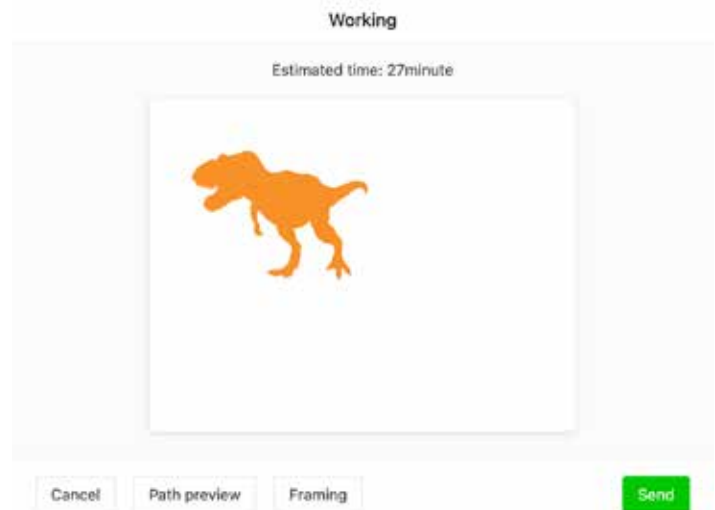

FIG. 14. *The Working window provides the user with the options to preview the laser head path, view the framing of the image, cancel the process, or send the job to the M1.*

FIG. 15. *The job will not be processed until the user presses the flashing blue button on the M1.*

The Creative Space software is unique in many regards, perhaps the most significant of which is the Projects Center option (FIG. 16), which presents an ever-increasing display of comprehensive plans for various categories of objects, sorted by laser device (M1, D1, or both), difficulty level (1, 2, or 3), processing type (laser engrave, laser cut, blade cut), and material type (wood, metal, leather, etc.). When a project is selected, the user sees the material required and has the option to buy it directly from the xTool website (FIG. 17). From this point the user can directly start the project from the main software user interface (FIG. 18).

In addition to the Projects Center link, the Creative Space interface provides direct access to Support and Shop links. The support link takes the user directly to support documents, as well as a Contact Us link to submit a help request to the support team. The shop link takes the user to the xTool website with direct access to purchase materials as well as accessories.
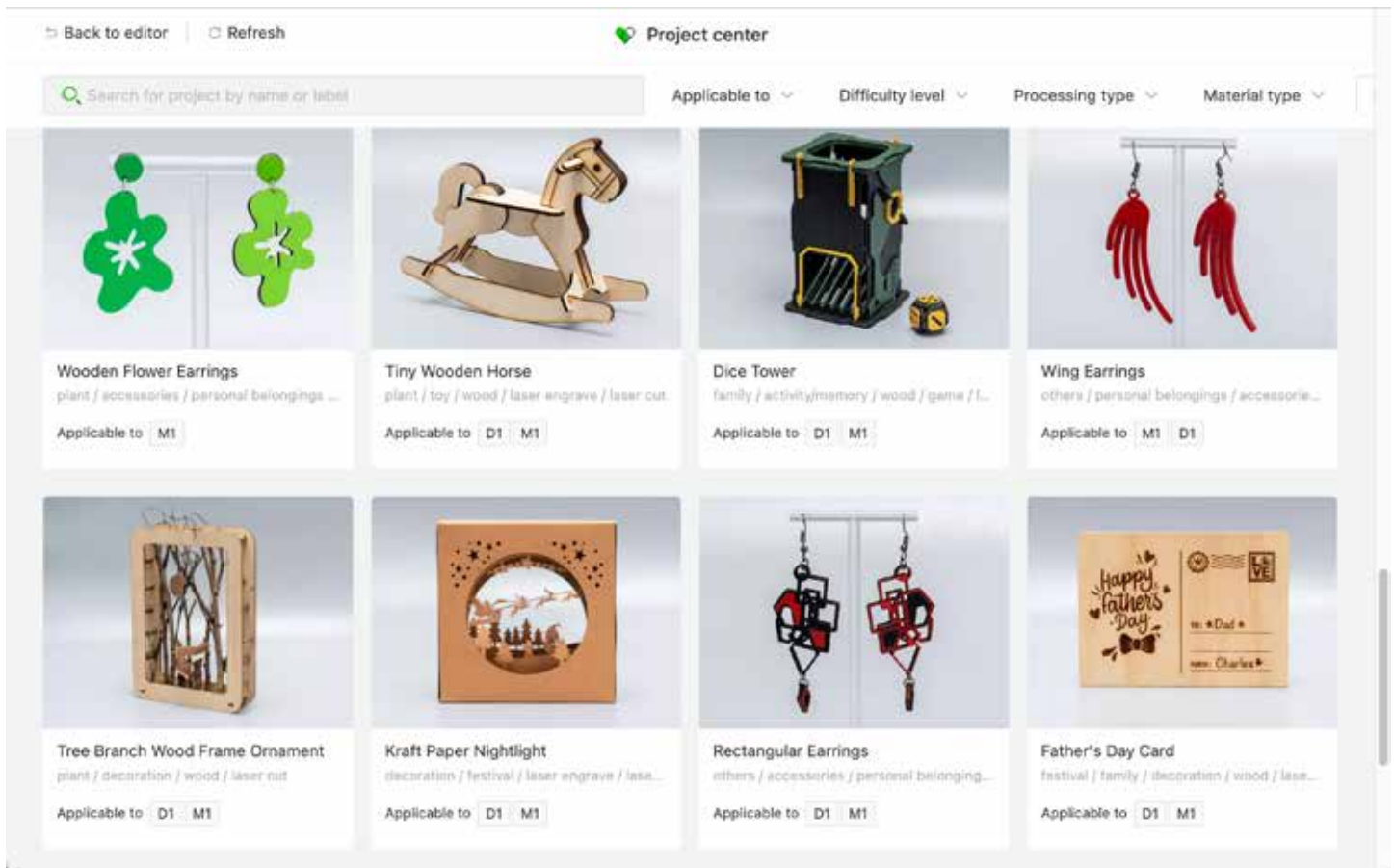
FIG. 16. From within the Creative Space software the user can select from a variety of projects, with immediate access to the necessary file(s) to create it.
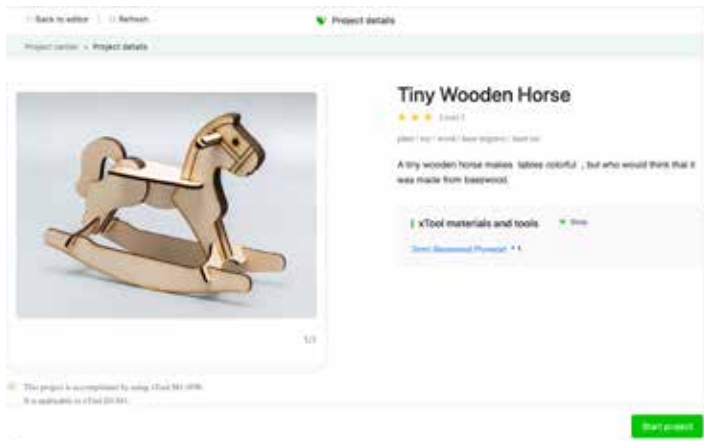

FIG. 17. Selecting a project leads to this screen, showing a description, a list of materials, a link to the xTool on-line store, and a button to load the project file into Creative Space.
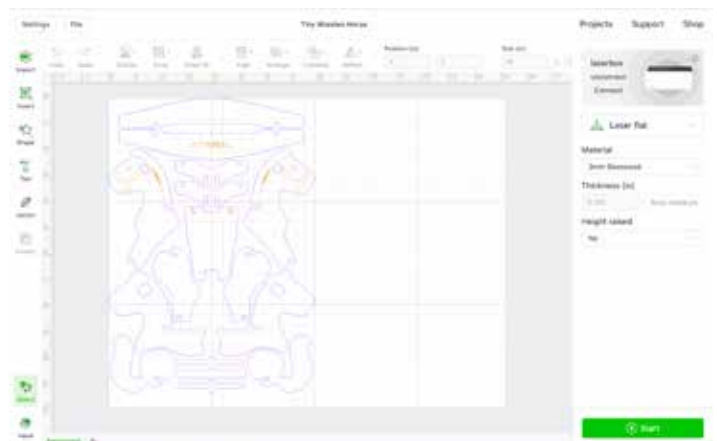

FIG. 18. The actual project file immediately appears in the Creative Space user interface.